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GEOGRAPHY ALIVE 9
AUSTRALIAN CURRICULUM | SECOND EDITION

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This textbook contains images of Indigenous people who are, or may be, deceased. The publisher appreciates that this inclusion may distress some Indigenous communities. These images have been included so that the young multicultural audience for this book can better appreciate specific aspects of Indigenous history and experience.

It is recommended that teachers should first preview resources on Indigenous topics in relation to their suitability for the class level or situation. It is also suggested that Indigenous parents or community members be invited to help assess the resources to be shown to Indigenous children. At all times the guidelines laid down by the relevant educational authorities should be followed.

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HOW TO USE

the Jacaranda Geography Alive resource suite

For more effective learning, the *Jacaranda Geography Alive* series is now available on the learnON platform. The features described here show how you can use *Jacaranda Geography Alive* to optimise your learning experience.

'Geographical concepts' is a valuable reference section that covers each of the seven concepts.

Each concept is clearly defined.

A variety of visual resources support the explanations.

1.1. Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

1. Select an occupational profile that is presented in figure 3. Use the **Job Outlook** web link in the Resources tab to locate the **Job Outlook** website. At this site you will be able to explore a career that interests you. **Job Outlook** is a federal government website that provides information on employment in a range of occupations. It also includes information on the training, skills and tools needed for the career that you are researching.

2. Develop a career profile for your occupation of choice. In your profile include:

- the geographical skills needed for this job
- the geographical tools that may be used in this occupation
- the study and training requirements that lead to this occupation
- the job prospects for your chosen occupation over the next five years.

3. In Australia, there is a range of industries that employ conservationists, oceanographers or agricultural scientists. Use the **Job Outlook** website in the Resources tab to locate the **Job Outlook** website to research industries that may deal with land degradation, marine pollution or world food needs. For example, the Agricultural, Forestry and Fishing industries offer all three occupations and list a range of technical and professional tasks in their job descriptions. Develop a job description for one of the occupations. Highlight the geographical skills required, the tools needed to work with in this field and the core skills that are essential for the position.

learnON RESOURCES — ONLINE ONLY
Explore more with this web link: Job Outlook

1.2.2 What is scale?

When we examine geographical questions at different spatial levels we are using the concept of scale to find more complete answers.

A little like using a zoom lens on a camera, scale enables us to examine issues from different perspectives, from personal to local, regional, national or global. Using scale helps in the analysis and explanation of phenomena. For example, climate is the most important factor in determining vegetation type on a global scale; whereas, at a local scale, soil and drainage might be more important. Different activities can also have an impact at a range of scales. The construction of an international airport in Cairns saw the development of tourism evolve from a local to an international scale with direct flights between Australia and South-East Asia.

FIGURE 2 Country of origin for tourists visiting Australia, and destinations for Australian tourists, 2015

1.2.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

1. (a) Compare the scale of movement of tourists from Australia to New Zealand and to China.
(b) What reasons can you give for the differences?
2. Suggest one national-scale and one international-scale event that might influence the number of Australians visiting the United States.
3. Predict future trends in the number of tourists leaving Australia.
4. (a) Brainstorm with your class an example of an environmental issue at a local, national and global scale.
(b) How would solutions differ at each scale?

Deepen your understanding of this topic with related case studies and questions.
Scale

1.2 Geographical concepts

1.2.1 Introduction

Geographic concepts help you make sense of your world. By using these concepts you can investigate and understand the world you live in, and try to imagine a different world. The concepts help you to think geographically. There are seven major concepts: **scale, place, interconnection, change, environment, sustainability and space**. In this book you will use the seven concepts to investigate two units: **Biores and food security** and **Geographies of interconnections**.

FIGURE 1 A way to remember these seven concepts is to think of the term **SPICES**.

TOPIC 1 The world of Geography 3

2.7.2 Benefits of coral reefs

Today, about 500 million people rely on reef systems, either for their livelihood, as a source of food, or as a means of protecting their homes along the coastline. (Coral reefs help break up wave action, so waves have less energy when they reach the shoreline, thus reducing coastal erosion.) It is estimated that coral reefs contribute between US\$28.8 billion and US\$375 billion to the global economy each year.

Reefs are important to both the fishing and tourism industries. Approximately 2 million people visit Australia's Great Barrier Reef Marine Park alone, generating more than A\$2 billion for the local economy. Nearly one-third of all tourists who visit Australia also visit the Great Barrier Reef.

Coral reefs have been found to contain compounds vital to the development of new medicines.

- Painkillers have been developed from the venom of cone shells.
- Some cancer treatments come from algae.
- Treatments for cardiovascular disease and HIV include compounds that were originally found in coral reefs.

2.7.3 Threats to coral reefs

Reefs also face a variety of threats.

- Urban development requires land clearing and wetland drainage, which increases erosion. Sediment washed into water prevents sunlight penetrating the water.
- Contamination by fossil fuels, chemical waste and agricultural fertilisers pollutes the sea.
- Tourism damages coral through boats dropping anchor or tourists directly removing coral or walking on it.
- Global warming increases water temperature, which bleaches the coral, turning it white and destroying the reef system.
- Predators, such as the crown of thorns starfish prey on coral polyps, which affects the whole ecosystem.

2.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

Explain

1. Explain the difference between a fringing reef and a barrier reef.
2. With the aid of a diagram, explain how coral reefs are formed.
3. Why are coral reefs important places?

Discover

4. Investigate two of the threats to coral reefs and prepare an annotated visual display that outlines:
 - the nature of the threat
 - the changes that will occur or have occurred as a result of this threat
 - the impact of these changes on the environment, including references to the rate and scale of the changes
 - a strategy for the long-term sustainable management of the reef environment.

Predict

5. Coral reefs are highly susceptible to climate change.
 - (a) Explain what you understand by the term climate change.
 - (b) With the aid of a diagram, explain how you think the coral reef environment would change if sea temperatures were to rise by 2 °C.

Deepen your understanding of this topic with related case studies and questions.
The Great Barrier Reef

2.8 What are Australia's major biomes?

2.8.1 What factors shape Australian biomes?

Australia is a land of contrasts. Its mountain ranges and river systems are small by world standards. In the north are tropical rainforests and savanna grasslands. In the centre is a wide expanse of desert that is second in area only to the Sahara Desert in Africa. In the south, temperate forests and grasslands dominate. Australia also has vast wetlands and coastal ecosystems.

Before European colonisation, the Australian landscape was shaped largely by natural processes and Aboriginal burning practices. With European occupation came large-scale land clearing, irrigation of the land through water diversion from rivers, and the draining of wetlands. New plant and animal species were introduced to the landscape. However, despite the large-scale change since European occupation, Australia's major biomes are still clearly evident.

FIGURE 2 The formation of fringing reefs, barrier reefs and coral atolls

1. Fringing coral reefs develop along the shores of continents and islands.
2. When sea levels rise, fringing reefs become barrier reefs.
3. Formation of a coral atoll
4. Eroded volcanic island has been partly submerged by rising sea.
5. Sandy island forms on reef from eroded coral and shell. What was once an island is now completely submerged.

TOPIC 2 All the world is a biome 27

2.8.1 What factors shape Australian biomes?

FIGURE 1 Climate classification of Australia. Climate plays a major role in the development of biomes.

Major classification groups

- Tropical
- Subtropical
- Desert
- Grassland
- Temperate

Source: Data copyright Commonwealth of Australia, 2013 Bureau of Meteorology

TOPIC 2 All the world is a biome 28

A series of activities to build and develop your understanding of each concept is provided.

Activities provide you with an opportunity to apply all of the seven concepts.

Linking to myWorld Atlas will deepen your understanding.

HOW TO USE THE JACARANDA GEOGRAPHY ALIVE RESOURCE SUITE vii

TOPIC 2 All the world is a biome

2.1 Overview

Numerous videos and interactivities are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

2.1.1 Introduction

Where do the foods we eat and the natural products we use daily come from? Biomes are communities of plants and animals that extend over large areas. Some are dense forests; some are deserts; some are grasslands, like much of Australia; and so the variations continue. Within each biome, plants and animals have similar adaptations that allow them to survive. Biomes can be terrestrial (land based) or aquatic (water based). Understanding the diversity within them is essential to our survival and wellbeing.

Within each biome, there are many variations in the landscape and climate, and in the plants and animals that have adapted to survive there.



TOPIC 2 All the world is a biome 15

Starter questions

1. As a class, develop your own definition of the word biome.
2. What information about biomes is conveyed by the images shown on the previous page?
3. Brainstorm a list of biomes.
4. Select one of the biomes you listed in question 3, and create a mind map of the unique features you think it has.
5. What type of biome do you live in? If you cannot decide, why do you think that is?
6. Make a list of the things you use that have come from a biome. Compare your list with other students in your class.

INQUIRY SEQUENCE

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2.2 SkillBuilder: Describing spatial relationships in thematic maps

WHAT ARE SPATIAL RELATIONSHIPS IN THEMATIC MAPS?

A spatial relationship is the interconnection between two or more pieces of information in a thematic map, and the degree to which they influence each other's distribution in space. Describing these relationships helps us understand how one thing affects another.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding

learnON RESOURCES – ONLINE ONLY

- Watch this eLesson: Describing spatial relationships in thematic maps (eles-1726)
- Try out this interactivity: Describing spatial relationships in thematic maps (ie-3344)

online

FIGURE 1 Thematic map of Asia showing biomes



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Questions raise issues, link the unit to your life, and prompt you to think about what you already know and feel about the unit.

A sequence for your inquiry.

A thought-provoking topic opener sets the scene for your inquiry.

Evocative and informative images stimulate interest and discussion.

Each section begins with a clearly identifiable subtopic number and inquiry question.

Aquatic biomes

Water covers about three-quarters of the Earth and can be classified as fresh water or marine. Freshwater biomes contain very little salt and are found on land; these include lakes, rivers and wetlands. Marine biomes are the saltwater regions of the Earth and include oceans, coral reefs and estuaries. Marine environments are teeming with plant and animal life, and are a major food source. Elements taken from the roots of mangroves have been used in the development of cancer remedies. Compounds from other marine life have also been used in cosmetics and toothpaste.

FIGURE 6 Water



2.3 Activities

To answer questions online and to receive immediate feedback and sample responses for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

Remember

1. Name the five major biomes of the Earth and classify them as either aquatic or terrestrial.
2. Identify the broad characteristics biomes share.

Explain

3. Look carefully at figure 1. Using geographic terminology and concepts (including reference to latitude), describe the location and characteristics of the five major biomes.
4. (a) The map in figure 1 identifies five basic biomes. However, the text tells you that within each there are variations. Suggest reasons for these variations. (b) Are all biomes equally important? Explain your answer.

Predict

5. Select one of the categories of biomes described in this section. Suggest how this biome might be changed and used by humans and what impact this change might have on the environment.

learnON RESOURCES – ONLINE ONLY

- Try out this interactivity: Beautiful biomes (ie-3317)

TOPIC 2 All the world is a biome 19

Easily identifiable visual material is referenced in the text and in activities.

Italicised key concepts are applied to the activities.

2.4 How do we use the grassland biome?

2.4.1 What are the characteristics of grasslands?

Grassland, pampas, savanna, chaparral, cerrado, prairie, rangeland and steppe all refer to a landscape that is dominated by grass. Once, grasslands occupied about 42 per cent of the Earth's land surface, but today they make up about 25 per cent of its land area. Grasslands are found on every continent except Antarctica.

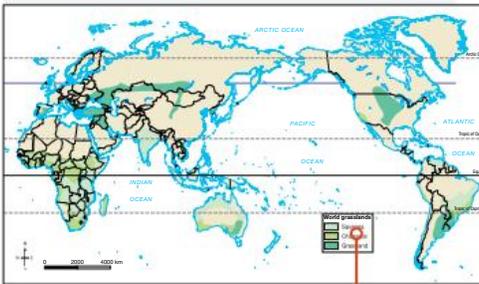
The grassland biome is dominated by grasses, and generally has few or no trees, though there may be more tree cover in adjoining areas, such as along riverbanks. They develop in places where there is not enough rain to support a forest but too much rain for a desert; for this reason they are sometimes referred to as a transitional landscape.

Grasslands are found in both temperate and tropical areas where rainfall is between 250 mm and 900 mm per year. In tropical regions, grasslands tend to have a distinct wet and dry season. In temperate regions, the summers tend to be hot and the winters cool. Generally, grasslands in the southern hemisphere receive more rainfall.

Grasslands can occur naturally or as a result of human activity. The presence of large numbers of grazing animals and frequent fires prevent the growth of tree seedlings and promote the spread of grasses. Unlike other plant species, grasses can continue to grow even when they are continually grazed by animals, because their growth points are low and close to the soil. Because grasses are fast-growing plants, they can support a high density of grazing animals, and they regenerate quickly after fire.

Some grasses can be up to two metres in height, with roots extending up to one metre below the soil.

FIGURE 1 Grasslands occupy about a quarter of the Earth's land surface.



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A wide range of engaging and informative visuals are included.

FIGURE 4 Dalywat Bay, Northern Territory

2.5 Activities
To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your **learnON** title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

- How have mangroves adapted to survive in their marine-terrestrial environment?
- What are seagrass meadows and why are they important?
- Refer to Figure 4 and describe the landscape at the following grid references: 04C309, 071329, 03C320 and 05C290.

2.6 SkillBuilder: Constructing and describing a transect on a topographic map

WHAT IS A TRANSECT?
A transect is a cross-section with additional detail, which summarises information about the environment.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 A transect of the Walls of Jerusalem National Park, Tasmania

2.7 Why are coral reefs unique?
2.7.1 Formation of coral reefs
Coral reefs are found in spaces around tropical and subtropical shores. They require specific temperatures and sea conditions and an area free from sediment. Coral reefs are built by tiny animals called coral polyps. The upper layer is alive, growing on the remains of millions of dead coral. Coral reefs are one of the oldest ecosystems on Earth and also one of the most vulnerable to human activity.
Coral reefs are one of the most diverse biomes on Earth and are built by polyps that live in groups. A reef is a layer of living coral growing on the remains of millions of layers of dead coral. There are inner and outer reefs as well as coral cays (small islands of coral) and coral atolls.

2.8 SkillBuilder: Constructing and describing a transect on a topographic map

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

learnON RESOURCES – ONLINE ONLY

- Watch this eLesson: Constructing and describing a transect on a topographic map (elles-1727)
- Try out this interactivity: Constructing and describing a transect on a topographic map (int-3345)

SkillBuilders develop and model key geographical skills in context.

References to online material are provided.

The Fieldwork inquiry and Geographical inquiry provide you with an opportunity to develop your inquiry skills in the field and through research.

UNIT 2 GEOGRAPHIES OF INTERCONNECTIONS

TOPIC 12

Fieldwork inquiry: What are the effects of travel in the local community?

12.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your **learnON** title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

12.1.1 Scenario and your task

People travel for many reasons at the local scale — for example, they may travel to work, to shops, to visit friends and to local sporting venues. Often there are times when traffic congestion occurs, creating danger areas for motorists and pedestrians. Examples of places where such congestion occurs are schools and shopping centres. Undertaking fieldwork allows you to observe and collect original data first-hand.

Your task

Your team has been commissioned by the local council to compile a report evaluating the impacts of travel movements around a local school or traffic hotspot. You will need to collect, process and analyse suitable data and then devise a plan to better manage future traffic and pedestrian movement in the area.

12.2 Process

12.2.1 Process

- As part of a class discussion, determine a suitable location for your fieldwork study. This might be your own or a local school, or a nearby shopping centre. Talk about some of the issues related to your fieldwork site and then devise a key inquiry question — for example: What are the effects of ...? or How can we reduce the impact of ...? This will be the focus of your fieldwork. You then need to establish the following:
 - What sort of data and information will you need to study the travel issue at your site?
 - How will you collect this information?
 - Where would be the best locations to obtain data?
 - When would be the best times of the day (or day(s)) of the week to obtain data?
 - How will you record the information you are collecting?

If you wish to collect people's views on the issue, or suggestions for improvements, you will need to plan and write suitable survey questions.

12.2.2 Collecting and recording your information and data

- As a class, plan the field trip by identifying and allocating tasks and possible sites to groups or pairs. It is often easier to share data collection. Once everything has been planned, you will need to perform your allocated tasks on the day.
- In class, invite your school principal or a member of your local council to be a guest speaker discussing your fieldwork site. They may be able to assist with background information that you may not be able to gain elsewhere. They can also provide a different perception of the effects of travel at your site. Plan a series of questions you would like to ask and be prepared to take notes that you can use in your report.
- After the field trip, it may be necessary to collate everyone's data and summarise surveys so that everyone has access to the shared information.

12.2.3 Analysing your information and data

- Look at your completed graphs and maps. What trends, patterns and relationships can you see emerging? Within your fieldwork area, are there some places that have a bigger issue with cars and pedestrians than other areas?
 - Is there an interconnection between traffic congestion and time of the day, or day of the week? What have your surveys revealed? What are the major effects of travel at your fieldwork site? How do people perceive the travel issues in this place? Go back to your key inquiry question. To what extent have you been able to answer it? Write your observations up as a fieldwork report using subheadings such as:
 - Background and key inquiry question
 - Conducting the fieldwork [planning and collecting data]
 - Findings [results of data analysis].
- Download the report template from the Resources tab to help you complete this project. Use the report template to create your report.

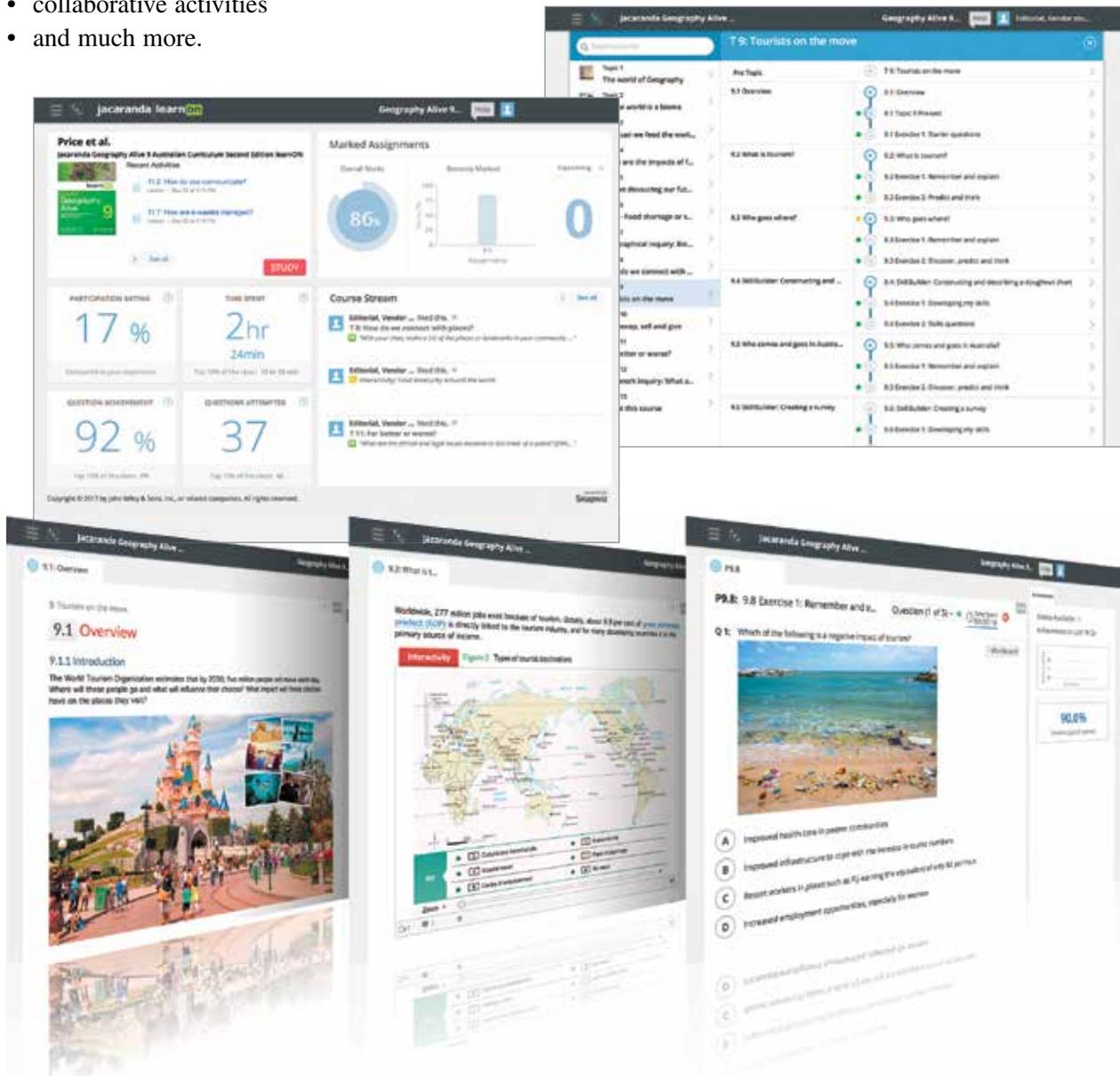
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TOPIC 12 Fieldwork inquiry: What are the effects of travel in the local community? **233**

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Jacaranda Geography Alive learnON is an immersive digital learning platform that enables real-time learning through peer-to-peer connections, complete visibility and immediate feedback. It includes:

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- and much more.



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TOPIC 1

The world of Geography

1.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

1.1.1 Work and careers in Geography

Geographical skills will be useful for your future employment. An understanding of Geography and its application for managing sustainable futures is pivotal knowledge that will be desirable to future employers. In Geography, students are developing an understanding of the world. The skills you develop in Geography are transferrable to the workplace and can be used as a basis for evaluating strategies for the sustainable use and management of the world's resources.

Skills for work

Geography is a foundational skill for many occupations. Learning to navigate further education and training paths will help you to understand the variety of occupations that the study of Geography can lead to. The study of Geography includes important geospatial and spatial technology skills. These skills underpin the knowledge base of a range of courses and careers. Start your pathways exploration by considering who might use the key geospatial and spatial technologies.

- *Geospatial skills*: the ability to collect and collate information gathered from fieldwork and observations. Geospatial skills are used in careers such as surveying, meteorology, agricultural science and urban planning.
- *Spatial technologies*: technologies that demonstrate the connections between location, people and activities in digital formats. Jobs in the spatial industry are varied and include working in business and government. Spatial technologies apply many techniques, such as photogrammetry, remote sensing and global positioning systems (GPS). Spatial technologies manage information about the environment, transportation and other utility systems.

FIGURE 1 GIS (geographical information systems) being used to manage spaces and plan escape routes during a fire



FIGURE 2 Using GPS to survey and record road traffic movements for a local council



1.1.2 Where can Geography lead?

There is a range of careers that utilise Geography as a foundation skill. As you consider your pathway options for senior studies you may like to research some of the careers that are provided in figure 3.

FIGURE 3 Geography pathways

| Meteorologist | Surveyor | Landscape architect |
|--|---|--|
| <p>Meteorologists use geographical skills to forecast the weather, study the atmosphere and understand climate change.</p> | <p>Surveyors use geographical skills to measure, analyse and report on land-related information for planning and development.</p> | <p>Landscape architects use geographical skills to plan and design land areas for large-scale projects such as housing estates, schools, hospitals, parks and gardens.</p> |
|  |  |  |
| Agricultural technician | Park ranger | Environmental manager |
| <p>Agricultural technicians use geographical skills to support and advise farmers on aspects of agriculture such as crop yield, farming methods, production and marketing.</p> | <p>Park rangers use geographical skills to support and maintain ecosystems in national parks, scenic areas, historic sites, nature reserves and other recreational areas.</p> | <p>Environmental managers use geographical skills for project management and the development of environmental reports.</p> |
|  |  |  |

1.1. Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

1. Select an occupational profile that is presented in figure 3. Use the **Job Outlook** weblink in the Resources tab to locate the Job Outlook website. At this site you will be able to explore a career that interests you. Job Outlook is a federal government website that provides information on employment in a range of occupations. It also includes information on the training, skills and tools needed for the career that you are researching.
2. Develop a career profile for your occupation of choice. In your profile include:
 - the geographical skills needed for this job
 - the geographical tools that may be used in this occupation
 - the study and training requirements that lead to this occupation
 - the job prospects for your chosen occupation over the next five years.
3. In Australia, there is a range of industries that employs *conservationists, oceanographers or agricultural scientists*. Use the **Job Outlook** weblink in the Resources tab to locate the Job Outlook website to research industries that may deal with land degradation, marine pollution or world food needs. For example, the Agricultural, Forestry and Fishing industries offer all three occupations and list a range of technical and professional tasks in their job descriptions.
Develop a job description for one of the occupations. Highlight the geographical skills required, the tools needed to work with in this field and the core skills that are essential for the position.

learnon RESOURCES – ONLINE ONLY



Explore more with this weblink: Job Outlook

1.2 Geographical concepts

1.2.1 Introduction

Geographic concepts help you make sense of your world. By using these concepts you can investigate and understand the world you live in, and try to imagine a different world. The concepts help you to think geographically. There are seven major concepts: *scale, place, interconnection, change, environment, sustainability* and *space*.

In this book you will use the seven concepts to investigate two units: *Biomes and food security* and *Geographies of interconnections*.

FIGURE 1 A way to remember these seven concepts is to think of the term SPICISS.

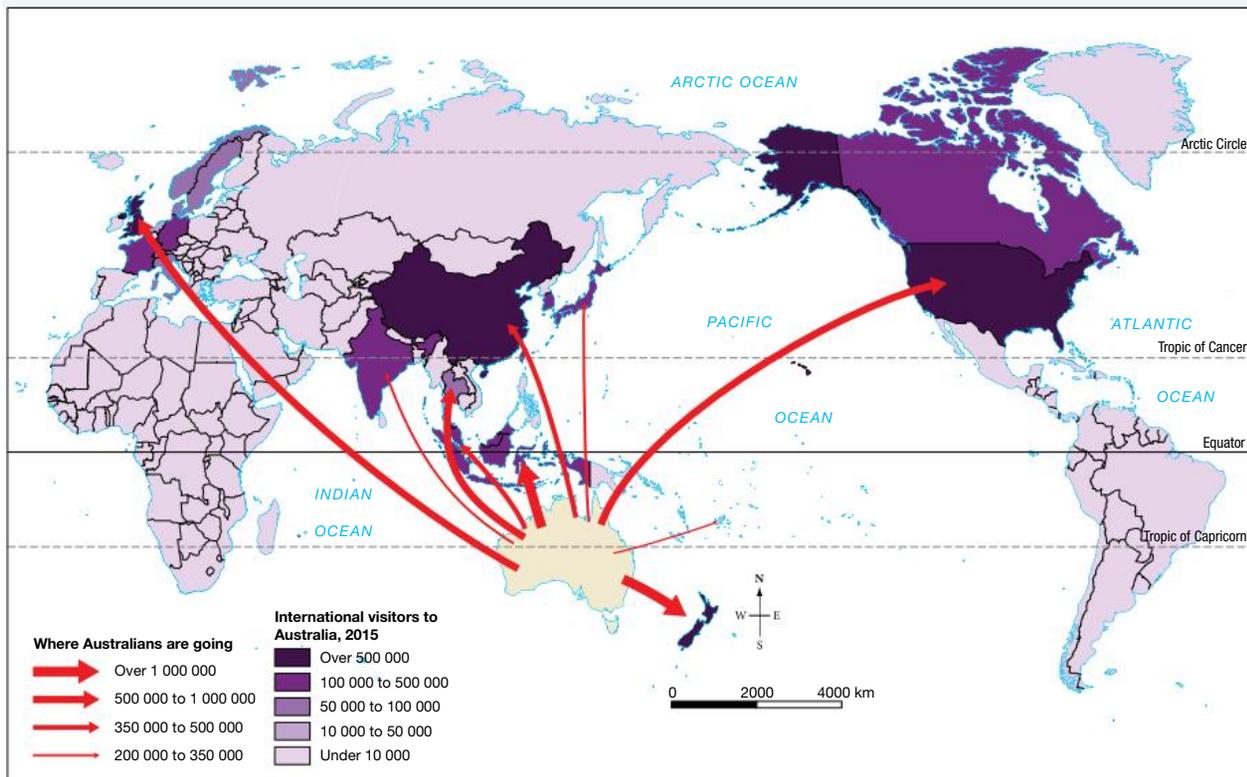


1.2.2 What is scale?

When we examine geographical questions at different spatial levels we are using the concept of scale to find more complete answers.

A little like using a zoom lens on a camera, scale enables us to examine issues from different perspectives, from personal to local, regional, national or global. Using scale helps in the analysis and explanation of phenomena. For example, climate is the most important factor in determining vegetation type on a global scale; whereas, at a local scale, soil and drainage might be more important. Different activities can also have an impact at a range of scales. The construction of an international airport in Cairns saw the development of tourism evolve from a local to an international scale with direct flights between Australia and South-East Asia.

FIGURE 2 Country of origin for tourists visiting Australia, and destinations for Australian tourists, 2015



Source: ABS, Austrade

1.2.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

- (a) Compare the **scale** of movement of tourists from Australia to New Zealand and to China.
(b) What reasons can you give for the differences?
- Suggest one national-**scale** and one international-**scale** event that might influence the number of Australians visiting the United States.
- Predict future trends in the number of tourists leaving Australia.
- (a) Brainstorm with your class an example of an environmental issue at a local, national and global **scale**.
(b) How would solutions differ at each **scale**?



Deepen your understanding of this topic with related case studies and questions.
Scale

1.2.3 What is place?

The world is made up of places, so to understand our world we need to understand its places by studying their variety, how they influence our lives and how we create and change them.

Everywhere is a place. Each of the world's biomes — for example, a desert environment — can be considered a place, and within each biome there are different places, such as the Sahara Desert. There can be natural places — an oasis is a good example — or man-made places such as Las Vegas. Places can have different functions and activities — for example, Canberra has a focus as an administration centre, while the MCG is a place for major sporting events and the Great Barrier Reef is a place of great natural beauty with a coral reef biome. People are interconnected to places and people in a wide variety of ways — for example, when we move between places or connect electronically via computers. We are connected to the places that we live in or know well, such as our neighbourhood or favourite holiday destination.

FIGURE 3 Large-scale farming of green peppers in a greenhouse where soils, moisture, nutrients and the weather are all controlled



1.2.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Refer to figure 3.

1. Why do you think people have **changed** this place by building greenhouses there?
2. What characteristics of a desert biome are being altered in this **place**?
3. What features might this location have for the production of food?
4. What would be the advantages and disadvantages of greenhouse farming?
5. Suggest the types of crops that would be suitable for greenhouse farming.
6. List ways in which people living in other **places** in Europe may be **interconnected** to the greenhouses in Almeria.



Deepen your understanding of this topic with related case studies and questions.

Place



1.2.4 What is interconnection?

People and things are connected to other people and things in their own and other places, and understanding these connections helps us to understand how and why places are changing.

Individual geographical features can be interconnected — for example, the climate within a place or biome, such as a tropical rainforest, can influence natural vegetation, while removal of this vegetation can affect climate. People can be interconnected to other people and other places via employment, communications, sporting events or culturally. The manufacturing of a product may create interconnections between suppliers, manufacturers, retailers and consumers.

FIGURE 4 Many countries have strict laws dealing with e-waste disposal. It is often easier to export the material to countries in South-East Asia, where there are fewer laws and the wastes can be broken down, recycled or sold. It is extremely hazardous.



Source: Spatial Vision

1.2.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

Refer to figure 4.

- Describe the distribution of the main ports dealing with e-waste trade.
- What is the **interconnection** between the main recycling countries and the main ports that receive and dispatch e-waste?

3. Where are the destinations of e-wastes from Europe?
4. Describe the **interconnection** between North America and Asia in relation to e-waste trade.
5. Create a diagram to show the **interconnections** that could occur for the growing, manufacturing, sales and consumption of a can of pineapple slices.



Deepen your understanding of this topic with related case studies and questions.

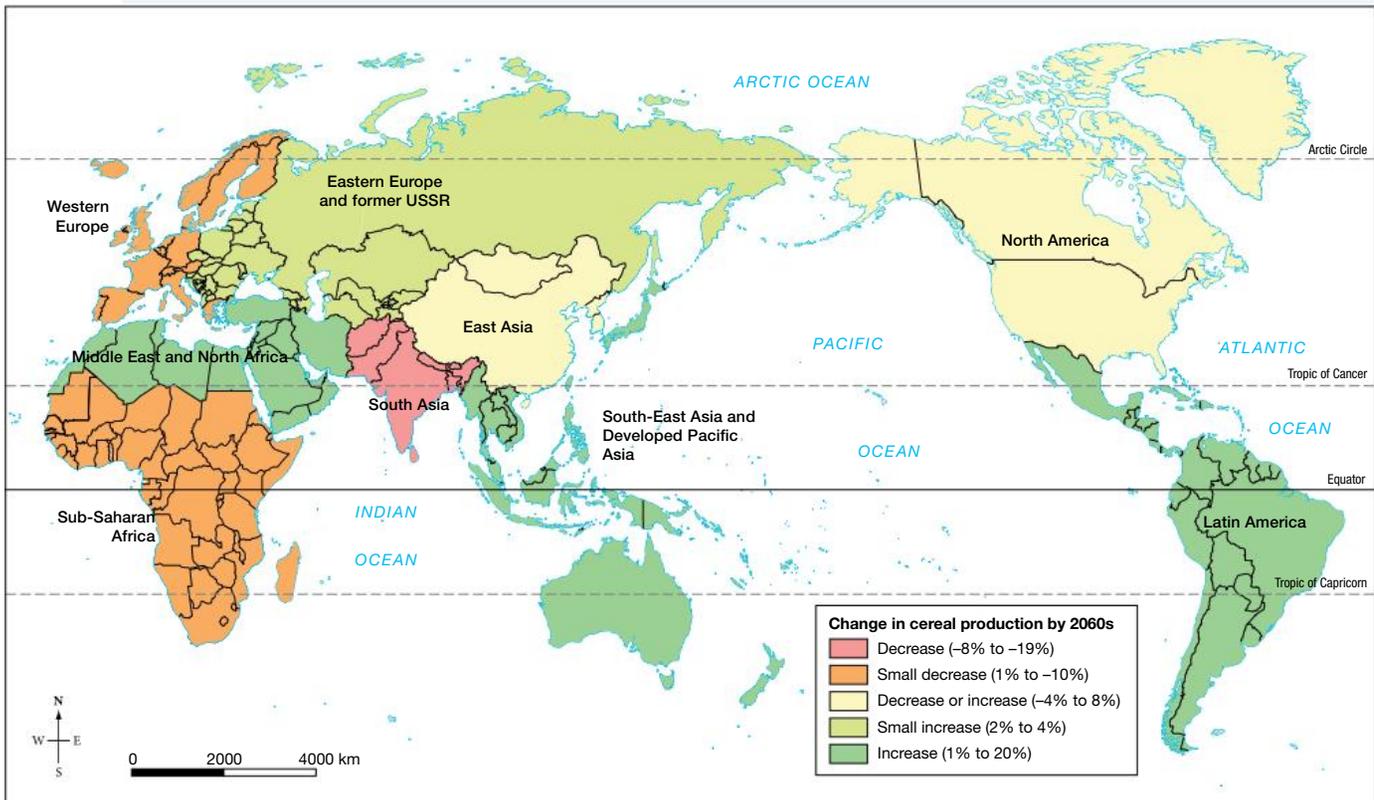
Interconnection

1.2.5 What is change?

The concept of change is about using time to better understand a place, an environment, a spatial pattern or a geographical problem.

From a geographical time perspective, change can be very slow — think of processes such as the formation of mountains or soil. On the other hand, a volcanic eruption or landslide can change landforms rapidly. It may take some years for the boundary of a city to expand outwards, but in the space of a few weeks whole suburbs can be demolished to make way for a freeway. Change can also have physical, economic and social implications. Consider the effect of the internet over the past few years.

FIGURE 5 Predictions of the effects of climate change on cereal crops



Source: Spatial Vision

1.2.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Refer to figure 5.

1. Which regions of the world are predicted to experience decreases in cereal production as a result of climate **change**?
2. Which regions are predicted to show an increase in cereal production?
3. Some countries, particularly those with a shortage of arable land, are buying land in other countries specifically for food production. What do you see as the advantages and disadvantages of such land purchases?
4. Explain how each of the factors listed below may influence whether a country experiences a **change** in cereal production in the future as a result of climate **change**.
 - (a) Level of development
 - (b) Level of technological advancement
5. How would predictions help governments plan for future food security?



Deepen your understanding of this topic with related case studies and questions.
Change



1.2.6 What is environment?

People live in and depend on the environment, so it has an important influence on our lives.

The biological and physical world that makes up the environment is important to us as a source of food and raw materials, a means of absorbing and recycling wastes, and a source of enjoyment and inspiration.

People perceive, adapt and use environments in many ways. For example, different people could look at a well-vegetated hillside and one might see it as a source of timber for construction, another might see a slope that could be cleared and terraced to produce food, while another might view it as a scenic environment for ecotourism.

FIGURE 6 The East Kolkata wetlands act as a sewage filtration system and recycle nutrients through the soil to allow a wide range of food crops to be grown. The ponds provide one-third of the city's fish supply and are a protected Ramsar site for migratory birds.



1.2.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Refer to figure 6.

1. Look closely at the image and decide whether this is a natural or human **environment**. Justify your decision.
2. In what ways might people have **changed** or modified the natural **environment** to allow farming to take place?
3. How would the people and economy of Kolkata benefit from these wetlands?
4. What would you consider to be the advantages and disadvantages of using a wetland **environment** as a natural sewage treatment system?
5. A major threat to the future of the wetlands is the growing population and urban spread into this farming area. How might this affect Kolkata's:
 - food security
 - ability to deal with sewage and waste
 - internationally recognised wetland **environment**?



Deepen your understanding of this topic with related case studies and questions.
Environment

1.2.7 What is sustainability?

Sustainability is about maintaining the capacity of the environment to support our lives and those of other living creatures.

Sustainability involves maintaining and managing our resources and environments for future generations. It is important to understand the causes of unsustainable situations to be able to make informed decisions on the best way to manage our natural world.

FIGURE 7 The unsustainable nature of fishing



1.2.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Refer to figure 7.

1. What does this cartoon tell us about the **sustainable** nature of fishing?
2. How has modern technology contributed to a decline in world fish populations?
3. Suggests reasons why fishing can be considered an **unsustainable** practice.
4. Give reasons why some fish species are over-exploited while others are not.
5. What difficulties would arise with managing an ocean-based resource compared to a land-based resource?



Deepen your understanding of this topic with related case studies and questions.

○ Sustainability

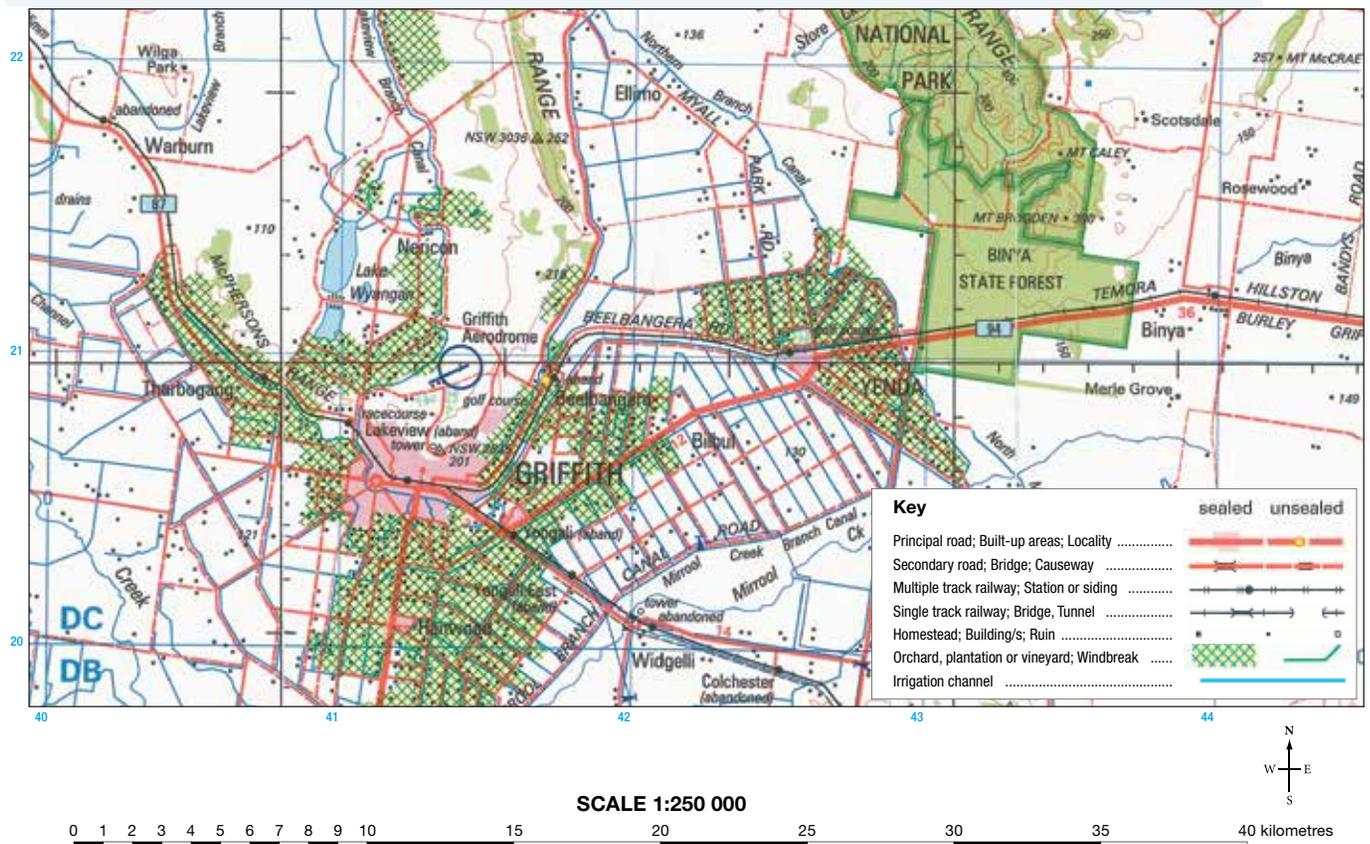


1.2.8 What is space?

Everything has a location on the space that is the surface of the Earth. Studying the effects of location, the distribution of things across this space, and how the space is organised and managed by people, helps us to understand why the world is like it is.

A place can be described by its absolute location; for example: latitude and longitude, a grid reference, street directory reference or an address. Or, a place can be described using a relative location — where it is in relation to another place in terms of distance and direction.

FIGURE 8 Topographic map extract, Griffith, New South Wales



Source: Commonwealth of Australia (Geoscience Australia).

1.2.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Refer to figure 8.

1. Use your atlas to locate Griffith. Provide its absolute location using longitude and latitude.
2. What is the location of Griffith Aerodrome relative to Lake Wyangan? Use distance and direction in your answer.
3. Identify the features located at the following grid references.
 - (a) 413208
 - (b) 435215
4. Give grid reference locations for the following.
 - (a) Griffith Aerodrome
 - (b) Lake Wyangan
5. Complete the following sentences by inserting the correct term to describe the distribution pattern. Choose from the following list of terms: rectangular; linear; scattered; clustered.
 - (a) Buildings are distributed in a pattern.
 - (b) Irrigated fields in the orchards and vineyards create a distribution pattern.
 - (c) Railway lines form a pattern.
 - (d) The distribution pattern for buildings around Yenda tends to be more than those to the west of Griffith.
6. How does the distribution of irrigated vineyards and orchards influence the distribution of buildings? Suggest a reason for your observation.
7. Describe how people have generally used the **space** shown in the map.



Deepen your understanding of this topic with related case studies and questions.

Space



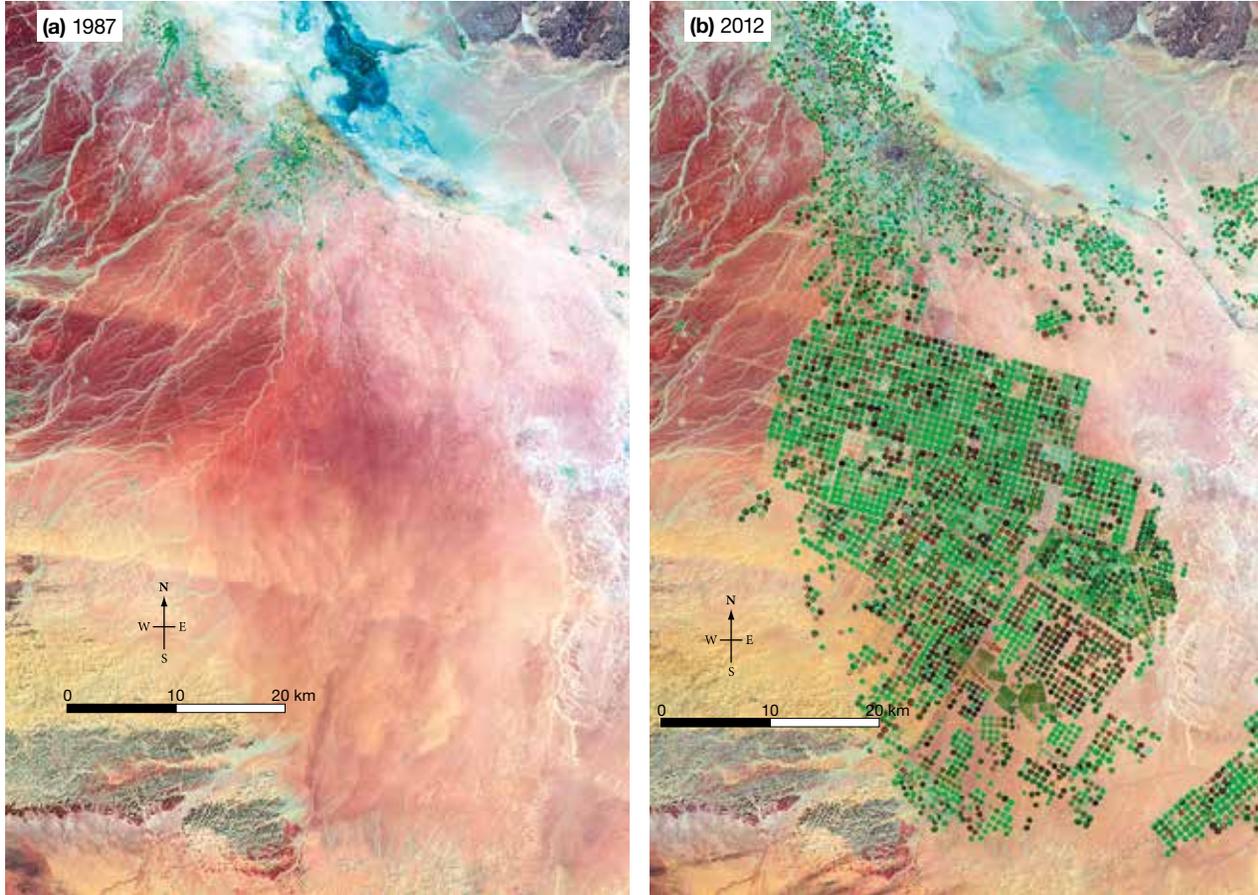
1.3 Review

1.3.1 Applying the concepts

Saudi Arabia is home to extensive desert regions. Today, thanks to advances in technology, much of the desert is being transformed into productive farming areas. Fruits, vegetables and grains are the main crops grown, and these help to improve the country's food security. Extensive drilling is tapping into underground aquifers as much as 1000 metres deep to access water for irrigation of water-hungry crops. Large circular sprays, called centre pivots, create a distinctive circular pattern of fields (see figure 1b).

Rainfall in the Wadi As-Sirhan Basin averages only 100–200 millimetres per year, which is insufficient to recharge underground aquifers. The water that is being pumped to the surface is actually 'fossil' water, possibly up to 20000 years old. The volume of water that is being used for desert agriculture has more than tripled in just over 25 years.

FIGURE 1 Satellite images of the Wadi As-Sirhan Basin in Saudi Arabia. *Note:* Landsat imagery shows new vegetation as bright green, while dry vegetation or land lying fallow is shown as rust-coloured. Dry desert areas are shown as pink and yellow.



1.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

1. Where is Saudi Arabia located? (*space*)
2. Looking at figure 1a, how would you describe this *place*?
3. What do you think the white lines to the north-west of the image are? What does this tell you about the climate in this region? (*environment, space*)
4. Comparing the two images, describe the *changes* that irrigation has brought to this *environment*.
5. Each of the fields in figure 1b is approximately 1 kilometre wide. What does this indicate about the *scale* of this irrigation region?
6. How would the isolation of this irrigation region affect the movement of fresh produce to markets in cities? (*interconnection*)
7. Hydrologists (water engineers) believe that it will be economical to continue pumping water for only another 50 years. Is the use of groundwater *sustainable* in the future?

UNIT 1

BIOMES AND FOOD SECURITY

Food is essential to human life. To ensure we have reliable food sources, we alter our world biomes — clearing vegetation, diverting and storing water, adding chemicals and even changing landforms. We will need to carefully manage our limited land and water resources and use more sustainable farming practices to ensure we have future food security.

- 2 All the world is a biome 15
- 3 How can we feed the world? 36
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A traditional Asian food market in Malaysia



TOPIC 2

All the world is a biome

2.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

2.1.1 Introduction

Where do the foods we eat and the natural products we use daily come from? Biomes. Biomes are communities of plants and animals that extend over large areas. Some are dense forests; some are deserts; some are grasslands, like much of Australia; and so the variations continue. Within each biome, plants and animals have similar adaptations that allow them to survive.

Biomes can be terrestrial (land based) or aquatic (water based). Understanding the diversity within them is essential to our survival and wellbeing.

Within each biome, there are many variations in the landscape and climate, and in the plants and animals that have adapted to survive there.



Starter questions

1. As a class, develop your own definition of the word *biome*.
2. What information about biomes is conveyed by the images shown on the previous page?
3. Brainstorm a list of biomes.
4. Select one of the biomes you listed in question 3, and create a mind map of the unique features you think it has.
5. What type of biome do you live in? If you cannot decide, why do you think that is?
6. Make a list of the things you use that have come from a biome. Compare your list with other students in your class.

INQUIRY SEQUENCE

| | | |
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2.2 SkillBuilder: Describing spatial relationships in thematic maps

online only

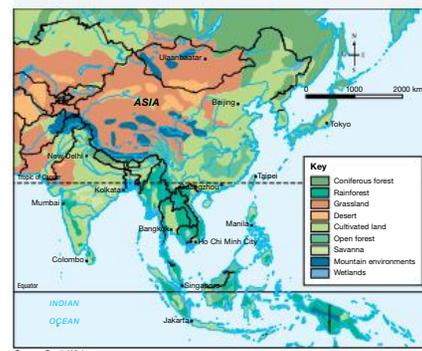
WHAT ARE SPATIAL RELATIONSHIPS IN THEMATIC MAPS?

A spatial relationship is the interconnection between two or more pieces of information in a thematic map, and the degree to which they influence each other's distribution in space. Describing these relationships helps us understand how one thing affects another.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Thematic map of Asia showing biomes



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 Watch this eLesson: Describing spatial relationships in thematic maps (eles-1726)

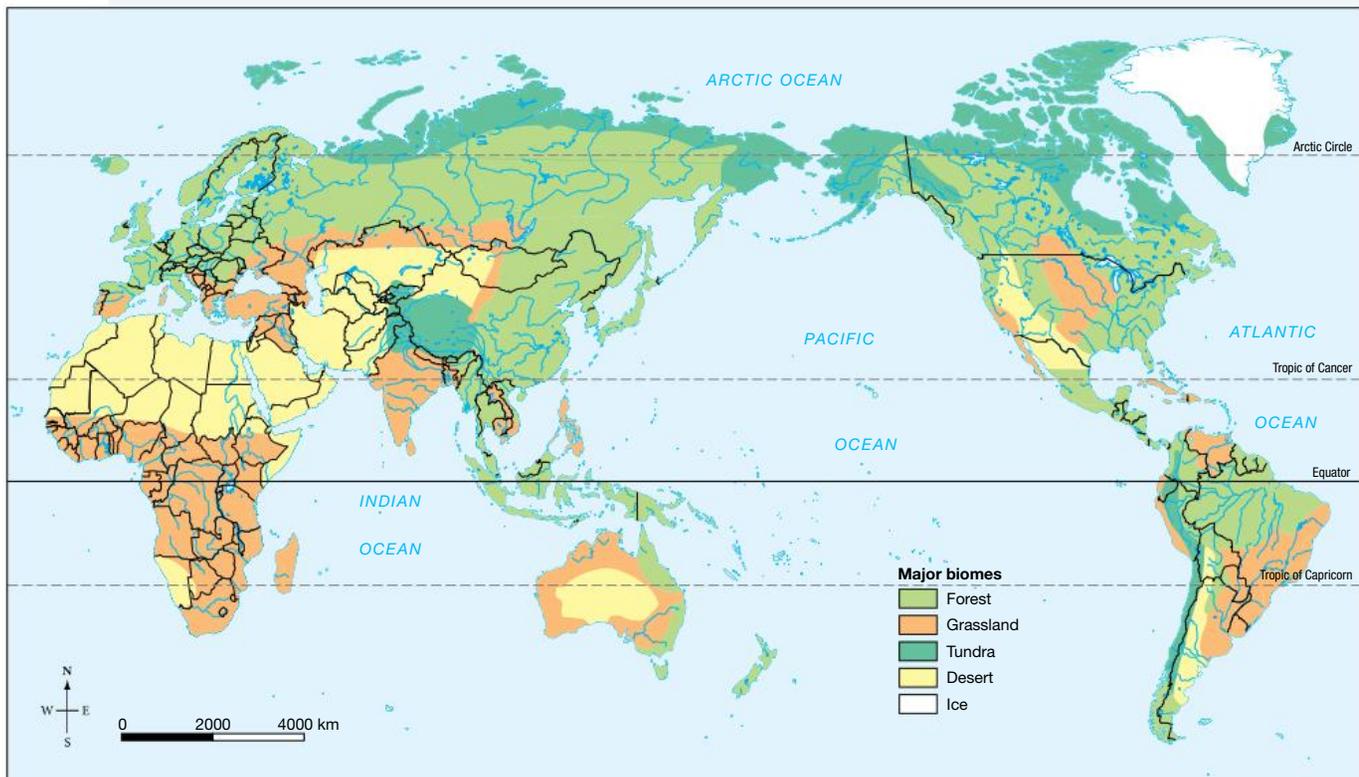
 Try out this interactivity: Describing spatial relationships in thematic maps (int-3344)

2.3 What is a biome?

2.3.1 What and where are the major biomes?

Biomes are sometimes referred to as ecosystems. They are places that share a similar climate and life forms. There are five distinct biomes across the Earth: forest, desert, grassland, tundra and aquatic biomes. Within each, there are variations in the visible landscape, and in the plants and animals that have adapted to survive in a particular climate.

FIGURE 1 Major biomes of the world



Source: Spatial Vision

Forests

Forests are the most diverse ecosystems on the Earth. Ranging from hot, wet, tropical rainforests to temperate forests, they have an abundance of both plant and animal life. Over 50 per cent of all known plant and animal species are found in tropical rainforests. Forests are the source of over 7000 modern medicines, and many fruits and nuts originated in this biome. Forests help regulate global climate, because they absorb and use energy from the sun rather than reflect it back into the atmosphere. Forest plants recycle water back into the atmosphere, produce the oxygen we breathe, and store the carbon we produce. Forests are under threat from **deforestation**.

FIGURE 2 Forest



Deserts

Deserts are places of low rainfall and comprise the arid and semi-arid regions of the world. Generally they are places of temperature extremes — hot by day and cold by night. Most animals that inhabit deserts are nocturnal (active at night), and desert vegetation is sparse. Desert rain often evaporates before it hits the ground, or else it falls in short, heavy bursts. Following periods of heavy rain, deserts teem with life. Not all deserts are hot. Antarctica and the Gobi Desert in central Asia are cold deserts. About 300 million people around the world live in desert regions.

FIGURE 3 Desert



Grasslands

Grasslands are sometimes seen as transitional environments between forest and desert. Dominated by grass, they have small, widely spaced trees or no trees. The coarseness and height of the grass varies with location. They are mainly inhabited by grazing animals, reptiles and ground-nesting birds, though many other animals can be found in areas with more tree cover. Grasslands have long been prized for livestock grazing, but overgrazing of grasslands is unsustainable and places them at risk of becoming deserts. Over one billion people inhabit the grassland areas of the world.

FIGURE 4 Grassland



Tundra

Tundra is found in the coldest regions of the world, and lies beyond the **treeline**. The landscape is characterised by grasses, dwarf shrubs, mosses and lichens. The growing season is short. Tundra falls into three distinct categories — Arctic, Antarctic and alpine — but they share the common characteristic of low temperatures. In Arctic regions there is a layer beneath the surface known as permafrost — permanently frozen ground. The tundra biome is the most vulnerable to global warming, because plants and animals have little tolerance for environmental changes that reduce snow cover.

FIGURE 5 Tundra



Aquatic biomes

Water covers about three-quarters of the Earth and can be classified as fresh water or marine. Freshwater biomes contain very little salt and are found on land; these include lakes, rivers and wetlands. Marine biomes are the saltwater regions of the Earth and include oceans, coral reefs and estuaries. Marine environments are teeming with plant and animal life, and are a major food source. Elements taken from the roots of mangroves have been used in the development of cancer remedies. Compounds from other marine life have also been used in cosmetics and toothpaste.

FIGURE 6 Water



2.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Name the five major biomes of the Earth and classify them as either aquatic or terrestrial.
2. Identify the broad characteristics biomes share.

Explain

3. Look carefully at figure 1. Using geographic terminology and concepts (including reference to latitude), describe the location and characteristics of the five major biomes.
4. (a) The map in figure 1 identifies five basic biomes. However, the text tells you that within each there are variations. Suggest reasons for these variations.
(b) Are all biomes equally important? Explain your answer.

Predict

5. Select one of the categories of biomes described in this section. Suggest how this biome might be **changed** and used by humans and what impact this **change** might have on the **environment**.

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 Try out this interactivity: Beautiful biomes (int-3317)

2.4 How do we use the grassland biome?

2.4.1 What are the characteristics of grasslands?

Grassland, pampas, savanna, chaparral, cerrado, **prairie**, rangeland and steppe all refer to a landscape that is dominated by grass. Once, grasslands occupied about 42 per cent of the Earth's land surface, but today they make up about 25 per cent of its land area. Grasslands are found on every continent except Antarctica.

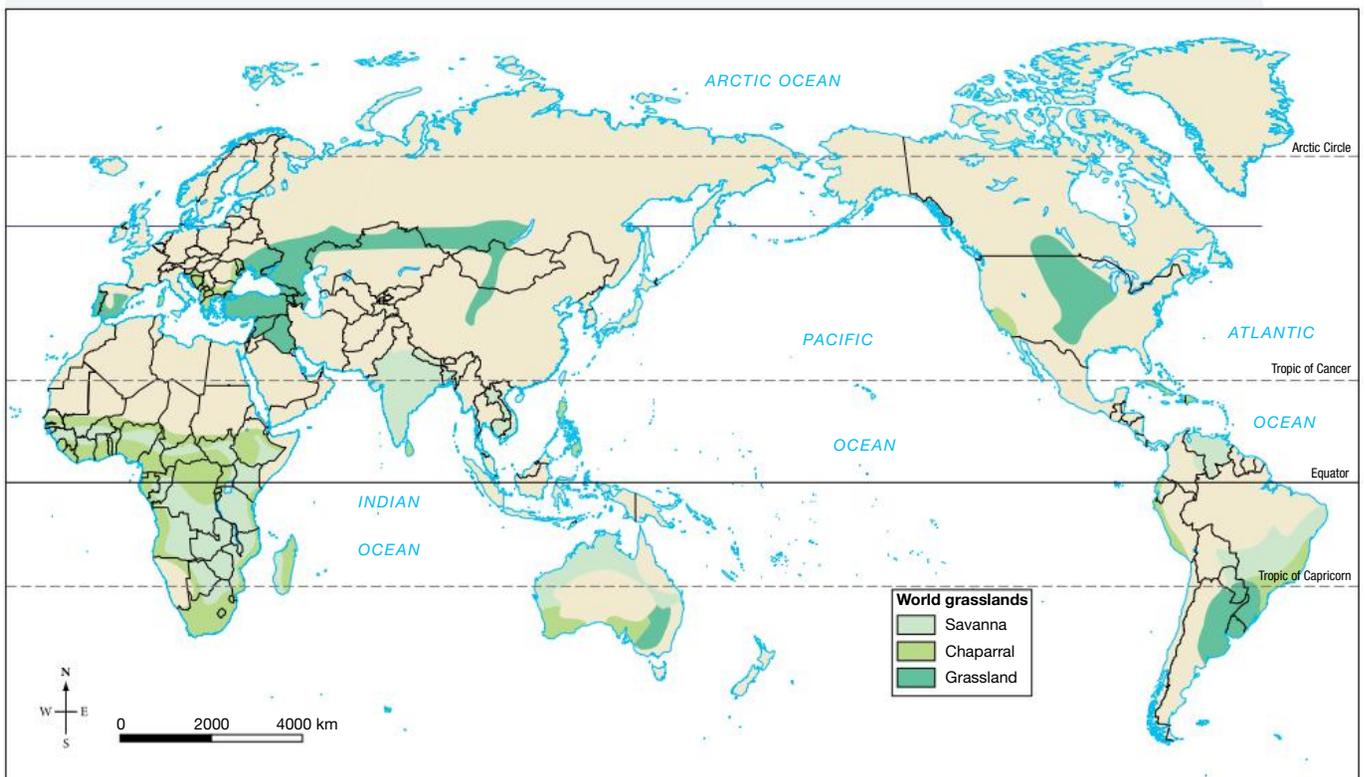
The grassland biome is dominated by grasses, and generally has few or no trees, though there may be more tree cover in adjoining areas, such as along riverbanks. They develop in places where there is not enough rain to support a forest but too much rain for a desert; for this reason they are sometimes referred to as a transitional landscape.

Grasslands are found in both temperate and tropical areas where rainfall is between 250 mm and 900 mm per year. In tropical regions, grasslands tend to have a distinct wet and dry season. In temperate regions, the summers tend to be hot and the winters cool. Generally, grasslands in the southern hemisphere receive more rainfall.

Grasslands can occur naturally or as a result of human activity. The presence of large numbers of grazing animals and frequent fires prevent the growth of tree seedlings and promote the spread of grasses. Unlike other plant species, grasses can continue to grow even when they are continually grazed by animals, because their growth points are low and close to the soil. Because grasses are fast-growing plants, they can support a high density of grazing animals, and they regenerate quickly after fire.

Some grasses can be up to two metres in height, with roots extending up to one metre below the soil.

FIGURE 1 Grasslands occupy about a quarter of the Earth's land surface.



Source: Spatial Vision

2.4.2 Why are grasslands important?

Grasslands are the most useful biome for agriculture because the soils are generally deep and fertile. They are ideally suited for growing crops or creating pasture for grazing animals. The prairies of North America, for example, are one of the richest agricultural regions on Earth.

Grasslands are also one of the most endangered biomes and are easily turned into desert. The entire ecosystem depends on its grasses and their annual regeneration. It is almost impossible to re-establish a grassland ecosystem once desert has taken over.

Almost one billion people depend on grasslands for their livelihood or as a food source.

Grasslands often depend on fire to germinate their seeds and generate new plant growth. Indigenous populations, such as Australian Aboriginal peoples, used this technique to flush out any wildlife that was hidden by long grass.

In more recent times, grasslands have been used for livestock grazing and are increasingly under pressure from **urbanisation**. Grasslands have also become popular tourist destinations, because people flock to them to see majestic herds such as wildebeest, caribou and zebra, as well as the migratory birds that periodically inhabit these environments.

All the major food grains — corn, wheat, oats, barley, millet, rye and sorghum — have their origins in the grassland biome. Wild varieties of these grains are used to help keep cultivated strains disease free. Many native grass species have been used to treat diseases including HIV and cancer. Others have proven to have properties for treating headaches and toothache.

Grasslands are also the source of a variety of plants whose fibres can be woven into clothing. The best known and most widely used fibre is cotton. Harvested from the cottonseed, it is used to produce yarn that is then knitted or sewn to make clothing. Lesser known fibres include flax and hemp. Harvested from the stalk of the plant, both fibres are much sturdier and more rigid than cotton but can be woven to produce fabric. Hemp in particular is highly absorbent and has UV blocking qualities.

In Australia today, less than one per cent of native grasslands survive, and they are now considered one of the most threatened Australian habitats. Since European occupation, most native grassland has been removed or changed by farming and other development. Vast areas of grassland were cleared for crops, and introduced grasses were planted for grazing animals such as sheep and cattle.

FIGURE 2 Grasslands can support a high density of grazing animals. In Australia, we use grasslands for fine wool production.



FIGURE 3 Wheat is a type of grass.



2.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is a grassland?
2. Describe the global distribution of grasslands.

3. Why are grasslands an important **environment**?
4. Describe the major threats to this **environment**.

Explain

5. Explain how Indigenous populations used the grassland **environment** in a **sustainable** way.
6. Explain why so little of Australia's grasslands remain.

Discover

7. Grasslands are located on six of the Earth's seven continents. Working in groups, investigate one of the grassland biomes. Using ICT, create a presentation on your chosen biome that covers the following:
 - the characteristics of the **environment**, including climate and types of grasses that dominate this **place**
 - the animals that are commonly found there
 - how the **environment** is used and **changed** for the production of food, fibre and wood products
 - threats to this particular grassland, including the **scale** of these threats
 - what is being done to manage this grassland **environment** in a **sustainable** manner.Investigate how different factors involved in ethical decision-making can be managed by people and groups.



Deepen your understanding of this topic with related case studies and questions.

o **Wheat**



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 Try out this interactivity: Grass, grains and grazing (int-3318)

2.5 What are coastal wetlands?

2.5.1 What are wetlands?

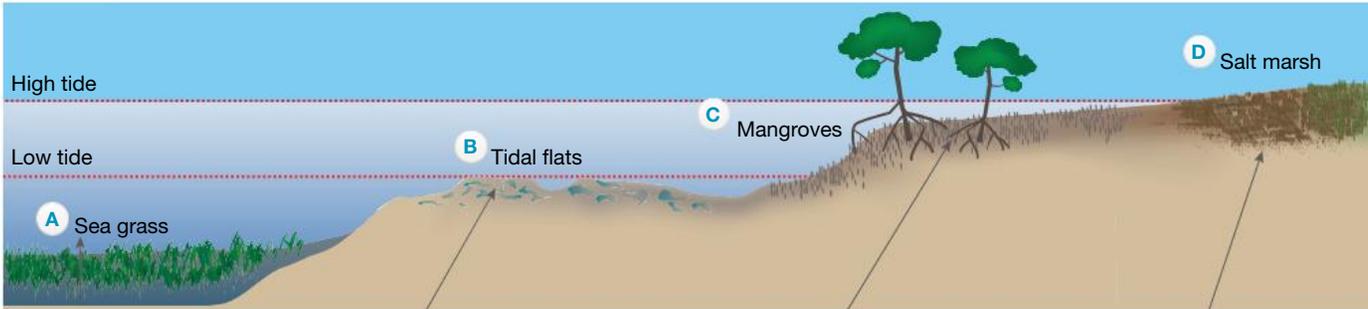
Wetlands are biomes where the ground is saturated, either permanently or seasonally. They are found on every continent except Antarctica. Wetlands include areas that are commonly referred to as marshes, swamps and bogs. In coastal areas they are often tidal and are flooded for part of the day. In the past they were often considered a 'waste of space', and in developed nations they were sometimes drained for agriculture or the spread of urban settlements.

2.5.2 Are wetlands important?

Wetlands are a highly productive biome. They provide important habitats and breeding grounds for a variety of marine and freshwater species. In fact, a wide variety of aquatic species that we eat, such as fish, begin their life cycle in the sheltered waters of wetlands. They are also important nesting places for a large number of migratory birds.

Wetlands are also a natural filtering system and help purify water and filter out pollutants before they reach the coast. In addition, they help regulate river flow and stabilise the shoreline. Figure 1 shows a cross-section through a mangrove wetland.

FIGURE 1 Cross-section of a wetland



- A** Seagrass meadows:
- are covered by water all the time
 - bind the mud and provide shelter for young fish
 - produce **organic matter**, which is consumed by marine creatures.

- B** Tidal flats:
- are covered by tides most of the time
 - are exposed for short periods of the day (low tide)
 - are formed by silt and sand that has been deposited by tides and rivers
 - provide a feeding area for birds and fish.

- C** Mangroves:
- have **pneumatophores** that trap sediment and pollutants from the land and sea
 - change shallow water into swampland
 - store water and release it slowly into the ecosystem
 - have leaves that decompose and provide a food source for marine life
 - provide shelter, breeding grounds and a nursery for marine creatures and birds.

- D** Salt marshes:
- are covered by water several times per year
 - provide decomposing plant matter — an additional food source for marine life
 - have high concentrations of salt.

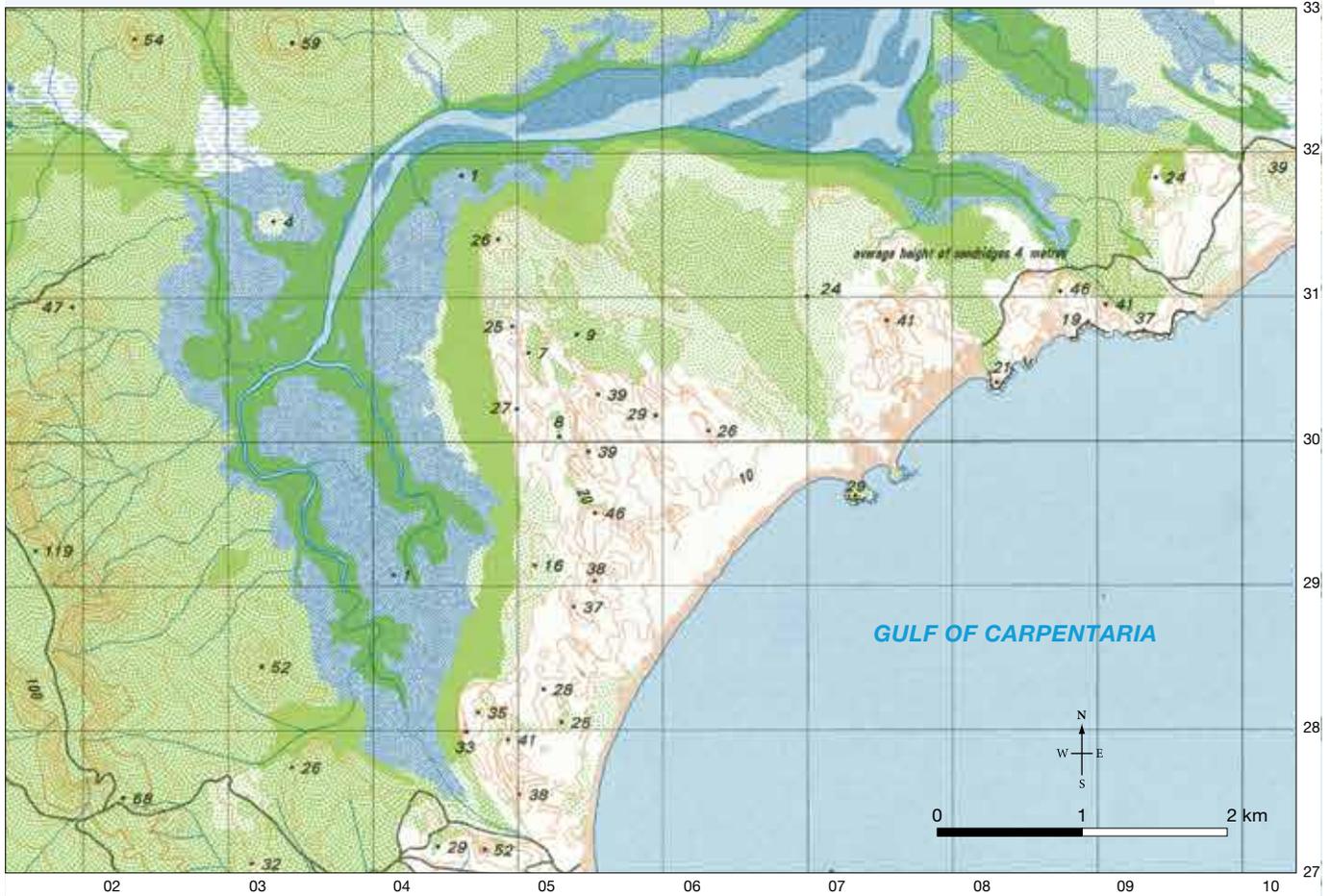
FIGURE 2 Seagrass



FIGURE 3 Pneumatophores



FIGURE 4 Dalywoi Bay, Northern Territory



Source: The Australian Army © Commonwealth of Australia 1999

| Key | |
|--|--|
| Vehicle track; Road bridge; Stock grid | Swamp; Swamp definite boundary |
| Mine; Building; Ruin; Church; Windpump; Yard | Perennial lake; Watercourse |
| Fence; Horizontal control point; Spot elevation | Intermittent lake; Watercourse |
| Contour with value and cliff; Pinnacle | Mainly dry lake; Watercourse |
| Depression contours; Sand; Distorted surface | Tank or Small dam; Waterhole |
| Levee; Sandbridge | Saline coastal flat; Intertidal flat; Rock bare or awash |
| Razorback ridgeline; fault line | Lighthouse; Intertidal ledge or reef |
| Vegetation; Dense, medium, scattered; Cleared lane | Exposed wreck; Submerged wreck |
| Rain forest; Pine | Submerged reef; Submerged rock |
| Orchard or vineyard; Line if trees or windbreak | Indefinite watercourse; Mangrove swamp |
| Watercourse; Area subject to inundation | |

2.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

Explain

1. How have mangroves adapted to survive in their marine–terrestrial **environment**?
2. What are seagrass meadows and why are they important?
3. Refer to figure 4 and describe the landscape at the following grid references: 042309, 071329, 030320 and 055290.

Predict

4. In figure 4, locate the grid square inside grid references: 030300, 030310, 040030, 040310.
- What is the area covered by these grid squares?
 - Describe how this **environment** would **change** over the course of the day.
 - A proposal has been put forward to construct a **canal housing estate** in this location. It is proposed that the estate will occupy this grid square and its surrounds. Describe the **scale** of this project.
 - Explain how the **environment** may **change** if this project goes ahead.

2.6 SkillBuilder: Constructing and describing a transect on a topographic map

online only

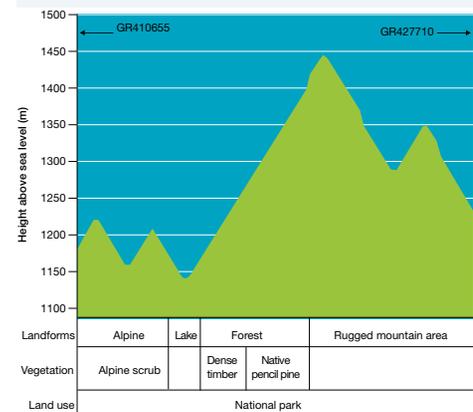
WHAT IS A TRANSECT?

A transect is a cross-section with additional detail, which summarises information about the environment.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 A transect of the Walls of Jerusalem National Park, Tasmania



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 **Watch this eLesson:** Constructing and describing a transect on a topographic map (eles-1727)

 **Try out this interactivity:** Constructing and describing a transect on a topographic map (int-3345)

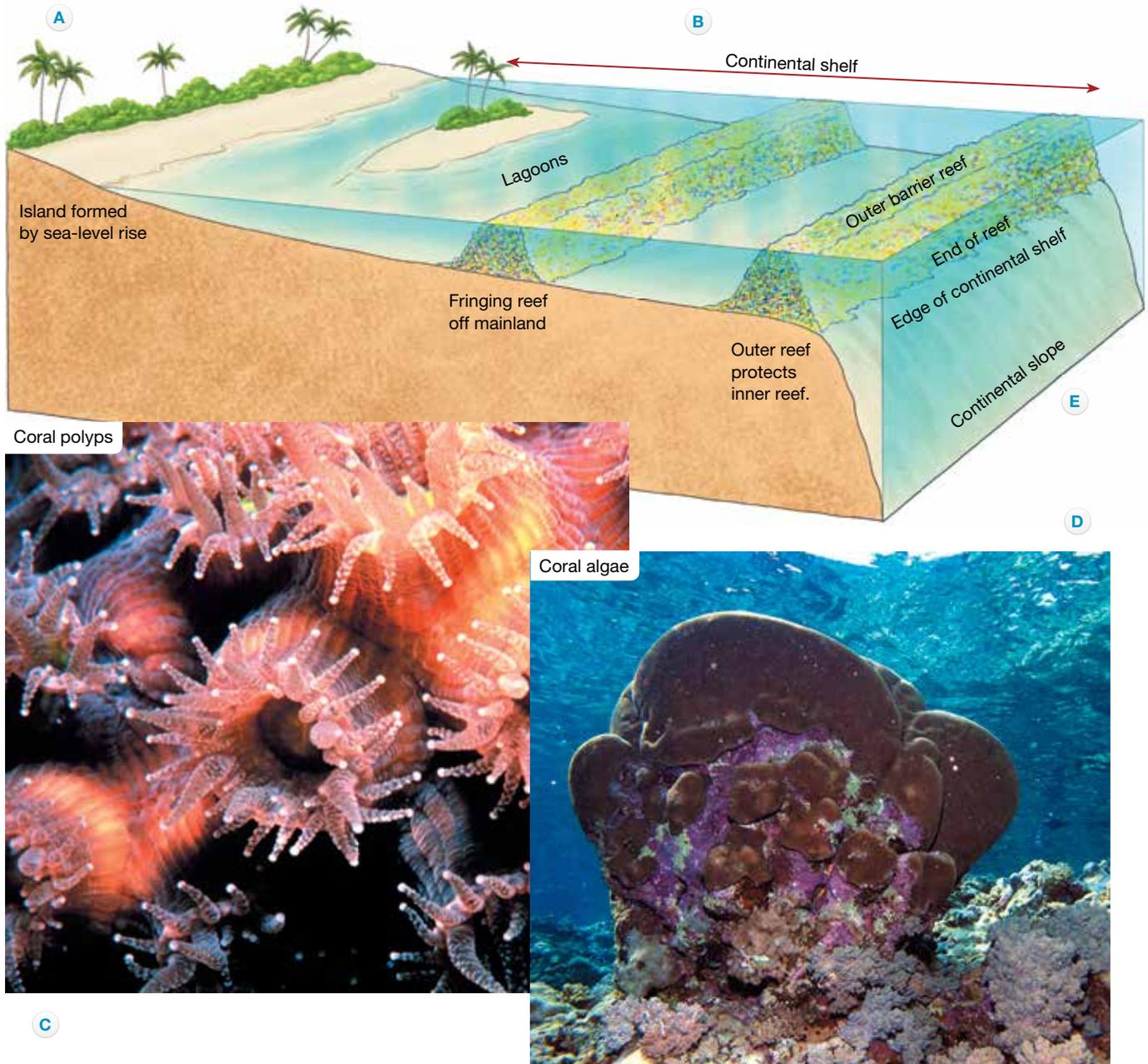
2.7 Why are coral reefs unique?

2.7.1 Formation of coral reefs

Coral reefs are found in spaces around tropical and subtropical shores. They require specific temperatures and sea conditions and an area free from sediment. Coral reefs are built by tiny animals called **coral polyps**. The upper layer is alive, growing on the remains of millions of dead coral. Coral reefs are one of the oldest ecosystems on Earth and also one of the most vulnerable to human activity.

Coral reefs are one of the most diverse biomes on Earth and are built by polyps that live in groups. A reef is a layer of living coral growing on the remains of millions of layers of dead coral. There are inner and outer reefs as well as coral cays (small islands of coral) and coral atolls.

FIGURE 1 Anatomy of a coral reef



- A** Continental island and fringing reef
- B**
 - Corals form in warm shallow salt water where the temperature is between 18 °C and 26 °C.
 - Water must be clear, with abundant sunlight and gentle wave action to provide oxygen and distribute nutrients.
- C** Coral polyps have soft, hollow bodies shaped like a sac with tentacles around the opening. They cover themselves in a limestone skeleton and divide and form new polyps.
- D** Producers such as algae give coral its colour and provide a food source for marine life such as fish. Coral reefs support at least one-third of all marine species. They are the marine equivalent of the tropical rainforest.
- E** Beyond the continental shelf, the water is too deep and cold for coral. Sunlight cannot penetrate to allow coral growth.

2.7.2 Benefits of coral reefs

Today, about 500 million people rely on reef systems, either for their livelihood, as a source of food, or as a means of protecting their homes along the coastline. (Coral reefs help break up wave action, so waves have less energy when they reach the shoreline, thus reducing coastal erosion.) It is estimated that coral reefs contribute between US\$28.8 billion and US\$375 billion to the global economy each year.

Reefs are important to both the fishing and tourism industries. Approximately 2 million people visit Australia's Great Barrier Reef Marine Park alone, generating more than A\$2 billion for the local economy. Nearly one-third of all tourists who visit Australia also visit the Great Barrier Reef.

Coral reefs have been found to contain compounds vital to the development of new medicines.

- Painkillers have been developed from the venom of cone shells.
- Some cancer treatments come from algae.
- Treatments for cardiovascular disease and HIV include compounds that were originally found in coral reefs.

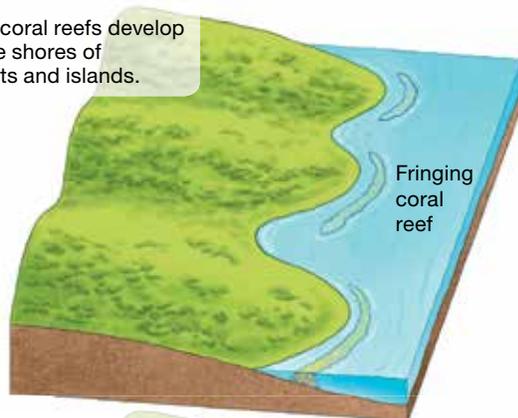
2.7.3 Threats to coral reefs

Reefs also face a variety of threats.

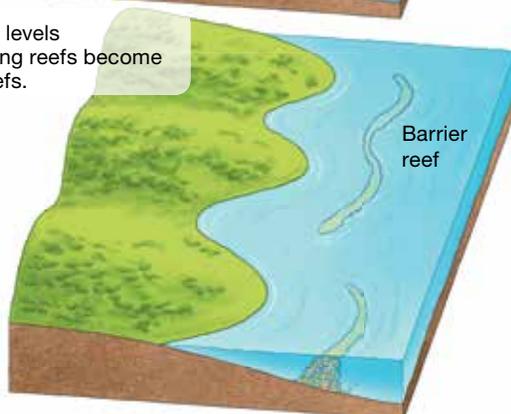
- Urban development requires land clearing and wetland drainage, which increases erosion. Sediment washed into water prevents sunlight penetrating the water.
- Contamination by fossil fuels, chemical waste and agricultural fertilisers pollutes the sea.
- Tourism damages coral through boats dropping anchor or tourists directly removing coral or walking on it.
- Global warming increases water temperature, which bleaches the coral, turning it white and destroying the reef system.
- Predators, such as the crown of thorns starfish prey on coral polyps, which affects the whole ecosystem.

FIGURE 2 The formation of fringing reefs, barrier reefs and coral atolls

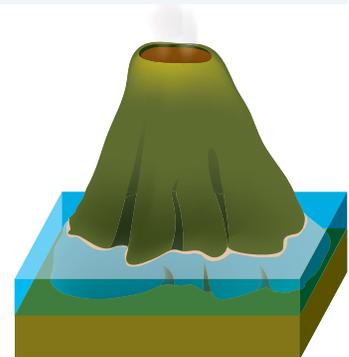
- 1 Fringing coral reefs develop along the shores of continents and islands.



- 2 When sea levels rise, fringing reefs become barrier reefs.



- 3 Formation of a coral atoll
a Volcanic island

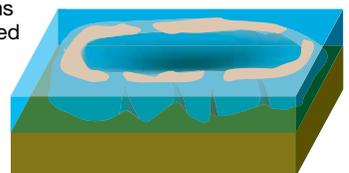


- b Eroded volcanic island has been partly submerged by rising sea.



- c Sandy island forms on reef from eroded coral and shell.

What was once an island is now completely submerged.



2.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

1. Explain the difference between a fringing reef and a barrier reef.
2. With the aid of a diagram, explain how coral reefs are formed.
3. Why are coral reefs important *places*?

Discover

4. Investigate two of the threats to coral reefs and prepare an annotated visual display that outlines:
 - the nature of the threat
 - the **changes** that will occur or have occurred as a result of this threat
 - the impact of these **changes** on the **environment**, including references to the rate and **scale** of the **changes**
 - a strategy for the long-term **sustainable** management of the reef **environment**.

Predict

5. Coral reefs are highly susceptible to climate **change**.
 - (a) Explain what you understand by the term **climate change**.
 - (b) With the aid of a diagram, explain how you think the coral reef **environment** would **change** if sea temperatures were to rise by 2 °C.



Deepen your understanding of this topic with related case studies and questions.

• The Great Barrier Reef

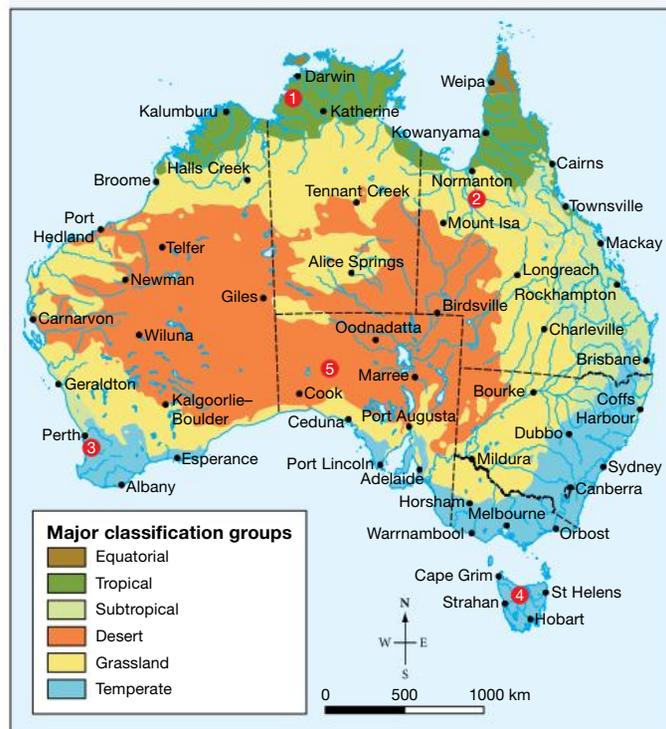
2.8 What are Australia's major biomes?

2.8.1 What factors shape Australian biomes?

Australia is a land of contrasts. Its mountain ranges and river systems are small by world standards. In the north are tropical rainforests and savanna grasslands. In the centre is a wide expanse of desert that is second in area only to the Sahara Desert in Africa. In the south, temperate forests and grasslands dominate. Australia also has vast wetlands and coastal ecosystems.

Before European colonisation, the Australian landscape was shaped largely by natural processes and Aboriginal burning practices. With European occupation came large-scale land clearing, irrigation of the land through water diversion from rivers, and the draining of wetlands. New plant and animal species were introduced to the landscape. However, despite the large-scale changes made since European occupation, Australia's major biomes are still clearly evident.

FIGURE 1 Climate classification of Australia. Climate plays a major role in the development of biomes.



Source: Data copyright Commonwealth of Australia, 2013 Bureau of Meteorology

1 Wetlands and rivers

In northern Australia, wetlands have been inhabited by Indigenous Australian peoples since the beginning of the Dreaming (more than 50 000 years). These areas provided them with food and water, and they used wetland plants such as river reeds and lily leaves to make fishing traps. Today, wetlands are still important habitats for native and migratory birds. In many parts of Australia, they are under threat, because water is diverted from rivers to produce food crops and cotton.

2 Savanna (grasslands)

Grasslands (or savanna) are generally flat, having either few trees and shrubs or very open woodland. For many native species, grasslands provide vital habitat and protection from predators. Many grasslands depend on a regular cycle of burning to germinate their seeds and to revive the land. Periodic burning also prevents trees from gaining dominance in the landscape. Before European occupation, Indigenous Australian peoples hunted the animals in the grasslands. However, since then, grasslands have been used extensively for grazing. These areas often mark the transition between desert and forest, and are a very fragile biome. Without careful management they can quickly change to desert. Less than one per cent of Australia's original native grasslands survive today.

3 Seagrass meadows

Seagrasses are submerged flowering plants that form colonies off long, sandy ocean beaches, creating dense areas that resemble meadows. Of the 60 known species of seagrass, at least half are found in Australia's tropical and temperate waters. Western Australia alone is home to the largest seagrass meadow in the world. Seagrasses provide important habitats for a wide variety of marine creatures, including rock lobsters, dugongs and sea turtles. They also absorb nutrients from coastal run-off, slow water flow, help stabilise sediment, and keep water clear.

4 Old-growth forest

An old-growth forest is one in its oldest growth stage. It is multi-layered, and the trees are of mixed ages. Generally, there are few signs of human disturbance. These forests are biologically diverse, often home to rare or endangered species, and show signs of natural regeneration and decomposition. The trees within some old-growth forests have been felled for their timber and to create paper products. **Logging** can reduce **biodiversity**, affecting not only the forest itself but also the indigenous plant and animal species that rely on the old-growth habitat.

FIGURE 2 A billabong in Kakadu National Park, part of an extensive wetland system that develops during the wet season



FIGURE 3 Savanna biomes are typically dominated by grasses and scattered trees.



FIGURE 4 Seagrass meadows provide food, shelter and breeding grounds for marine life.



FIGURE 5 Different layers of vegetation can be seen in old-growth forests.



It is estimated that **clearfelling** of Tasmania's old-growth forests would release as much as 650 tonnes of carbon per hectare into the atmosphere. In Victoria, near Melbourne, many old-growth forests lie within protected water supply catchments and help maintain the integrity of the city's water supply.

5 Desert

Australian deserts are places of temperature extremes. During the day, temperatures sometimes exceed 50 °C, but at night this can drop to freezing. Australia's desert regions are often referred to as the outback but they are not all endless plains of sand. Some, such as the Simpson and Great Sandy Deserts, are dominated by sand. The Nullarbor Plain and Barkly Tablelands are mainly smooth and flat, while the Gibson Desert and Sturt Stony Desert contain low, rocky hills. In some areas, the landscape is dominated by spinifex and acacia shrubs.

FIGURE 6 Vegetation in desert biomes has specific adaptations to enable it to survive in the harsh climate.



Some, such as the Simpson and Great Sandy Deserts, are dominated by sand. The Nullarbor Plain and Barkly Tablelands are mainly smooth and flat, while the Gibson Desert and Sturt Stony Desert contain low, rocky hills. In some areas, the landscape is dominated by spinifex and acacia shrubs.

2.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

1. Explain why Australia has such a wide variety of biomes.
2. With the aid of a flow diagram, show how the Australian **environment changed** when European occupiers arrived.
3. Explain what you understand by the term **biodiversity** and why it is important.
4. What other types of biomes would you expect to find in Australia?

Discover

5. Select one of the climate zones shown in figure 1 and investigate the biomes found within it. Prepare a report on the importance of one of these biomes and how it has **changed** over time. What do you think should be done to protect it?
6. (a) Investigate one of the Australian biomes and examine how plants and animals have adapted to survive in it. Create a class collage depicting the way plants and animals have adapted to the Australian **environment**.
(b) Explore what this biome is like in another **place** on Earth. With the aid of a Venn diagram, compare the two.

Predict

7. (a) Describe the **interconnection** between biomes and climate.
(b) Select one of the biomes discussed in this section. Predict what might happen if it were **changed**; for example, if the wetlands were drained, or all the old-growth forests were cut down. Include a reference to the effect this would have on biodiversity. Produce a before-and-after snapshot of your chosen biome.



Deepen your understanding of this topic with related case studies and questions.
• **Australia's alpine biomes**

2.9 Why are biomes different?

2.9.1 Why is climate the major influence on biomes?

Biomes are controlled by climate. In turn, climate is influenced by factors such as distance from the equator; altitude and distance from the sea; the direction of prevailing winds; and the location of mountain ranges. These play a key role in determining a region's climate and soil, which ultimately influence which plants and animals will inhabit it.

Temperature and rainfall patterns across the Earth determine which plant and animal species can survive in a particular biome. For instance, a polar bear could not survive in the hot climate of a desert or a tropical rainforest. Camels would not survive in the polar regions of the Earth, and fish cannot survive without water. The plants and animals of a region have adapted over time to the variations in the region's climate conditions.

2.9.2 What are the major influences on climate?

The major influences on climate are the geographical features of the Earth's surface, such as mountain ranges and **latitude**. Similarities have been found in the adaptations of plant and animal species in mountain regions and those found near the poles.

Landform

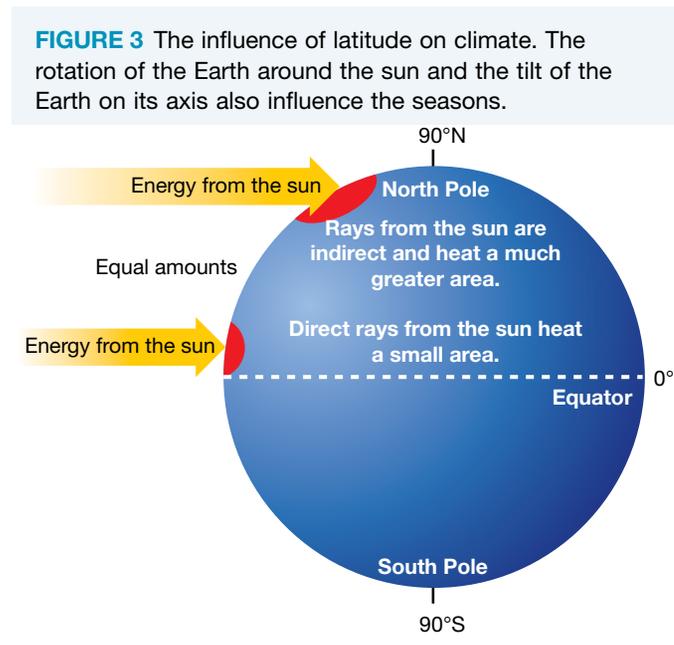
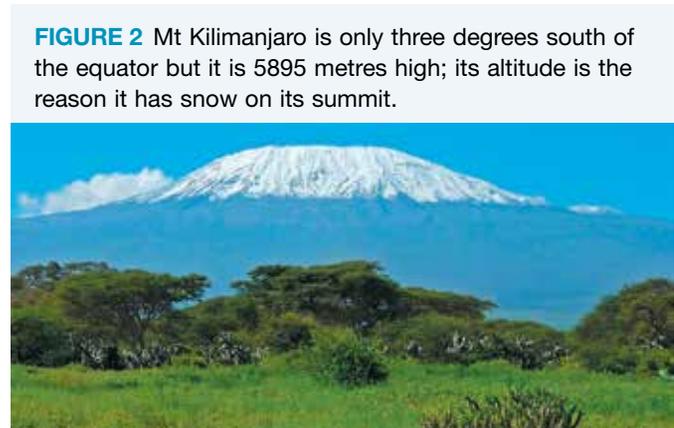
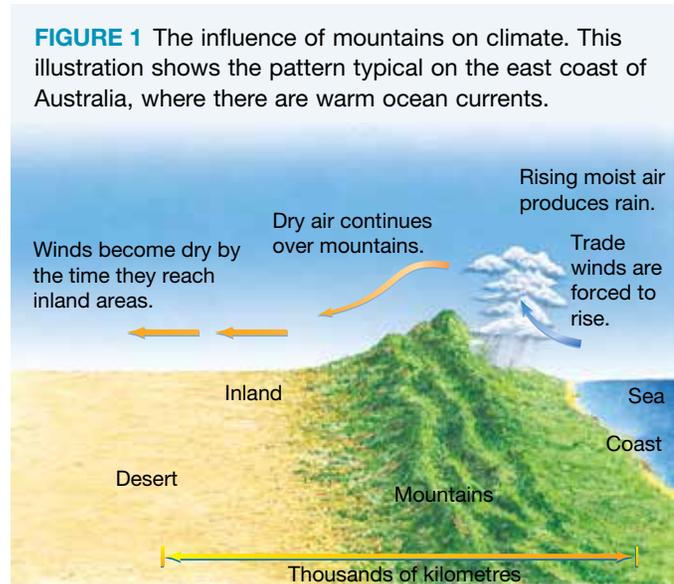
The major geographical influence on climate is the location of mountain ranges (see figure 1). Mountain ranges affect the amount of **precipitation** that reaches inland areas, because they pose a barrier to moisture-laden prevailing winds. **Rain shadows** form on the **leeward** side of mountains (opposite to the **windward** side). Deserts often form in rain shadows.

Altitude also plays a significant role in determining climate. Temperatures fall by 0.65 °C for every 100 metres increase in elevation. This can be illustrated by Mt Kilimanjaro (figure 2), which is located on the border of Tanzania and Kenya, in Africa, approximately 3° latitude from the equator. Towering 5895 metres above sea level, Mt Kilimanjaro is the highest mountain in Africa. Depending on the time of the day, the temperature at the base of the mountain ranges from 21 °C to 27 °C. At the summit, temperatures can plummet to -26 °C. As you move from base to summit, variations occur in the landscape as it transitions from rainforest to alpine desert to desert tundra.

Latitude

The sun's rays are more direct at the equator. With more energy focused on that region, it heats up more quickly. At the poles, the sun's rays are spread over a larger area and therefore cannot heat up as effectively. As a result, areas at the poles are much cooler than areas at the equator (see figure 3).

The tilt of the Earth on its axis also has a part to play. When a hemisphere tilts towards



the sun, the sun's rays hit it more directly. This means that a larger space is in more intense sunlight for longer. The days are longer and warmer, and the hemisphere experiences summer. The reverse is true when a hemisphere tilts away from the sun in winter.

Ocean currents and air movement

There are other factors that influence climate and play a role in the development of biomes. Two of these are ocean currents and air movement. In addition, differences also occur when you move from the coast to inland areas.

When cold ocean currents flow close to a warm land mass, a desert is more likely to form. This is because cold ocean currents cool the air above, causing less evaporation and making the air drier. As this air moves over the warm land, it heats up, making it less likely to release any moisture it holds; thus, deserts form. For example, cold ocean currents flow off the coast of Western Australia, while the Pacific Ocean currents are warmer. As a result, Perth on average receives less rainfall than Sydney.

2.9.3 The role of soil in biomes

Soil is important in determining which plants and animals inhabit a particular biome. Soils not only vary around the world but also within regions. The characteristics of soil are determined by:

- temperature
- rainfall
- the rocks and minerals that make up the bedrock, which is the basis of soil development.

The amount of vegetation present also plays an important role in determining the quality of the soil. Figure 4 shows a typical soil profile. The different soil layers are referred to as horizons.

Why do soils differ?

Biomes located in the high latitudes (those farthest from the equator) have lower temperatures and less exposure to sunlight than biomes located in the low latitudes (those close to the equator). There are also variations in the amount of precipitation that biomes receive. This is determined partly by their location in relation to the equator (see figure 5).

Temperature and precipitation patterns are important factors in determining the rate of soil development. However, soil moisture, its nutrient content and the length of the growing season also play key roles in soil development and, ultimately, the biodiversity of a biome.

FIGURE 4 A typical soil profile has a number of distinct layers.

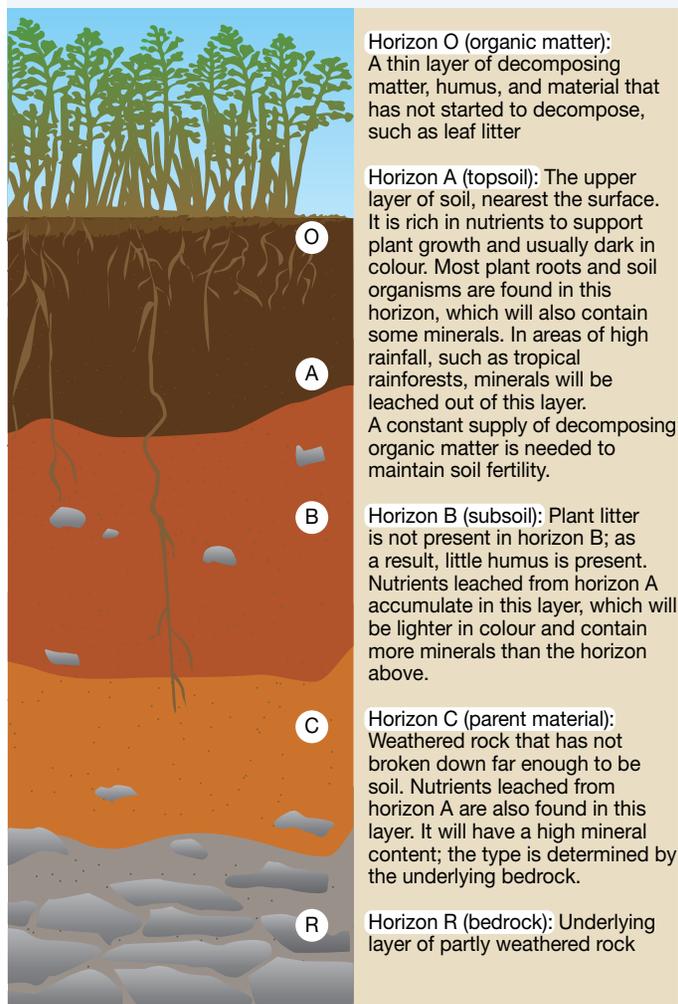
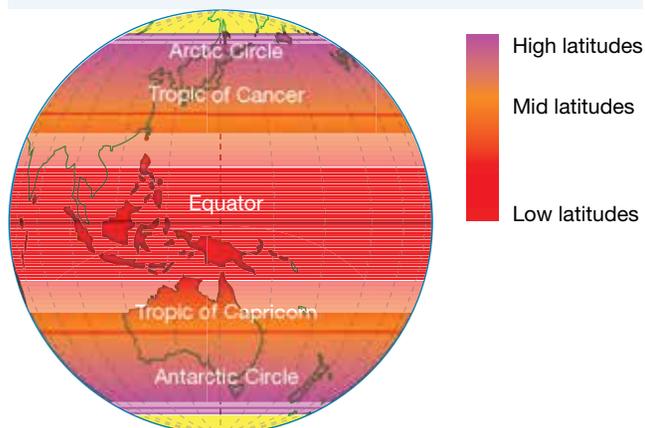
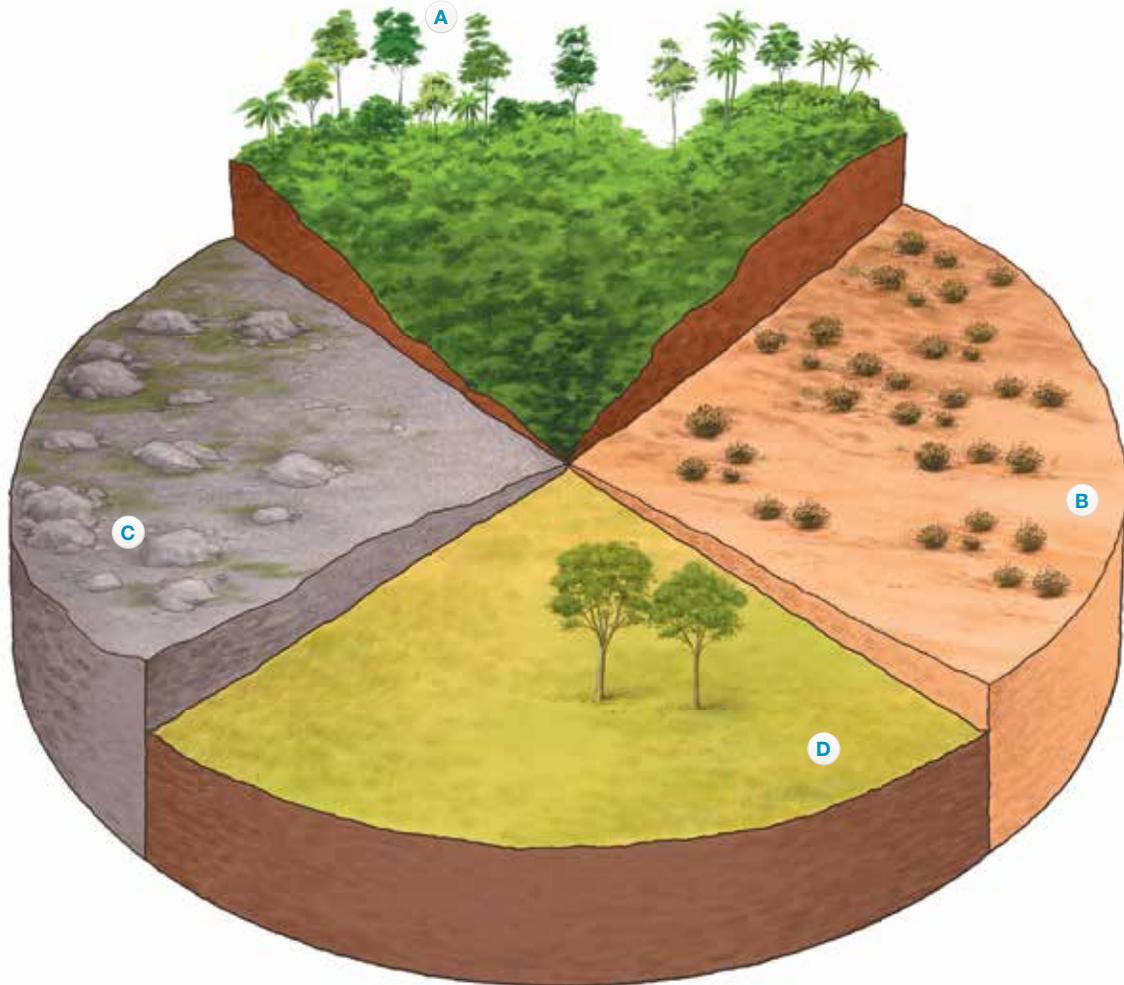


FIGURE 5 Just as there is a link between climate and latitude, there is also a link between soil, climate and latitude.



Soil is more abundant in biomes that have both high temperatures and high moisture than in cold, dry regions. This is because erosion of bedrock is more rapid when moisture content is high, and organic material decomposes at a faster rate in high temperatures. The decomposition of organic matter provides the nutrients needed for plant growth, which in turn die and decompose in a continuous cycle. This is further demonstrated in figure 6.

FIGURE 6 Different biomes have different soil and vegetation characteristics.



A Tropical rainforest

- High temperatures cause weathering, or breakdown, of rocks and organic matter.
- High rainfall **leaches** nutrients from the soil.
- Soil is often reddish because of high iron levels.
- Organic matter is often a shallow layer on the surface. Nutrients are constantly recycled, allowing the rainforest to flourish.
- Soil fertility is rapidly lost if trees are removed, as the supply of organic material is no longer present.

B Desert

- Limited vegetation means a limited supply of organic material for soil development.
- High temperatures rapidly break down any organic material.
- Soils are pale in colour rather than dark.
- Lack of rainfall limits plant growth.
- Lack of vegetation makes surface soil unstable and easily blown away.
- Soil does not have time to develop and mature.

C Tundra

- Soil is shallow and poorly developed.
- Includes layers that are frozen for long periods.
- Subsoil may be permanently frozen.
- Is covered by ice and snow for most of the year.
- Growing season may be limited to a few weeks.
- Soil may contain large amounts of organic material but extreme cold means it breaks down very slowly.
- Trees are absent; mosses and stunted grasses dominate.

D Temperate

- Generally brown in colour, soils have distinctive horizons and are generally about one metre deep.
- Ideal soils for agriculture; they are not subjected to the extremes of climate found in high and low latitudes.
- Moderate climate; temperature and rainfall are sufficient for plant growth.
- Dominated by temperate grasslands and deciduous forests.

What else is in the soil?

Soil not only supports the plants and animals that we see on the surface of the land; the soil itself is also home to a variety of life forms such as bacteria, fungi, earthworms and algae.

While most soil organisms are too small to be seen, there are others that are visible. For instance, more than 400 000 earthworms can be found on a hectare of land. Regardless of size, all soil organisms play a vital role in maintaining soil quality and fertility. For example, earthworms:

- compost waste and fertilise the soil
- improve drainage and aeration
- bring subsoil to the surface and mix it with topsoil
- secrete nitrogen and chemicals that help bind the soil.

FIGURE 7 There are more microbes in a teaspoon of soil than there are people on Earth.



2.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What are the major influences on the development of biomes?

Explain

2. Explain the difference between the windward and leeward side of a mountain range.
3. Explain why soils vary across biomes.

Predict

4. (a) Use your atlas to locate Rwanda in central Africa. What type of biome would you expect to find in Rwanda? Give reasons for your answer.
(b) What do you think the soil would be like in Rwanda?
(c) Use the internet to test your theory.
5. Would you expect to find soil variations within biomes? Give reasons for your answer.
6. Predict the **changes** that might occur if earthworms or micro-organisms within the soil were no longer present.

Think

7. (a) What type of climate and biomes would you expect to find at the equator? Why?
(b) Describe the climate and landscape on Mount Kilimanjaro.
(c) What are some of the factors that create variations in biomes?

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 Try out this interactivity: Why are biomes different? (int-3319)

2.10 How do we protect biomes?



Access this subtopic at www.jacplus.com.au

2.11 Review



2.11.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

2.11.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

2.2 SkillBuilder: Describing spatial relationships in thematic maps

2.2.1 Tell me

What are spatial relationships in thematic maps?

A spatial relationship is the interconnection between two or more pieces of information in a thematic map, and the degree to which they influence each other's distribution in space.

Why are spatial relationships in thematic maps useful?

Spatial relationships between features or information in thematic maps are the links between the distribution of those features. Finding these links can help us to see the world in an organised manner. They are useful in helping you, as a student, to understand how one thing affects another.

They are also used by:

- councils, when determining planning permits
- transport authorities, when determining new freeways, rail links and tunnels
- meteorologists, when predicting the weekly weather.

Model

The maps in figures 1a and 1b show that, across Asia, there is a strong interconnection between climate and biomes. In areas of high rainfall throughout the tropics, rainforest biomes dominate. In western India's hot desert and in the cold mountains, desert biomes exist. In central Asia, the cold deserts and semi-deserts are so dry that desert and grassland biomes dominate the environment. There is no interconnection between climate and the wetland biomes of north-east China and Bangladesh's delta region. Overall though, there is a strong spatial relationship in Asia between biomes and climate.

A description of a spatial relationship in thematic maps:

- clearly identifies which features on thematic maps are linked or interconnected
- points out obvious anomalies, where no linkages or interconnections can be observed
- describes the extent of interconnections (for example, as strong or weak).

2.2.2 Show me

How to find and describe a spatial relationship in thematic maps

You will need:

- two thematic maps that can be compared
- an atlas.

Procedure:

STEP 1

Use an atlas to familiarise yourself with the mapped area. Place names are important to use in your writing. In figure 1, identify places such as India and China.

STEP 2

Identify areas on both maps that have a distinct interconnection by looking for similar patterns in similar parts of the maps. In figure 1, biomes are clearly linked to climate, with temperatures, rainfall and other climatic factors having an important role in determining what will grow in an area. Write a few sentences outlining where these strong interconnections occur. For example: 'In central Asia, the cold deserts and semi-deserts are so dry that desert and grasslands biomes dominate the environment'.

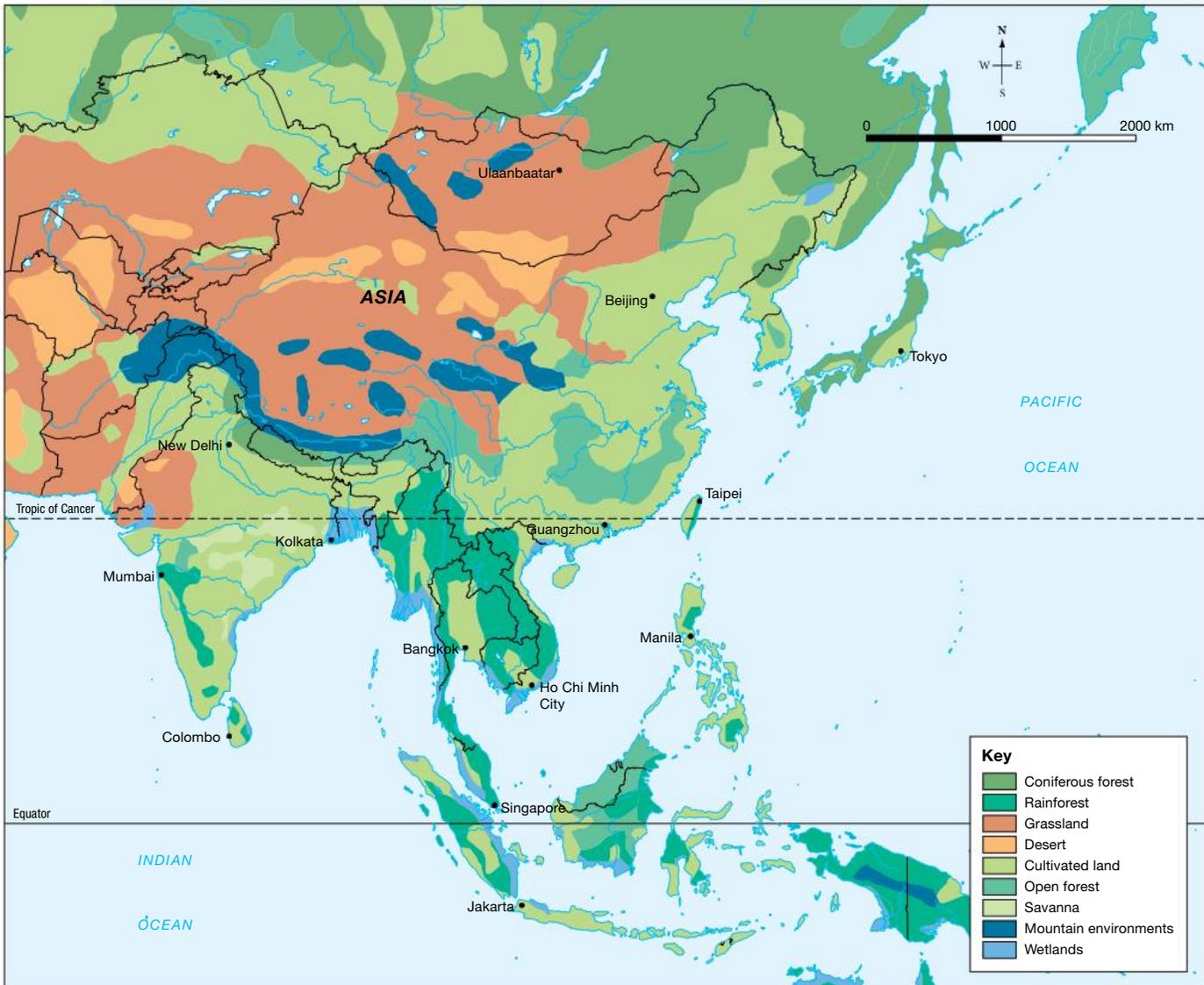
STEP 3

Search the maps carefully and look for any areas where there seem to be no connections between biomes and climate. If necessary, write a few sentences outlining where there are no interconnections. For example: 'The wetland biomes of north-east China and the Bangladesh delta are not linked to climate'.

STEP 4

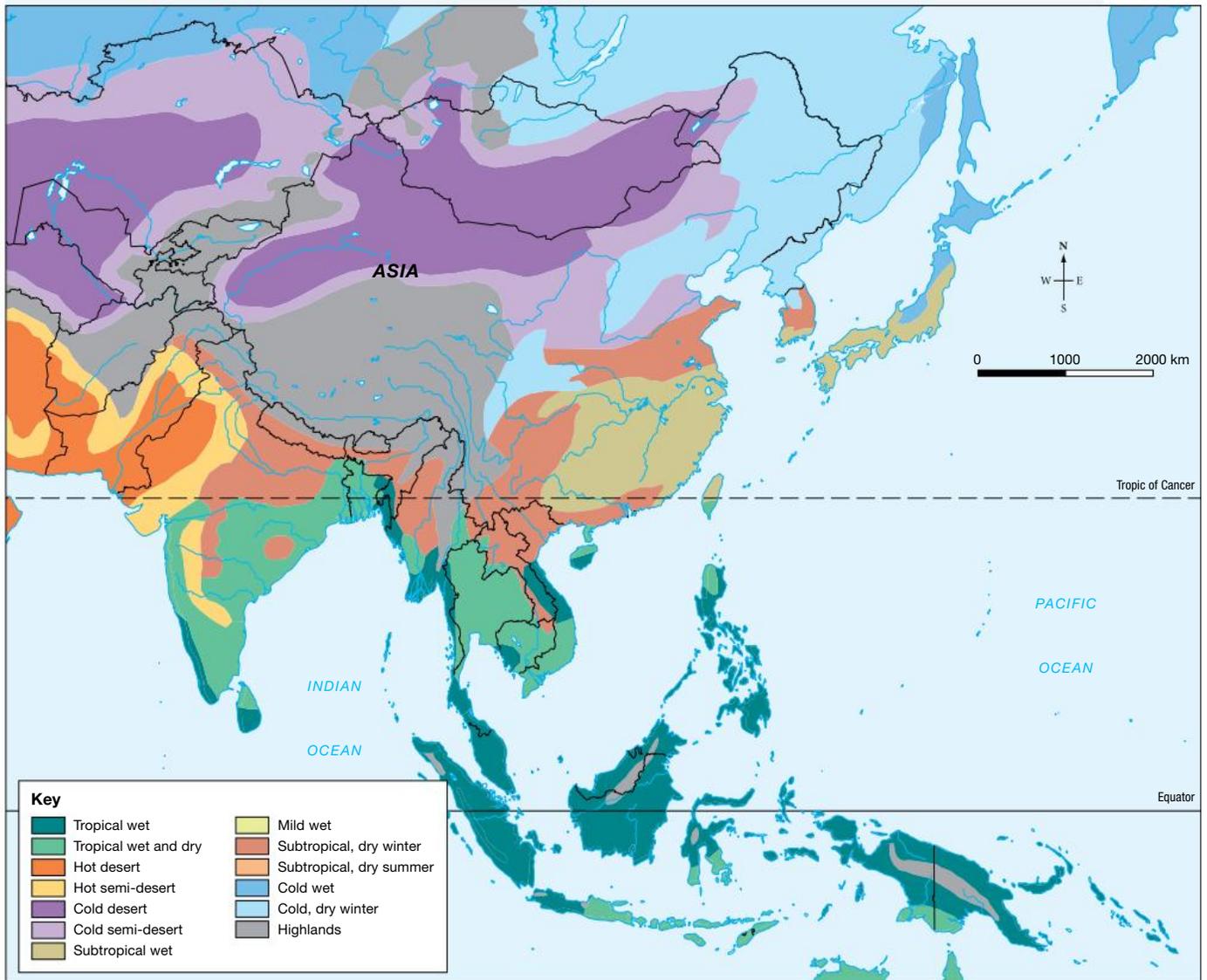
Conclude your paragraph with a final statement about spatial relationships. For example: 'In Asia there is a strong spatial relationship between biomes and climate'.

FIGURE 1a Thematic map of Asia showing biomes



Source: Spatial Vision

FIGURE 1b Thematic map of Asia showing climatic zones



Source: Spatial Vision using Natural Earth

2.2.3 Let me do it

Developing my skills

Use the thematic maps for Australia's biomes and climate in your textbook, figure 1 in section 2.3.1 and figure 1 in section 2.8.1. In a paragraph, describe the spatial relationship between biomes and climate in Australia.

Questions

1. Is there a strong relationship between Australia's arid climates and desert biomes? Explain your answer.
2. Is there a *spatial* relationship between Australia's tropical rainforests and climate?
3. Is the *spatial* relationship between climate and the savanna (grassland) biome strong or weak? Explain your answer.
4. Name the main biome found in Tasmania. Why might there be only one biome on the map?
5. Find one biome that does not occur in Australia. Suggest reasons why this is the case.

Checklist

I have:

- clearly identified which features on thematic maps are linked or interconnected
- pointed out obvious anomalies, where no linkages or interconnections can be observed
- described the extent of interconnections (for example, as strong or weak).

Skills questions

1. Finding the *spatial* relationships between thematic maps shows:
 - (a) the *interconnection* between biomes and climate
 - (b) the *interconnection* between features
 - (c) the importance of a feature
 - (d) the distribution of a feature.
2. A *spatial* relationship on a thematic map is about:
 - (a) slope
 - (b) rainfall
 - (c) patterns
 - (d) colours.
3. Why is it necessary to have two thematic maps when finding *interconnections* between features?
4. Why do we look for areas where no *spatial* relationship exists — that is, where there is an anomaly?

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Watch this eLesson: Describing spatial relationships in thematic maps (int-1726)



Try out this interactivity: Describing spatial relationships in thematic maps (int-3344)

2.6 SkillBuilder: Constructing and describing a transect on a topographic map

2.6.1 Tell me

What is a transect?

A transect is a cross-section with additional detail which summarises information about the environment. In addition to the shape of the land, a transect shows what is on the ground, including landforms, vegetation, soil types, settlements and infrastructure.

Why are transects useful?

Transects are useful for showing:

- one or more features that occur along a line between two places
- interconnections between features
- change that occurs along the line.

You can use transects to identify changes in landforms, vegetation and land use. They can also help to show the way certain features, such as landforms, influence other features, such as vegetation. They help us to understand interconnections in the environment.

Transects are used by:

- land developers wanting to explore the key features of an environment
- agronomists seeking to record plant species between two points
- journalists wanting to show differences within a country.

Model

The transect reveals that the main vegetation in the southern areas of the Walls of Jerusalem National Park (where the undulating land reaches 1200 metres) is light alpine scrub. This area contains a lake before the scrub changes to dense timber as the land increases in height. The dense timber gives way to native pencil pines as the land gains further height from 1250 metres to 1400 metres. Where the land rises to 1450 metres, the area is described as rugged mountains. All of this area is designated national parkland.

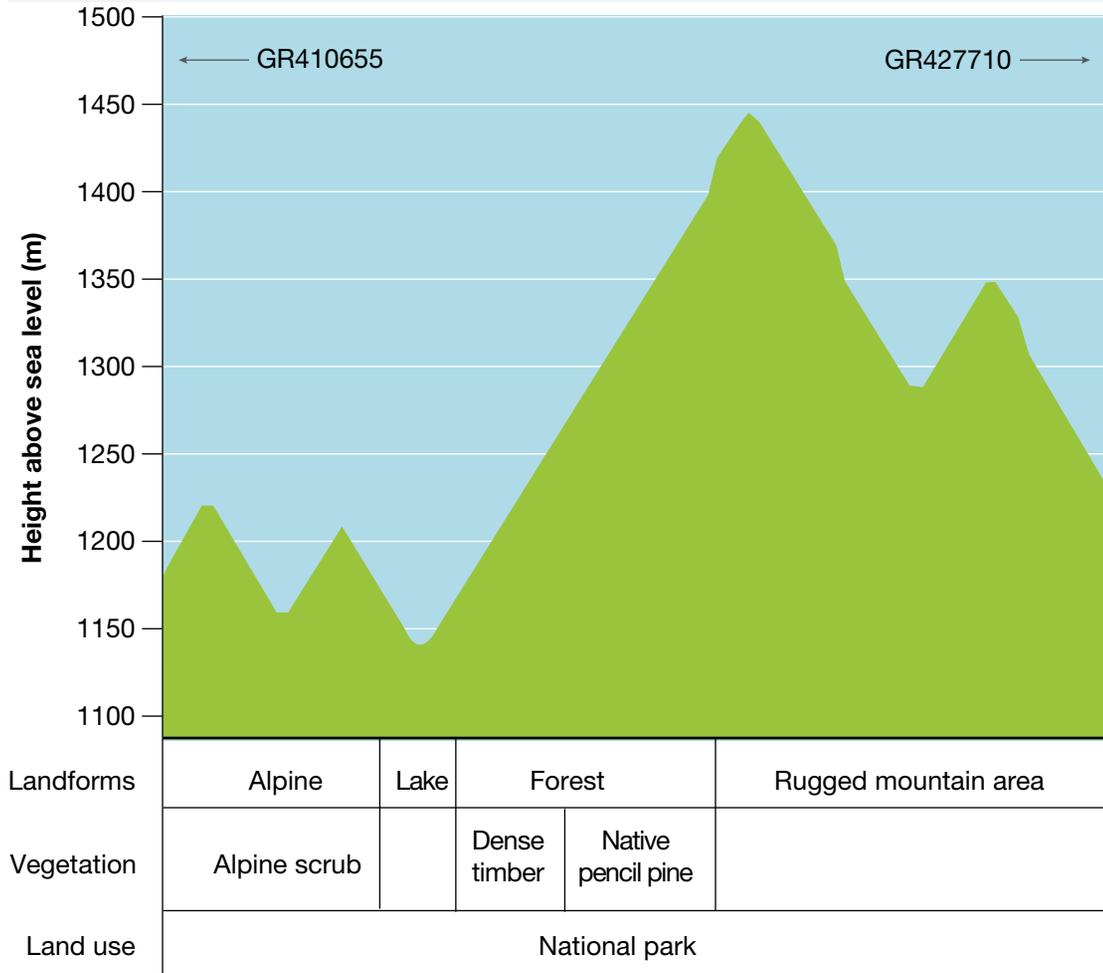
A good transect:

- is drawn in pencil
- has ruled axes
- has labelled axes
- uses small dots
- is drawn with a smooth curve
- identifies key aspects such as slope, landform, vegetation and land use
- includes a title.

A good description of a transect:

- describes the key aspects of slope, landform, vegetation and land use
- identifies interconnections between key features
- notes any anomalies.

FIGURE 1 A transect of the Walls of Jerusalem National Park, Tasmania



2.6.2 Show me

How to construct and interpret a transect

You will need:

- a topographic map of the region being considered
- a piece of paper with a straight edge for marking the contours
- another sheet of paper, or graph paper, to draw the transect on
- a light grey pencil
- a ruler.

Procedure:

To complete a transect, you must have a topographic map of the place you wish to examine. You then need to choose the area you would like to look at and the two points that will give you the best line through that area. Remember that you will be examining the land's shape and features. In figure 1, the two selected points are grid references 410655 and 427710.

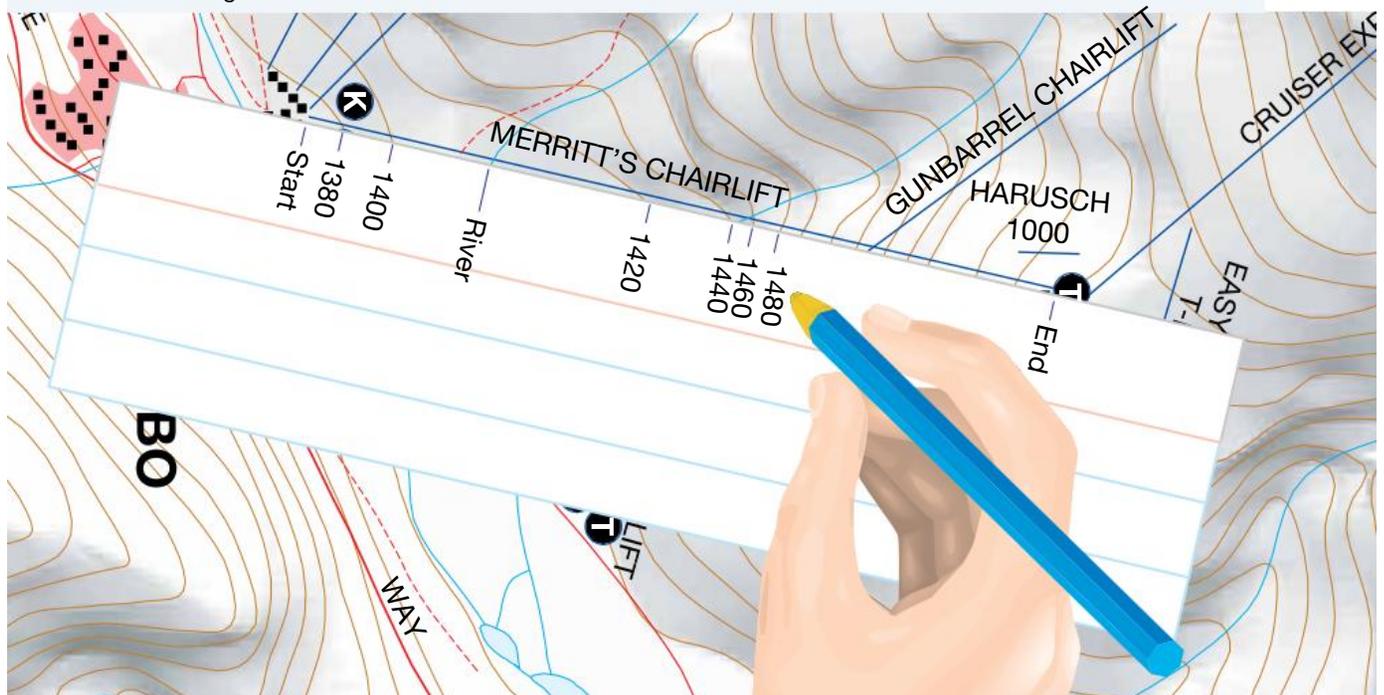
STEP 1

Place the straight edge of a piece of paper between the two points. Mark the two extremities of your transect on the edge. Label these 'Start' and 'Finish' or give them place names or grid references from the map.

STEP 2

Create a mark where each contour line touches the edge of the paper. Beside each mark, write the height of the contour line. (It's a good idea to check the contour interval on the topographic map. This will tell you how many metres the lines increase or decrease by.) It may be necessary to lift the page edge or follow the contour line to find a number. Hold your page firmly and lift the edges to prevent your page moving off the line of the transect. When you have completed all the contour markings, you can lift the page away from the map.

FIGURE 2 Marking the contour lines



STEP 3

On the other sheet of paper, use your ruler to draw a vertical and a horizontal axis. The horizontal base line should be as long as your cross-section from start to finish. The vertical scale needs to give a realistic impression of the slopes and landforms. If you exaggerate the scale too much, you distort the shape of the land and a hilly area can appear mountainous. Although some vertical exaggeration is acceptable, try to choose a vertical scale carefully. For this exercise, use one centimetre to represent 100 metres.

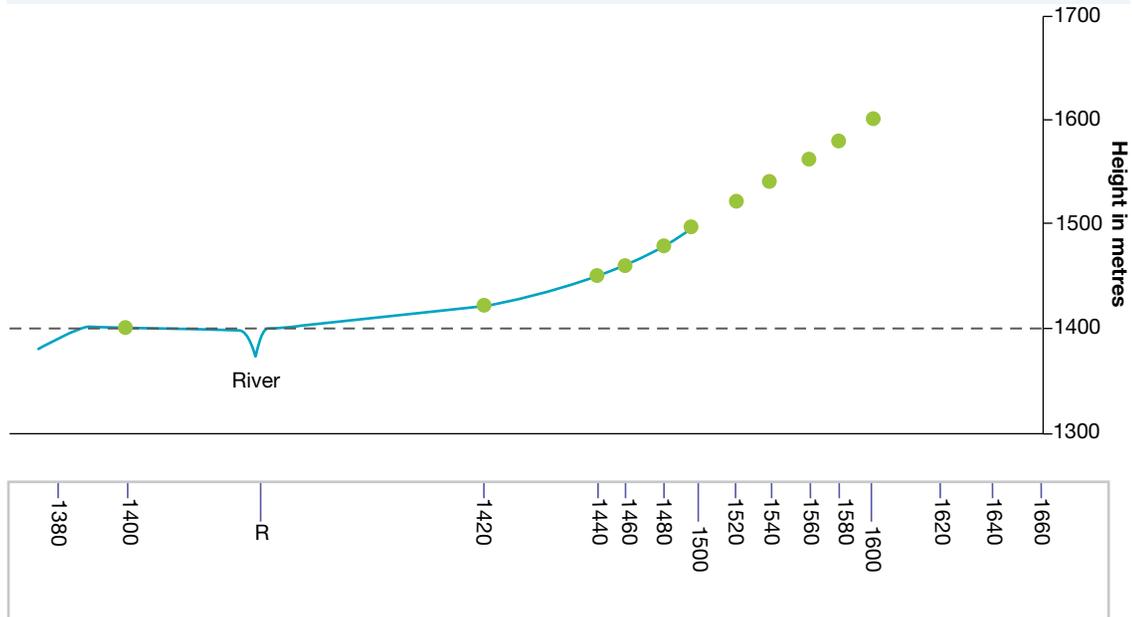
STEP 4

Place the marked edge of the paper along the horizontal axis. At each contour marking, find the matching height on the vertical scale. Put a small dot directly across from that height and above the contour marked on the edge of the paper.

STEP 5

Join the dots with a smooth line to show the slope of the land, as shown in figure 3. Notice that a notch has been used to show a river on the cross-section, and that the river has been labelled. Think about the depth of the river, and keep the notch shallow. Other features can be marked in a similar way when preparing the cross-section.

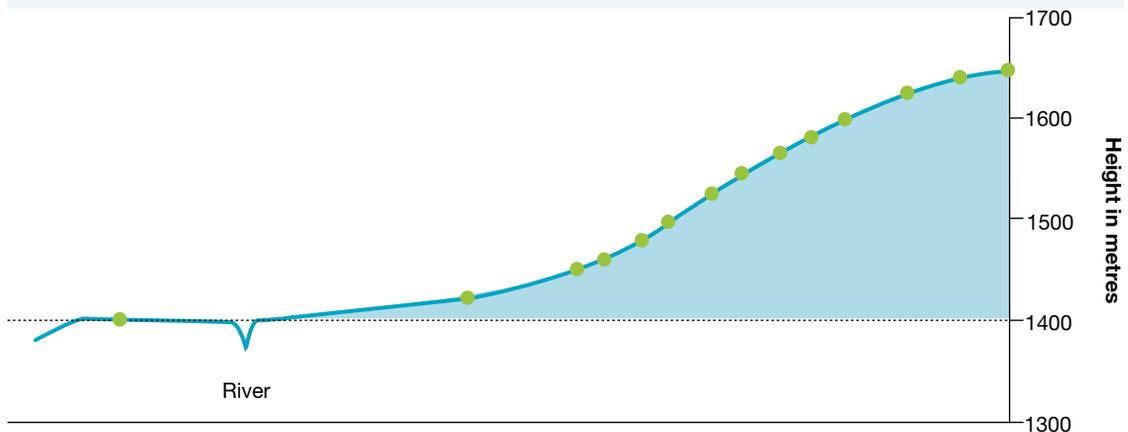
FIGURE 3 Drawing up the shape of the transect



STEP 6

Complete the cross-section with the geographical conventions of a title and labelled axes. Shade the area below the line of your cross-section.

FIGURE 4 The shape of the land is completed.



STEP 7

Beneath your completed cross-section, draw a table, like that in figure 5, to indicate when a feature changes on the transect. Label each category to the left of the vertical axis, as in figure 5. Common categories used here include landforms, vegetation, land use, transport, settlement and sometimes soils, depending on what you would like to show on your transect.

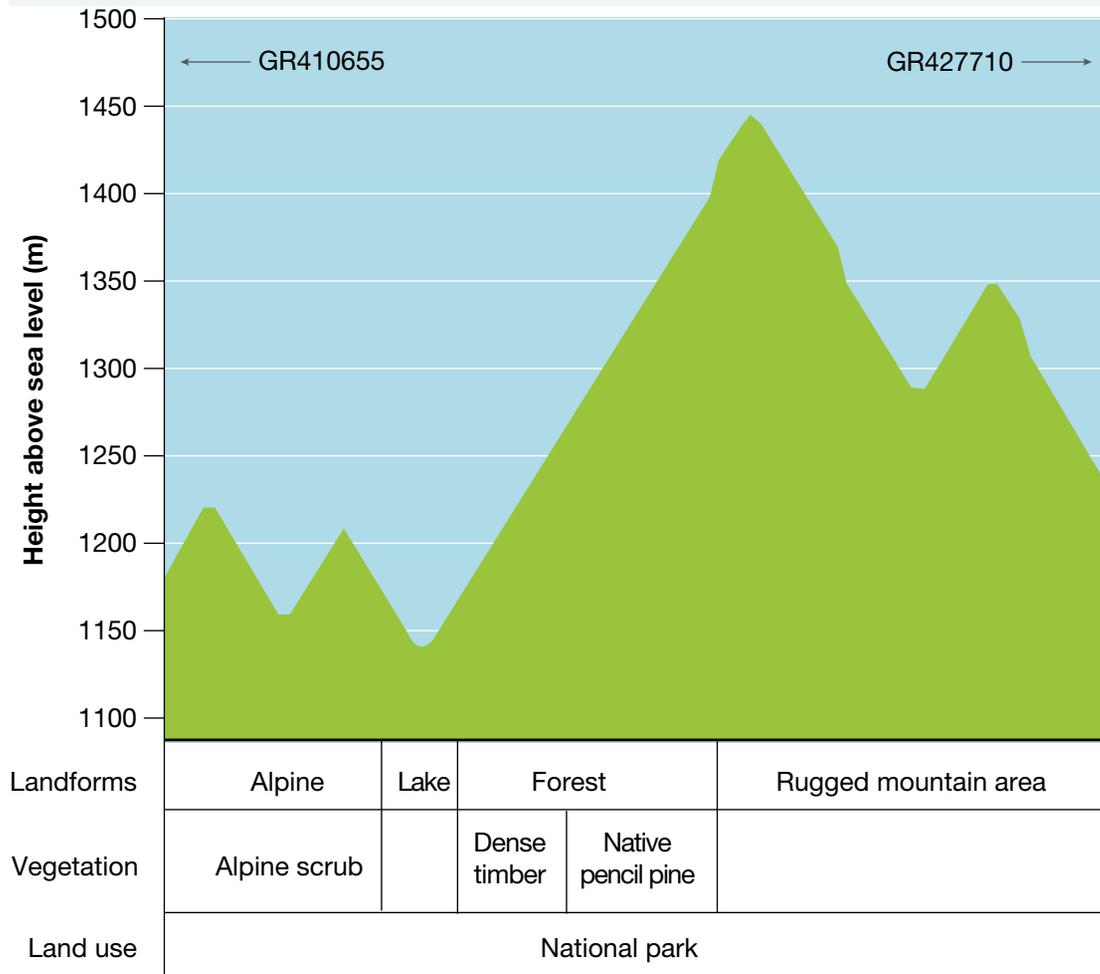
STEP 8

Complete your transect by referring back to the map to determine where a feature occurs, such as native pencil pine in figure 5. Place your paper edge back onto the topographic map to be accurate. Figure 5 shows three categories completed: landforms, vegetation and land use.

STEP 9

Check that the geographical conventions are complete on your transect: include a title and label the axes as 'Height above sea level' and 'Distance'.

FIGURE 5 A transect of the Walls of Jerusalem National Park, Tasmania



STEP 10

Compare your transect with that of a classmate. Are the transects identical shapes? If not, it will be because you have chosen different scales to draw the vertical axis. Land formations can become distorted or misshapen by the choice of scale, and this is referred to as vertical exaggeration. To calculate the vertical exaggeration (VE) of your transect, find the scale bar on your map. In figure 5, the original map had a scale of 1 centimetre to 250 metres, and the transect in figure 5 had a scale of 1 centimetre to approximately 75 metres. The vertical exaggeration of 3.3 is found by dividing the horizontal scale by the vertical scale:

$$\begin{aligned} \text{VE} &= 250/75 \\ &= 3.3 \end{aligned}$$

This VE is reflected in the shape of the transect, which has sharp, high peaks that are not truly representative of the real world. Ideally, vertical exaggeration should not distort the natural shape too much.

learn on RESOURCES – ONLINE ONLY

 **Watch this eLesson:** Constructing and describing a transect on a topographic map (eles-1727)

 **Try out this interactivity:** Constructing and describing a transect on a topographic map (int-3345)

2.6.3 Let me do it

Developing my skills

Using the topographic map for Dalywoi Bay, figure 4 in subtopic 2.5, complete a transect from grid reference 017310 to grid reference 080295. Use the categories of landforms, vegetation and land use. Also calculate the vertical exaggeration of your transect.

Questions

1. List the biomes found on your transect.
2. Using the scale, mark the horizontal distance on your transect where the land is affected by water.
3. How is the vegetation interconnected with the shape of the land?
4. How does the landform affect human activities?
5. If you were to build a house on the land shown in your transect, where would you choose to build, and why?

Checklist

In drawing a transect, I have:

- drawn in pencil
- ruled the axes
- labelled the axes
- used small dots
- drawn with a smooth curve
- identified key aspects such as slope, landform, vegetation and land use
- included a title.

In describing a transect, I have:

- described the key aspects of slope, landforms, vegetation and land use
- identified interconnections between the key features
- noted any anomalies.

Skills questions

1. Transects are used to show:
 - (a) the height of the land at a *place*
 - (b) the shape of the land
 - (c) the contours of an area
 - (d) the land's shape and features.
2. A transect is most likely to include information about:
 - (a) wind
 - (b) history
 - (c) vegetation
 - (d) rainfall.
3. What is the purpose of including information about landforms, vegetation, land use, transport and settlement?
4. Why is it important to understand vertical exaggeration?

2.10 How do we protect biomes?

2.10.1 Can we recreate what has been lost?

It is important to consider the long-term impact of our actions and ensure that they do not have a negative impact on the environment. In the past, human activity has polluted and degraded the land. However, we are now attempting to learn from our mistakes and repair any damage done.

What is Biosphere 2?

Biosphere 2 (see figures 1 and 2) is a research facility in the Arizona Desert. It has been designed to investigate Earth's life systems. Covering an area of 1.5 hectares and standing almost 28 metres at its highest point, Biosphere 2 is the world's largest ecological laboratory. Its mission is to learn more about how the environment connects with us and how we in turn connect with the environment.

Within the confines of Biosphere 2, five natural environments have been recreated: rainforest, desert, savanna, wetland and ocean (including a coral reef). In addition, agricultural and human living spaces have also been created. More than 3000 living organisms are found across the complex. All systems, including oxygen levels, water supply and climate are managed by complex computer systems within the facility.

While early experiments focused on our ability to artificially recreate the Earth's biosphere and sustain life within it, the emphasis has now moved to investigating the impact of human activity. Scientists are looking at how increased burning of fossil fuels and the destruction of habitats will affect the natural systems that sustain all life on the planet.

The project has helped demonstrate the complexity of the natural processes that occur on Earth and within particular biomes. Constant work, effort and thought is needed to maintain the natural order.

FIGURE 1 Ocean recreated within Biosphere 2

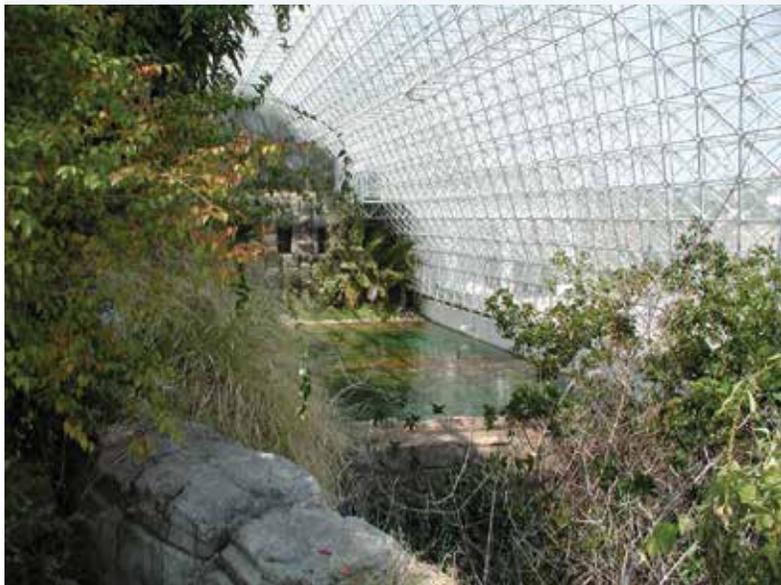


FIGURE 2 Aerial view of Biosphere 2



2.10.2 What is Landcare?

Landcare was born in 1986, when a group of farmers near St Arnaud in central Victoria banded together to find sustainable solutions to their common problem: **land degradation**. The idea has since been adopted by the Australian Government and has spread nationwide. Landcare is about communities working together on environmental projects such as:

- cleaning up polluted creeks and waterways
- planting trees
- restoring beach dune systems
- finding workable solutions to problems such as **salinity** in farming communities
- addressing the growing problem of waste disposal and plastic bags.

FIGURE 3 Clean-up Australia



2.10.3 What lessons can we learn from Indigenous communities?

Long before the arrival of European colonisers, Indigenous Australian peoples practised their own form of agriculture. Rather than being simple hunter-gatherers they used knowledge amassed over thousands of years to manage the native plants and animals they relied on to sustain them. Fire formed the basis of their land management system. A complex system of burning ensured that food supplies were both sustainable and predictable.

Careful planning enabled them to change the landscape to meet their needs. First they created a grassland devoid of trees, the food source for grazing animals. Adjacent to this they cleared out the undergrowth and thinned the trees to create an open forest area that would provide shelter for these same grazing animals. Then they burned the grassland to create the new growth that would encourage the grazers from the shelter of the trees and make hunting easier.

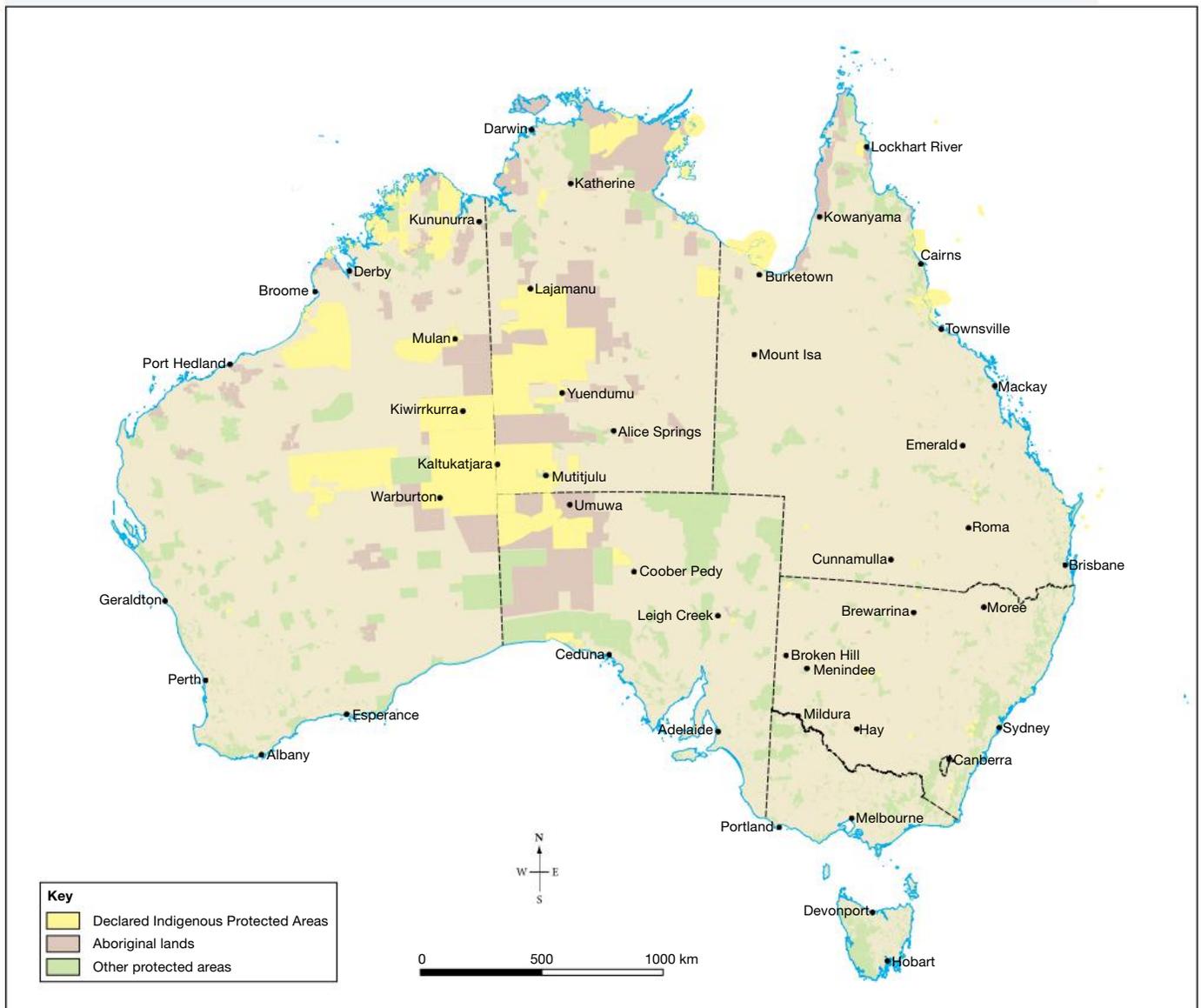
Burning was usually carried out at night time or in the early morning to produce a ‘cool fire’. The evening dew helps control the heat produced and makes the fire easier to control. Such fires were also self-extinguishing; once the grass was burned, the fire simply went out.

This was preferable to a ‘hot fire’ fanned by the flammable oils sweated by plants in the heat of the day, which could easily get out of control.

Indigenous Protected Areas (IPAs)

Indigenous Protected Areas are wholly managed using traditional practices. Generations of knowledge is passed down, ensuring it is preserved for future generations. Approximately 36 per cent of Australia’s protected areas are under the control of local Indigenous communities. The first was established at Nantawarrina, about 555 kilometres north of Adelaide, in 1998. The largest is Southern Tanami in the Northern Territory, at 10.16 million hectares, and the smallest is Pulu Islet in the Torres Strait, at about 15 hectares.

FIGURE 4 Map of Indigenous Protected Areas, 2013



Source: © Commonwealth of Australia, Department of the Environment, 2016

2.10 Activities

Discover

1. Use the internet to learn more about Biosphere 2 and a similar facility, the Eden Project, in England. Display your findings as an annotated visual display.
2. Investigate what projects have been carried out in your local area to restore the natural **environment**.

Think

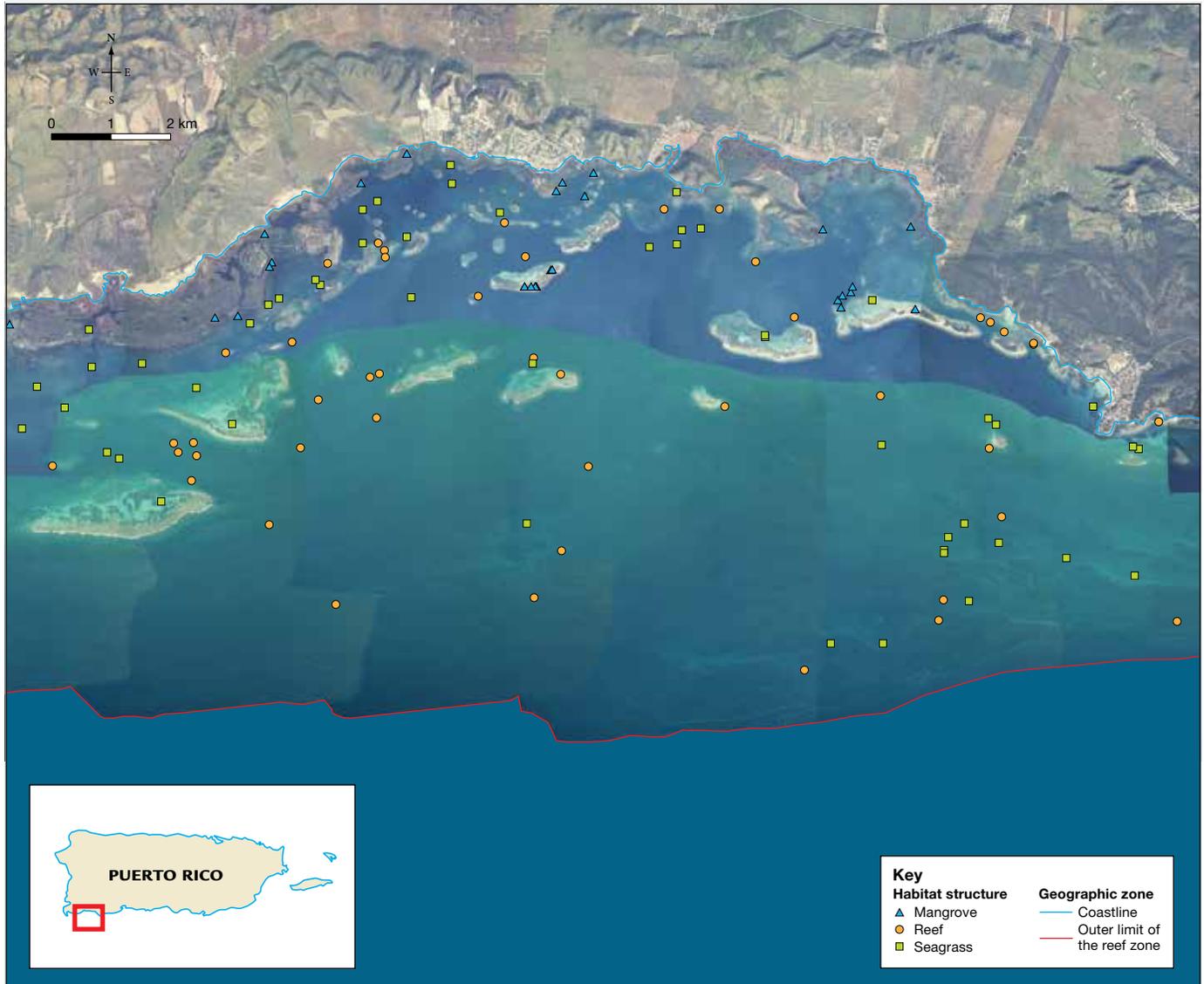
3. Do you think projects such as Biosphere 2 serve a useful purpose? Give reasons for your answer.
4. The media is constantly filled with information about the state of the **environment**. Write a letter to the editor in response to the following statement:
‘Biosphere 2 has done little to increase or improve our understanding of the **environment**, which continues to deteriorate. Our energies should be directed towards the **sustainable** use of the resources we have, rather than being frittered away on such experiments, which are nothing more than expensive toys’.
5. How did Indigenous land management differ from that of European colonisers?
6. Why do you think Indigenous Protected Areas have been established?
7. Each year bushfires cause an enormous amount of damage to biomes.
 - (a) Why were uncontrolled fires relatively unknown prior to the arrival of European colonisers?
 - (b) Do you think more widespread use of Indigenous land management methods could prevent such widespread destruction? Justify your point of view.
 - (c) Investigate what is meant by the terms ‘cool fire’ and ‘hot fire’.
 - (i) Use diagrams to demonstrate your understanding of these terms.
 - (ii) Explain why a ‘cool burn’ is used as a form of land management.

2.11 Review

2.11.1 Review

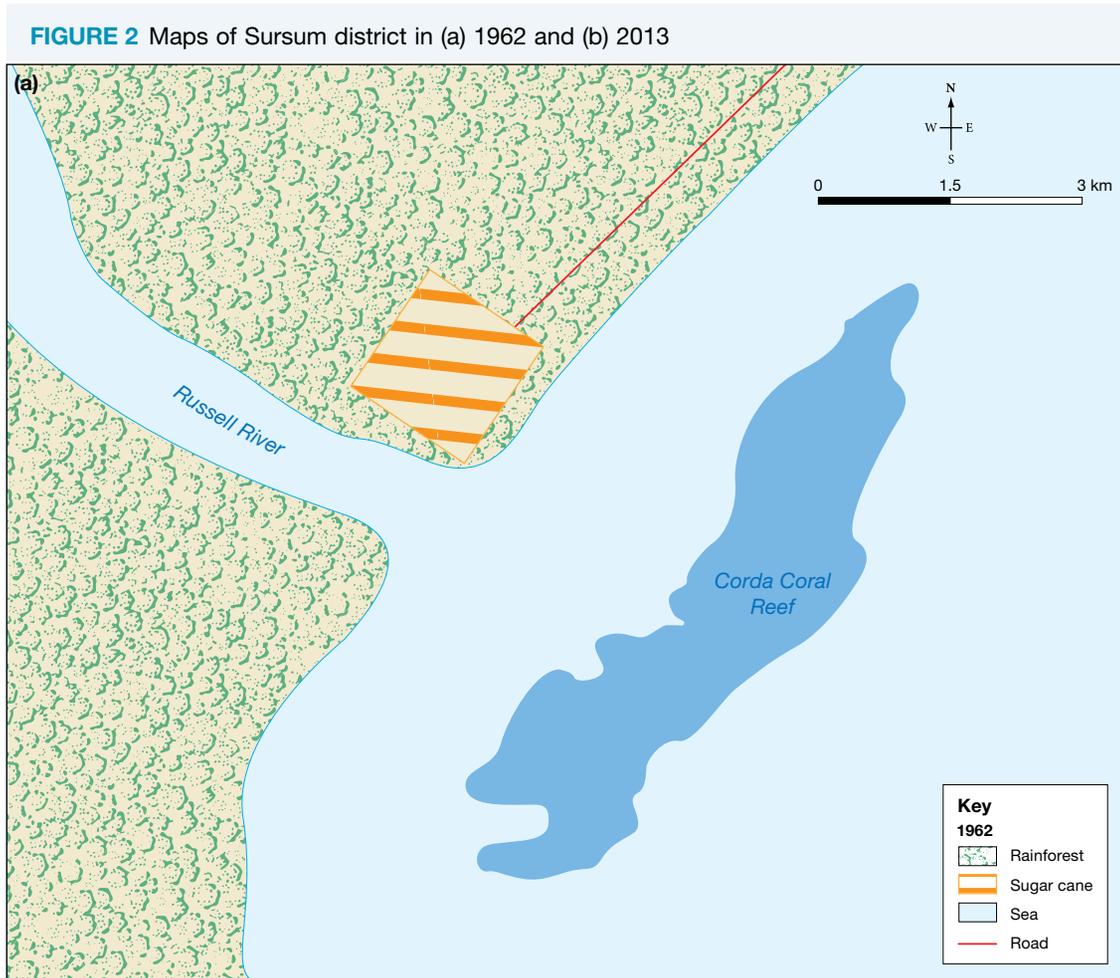
1. Identify the five major biomes and at least one characteristic that makes each biome unique.
2. In your notebook, draw a circle to represent the Earth, and then annotate it with the following information:
 - (a) the major lines of latitude
 - (b) the *interconnection* between latitude, climate, vegetation and soil development.
3. (a) Make a sketch of the aerial photograph in figure 1. Annotate your sketch to show the following features:
 - a coral reef
 - seagrass meadows
 - tidal flats
 - mangroves.(b) Include additional annotations to explain their function within the coastal environment.

FIGURE 1 Aerial photo and map of the Bay of La Parguera, Puerto Rico



Source: Spatial Vision

4. (a) Using a Venn diagram, compare the world biomes of coral reefs and coastal mangroves.
 (b) Describe the *interconnection* between these two *environments*.
5. Study the two maps in figure 2 and answer the following questions.
 (a) What type of *environment* is found in this *place*?
 (b) Describe the *changes* that have taken place in this *environment* between 1962 and 2013. Include reference to the *scale* of this *change* in your response.
 (c) Explain the *interconnection* between human activity and the decline of the coral reef *environment* in this *place*.
6. Why would Australia be described as a land of contrasts?
7. (a) Explain why grasslands are important.
 (b) Why are grasslands considered to be the most endangered biomes?
 (c) Where would you find grasslands in Australia?
 (d) Use the internet to find two photographs or maps of a *place*. The photos or maps should have been taken or created some time apart. Save your photos or maps and digitally annotate them as follows.
 (e) Annotate the first to identify the key features of the *environment*.
 (f) Annotate the second to explain how the *environment* has *changed* over time.



Source: Spatial Vision



2.11.2 Reflect

No soil? No worries

In the eighteenth century it was discovered that plants could be grown without soil, using a system known as hydroponics. A mineral-rich solution dissolved in water provided all that the plants needed to thrive.

In the 1930s, experiments were conducted on Wake Island — a rocky atoll devoid of soil located in the Pacific Ocean north-east of Australia, and used as a refuelling depot. Scientists proved that it was possible to grow vegetables to meet the needs of airline staff and passengers who used the island. Science fiction took the idea a step further in the 1960s, when the Robinson family, in the television series *Lost in Space*, used hydroponics to meet their needs on remote planets.

Today, a 200-square-metre greenhouse provides an average of 113 kilograms of fruit, vegetables and herbs each month — enough to sustain the 230 research workers at McMurdo Station on Ross Island through the winter months. During the summer months, however, when the community can swell to more than 1000 people, the greenhouse acts as a supplement to the fresh produce flown in from New Zealand. It is all done without soil, the greenhouse has no glass, and night and day are simulated by artificial lights. Lights can also be used to create the heat that is needed for plant growth, and this heat remains trapped within the greenhouse.

It is essential to ensure that any virus or bacteria found in the greenhouse do not contaminate the Antarctic environment. The whole process must be carefully monitored and, at the earliest sign of problems, the contents of the greenhouse have to be destroyed and the interior ‘frozen out’ — temperatures inside the greenhouse are allowed to drop so low that ice forms on all surfaces.

Experiments in hydroponics are also underway on the International Space Station, as a first step in paving the way for self-sufficient colonies on the moon — part of NASA's space exploration program.

1. What do you understand by the term *hydroponics*?
2. Make a list of the advantages and disadvantages of hydroponics.
3. (a) Work with a partner to brainstorm as many products as you can that come from biomes. Include food, fibres and other commodities.
(b) Next to each product, suggest where you think it comes from.
(c) Identify items that you think could not be produced if we did not have a variety of biomes. Select one of these and explain why.
4. Do you think that hydroponics is a *sustainable* alternative for meeting our future food needs? Give reasons for your answer.

FIGURE 3 This greenhouse could be anywhere — climate is no longer a factor in plant growth.



FIGURE 4 An artist's impression of a greenhouse on the moon



5. (a) Suggest how an *environment* might *change* if a virus or bacteria that originated in a greenhouse was released into the *environment*.
(b) What do you think the *scale* of this *change* might be? Justify your opinion.
(c) Do you think it would be possible to restore or recreate an *environment*? Why or why not?
6. Are biomes really important? Write a letter to the editor of a newspaper expressing your views on this topic. Make sure you include evidence to support your opinion.
7. Analyse how different values and beliefs contribute to different perspectives on social issues.
8. (a) Few people realise that less than 1 per cent of Australia's native grasslands survive. Why does such a significant loss of grassland biomes not attract the same attention as the loss of other biomes such as our tropical rainforest and coral reefs?
(b) How would the following groups of people perceive the value of grassland biomes?
 - Graziers (sheep and cattle farmers)
 - City dwellers
 - Environmentalists
9. *Biosphere 2 is just like a theme park for scientists: an expensive research facility that does little to protect world biomes.*
(a) Follow these steps:
 - In small groups, choose a leader who will report back to the rest of the class and a scribe who is responsible for taking notes.
 - In your group, discuss the quote and come to a decision on your group's viewpoint.
 - Each leader will present the viewpoint to the class.
(b) Evaluate:
 - your own contribution to the group discussion
 - others' contribution to the group discussion and provide them with feedback
 - the role of the leader and their presentation to the class.

TOPIC 3

How can we feed the world?

3.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

3.1.1 Introduction

Food dominates every person's life. For many people, what to have for breakfast, lunch and dinner can be a constant thought and sometimes a worry.

A local market in a developing nation



Starter questions

1. Have you ever thought about where the food you eat is actually produced? Do you know how much is produced in Australia and how much is imported? Check the labels of various foods in your pantry or fridge to work out the sources of your favourite or most consumed foods.
2. Do you think there is enough food in the world for everybody? Why? How do you know?
3. If you had to, could you grow fruit and vegetables in your home garden? Does your family have a garden and, if so, does your family grow its own food? Conduct a class discussion to establish how many students in your class grow their own food.

INQUIRY SEQUENCE

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| 3.2 How can we feed the world? | 37 |
| 3.3 What does the world eat? | 40 |
| 3.4 How does traditional agriculture produce food? | 43 |
| 3.5 How did Indigenous Australian peoples achieve food security? | 46 |
| 3.6 SkillBuilder: Constructing ternary graphs | online only 50 |
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3.2 How can we feed the world?

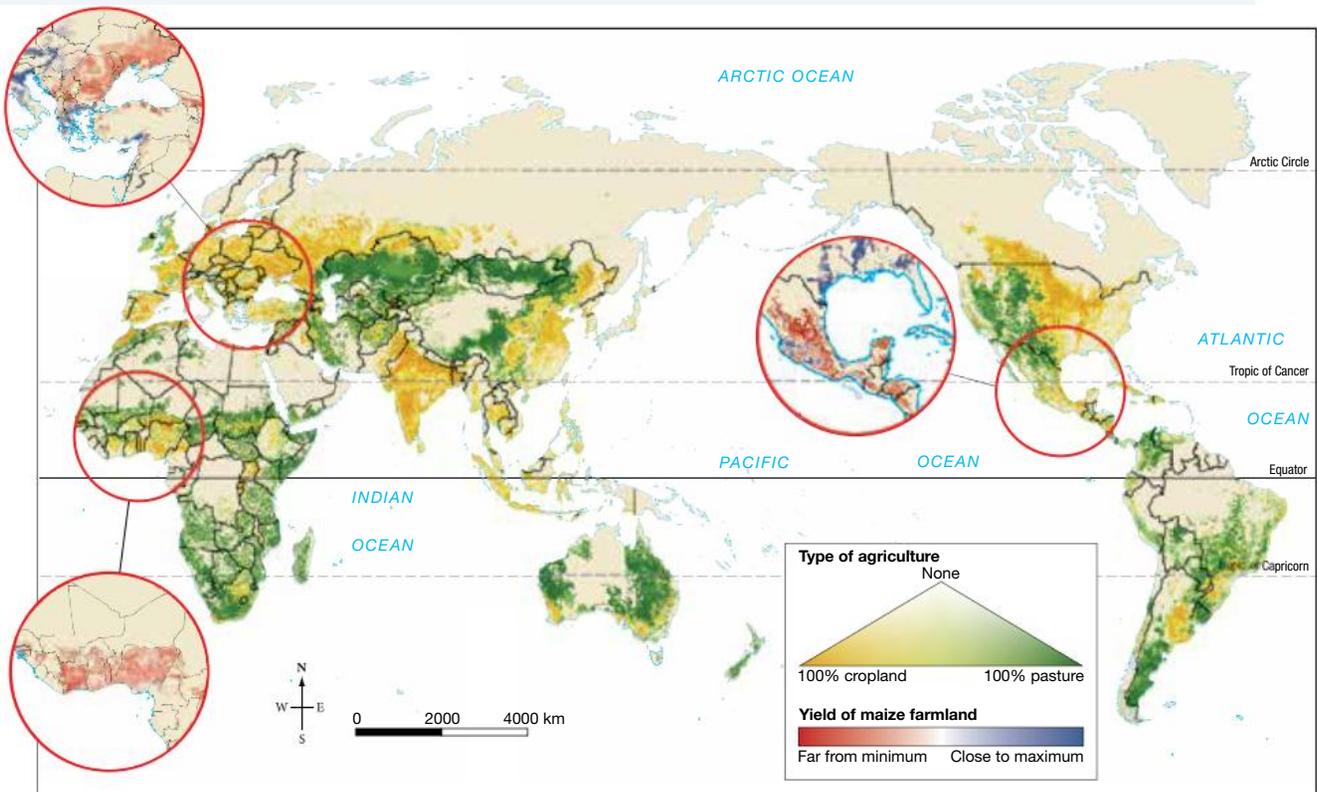
3.2.1 What are our food problems?

At the beginning of the twentieth century, the entire world population was less than 2 billion people. Today, the current world population is more than 7 billion. Earth's population is projected to rise to 9 billion people by 2050, and we all need food. What can we do to ensure there is enough food for everyone?

The map in figure 1 (on page 38) shows that crops occupy half the available agricultural land space. Almost all future population growth will occur in the developing world. This increased population, combined with higher standards of living in developing countries, will create enormous strains on land, water, energy and other natural resources.

There is currently about one-sixth of a hectare of **arable** land **per capita** in East and South Asia. With population growth, and almost no additional land available for agricultural expansion, arable land per capita will continue to decline.

FIGURE 1 World distribution of cropland, pasture and maize. More maize, for example, could be grown if improvements were made to seeds, irrigation, fertiliser and markets.



Source: Spatial Vision

3.2.2 Food production increases

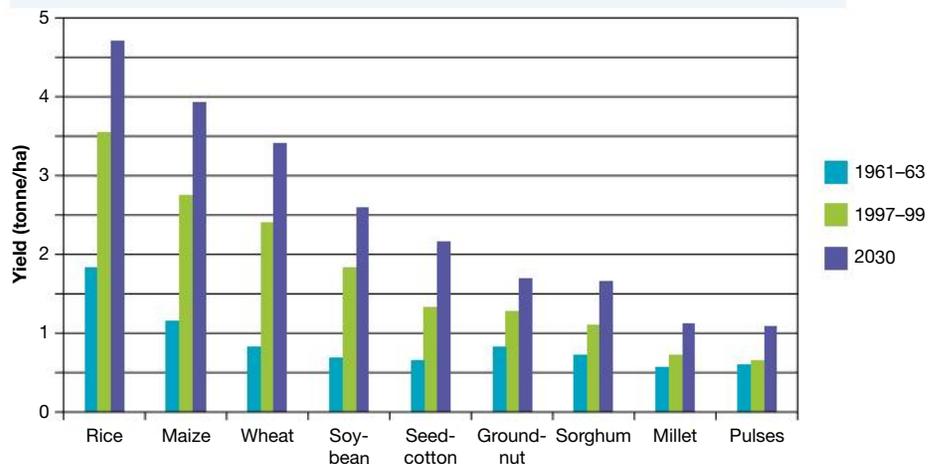
Agricultural yields vary widely around the world owing to climate, management practices and the types of crops grown. Globally, 15 million square kilometres of land are used for growing crops — altogether, that’s about the size of South America. Approximately 32 million square kilometres of land around the world are used for pasture — an area about the size of Africa. Across the Earth, most land that is suitable for agriculture is already used for that purpose and, in the past 50 years, we have increased our food production.

According to the Food and Agriculture Organization (FAO), the three main factors that have affected recent increases in world crop food production are:

- increased cropland and range-land area
- increased yield per unit area
- greater cropping intensity.

Current FAO projections suggest that cereal demand will increase by almost 50 per cent by 2050. This can either be obtained by increasing yields, expanding cropland through conversion of natural habitats, or growing crops more efficiently. Figure 2 shows the growth in crop yields from 1961 to what is proposed in 2030. Rice, maize and wheat have had significant increases in yield.

FIGURE 2 Crop yields in developing countries, 1961–2030



Agricultural **innovations** have also changed and increased global food production. They have boosted crop yields through advanced seed genetics; agronomic practices (scientific production of food plants); and product innovations that help farmers maximise productivity and quality. In this way, the nutritional content of crops can be increased (see figure 3).

3.2.3 We could do more

It should be possible to get more food out of the land we are already using. Figure 1 shows the places where maize yields could increase and become more **sustainable** by improving nutrient and water management, seed types and markets.

FIGURE 3 Farmers in a village in Kenya examine information on plant diseases using a laptop at a plant health clinic. They can also consult a plant pathologist and show them samples of their crops.



3.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1 and describe the distribution of **places** in the world with pasture and grasslands.
2. How could crop production be increased in **places** such as Eastern Europe or Western Africa?

Explain

3. Explain the impact of an increasing population on world **environments**.
4. Explain why agricultural innovations can **change** food production.

Discover

5. Research the reasons why the **environments** of Canada, Northern Africa and Central Australia, shown on figure 1, do not produce any crops.
6. Figure 1 shows where more crops could be grown. Investigate how Mexico or a country in West Africa or Eastern Europe could improve the **sustainability** of its agriculture.

Predict

7. With reference to specific **places**, suggest how increasing population densities might influence future crop production.
8. Figure 1 refers to the potential increase in maize crop yields. Suggest how this could be of benefit to a future world population.

Think

9. Should countries in the developed world be supporting those who struggle to produce their own food?
10. Would food production be secure if we grew fewer crops better?
11. Use the **Feed the world** weblink in Resources tab to watch the interactive maps. Describe how the challenge of meeting the needs of a growing and increasingly affluent population can be met.
12. Figure 2 refers to crop yields in developing countries over time. Suggest why rice, maize and wheat have the greatest increases in yields. Would these increases be similar in the developed regions of the world? Explain your answer.

learnon RESOURCES – ONLINE ONLY

 Explore more with this weblink: Feed the world

3.3 What does the world eat?

3.3.1 The major food staples

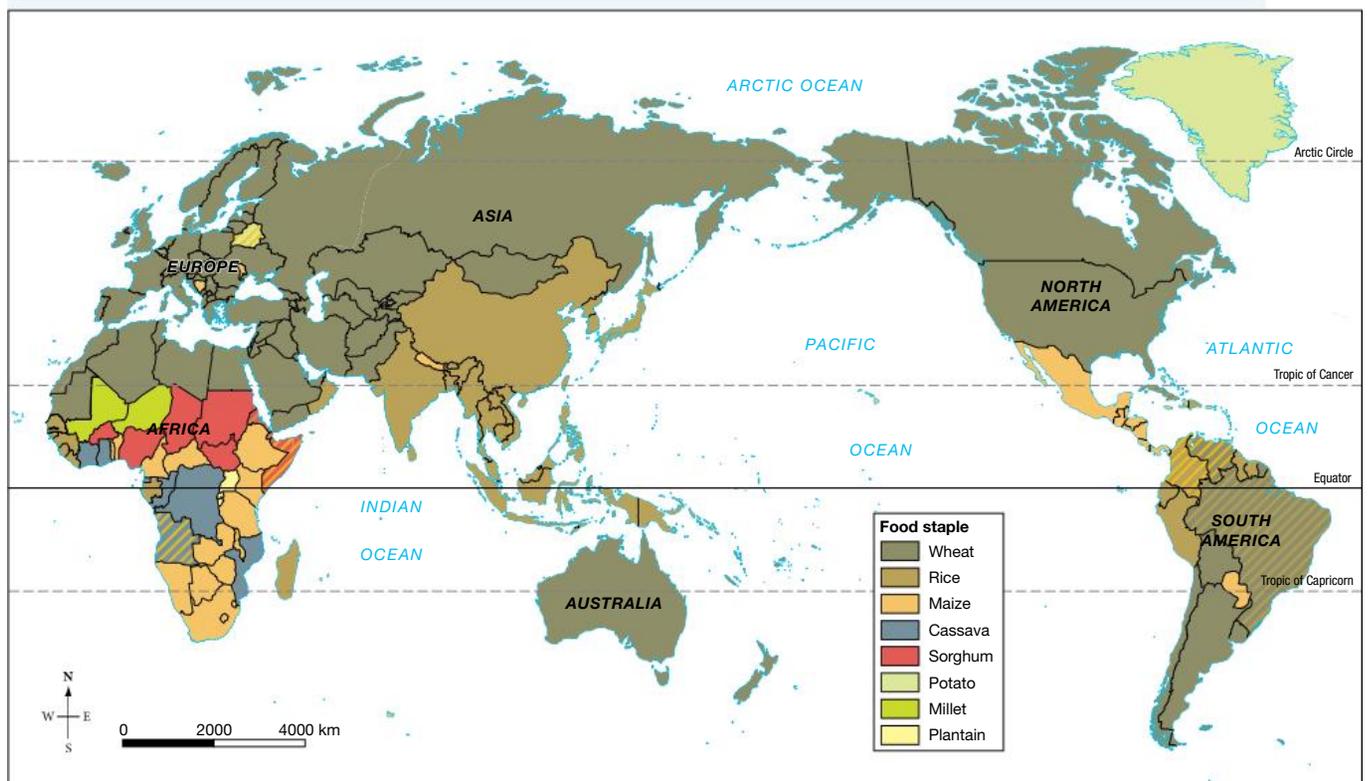
Staple foods are those that are eaten regularly and in such quantities that they constitute a dominant portion of a diet. They form part of the normal, everyday meals of the people living in a particular place or country. They are called staples because they are easy to access and are grown or produced locally.

The world has over 50 000 **edible** plants. Staple foods vary from place to place, but are typically inexpensive or readily available. The staple food of an area is normally interconnected to the climate of that area and the type of land.

Most staple foods are cereals, such as wheat, barley, rye, oats, maize and rice; or root vegetables, such as potatoes, yams, taro and cassava. Rice, maize and wheat provide 60 per cent of the world's food energy intake; 4 billion people rely on them as their staple food.

Other staple foods include legumes, such as soya beans and sago; fruits, such as breadfruit and plantains (a type of banana); and fish.

FIGURE 1 Staple foods around the world



Source: Data from FAO

3.3.2 Wheat, maize and fish

Wheat is a cereal grain that is cultivated across the world. In 2015, world production of wheat was 715.90 million tonnes, making it the third most produced cereal after maize (1018.1 million tonnes) and rice (740.9 million tonnes). World trade in wheat is greater than for all other crops combined. In terms of total production tonnage, it is currently second to rice as the main human food crop and ahead of maize, after allowing for maize's more extensive use as an animal feed.

Wheat was one of the first crops to be easily cultivated on a large scale, and had the added advantage of yielding a harvest that could be stored for a long time. Wheat covers more land area than any other commercial crop, and is the most important staple food for humans.

Maize, or corn, was commonly grown throughout the Americas in the late fifteenth and early sixteenth centuries. Explorers and traders carried maize back to Europe and introduced it to other countries. It then spread to the rest of the world, owing to its ability to grow in different environments. Sugar-rich varieties called sweet corn are usually grown for human consumption, while field corn varieties are used for animal feed and **biofuel**. Maize is the most widely grown grain crop in the Americas, with 361 million metric tonnes grown annually in the United States alone.

FIGURE 2 Wheat is used in a wide variety of foods such as breads, biscuits, cakes, breakfast cereals and pasta.



TABLE 1 Top 10 maize producers, 2015

| Country | Production (million tonnes) |
|----------------|-----------------------------|
| United States | 363 |
| China | 229 |
| Brazil | 77 |
| European Union | 65 |
| Ukraine | 26 |
| Argentina | 25 |
| India | 23 |
| Mexico | 23 |
| South Africa | 13 |
| Russia | 12 |

Source: <http://www.perfectinsider.com/top-ten-maize-producing-countries-in-the-world/>

FIGURE 3 Corn cobs drying outside in Serbia



Fish is a staple food in some societies. The oceans provide an irreplaceable, renewable source of food and nutrition essential to good health. According to the United Nations Food and Agriculture Organization, about 75 per cent of fish caught is used for human consumption. The remainder is converted into fishmeal and oil, used mainly for animal feed and farmed fish.

In general, people in developing countries, especially those in coastal areas, are much more dependent on fish as a staple food than those in the developed world. About 1 billion people rely on fish as their primary source of animal protein.

Use the **United Nations Food and Agriculture Organization** weblink in the Resources tab to find out what is being done to promote sustainable aquatic biomes.

FIGURE 4 A fish haul in Bali, Indonesia



3.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Make a list of the main staple foods of the world and the **places** (continents) where they are grown.
2. What is biofuel?

Explain

3. Explain why plants, rather than animals, dominate as the major staple foods of the world.
4. Australia is a major exporter of wheat. Why is Australia able to produce such a surplus?

Predict

5. With the increase in world population and greater pressure on fish stocks, what could be done to sustain fish stocks in oceans and lakes?
6. Maize is currently used as a feed for animals, as biofuel and as food for humans. Why might this be an **unsustainable environmental** practice in future?

Think

7. Although fish may be seen as a staple food for many people, why is it not possible for fish to be a staple food for everyone?
8. Referring to table 1, why do you think countries other than those in the Americas are producing large quantities of maize?

Explore more with this weblink: [United Nations Food and Agriculture Organization](#)

myWorldAtlas

Deepen your understanding of this topic with related case studies and questions.

- ◉ Rice
- ◉ Wheat

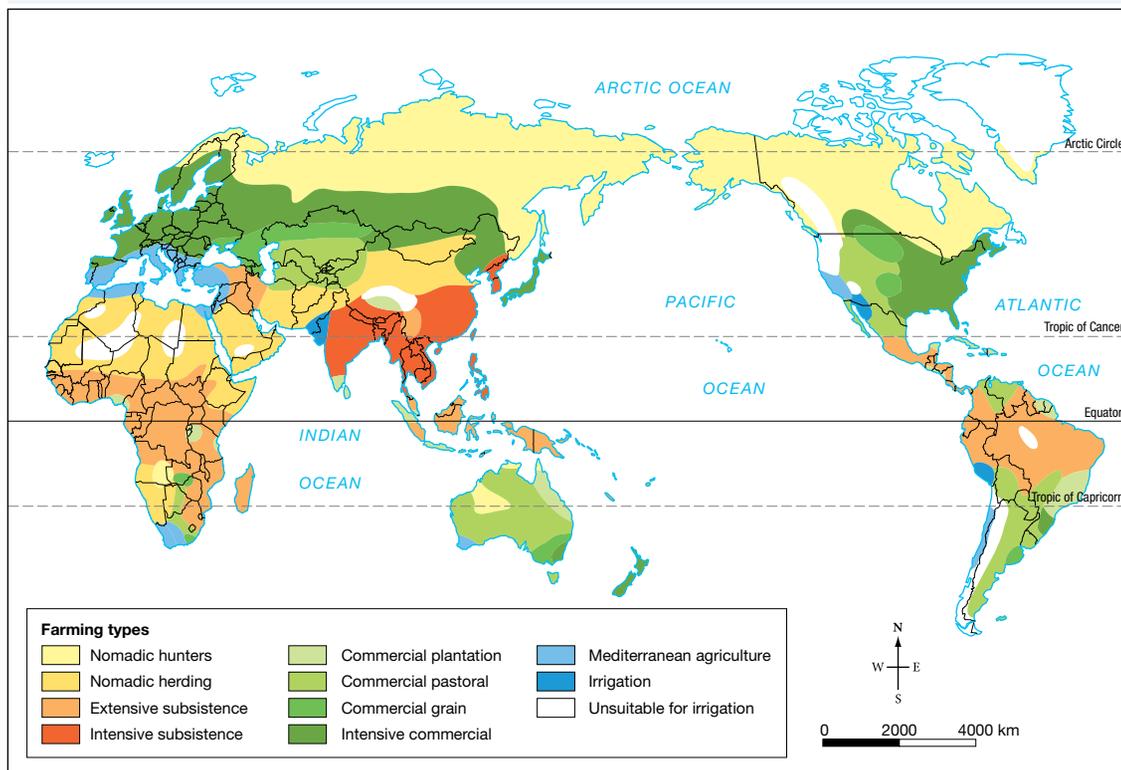
3.4 How does traditional agriculture produce food?

3.4.1 Subsistence agriculture

In the more developed countries of the world, people have easy access to food in stores such as supermarkets. However, many people in developing nations are still tied to **subsistence** agriculture and visits to local markets to buy and exchange food.

For many people, changes in technology and the development of sophisticated agricultural practices have, over millennia, removed the need to hunt and gather food. With modern forms of transport, there is now enormous movement of food stocks around the world. Nevertheless, many people around the world still practise traditional agriculture.

FIGURE 1 World agricultural practices and food production



Source: Reproduced from www.S-cool.co.uk

3.4.2 Hunters and gatherers: the San people

Today, about 50 000 San people (or Kalahari Bushmen) live in the Kalahari Desert in southern Africa. Approximately 6 per cent still live in the traditional way.

Traditionally **nomadic** San people travel in small family groups, roaming over regions of up to 1000 square kilometres. They have no pack animals, and carry few possessions — only spears, bows and arrows, bowls and water bags. The bushmen's San people's clothes are made from animal skins. When needed, they construct dome-shaped shelters of sticks that are thatched with grass.

The San people are experts at finding water and tracking animals. The men hunt antelope and wildebeest, while the women hunt small game such as lizards, frogs and tortoises, and gather roots, berries and grubs. When the waterholes are full, empty ostrich shells are filled with water, and buried in the sand for times of drought.

FIGURE 2 A San tribesman teaches his son how to use a bow and arrow.



3.4.3 Nomadic herders: the Bedouin people

Bedouin people are nomads who live mainly in Syria, Iraq, Jordan, the countries of the Arabian Peninsula, and the Sahara. Some groups are camel herders who live in the inner desert regions. Others herd sheep and goats on the desert fringes, where more water is available. Unless Bedouin communities find a good piece of grazing land, they rarely stay in one place longer than a week.

Bedouin camel-herding families can survive on as few as 15 camels. The camels provide not only transportation but also milk — the main staple of the Bedouin diet. Camel meat is sometimes eaten, and dried camel dung is used as fuel. Camel hair is collected and woven into rugs and tent cloth.

FIGURE 3 A Bedouin camp in Saudi Arabia



3.4.4 Shifting agriculture: the Huli people

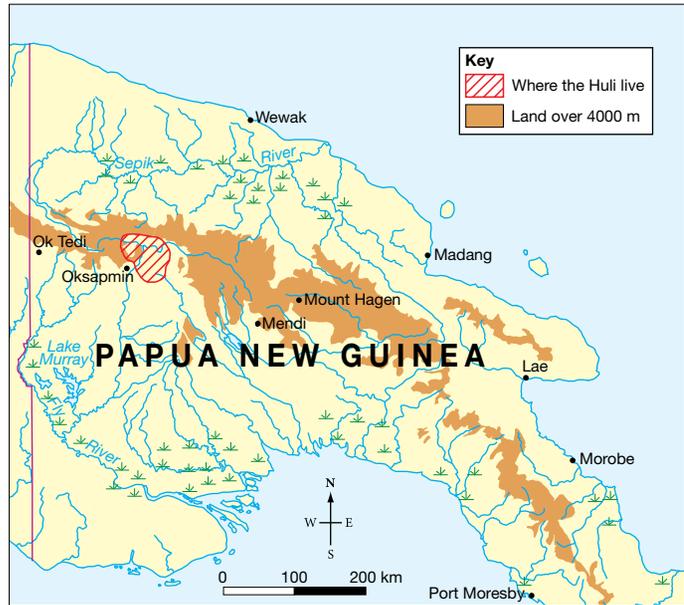
The Huli people live in the rainforests of the Papua New Guinea highlands. Many still lead a traditional way of life. The land on which they live has steep hillsides and dense rainforest.

The Huli people today use a farming system known as shifting agriculture. This means that land is used for food production until its fertility declines; it is then abandoned until its fertility returns naturally. The Huli people clear a patch of rainforest and plant crops of sweet potato, sugar cane, corn, taro and green vegetables. It is the role of the women to tend these gardens, and their individual huts are built next to the gardens. The men live together in a communal house.

When the soil of the garden no longer produces good crops, a new patch of rainforest is cleared, leaving the old one to recover naturally. The garden crops are supplemented by food that the men have hunted. Wild and domesticated pigs are a common source of meat.

While most Huli people still live in their traditional lands, they wear some items of Western-style clothing, and knives, cooking utensils and mirrors are common.

FIGURE 4 A map showing Huli land, Papua New Guinea



Source: MAPgraphics Pty Ltd, Brisbane

FIGURE 5 A Huli tribesman, Papua New Guinea



3.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Name three major types of traditional food production.
2. In which **places** in the world would you find Bedouin people?

Explain

3. Describe the traditional lifestyle of the San people.
4. Explain the advantages and disadvantages of nomadic herding practices regarding **sustainability**.

Discover

5. Why do people who live in rainforests need to use their **environment's** resources **sustainably**?
6. Name one impact on people and one impact on the natural **environment** if rainforests in the world were to **change** by decreasing significantly.

Predict

7. How might modern technology affect the Huli people in the next 25 years with respect to their traditions and food production practices?
8. What **changes** may occur to the way of life of nomadic herders in the future?

Think

9. In what ways are the traditional lives of hunters and gatherers and nomadic herders similar and different?
10. Referring to figure 1, explain why food production is concentrated in the **places** and **spaces** bordering the tropical zones.

3.5 How did Indigenous Australian peoples achieve food security?

3.5.1 Introduction

Since the beginning of the Dreaming Aboriginal and Torres Strait Islander peoples established management practices of their lands, waterways, lakes and marine environments to ensure food security. At the time of European occupation in 1788 most Aboriginal and Torres Strait Islander peoples were hunters and gatherers. However, some nations had abundant food supplies in their regions and were able to settle in one place. In all cases their deep knowledge and close association with the land allowed for sustainable management of the ecosystems and biomes in which they lived. The 'world view' that describes this sustainable lifestyle is called an 'earth-centred' approach. This means people's interaction with the environment is one of a caring stewardship.

3.5.2 Aboriginal and Torres Strait Islander peoples' food sourcing

Aboriginal and Torres Strait Islander peoples sourced their foods from a wide range of uncultivated plants and wild animals, with some estimates suggesting there were up to 7000 different sources of food. The composition of the food was greatly influenced by both the season and geographic location of the community region.

In Aboriginal and Torres Strait Islander communities there was a division of labour among men, women and children. Food sources based on cereals, fruits and vegetables were collected or gathered daily by women and children. Men were involved more in hunting for game and fishing, as well as wider scale land management using fire.

To ensure food security, communities developed a range of food-gathering techniques that were sustainable. For example, some seeds from gathered plants were left behind to allow for new growth, and a few eggs were always left in nests to hatch. This ensured that species would survive and communities could expect to find food in the same place in the future. See figure 1 for details of food types from both tropical and temperate regions of Australia, including arid and desert regions.

FIGURE 1 A generalised selection of different foods and water resources

What did Aboriginal and Torres Strait Islander peoples use to achieve food (and water) security?

Water: Water was obtained from rivers, lakes, rock holes, soaks, beds of intermittent creeks and dew deposited on surfaces. Moisture obtained from foods such as tree roots and leaves also provided water.

Cereal foods: Grass seeds from the clover fern were ground to form flour for damper. Many other seed types were similarly treated.

Fruit and vegetables: Fruits, berries, orchids and pods were available, depending on the region and seasonal availability (for example, sow thistle, lilly pilly, pigface fruit, kangaroo apple, wild raspberry, quandong and native cherry) as well as wild figs, plums, grapes and gooseberries. Also eaten were plant roots such as bull rushes, yams and bulbs; the heart of the tree fern and the pith of the grass tree; and the blister gum from wattles, native truffles and mushrooms.

Eggs: Emu, duck, pelican and many other birds' eggs were eaten.

Meat: Meats included insects such as the larval stage of the cossid moth or witchetty grub and the Bogong moth, honey ants, native bees and their honey and scale insects; animals such as kangaroos, emus, eels, crocodiles, sea turtles, snakes, goannas and other lizards; and birds such as ducks, gulls and pelicans.

Fish and shellfish: Freshwater fish such as perch, yabbies and mussels in creeks and rock holes as well as saltwater fish of all varieties were caught.

Medicines: Over 120 native plants were used as sedatives, ointments, diarrhoea remedies, and cough and cold palliatives as well as for many other known treatments.

3.5.3 Torres Strait Islander people

Torres Strait Islander peoples' food sources, both historically and today, are based on fishing, horticulture and inter-island trading activities. Torres Strait Islander peoples have a profound understanding of the sea, including its tides and sea life. While their food sources vary from island to island, their lifestyle can be best described as subsistence agriculture with seafood, garden foods and other produce stored and preserved for both local use and trade.

3.5.4 The use of fire

The use of fire was a significant aspect of the Indigenous Australian peoples' land management. What has been described as the 'park like' landscape of the Australian bush was purposely created by clearing forest in a controlled burn using fire sticks. After the fires, new plant growth with tender shoots attracted all types of birds and animals to the area. The grassland areas that resulted from the controlled burning of the landscape became ideal places to hunt kangaroos. Burning also caused animals to be flushed out into the open where they could be speared (see figure 3). The Indigenous Australian peoples' use of fire had to be carefully managed as part of their efforts to ensure food security and as such was a sustainable practice based on a sound knowledge of fire control.

FIGURE 2 Cooking bush food in a traditional Kup Murrie, or ground oven



FIGURE 3 Using fire for hunting and to manage the land



3.5.5 The arrival of Europeans

Since European occupation, Aboriginal and Torres Strait Islander peoples have been displaced from their lands and traditional methods of sourcing food have mostly ceased. This is because government policies forced Indigenous communities to move to missions and as a consequence there was a denial of access to their lands. However, some methods of food sourcing continued up until recent times in areas the Europeans hadn't yet occupied, including in remote arid and desert areas and in the sparsely settled northern parts of Australia.

Today, many Aboriginal and Torres Strait Islander peoples, particularly in remote areas, are suffering from food insecurity due to the forced move away from nutritious bush tucker and historical government policies. This, among other things, has led to health issues such as low life expectancy, and related issues such as poor education and reduced work opportunities.

More recently, with the introduction of the Native Title Act (1993) and involvement of state governments, members of Indigenous communities have been able to re-establish connections with their lands through collaborative land and water management projects.

3.5.6 The Bogong moth: a past food source

While there were many other sources of food for Indigenous communities that lived near the south-eastern Australian highlands, the Bogong moth was a particularly important seasonal speciality. The Bogong moth, which lived in the ground as larvae in Queensland, migrated in millions to the south-eastern highlands to seek out cool, rocky overhangs and crevices where they could sleep through the long, hot summer months, surviving off the fat in their bodies. (see figure 4).

The Bogong moths were a rich source of fat and protein for Indigenous Australian peoples who lived adjacent to the highlands of Victoria and New South Wales. Many culture groups would migrate from the valleys and foothills into the highlands and set up camps for the feasting ceremony. They would smoke out the moths, which they called 'cori', collecting them by the thousands to be cooked over hot rocks for feasting. In addition to savouring this important seasonal food source, making the annual pilgrimage to the high country presented these groups with an important opportunity to interact socially, participate in ceremonies and to arrange inter-community marriages.

FIGURE 4 Massed Bogong moths on a rock face



3.5.7 Eel farming by the Gunditjmara people

The home of the Gunditjmara people, the Budj Bim National Heritage Landscape, is the site of one of Australia's largest ancient aquaculture systems. This area, which is part of the Mount Eccles National Park near Portland in Victoria, shows evidence of a large, permanent settlement of stone huts and channels used for farming and the local trade of eels (see figure 5). The Gunditjmara people managed this landscape by digging channels and constructing weirs to bring water and young eels from Darlot Creek to local ponds and wetlands. Woven baskets placed at the weirs were used to harvest the mature eels. The area provided an abundance of food, ensuring food security for all.

Following European occupation of the area in the 1830s, the Gunditjmara people fought for their lands in the Eumerella Wars, which lasted for more than 20 years. By the 1860s the remaining Gunditjmara people were displaced to a government mission at Lake Condah. The mission lands were returned to the Gunditjmara people in 1987 and thereafter the Deen Maar Indigenous Protected Area (IPA) was declared in 1999 and the area was listed on the Australian National Heritage register in 2004.

Today the Gunditjmara people, as part of the Winda-Mara Aboriginal Corporation, manage the 248-hectare Darlots Creek (Killara), which flows from Lake Condah in the Budj Bim National Heritage Landscape. They aim to reinstate the wetlands and manna gum woodlands and re-establish the eel aquaculture industry as a sustainable business prospect. Further works are in progress to control weeds and feral animals and to expand tourism by building visitor boardwalks and information signage.

FIGURE 5 Remains of Aboriginal stone eel traps at Lake Condah



3.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What was the division of labour for men, women and children when sourcing food?
2. How did Indigenous Australian peoples use fire to source food?
3. Who are the traditional owners of the Budj Bim region of Victoria?

Explain

4. Why did Aboriginal and Torres Strait Islander peoples lose access to 'bush tucker' after European occupation?
5. How did the Indigenous Australian peoples access the Bogong moth as a food source?

Predict

6. How might the re-establishment of eel farming help the economic opportunities of the Gunditjmara people?

Think

7. What lessons could be learned from the way the Budj Bim National Heritage Landscape is managed and applied to a national park with which you are familiar?
8. Which foods that Aboriginal and Torres Strait Islander peoples sourced could be utilised in cooking today? Have you tried any of the wide range of traditional food types? If so, how tasty or appetite satisfying were they to you?

3.6 SkillBuilder: Constructing ternary graphs

online only

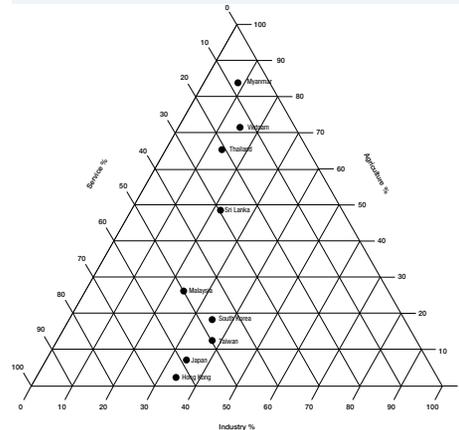
WHAT ARE TERNARY GRAPHS?

Ternary graphs are triangular graphs that show the relationship or interconnection between three features. They are particularly useful when a feature has three components and the three components add up to 100 per cent. Ternary graphs are most often used to show soil types, employment structures and age structures.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Economic activity in selected countries



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Watch this eLesson: Constructing ternary graphs (eles-1728)

Try out this interactivity: Constructing ternary graphs (int-3346)

3.7 How have we increased our food?

3.7.1 How does food increase come about?

World food production has grown substantially over the past century. Increased fertiliser application and more water usage through irrigation have been responsible for over 70 per cent of crop yield increases. The Second Agricultural Revolution in developed countries after World War II, and the **Green Revolution** in developing countries in the mid 1960s, transformed agricultural practices and raised crop yields dramatically.

Since the 1960s agriculture has been more productive, with world per capita agricultural production increasing by 25 per cent in response to a doubling of the world population.

3.7.2 Environmental factors

In the past, growth in food production resulted mainly from increased crop yields per unit of land and to a lesser extent from expansion of cropland. From the early 1960s, total world cropland increased by only 9 per cent, but total agricultural production grew nearly 60 per cent. Increases in yields of crops, such as sweet potatoes and cereals, were brought about by a combination of:

- increased agricultural inputs
- more intensive use of land
- the spread of improved crop varieties.

In some places, such as parts of Africa and South-East Asia, increases in fisheries (areas where boats are used to catch fish) and expansion of cropland areas were the main reasons for the increase in food supply.

In addition, cattle herds became larger. In many regions — such as in the savanna grasslands of Africa, the Andes, and the mountains of Central Asia — livestock is a primary factor in food security today. Fertilisers have increased agricultural outputs and enabled more intensive use of the land. Global fertiliser use is likely to rise to above 200.5 million tonnes in 2018, 25 per cent higher than recorded in 2008.

TABLE 1 Fertiliser use, 1959–60, 1989–90 and 2020

| Region/nutrient | Fertiliser user | | | Annual growth | |
|------------------------|---------------------------|---------|-------|---------------|-----------|
| | 1959/60 | 1989/90 | 2020 | 1960–90 | 1990–2020 |
| | (million nutrient tonnes) | | | (per cent) | |
| Developed countries | 24.7 | 81.3 | 86.4 | 4.0 | 0.2 |
| Developing countries | 2.7 | 62.3 | 121.6 | 10.5 | 2.2 |
| East Asia | 1.2 | 31.4 | 55.7 | 10.9 | 1.9 |
| South Asia | 0.4 | 14.8 | 33.8 | 12.0 | 2.8 |
| West Asia/North Africa | 0.3 | 6.7 | 11.7 | 10.4 | 1.9 |
| Latin America | 0.7 | 8.2 | 16.2 | 8.2 | 2.3 |
| Sub-Saharan Africa | 0.1 | 1.2 | 4.2 | 8.3 | 3.3 |
| World total | 27.4 | 143.6 | 208.0 | 5.5 | 1.2 |
| Nitrogen | 9.5 | 79.2 | 115.3 | 7.1 | 1.3 |
| Phosphate | 9.7 | 37.5 | 56.0 | 4.5 | 1.3 |
| Potash | 8.1 | 26.9 | 36.7 | 4.0 | 1.0 |

Sources: Bumb, B. and C. Baanante. 1996. World Trends in Fertilizer Use and Projections to 2020. Policy Brief 38, Table 1. Washington, DC: International Food Policy Research Institute <http://www.ifpri.org/publication/world-trends-fertilizer-use-and-projections-2020>

3.7.3 Trade factors and economic factors

From the 1960s onwards, there has been significant growth of world trade in food and agriculture. Food imports to developing countries have grown, together with imports of fertilisers, thus reducing the likelihood of developing countries suffering from famine.

TABLE 2 Share of crop production increases, 1961–2030

| | Arable land expansion (1) | | Increases in cropping intensity (2) | | Harvested land expansion (1+2) | | Yield increases | |
|---------------------------------|---------------------------|--------------|-------------------------------------|--------------|--------------------------------|--------------|-----------------|--------------|
| | 1961–1999 | 1997/99–2030 | 1961–1999 | 1997/99–2030 | 1961–1999 | 1997/99–2030 | 1961–1999 | 1997/99–2030 |
| All developing countries | 23 | 21 | 6 | 12 | 29 | 33 | 71 | 67 |
| South Asia | 6 | 6 | 14 | 13 | 20 | 19 | 80 | 81 |
| East Asia | 26 | 5 | –5 | 14 | 21 | 19 | 79 | 81 |
| Near East/North Africa | 14 | 13 | 14 | 19 | 28 | 32 | 72 | 68 |
| Latin America and the Caribbean | 46 | 33 | –1 | 21 | 45 | 54 | 55 | 46 |
| Sub-Saharan Africa | 35 | 27 | 31 | 12 | 66 | 39 | 34 | 61 |
| World | 15 | | 7 | | 22 | | 78 | |

3.7.4 What was the Green Revolution?

The Green Revolution was a result of the development and planting of new **hybrids** of rice and wheat, which saw greatly increased yields. There have been a number of green revolutions since the 1950s, including those in:

- the United States, Europe and Australia in the 1950s and 1960s
- New Zealand, Mexico and many Asian countries in the late 1960s, 1970s and 1980s.

With its high-yield varieties of cereals, chemical fertilisers and pesticides, and irrigation, the Green Revolution has had a very positive effect on global food production.

What happened?

The Green Revolution saw a rapid increase in the output of cereal crops — the main source of calories in developing countries. Farmers in Asia and Latin America widely adopted high-yielding varieties. Governments, especially in Asia, introduced policies that supported agricultural development. In the 2000s, cereal harvests in developing countries were triple those of 40 years earlier, while the population was a little over twice as large. Yield gains accounted for much of the increase in cereal output and calorie availability. Planting of these varieties coincided with expanded irrigation areas and fertiliser use, as seen in figure 1 where fertiliser is being spread in the Punjab.

FIGURE 1 Spreading fertiliser in the Punjab, India, during the Green Revolution



3.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. In the past, what were the two reasons for the increase in food production?
2. Refer to table 1. Describe the trends in the use of fertilisers and irrigated land from 1965 to 2000.

Explain

3. Explain the significance of trade in food production.
4. Discuss the three reasons for improved crop production.

Discover

5. Research the background of the Green Revolution — why it occurred and the key **places** involved.
6. Investigate the **changes** that came about as a result of the Green Revolution.

Predict

7. Some scientists are suggesting that there will be a new Green Revolution. Investigate current thinking and predict the potential **scale** of this possible agricultural **change**.

Think

8. Were the **changes** brought about during the Green Revolution successful? When explaining your decision, refer to the Punjab and other **places**.

3.8 How are biomes modified for agriculture?

3.8.1 How do we use technology for food production?

In the twentieth century, rapid global population growth gave rise to serious concerns about the ability of agriculture to feed humanity. However, additional gains to food production have come from newer processes and technology.

Across the world, humans have modified biomes to produce food through the application of innovative technologies. In general, the focus of agriculture is to modify water, climate, soils, land and crops.

3.8.2 How do we modify climate?

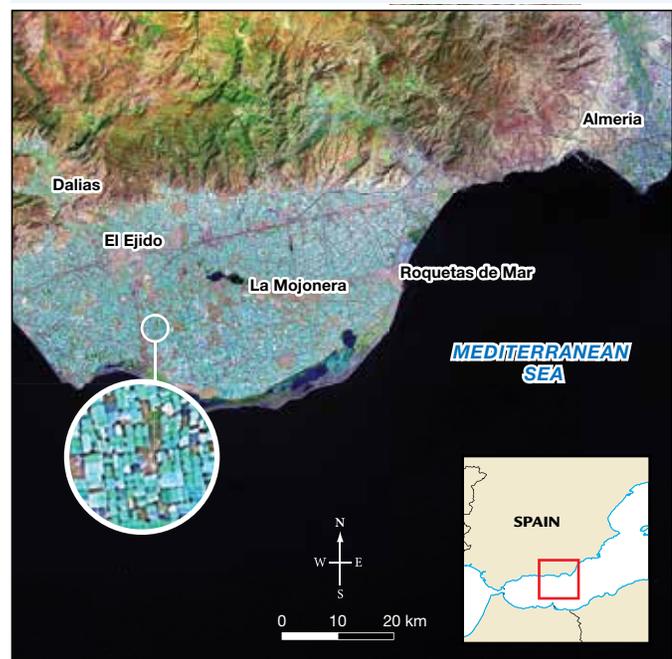
Irrigation is the artificial application of water to the land or soil to supplement natural rainfall. It is used to assist in the growing of agricultural crops to increase food production in dry areas and during periods of inadequate rainfall.

In flood irrigation, water is applied and distributed over the soil surface by gravity. It is by far the most common form of irrigation throughout the world, and has been practised in many areas, virtually unchanged, for thousands of years.

Modern irrigation methods include computer-controlled drip systems that deliver precise amounts of water to a plant's root zone.

Another way of modifying climate is with the use of greenhouses (or glasshouses) used for growing flowers, vegetables, fruits and tobacco (see figure 2). Greenhouses provide an artificial biotic environment to protect crops from heat and cold and to keep out pests. Light and temperature control allows greenhouses to turn non-arable land into arable land, thereby improving food production in marginal environments. Greenhouses allow crops to be grown throughout the year, making them especially important in high-latitude countries.

FIGURE 1 False-colour satellite image of greenhouses in the Almeria region



Source: American Geophysical Union and Google Maps

The largest expanse of plastic greenhouses in the world is around Almeria, in south-east Spain. Here, since the 1970s, semiarid pasture land has been replaced by greenhouse **horticulture** (see figures 1 and 2). Today, Almeria has become Europe’s market garden. To grow food all year round, the region has about 26000 hectares of greenhouses.

FIGURE 2 Inside an Almerian greenhouse



3.8.3 How do we modify soils?

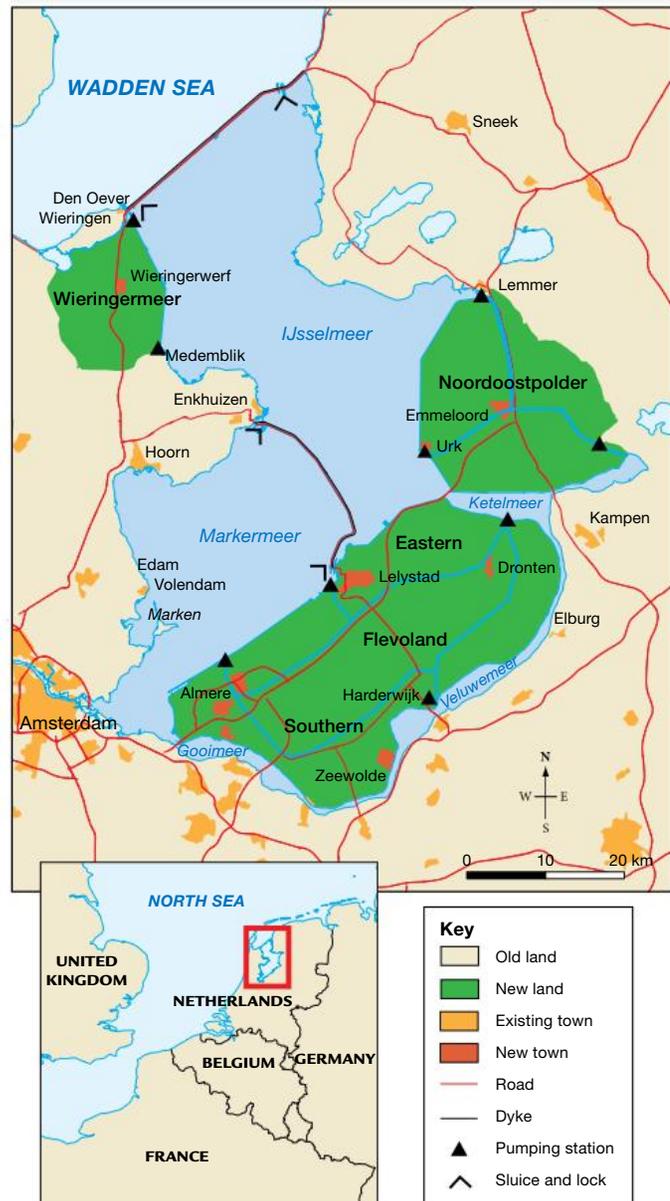
Fertilisers are organic or inorganic materials that are added to soils to supply one or more essential plant nutrients. Fertilisers are essential for high-yield harvests, and it is estimated that about 40 to 60 per cent of crop yields are due to fertiliser use. It is estimated that almost half the people on Earth are currently fed as a result of adding fertiliser to food crops.

3.8.4 How do we modify landscapes?

People change landscapes in order to produce food. **Undulating** land can be flattened, steep slopes terraced, or stepped, and wetlands drained. Land reclamation is the process of creating new land from seas, rivers or lakes. In addition, it can involve turning previously unfarmed land, or degraded land, into arable land by fixing major deficiencies in the soil’s structure, drainage or fertility.

In the Netherlands, the Dutch have tackled huge reclamation schemes to add land area to their country. One such scheme is the IJsselmeer (see figure 3), where four large areas (*polders*) have been reclaimed from the sea, adding an extra 1650 square kilometres for cultivation. This has increased the food supply in the Netherlands and created an overspill town for Amsterdam.

FIGURE 3 Land reclamation in the Netherlands



Source: Spatial Vision

3.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What **changes** to the **environment** are made by land reclamation?

Explain

2. Refer to figure 3. Use the **scale** to calculate the approximate area of new land created in Flevoland.

Discover

3. How is land that is reclaimed from the sea, such as the Netherlands' polders, made productive for farming and food production?

Predict

4. Refer to figures 1 and 2. How do greenhouses modify **spaces** and **places** on the Earth's surface?
5. Refer to figure 3. What might be the purpose of the pumping stations?

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3.9 How is food produced in Australia?

3.9.1 Why are farms found in certain locations?

Modern food production in Australia can be described as commercial agricultural practices that produce food for local and global markets. Farms may produce single crops, such as sugar cane, or they may be mixed farms that produce sheep and cereals, for example. Farms use sophisticated technology, and in many cases are managed by large corporations with an **agribusiness** approach.

There is a wide range of types of agriculture in Australia, as shown in figure 1. These types occupy spaces across all biomes found in Australia, from the tropics to the temperate zones.

The location of farms in Australia shows that there is a change in the pattern of farming types, from the well-watered urban coastal regions towards the arid interior. Because much of Australia's inland rainfall is less than 250 millimetres, farm types in these places are limited to open-range cattle and sheep farming.

The pattern of land use and transition of farm types is shown in figure 2. It indicates that **intensive farms**, which produce perishables such as fruit and vegetables, are located on high-cost land close to urban markets. At the other extreme, the **extensive farms**, which manage cattle, sheep and cereals, are found on the less expensive lands distant from the market.

3.9.2 Some farm types in Australia

Extensive farming of sheep or cattle

Sometimes known as livestock farming or grazing, sheep and cattle stations are found in semi-arid and desert grassland biomes, with rainfall of less than 250 millimetres. In 2015 Australia's 70 million sheep and 27 million cattle were found mainly in Queensland, Victoria and New South Wales. Farms are large in scale, covering hundreds of square kilometres. These days, they have very few employees, and often use helicopters and motor vehicles for mustering. Meat and wool products go to both local and overseas markets for cash returns.

Wheat farms

About 25 000 farms in Australia grow wheat as a major crop, and the average farm size is 910 hectares, or just over 9 square kilometres. Wheat production in Australia for 2015 was estimated at 23 million tonnes. As in other areas of the world, extensive wheat farming is found in mid latitude temperate climates that have warm summers and cool winters, and annual rainfall of approximately 500 mm. In Australia, these conditions occur away from the coast in the semi-arid zone. The biome associated with this form of food production is generally open grassland, **mallee** or savanna that has been cleared for the planting of crops.

Soils can be improved by the application of fertilisers, and crop yields increased by the use of disease-resistant, fast-growing seed varieties. Wheat farms are highly mechanised, using large machinery for ploughing, planting and harvesting. The farm produce, which can amount to 2 tonnes per hectare, is sold to large corporations in local and international markets.

FIGURE 3 Cattle mustering



Mixed farms

Mixed farms combine both grazing and cropping practices. They are located closer to markets in the wetter areas, and are generally small in scale, but operate in much the same way as cattle and sheep farms.

Intensive farming

Intensive farms are close to urban centres, producing dairy, horticulture and market gardening crops. They produce milk, fruit, vegetables and flowers, all of which

FIGURE 4 Wheat farming with a combine harvester



are perishable, sometimes bulky, and expensive to transport. The market gardens are capital- and labour-intensive, because the cost of land near the city is high, and many workers are required for harvesting.

Plantation farming

This form of agriculture is often found in warm, well-watered tropical places. Plantations produce a wide range of produce such as coffee, sugar cane, cocoa, bananas, rubber, tobacco and palm oil. Farm sizes can be 50 hectares or more in size. Although many such farms in Australia are family owned, in other parts of the world they are often operated by large multinational companies. Biomes that contain plantations are mainly tropical forests or savanna, and require large-scale clearing to allow for farming. Cash returns are high, and markets are both local and global.

FIGURE 5 Strawberries are typically grown in market gardens.



FIGURE 6 A banana plantation near Carnarvon, Western Australia



3.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Which type of agricultural land use is closest to urban centres, and which is the furthest away?
2. How does the **environment** in the centre of Australia affect farming types?
3. What is the **interconnection** between climate and farm type in Australia? (*Hint:* Refer to a climate map in your atlas for other ideas.)

Explain

4. Explain why extensive, large-**scale** cattle and sheep farms are typically located in remote and arid regions of Australia.

5. Using the map of farm production in Australia, describe and explain the location of:
 - (a) wheat farms
 - (b) dairy farms.

Discover

6. Investigate which foods are grown closest to you.
7. Collect information on the percentage of land used for the different forms of farming in Australia, and then show this data in a graph. Comment on the details shown in your graph.
8. One of the growing plantation industries is that of palm oil. It often has great impacts on tropical biomes; loss of habitat is one such impact. On a world map, locate major palm oil production areas and explain the implications of loss of habitat in those areas.
9. Various plantations in Queensland (such as pineapple, sugar cane and banana plantations) are associated with fertiliser run-off, which is affecting the Great Barrier Reef. Find out what effects fertiliser has on these aquatic **environments**.

Predict

10. What would be the impact of flood or drought on any of the commercial methods of food production?
11. Predict the impact of the growth of Australian capital cities on the **sustainability** of surrounding market gardens.

Think

12. Why is much of Australia's food production available for export?
13. It used to be said that Australia's economy 'rode on the sheep's back'. What do you think this means, and do you think it is still true today?

3.10 What does a farming area look like?

Modern-day food production relies heavily on technology to create ideal farming conditions. This may involve reshaping the land to allow for large agricultural machinery and for the even distribution and drainage of water. Uneven or unreliable rainfall can be supplemented by irrigation. As a result of such changes, large areas can become important farmland.

CASE STUDY

Griffith

Griffith, located in the Western Riverina of New South Wales, is an important agricultural and food-processing centre for the region, generating more than \$1.9 billion dollars' worth of food. It is responsible for 60 per cent of the oranges, 44 per cent of the rice and 51 per cent of the wine produced in New South Wales.

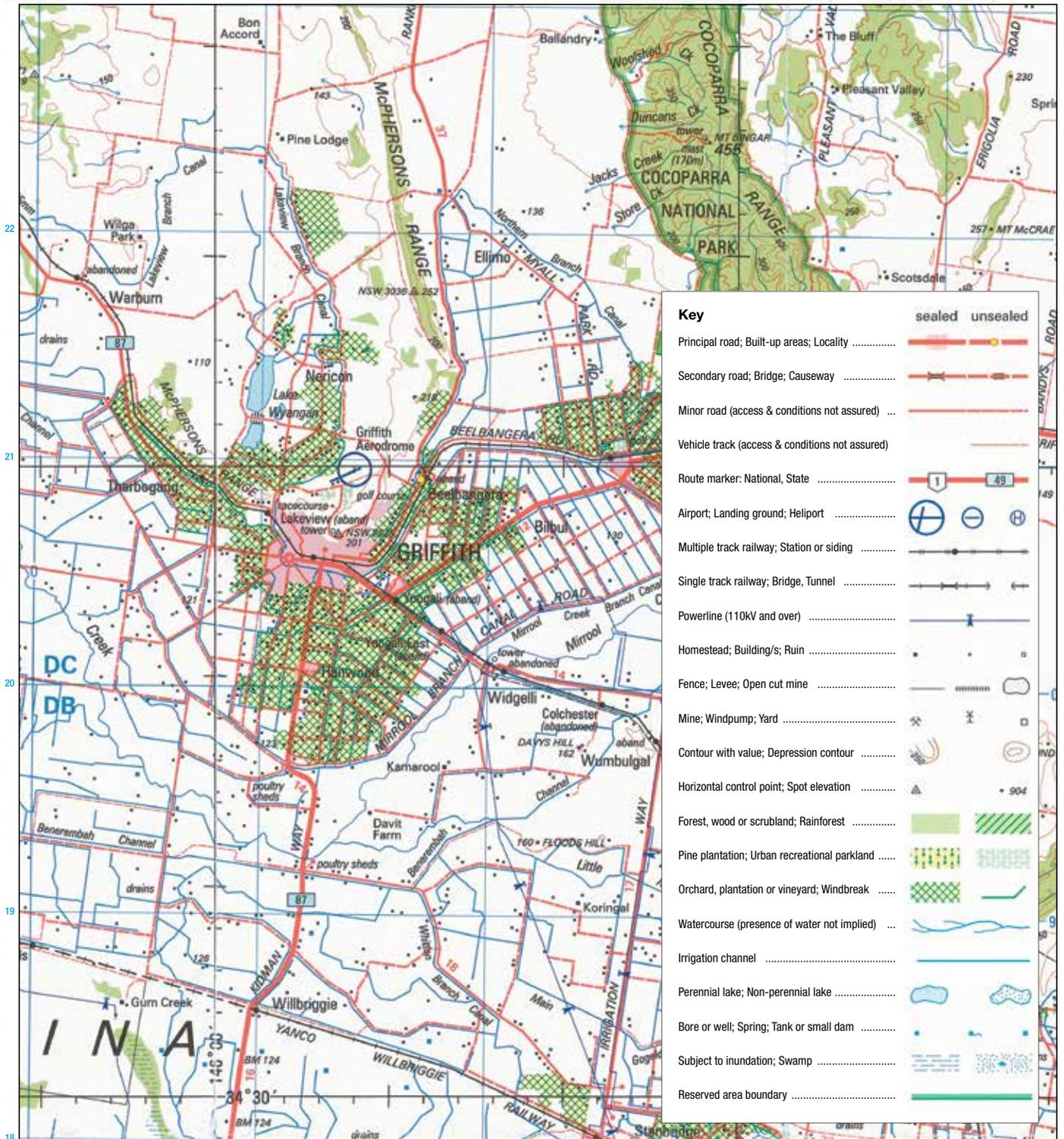
The first European explorer to the area was John Oxley, who described the region as 'uninhabitable and useless to civilised man'. This was largely due to the lack of a suitable water supply. The construction of irrigation canals in 1906 established a reliable source of water that could be used in food production. The region has become an important food centre owing to the large-scale use of irrigation combined with suitable flat land, fertile soils and a mild climate.

To investigate the area in a little more detail, study the topographic map shown in figure 2.

FIGURE 1 Orange trees growing in an orchard near Griffith, New South Wales



FIGURE 2 Topographic map extract, Griffith, New South Wales



Source: Commonwealth of Australia (Geoscience Australia).

SCALE 1:250 000



3.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Discover

1. What types of **environment** might have existed in the Griffith area when Oxley first arrived?
2. Identify and name a possible source for irrigation water on the map in figure 2.
3. How is water moved around this area? (*Hint:* Follow the blue lines.)
4. Using the contour lines and spot heights in figure 2 as a guide, estimate the average elevation of the map area.
5. What is the importance of topography (the shape of the land) to irrigation?
6. What types of farming are found at the following **places** in figure 2?
 - (a) GR410195
 - (b) GR413220
7. Approximately what percentage of the map in figure 2 area is irrigated?

Explain

8. Are orchards and vineyards an example of intensive or extensive farming? Explain.
9. Compare the pattern of irrigation channels and buildings in AR3919 and AR4220 in figure 2. Suggest a reason for the differences you can see.

Think

10. Within Griffith there are many factories that process raw materials, such as rice mills, wineries and juice factories. What would be the advantages and disadvantages of locating processing factories close to growing areas?

3.11 SkillBuilder: Describing patterns and correlations on a topographic map

WHAT ARE PATTERNS AND CORRELATIONS ON A TOPOGRAPHIC MAP?

online only

A pattern is the way in which features are distributed or spread. A correlation shows how two or more features are interconnected—that is, the relationship between the features. Patterns and correlations in a topographic map can show us cause-and-effect connections.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1
Topographic map extract showing the Clare Valley, South Australia



learnon RESOURCES — ONLINE ONLY

-  **Watch this eLesson:** Describing patterns and correlations on a topographic map (eles-1729)
-  **Try out this interactivity:** Describing patterns and correlations on a topographic map (int-3347)
-  **Complete this digital doc:** Topographic map of Griffith, New South Wales (doc-11566)

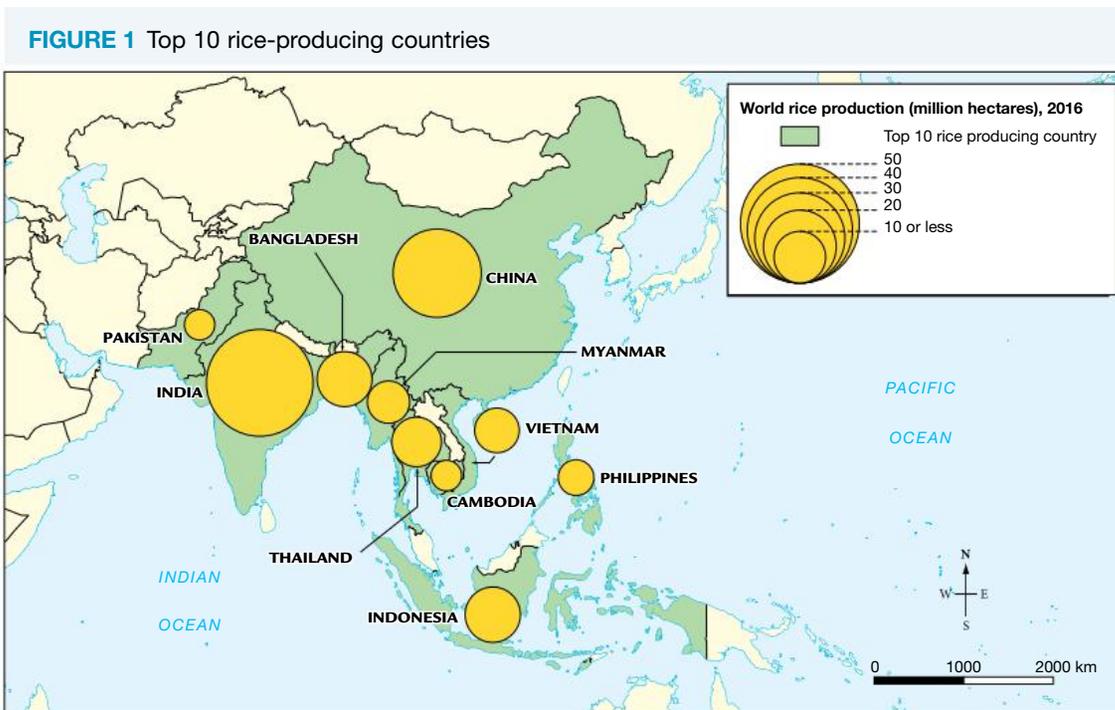
3.12 Why is rice an important food crop?

3.12.1 The importance of rice

Rice is the seed of a semi-aquatic grass. In warm climates, in more than 100 countries, it is cultivated extensively for its edible grain. Rice is one of the most important staple foods of more than half of the world's population, and it influences the livelihoods and economies of several billion people. In Asia, rice provides about 49 per cent of the calories and 39 per cent of the protein in people's diet. In 2010, approximately 154 million hectares of rice were harvested worldwide, and 95 kilograms were produced for each person on Earth.

Figure 1 shows that the largest concentration of rice is grown in Asia. About 132 million hectares are cultivated with this crop, producing 88 per cent of the world's rice. Of this, 48 million hectares and 31 per cent of the global rice crop are in South-East Asia alone.

Countries with the largest areas under rice cultivation are India, China, Indonesia, Bangladesh, Thailand, Vietnam, Myanmar (Burma) and the Philippines, with 80 per cent of the total rice area.



Source: WorldAtlas.com, <http://www.worldatlas.com/articles/the-countries-producing-the-most-rice-in-the-world.html>

3.12.2 Factors affecting rice production in Asia

Climate and topography

Rice can be grown in a range of environments that are hot or cool, wet or dry. It can be grown at sea level on coastal plains and at high altitudes in the Himalayas. However, ideal conditions in South-East Asia are high temperatures, large amounts of water, flat land and fertile soil.

In Yunnan Province, China, the mountain slopes have been cultivated in terraced rice paddies by the Hani people for at least 1300 years (see figure 2). The terraces stop erosion and surface run-off.

FIGURE 2 Spectacular rice terraces in Yunnan Province, China. These terraces are at an elevation of 1570 metres.



Irrigation

Traditional rice cultivation involves flooding the paddy fields (*padi* meaning 'rice plant' in Malay) for part of the year. These fields are small, and earth embankments (*bunds*) surround them. Rice farmers usually plant the seeds first in little seedbeds and transfer them into flooded paddy fields, which are already ploughed. Canals carry water to and from the fields. Houses and settlements are often located on embankments or raised islands near the rice fields.

Approximately 45 per cent of the rice area in South-East Asia is irrigated, with the largest areas being found in Indonesia, Vietnam, the Philippines and Thailand. High-yielding areas of irrigated rice can also be found in China, Japan and the Republic of Korea. Because water is available for most of the year in these places, farmers can grow rice all year long. This intensive scale of farming can produce two and sometimes three crops a year.

Upland rice is grown where there is not enough moisture to nurture the crops; an example of such cultivation takes place in Laos. This method produces fewer rice varieties, since only a small amount of nutrients are available compared to rice grown in paddy fields.

Pests and diseases

Rice yields can be limited if any of the following conditions exist:

- poor production management
- losses caused by weeds (biotic factor)
- pests and diseases (biotic factor)
- inadequate land formation and irrigation water
- inadequate drainage that leads to a build-up of salinity and alkalinity.

Technology

Agricultural biotechnology, especially in China, has produced rice that is resistant to pests. There are also genes for herbicide resistance, disease resistance, salt and drought tolerance, grain quality and photosynthetic efficiency. Genetic engineering may be the way of the future in rice cultivation in some parts of the world.

However, in the Philippines, a new strain of rice has been developed that grows well in soils lacking phosphorus. This could change crop yields considerably, and has been a result of cross breeding rather than genetic engineering.

FIGURE 3 Planting rice in paddy fields in north-east Thailand



FIGURE 4 Rice demonstration plots at the International Rice Research Institute in the Philippines



Environmental issues

Increasing temperatures, due to global warming, may be causing a drop in rice production in Asia, where more than 90 per cent of the world's rice is produced and consumed. The Food and Agriculture Organization of the United Nations (FAO) has found that in six of Asia's most important rice-producing countries — China, India, Indonesia, the Philippines, Thailand and Vietnam — rising temperatures over the past 25 years have led to a 10–20 per cent decline in rice output.

Scientists state that if rice production methods cannot be changed, or if new rice strains able to withstand higher temperatures cannot be developed, there will be a loss in rice production over the next few decades as days and nights get hotter. People may need to turn to a new staple crop.

Rice growing is eco-friendly and has a positive impact on the environment. Rice fields create a wetland habitat for many species of birds, mammals and reptiles. Without rice farming, wetland environments created by flooded rice fields would be vastly reduced.

3.12.3 Factors affecting rice production in Australia

Climate and topography

Eighty per cent of rice produced in Australia consists of temperate varieties that suit climates with high summer temperatures and low humidity. Rice is grown in the Murrumbidgee valleys of New South Wales and the Murray valleys of New South Wales and Victoria. The scale of production is sophisticated.

Sowing and irrigation

In Australia, rice grows as an irrigated summer crop from September to March. Most of it is sown by aircraft rather than planted by hand. Experienced agricultural pilots use satellite guidance technology to broadcast seed accurately over the fields.

Before sowing, the seed is soaked for 24 hours and drained for 24 hours, leaving a tiny shoot visible on the seed. Once sown, it slowly settles in the soft mud, and within three to four days each plant develops a substantial root system and leaf shoot. After planting, fresh water is released from irrigation supply channels to flow across each paddy field until the rice plants are well established.

Most countries grow rice as a **monoculture**, whereas Australian rice grows as part of a unique farming system. Farmers use a **crop rotation** cycle across the whole farm over four to five years. This means that the growers have other agricultural enterprises on the farm as well as rice. This system, designed for efficiency, sustainability and safety, means Australian growers maintain water savings, and have increased soil nutrients, higher yields and much healthier crops.

Once Australian rice growers harvest their rice, they use the sub-soil moisture remaining in the soil to plant another crop — either a wheat crop or pasture for animals. This form of rotation is the most efficient in natural resource use and agricultural terms.

Pests and diseases

Rice bays (areas contained by embankments — see figure 5) are treated with a chemical application, which prevents damage by pests and weeds. Without this treatment, crop losses would be extensive.



FIGURE 5 Murrumbidgee irrigation area rice fields

In the last 100 days before harvesting, the rice plant has no chemical applications, so that when it is harvested, it is virtually chemical free.

Technology

Most farms use laser-guided land levelling techniques to prepare the ground for production. This gives farmers precise control over the flow of water on and off the land. Such measurement strategies have contributed to a 60 per cent improvement in water efficiency. Most of the equipment used on rice farms is fitted with computer-aided devices, such as GPS (global positioning systems), CAD (computerised whole farm design), GIS (geographical information systems) and remote sensing. Australian rice growers are the most efficient and productive in the world.

Environmental issues

The rice industry encourages biodiversity enhancement and greenhouse gas reduction strategies. Some farms in southern New South Wales are avoiding the use of chemical fertilisers and pesticides by converting farms to biodynamic practices, and have avoided salinity by planting red gums.

FIGURE 6 Harvesting rice near Griffith, New South Wales



3.12 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. Which countries produce most of the world's rice?
2. What is meant by the term *monoculture*?

Explain

3. Explain why **places** in Asia are ideally suited to rice growing.
4. Use the **Terraced rice** weblink in to explain how the terraced rice fields shown in figure 2 have been formed.
5. Explain the **environmental** issues that may affect future rice production.
6. Describe and explain the similarities and differences between the rice cultivation methods used in Asia and Australia.

Discover

7. Investigate two different rice growing **places** in Asia and describe the reasons for the different **environments**.
8. Investigate an example of an Australian rice farm and outline its yearly rice-growing cycle.
9. Research the **interconnection** between rice-growing and the Murray River for ensuring a **sustainable environment**.

Predict

10. Predict how technology will influence **changes** to rice cultivation in both Asia and Australia.

 Try out this interactivity: How is rice grown? (int-3322)

 Explore more with this weblink: Terraced rice



Deepen your understanding of this topic with related case studies and questions.

o Rice



3.13 Why is cacao a special food crop?

Access this subtopic at www.jacplus.com.au

online only

3.14 Daly River: a sustainable ecosystem?

Access this subtopic at www.jacplus.com.au

online only

3.15 How can aquaculture improve food security for Indigenous Australian peoples?

Access this subtopic at www.jacplus.com.au

online only

3.16 Review

online only

3.16.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

3.16.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

3.6 SkillBuilder: Constructing ternary graphs

3.6.1 Tell me

What are ternary graphs?

Ternary graphs are triangular graphs that show the relationship or interconnection between three features. Most graphs you have seen show the relationship between two features, not three.

Why are ternary graphs useful?

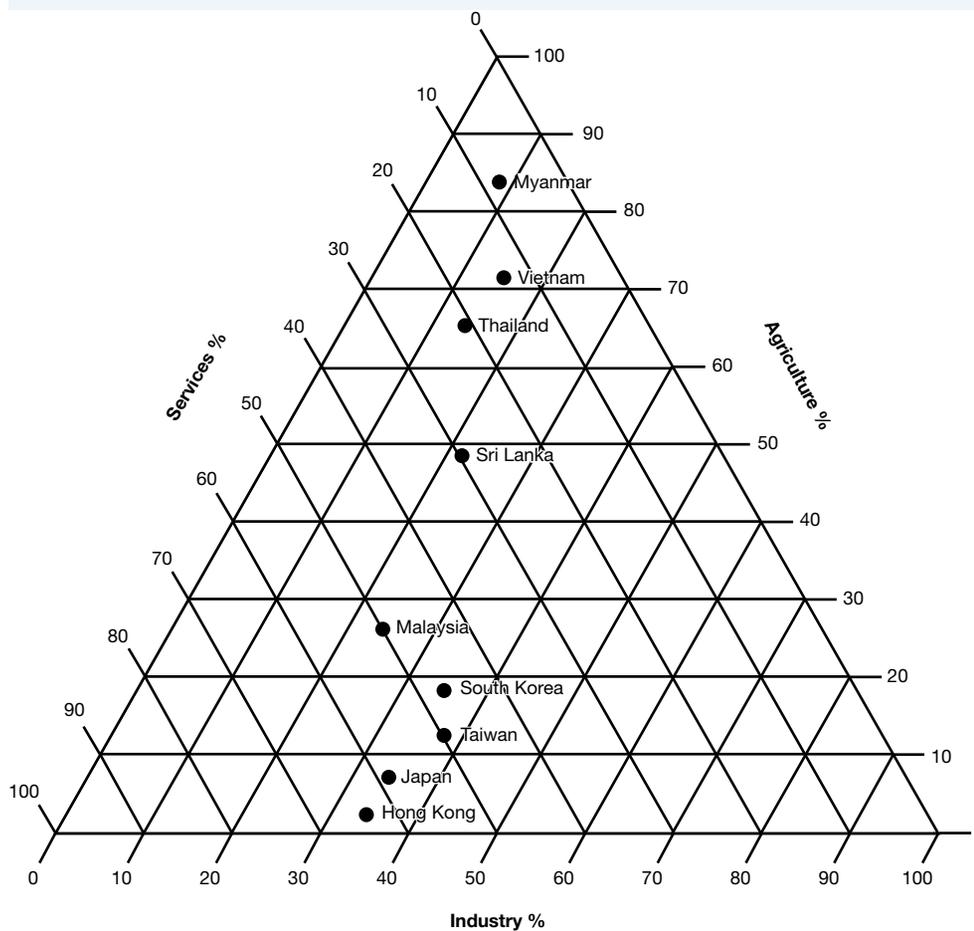
Ternary graphs are particularly useful when a feature has three components, and the three components add up to 100 per cent. Ternary graphs are most often used to show soil types, employment structures and age structures. They allow us to clearly see the interconnection between features. For example, with soil types, three different properties can be identified — clay, sand and silt. They can be graphed according to the proportion of each within a soil type, such as clay loam, sandy clay loam or silty clay loam.

Ternary graphs are useful for:

- economists comparing three economic features
- demographers considering population structures
- agriculturalists considering soil types.

Model

FIGURE 1 Economic activity in selected countries



A good ternary graph:

- is constructed as an equilateral triangle
- has each side of the triangle divided into 10 lines
- has lines drawn across the triangle that always total 100 per cent
- contains accurately plotted data
- has labelled axes
- includes a clear title.

3.6.2 Show me

How to construct a ternary graph

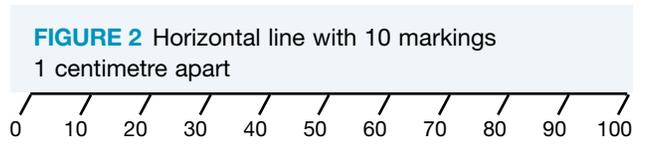
You will need:

- data on three features expressed as percentages and totalling 100 per cent
- a pencil
- a ruler
- an eraser.

Procedure:

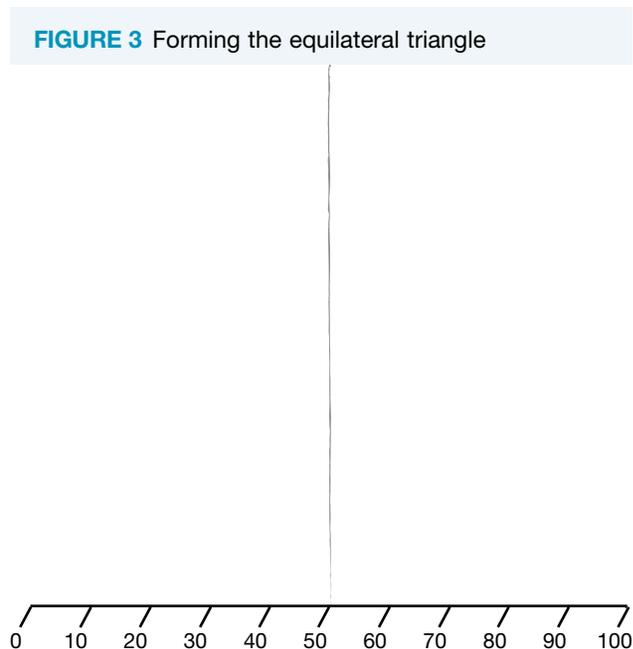
STEP 1

First you have to create an equilateral triangle — all three sides are equal and all three internal angles are 60° . Each side of the triangle becomes an axis on the graph. Begin by drawing a 10-centimetre horizontal line, and draw 10 marks that are one centimetre apart. Label these 0 to 10, with 0 on the left-hand side of your line and 100 at the right-hand side. Angle these marks to the left at 60° .



STEP 2

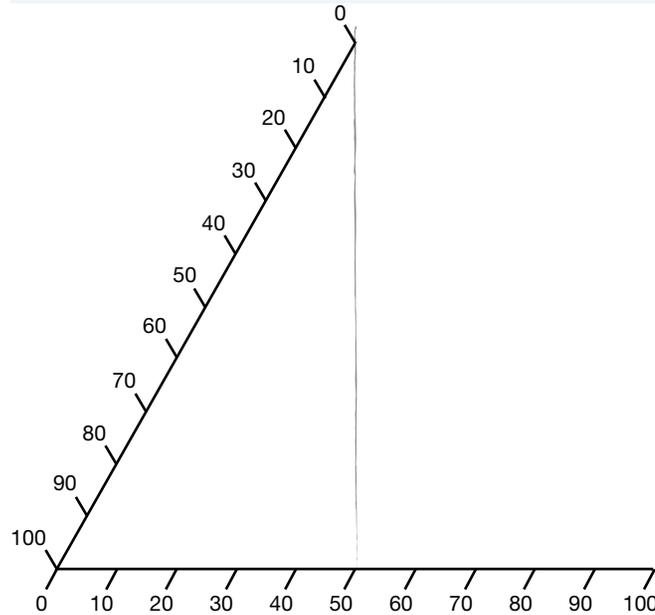
At the 50 per cent point, draw a faint vertical line of about 9 centimetres, which will help you to draw the other two axes. Later, you can rub this line out.



STEP 3

Now from the 0 per cent point, draw a diagonal line that is 10 centimetres long and intersects with the vertical line shown in figure 3. (It will intersect a few millimetres below the top of the vertical line.) Draw 10 marks that are one centimetre apart along this diagonal axis. However, this time, mark 100 per cent at the bottom of the line and 0 at the top.

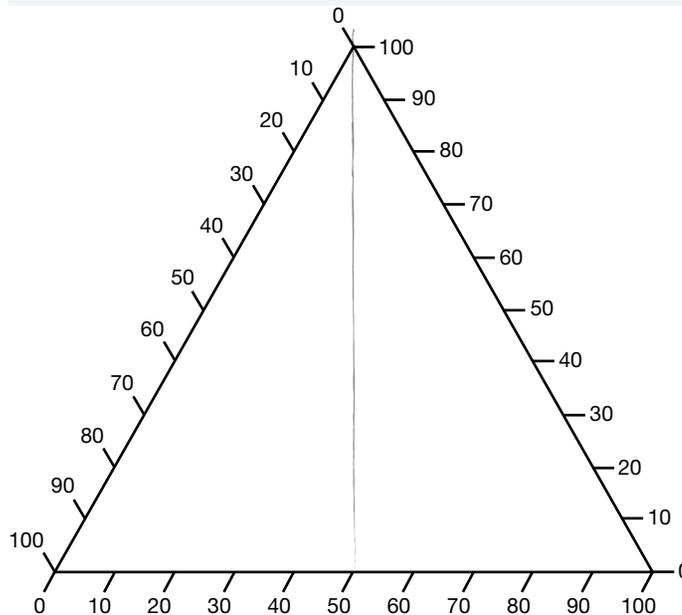
FIGURE 4 Creating a second axis



STEP 4

Repeat this step on the other side of the vertical line to complete the triangle, but reverse the markings, so 0 is at the bottom of the line and 100 is at the top. Your base graph should show a flow of 0 to 100 per cent around the graph, as in figure 5.

FIGURE 5 A ternary graph outline



STEP 5

Erase the vertical line that you drew to centre your graph.

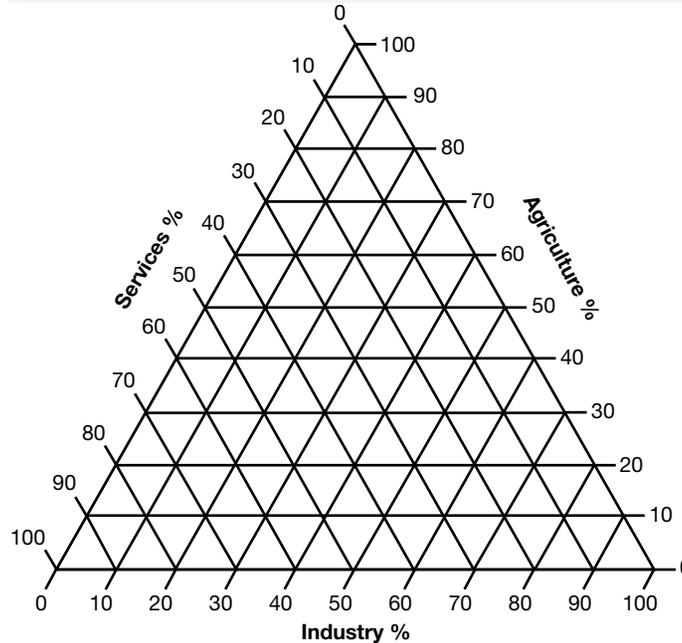
STEP 6

Now you need to use a ruler and carefully join points across the triangle that add to 100 per cent. This will provide a grid on which you can plot data.

STEP 7

Label the axes with the three features that you are going to plot. For figure 1, this is Services, Industry and Agriculture. Put the percentage symbol (%) after each label.

FIGURE 6 A ternary graph with its grid completed and axes labelled



STEP 8

Sample data for figure 1 would appear in a table like table 1.

FIGURE 7 Reading the grid

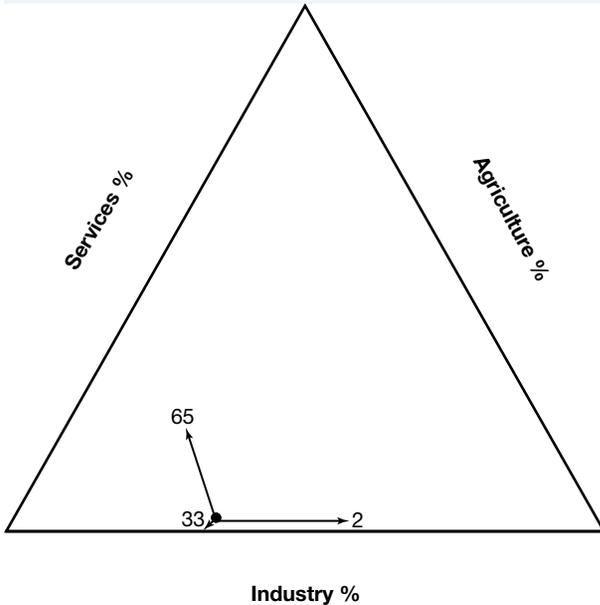


TABLE 1 Sample data on economic activity for selected countries in figure 1

| Country | Agriculture % | Industry % | Services % |
|-----------|---------------|------------|------------|
| Hong Kong | 2 | 33 | 65 |
| Myanmar | 84 | 8 | 8 |
| Sri Lanka | 49 | 21 | 30 |

To plot data, you need to find the point where the percentages for the three features intersect.

Plotting and reading ternary graphs needs concentration. You need to follow the diagonal lines sloping down from left to right (\) from the left-hand axis, the diagonal lines sloping up from left to right (/) from the bottom axis, and the horizontal lines from the right-hand axis. Look at the patterns outlined in figure 7 to make sure you read the grid in the correct manner. (Correctly angling the markers that fall outside the triangle will help you in plotting and reading the graph.)

When plotting country data, find the spot represented by the three sets of data and draw a small dot. Label it with the country name. Check that you can find the three countries in table 1 on your ternary graph.

STEP 9

Complete the graph with an appropriate title. In this case, the graph shows economic activity in selected countries.

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 Watch this eLesson: Constructing ternary graphs (eles-1728)

 Try out this interactivity: Constructing ternary graphs (int-3346)

3.6.3 Let me do it

Developing my skills

Use the following set of data to construct a ternary graph on labour force by occupation, 2011–12, in selected countries.

TABLE 2 Labour force by occupation, 2011–12, selected countries

| Country | Agriculture % | Manufacturing % | Services % |
|-------------|---------------|-----------------|------------|
| Australia | 4 | 21 | 75 |
| Colombia | 18 | 14 | 68 |
| Finland | 4 | 24 | 74 |
| Germany | 2 | 24 | 74 |
| India | 53 | 19 | 28 |
| Indonesia | 38 | 13 | 49 |
| Italy | 4 | 28 | 68 |
| Sri Lanka | 32 | 26 | 42 |
| South Korea | 6 | 24 | 70 |
| Thailand | 41 | 13 | 46 |
| Venezuela | 7 | 22 | 71 |
| Vietnam | 48 | 22 | 30 |

Questions

1. Which country has the greatest percentage of its population employed in agriculture?
2. Which country has the greatest percentage of its people employed in services?
3. Which countries have the lowest percentage of people employed in manufacturing?
4. Which country has the most even distribution across the three areas of employment?
5. Onto your graph, plot where you think the following countries would be placed: the United States, Gambia and Argentina. Explain your answer.

Checklist

I have:

- constructed an equilateral triangle
- divided each side of the triangle into 10
- drawn lines across the triangle that always total 100 per cent
- accurately plotted the data
- labelled the axes
- provided a clear title.

Skills questions

1. Ternary graphs are used to show:
 - (a) the *interconnection* between features
 - (b) cause and effect
 - (c) the distribution of one aspect
 - (d) the pattern of features.
2. Ternary graphs show the percentages of:
 - (a) one component
 - (b) two components
 - (c) three components
 - (d) four components.
3. Why is 100 per cent a key element of the ternary graph?
4. Why is care required when reading a ternary graph?

3.11 SkillBuilder: Describing patterns and correlations on a topographic map

3.11.1 Tell me

What are patterns and correlations on a topographic map?

A pattern is the way in which features are distributed or spread. A correlation shows how two or more features are interconnected — that is, the relationship between the features.

Why are patterns and correlations in topographic maps useful?

Patterns and correlations in a topographic map can show us cause-and-effect connections. A feature may be seen to occur at a place on a map and, when we ask why, other features on the topographic map help to explain the answer.

Topographic maps are useful for showing:

- landforms and land use connections
- water features and flooding for emergency services
- vegetation cover and slopes for fire authorities
- landforms and settlements for urban developers.

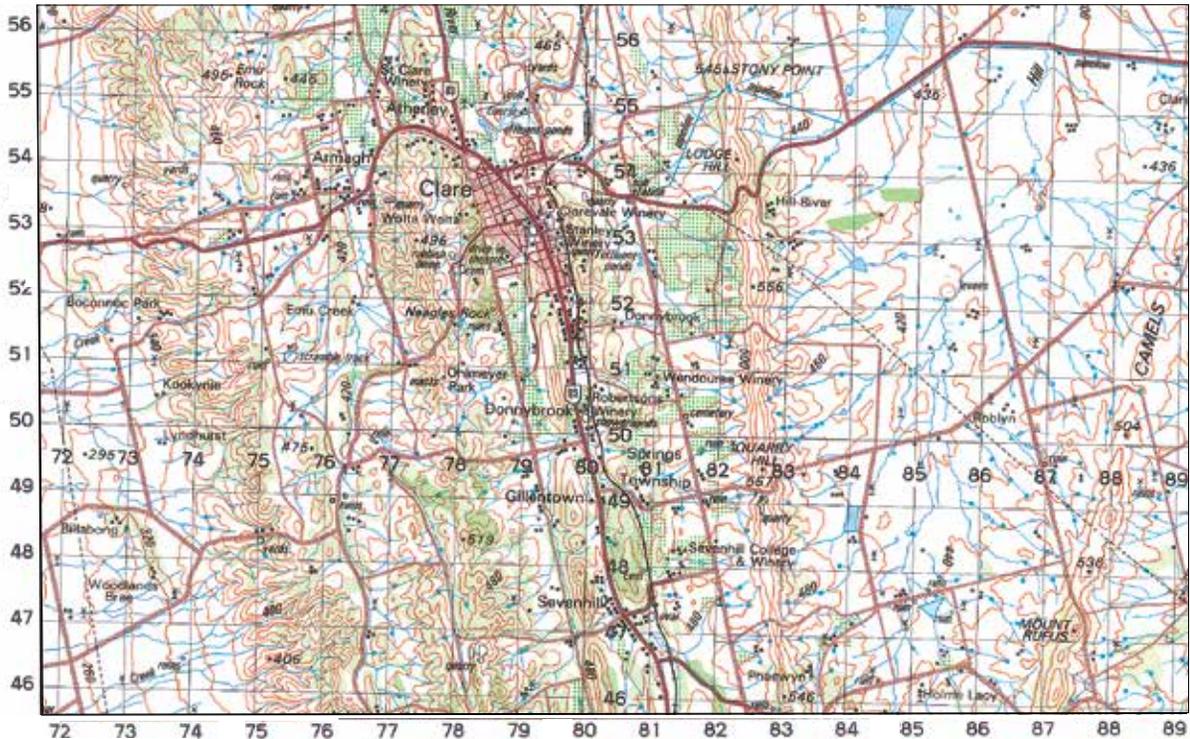
Model

In the environs of the township of Clare, South Australia, the eastern ridge slopes are used extensively for grape growing. Roads run parallel to the ridge and, owing to the steepness of the land, it is possible to drive over the ridge at only a few points, such as at Hughes Park (GR 800405). Settlements follow the ridge road along North Road. Streams that have their source on the ridge tend to flow west and form larger streams. Those streams flowing to the east are often dammed. Windmills throughout the flatter areas suggest water is needed for animal pasture in the drier months of the year. Spring Gully Conservation Park is a treed area on the steepest part of the ridge. The vineyards to the north at White Hut and Stanley Flat are not on sloped land, suggesting that the types of grapes grown there differ from those across most of the area. The Clare Valley region is an important vineyard area, adding significantly to the agricultural output of South Australia.

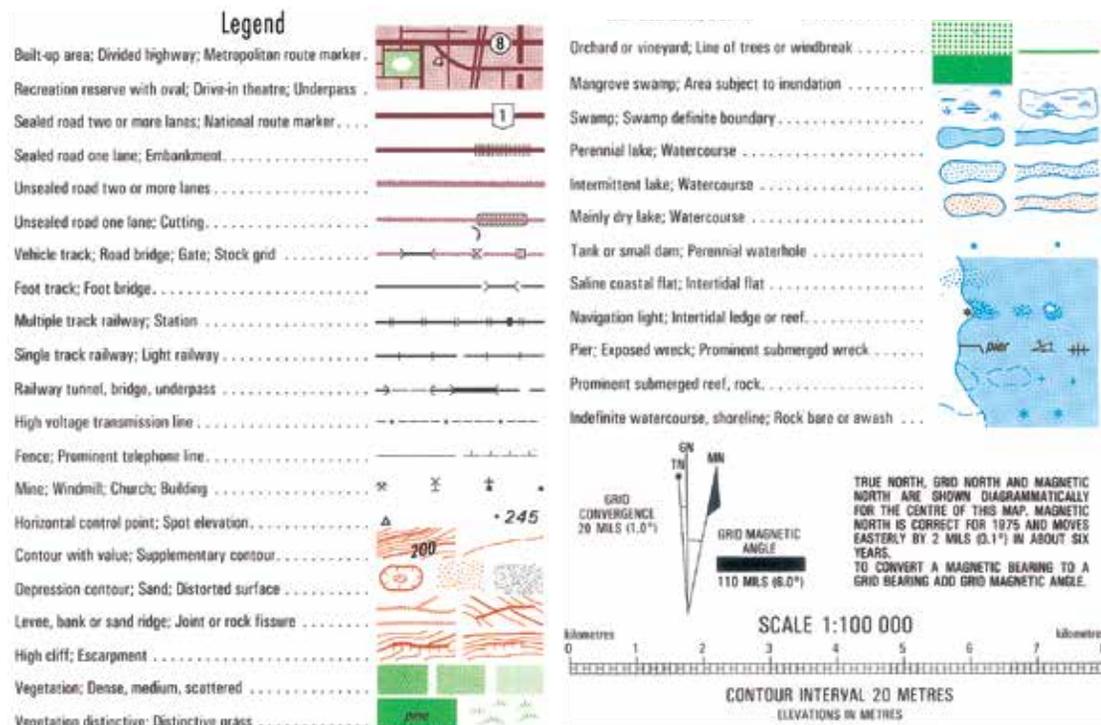
A good description of patterns and correlations in a topographic map:

- uses place names
- mentions distances
- identifies regions
- identifies connections
- notes anomalies
- is written in paragraphs, and includes an introduction that identifies the place and a conclusion that summarises the key findings.

FIGURE 1 Topographic map extract showing the Clare Valley, South Australia



Source: Spatial Vision



3.11.2 Show me

How to describe patterns and correlations in a topographic map

You will need:

- a topographic map of the place being considered.

Procedure:

STEP 1

Take the time to carefully analyse the topographic map, particularly its legend. Visualise the landforms and land use of the mapped place.

STEP 2

Now systematically look for connections between features, beginning with places that have strong connections. Try this list of connections that can be applied to most topographic maps:

- landforms and water or drainage
- landforms and vegetation types
- landforms and settlement
- landforms and agricultural use
- water and vegetation
- settlement and agricultural uses.

After you have identified these connections, write a few sentences describing any connections that are obvious. Begin by introducing the place being discussed, as in the paragraph under the heading 'Model' in section 3.11.1, which opens with 'In the environs of the township of Clare, South Australia . . .' An example of a connection found in figure 1 is that there is a strong link between land slope and vineyards.

STEP 3

Now systematically look for any anomalies that are evident. You are looking for things that seem unusual or show no connections. For example, in figure 1, the wineries at White Hut and Stanley Flat are not on east-facing slopes.

STEP 4

Complete your description with a concluding statement about the place. The paragraph under the heading 'Model' in section 3.11.1 concludes with the statement: 'The Clare Valley region is an important vineyard area, adding significantly to the agricultural output of South Australia.'

3.11.3 Let me do it

Developing my skills

Using the topographic map of the Griffith area, figure 2 in subtopic 3.10, write a paragraph identifying any patterns and correlations that are evident.

Questions

1. Why are the water channels straight? Is there an interconnection between slope and water resources? Explain your answer.
2. To what extent is there a correlation between orchards and slope? Explain your answer.
3. Describe the direction of development of Griffith township. Suggest why it has developed in this way.
4. How do we know that the irrigated orchards are smallholdings?
5. Is there a correlation between land slope and agricultural land use?

Checklist

I have:

- used place names
- mentioned distances
- identified regions
- identified connections
- noted anomalies
- written in paragraphs and included an introduction that identifies the place and a conclusion that summarises the key findings.

Skills questions

1. Patterns and correlations in topographic maps are used to show:
 - (a) the shape of the land between two *places*
 - (b) cause and effect
 - (c) the distribution of one aspect
 - (d) types of animals.
2. Patterns and correlations in topographic maps do not include information about:
 - (a) settlements
 - (b) numbers of cattle
 - (c) slope
 - (d) landforms.
3. Why should you include a statement of the location?
4. Why is it important to conclude your paragraph of writing?

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Watch this eLesson: Describing patterns and correlations on a topographic map (eles-1729)



Try out this interactivity: Describing patterns and correlations on a topographic map (int-3347)

3.13 Why is cacao a special food crop?

3.13.1 Where is cacao grown?

Where does chocolate come from? Chocolate is made from the beans of the cacao plant. The chocolate that is produced from these beans might come from cacao grown in Ghana, Mexico, Malaysia or Indonesia. Look on the wrapper next time you eat a chocolate bar!

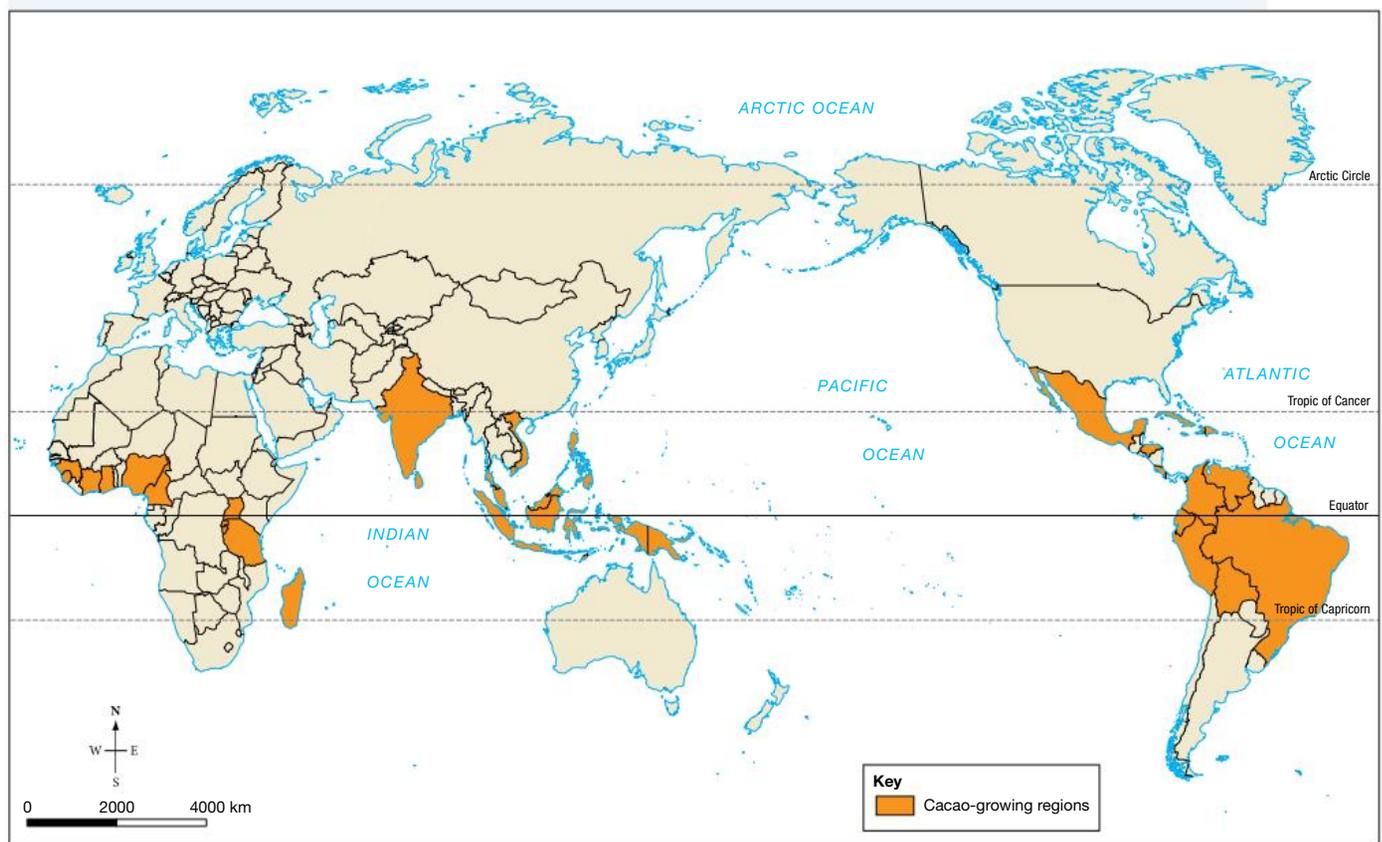
Chocolate has been eaten or drunk by people for 4000 years. A recent study showed that today, 91 per cent of females and 87 per cent of males consume chocolate products in places such as Great Britain, Australia, Switzerland, China and the United States. However, rising disposable incomes and changing tastes will continue to change the scale of production, both overseas and locally; people in India and China are now eating more chocolate.

The cacao tree is a native of the Amazon Basin and other tropical areas of South and Central America, where wild varieties still grow in the forests. Many countries now grow cacao, but the main places are:

- West Africa — Ghana, Nigeria and Cote D'Ivoire
- South America — Brazil and Ecuador
- Asia — Malaysia and Indonesia.

Malaysia and Indonesia, where cacao is a relatively new crop, are becoming increasingly important growing areas.

FIGURE 1 The main cacao-growing regions of the world



Source: Spatial Vision

3.13.2 What influences the growth and production of cacao?

Environmental factors

Most of the world's cacao is grown in a narrow belt between 10 degrees north and 10 degrees south of the equator. Cacao trees grow well in humid tropical climates with regular rainfall and a short dry season. The trees need temperatures between 21° and 23° C and rainfall of 1000 to 2500 millimetres per year. The soil must drain well but have good moisture-holding capacity. The trees cannot tolerate tropical sun and must be grown in the shade of other trees, such as banana trees, palms and rubber plants. Although cacao plants can reach a height of 12 metres, most are only six to seven metres tall. Growth is very fast, and the plant can flower and fruit two to three years after planting.

FIGURE 2 A cacao bean and seeds



FIGURE 3 A cacao farmer from Ghana carrying cacao pods



Economic factors

Around the world, six million cacao farmers — and 40 million to 50 million people in total — depend on cacao for their livelihood. For the past century, demand has grown by three per cent per year.

Cacao beans are an important export for West African nations such as Ghana and the Cote d'Ivoire. These countries are the source of more than 70 per cent of the world's cocoa.

Cacao beans are traded on the world market and their price can change daily, depending on supply and demand around the world. For example, too many beans on the world market can cause prices to drop, leaving farmers without the cash they need to cultivate their crops, and this ultimately lowers the supply. Adverse weather or tree disease can shrink supply as well.

Cacao is a **cash crop**, grown mostly in an **agroforestry** system, allowing for biodiversity and **income diversity** for families.

Labour

Cacao is one of the world's most labour-intensive crops. Much of the work is done by hand on a daily basis. The flowers are often pollinated by hand and defective pods are removed to allow the plant to put more energy into good ones.

Cultural factors

In Australia, chocolate Santas and Easter bunnies feature on special occasions. In many cacao-farming villages in other countries, drying the beans is done as a collective effort, with farming families gathering to turn the beans and visit with one another. In Oaxaca, Mexico, traditional healers called *curanderos* give chocolate drinks to cure bronchitis. They also plant cacao beans in the earth to ward off evil forces and heal those who have *espanto* — sickness caused by fright. Children drink chocolate for breakfast to ward off stings from scorpions or bees.

What is the future for chocolate?

Consumer demand for chocolate is on the rise, but the cacao tree is under threat from pests, fungal infections, climate change, and farmers' lack of access to fertilisers and other products that enhance yields. In West Africa, there are efforts to train farmers in organic, sustainable farming practices.

Global consumption is increasing, especially for darker, more cocoa-heavy varieties. Research is underway to develop hardier trees that can produce bigger yields while still making tasty chocolate. Fairtrade arrangements are improving the lives of farmers, increasing their income and helping them replace old trees and equipment.

3.13 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. On a world map, label and name the **places** where cacao is grown.
2. What **environmental** factors suit cacao growing in the Daintree region of North Queensland?

Explain

3. Explain how world cacao bean prices can affect a cacao farmer's income.
4. Explain the significance of chocolate in different cultures throughout the world.

Discover

5. Research an example of a **sustainable** growing method, such as shade cacao farming.
6. Investigate the industry assistance being given to cacao farmers, such as the Farmer Field Schools and the Cocoa Livelihoods Program.

7. Research the phenomenon of Fairtrade and how this operation has enabled the **sustainability** of cacao in many **places** in the world.

Think

8. Open Google Earth and select the Fairtrade Certified checkbox within the Global Awareness layer.
 - (a) Investigate a number of cocoa cooperatives on different continents.
 - (b) Describe the **scale** of these cooperatives and their importance to their countries. Where is their cocoa sold?
 - (c) The idea of Fair trade can benefit both farmers and the **environment** by promoting **sustainable** farming. After reading about the work of the cooperatives, consider whether the prices that farmers sell their cocoa for are fair.
9. Should money be spent on research to produce hardier cacao trees with bigger yields just to satisfy the chocolate desires of the Western world? It has been suggested that there could be a crisis in chocolate production by 2020, with chocolate becoming rare and very expensive. Should money be spent on other types of agriculture?

3.14 Daly River: a sustainable ecosystem?

3.14.1 Contrasting approaches to the land

Indigenous Australian peoples have been in Australia since the beginning of the Dreamings (more than 50 000 years by European estimates). Their perception of the land was that it provided sufficient resources to ensure their survival and wellbeing. Their interaction with the environment was sustainable and had a relatively low impact on the various biomes and associated ecosystems.

When Europeans colonised Australia, they thought that much of the continent was uninhabitable. They considered the land to be barren, hostile and unable to provide enough resources to ensure adequate food supplies and human survival.

Indigenous Australian peoples practiced seasonal land occupation travelling over very large areas in small groups, although in coastal and well-watered regions where food supplies were more abundant, a more sedentary lifestyle was adopted. They carried very little — usually just weapons and a few tools made of wood, stone or bone. They would seek shade under trees during the hottest part of the day and used campfires and blankets of tree bark to keep warm at night. Their hunting and gathering skills ensured an abundant supply of food and water. Aboriginal peoples divided their year into seasons that were determined by the weather and the available food resources associated with that weather. Use the **Daly River food calendar** weblink in the Resources tab to learn more about how Aboriginal peoples managed food supplies based on seasonally available resources in the Daly River area of the Northern Territory.

The Daly River area

Before European occupation, the Malak Malak Aboriginal people used Daly River as a traditional meeting place for trade and ceremonies. The Malak Malak were strong defenders of their country and hunted and gathered across the whole area.

Contact with the Europeans came late to this region when the Europeans occupied the area and made attempts in the 1880s to establish agriculture, pastoralism and mining.

FIGURE 1 Daly River in the wet season



FIGURE 2 Daly River is the name of a river and a town in the Northern Territory.



Source: Spatial Vision

However, by the 1920s, the vision of crops of peanuts and tobacco came to nothing, owing to pests, native grasses, acidic soil and flooding in the wet season, all of which made farming impossible. This was compounded by poor communication links and transport, and the fact that farm labourers were difficult to secure, unreliable and inexperienced. In 1967, the Tipperary Land Corporation cleared large tracts of land around the settlement and started growing sorghum, but their plans also came to nothing, with the whole operation being closed down in 1973. Most Aboriginal people worked on particular farms and worked as labourers or in fishing and crocodile-shooting enterprises. Many moved to nearby towns and communities.

Fish River Station

The Fish River cattle station (180 000 hectares) is on the Northern Territory's Daly River. Its isolation had previously made ranching difficult, and the local biomes, habitats and ecosystems were largely untouched.

The station was acquired by the Indigenous Land Council in 2011 along with environment groups and a department of the Federal Government, and was handed back to the traditional owners to foster cultural and sustainable economic development. The Indigenous owners (the Wagiman, Labarganyan, Malak Malak and Kamu peoples) will be able to generate income through programs such as fencing, cultural site protection, weed eradication, plant and animal surveys, feral animal eradication, soil conservation, and regeneration of threatened flora and fauna species. The plan will combine science with traditional knowledge to encourage biodiversity and will find ways to pass this knowledge to future generations.

FIGURE 3 Fish River Station rangers Desmond Daly and Jeff Long patrol 178 000 hectares of land.



3.14 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. When did the Europeans begin to occupy the Daly River area of the Northern Territory?
2. Why was the Fish River Station handed back to the traditional Aboriginal owners?

Explain

3. Describe the practice of seasonal land occupation by the Indigenous Australian peoples. How does it differ from your way of life?
4. Why would the seasonal **changes** in availability of food be an important part of Indigenous peoples knowledge of their land and its food supplies?

Discover

5. What are the features of the biomes found in the Daly River area? Describe some of their characteristics.
6. Litchfield National Park is close to the Daly River. Find out why this park has been set up in that area.

Predict

7. How might the re-establishment of native flora and fauna improve the ecosystems of the Daly River area and enhance their **sustainability**?
8. How could tourism on the Fish River Station help with its economic development?

Think

9. Use the **Daly River food calendar** weblink in the Resources tab. What are the similarities and differences between modern food consumption and that shown in the Daly River seasonal calendar?
10. The United Nations has established a body called the Food and Agriculture Organization. Explain why this organisation would be important in managing agriculture now and in the future.
11. Find out more about the Indigenous Land Corporation, Northern Land Council and the Pew Environment Group.
12. Use the **United Nations Food and Agriculture Organization** weblink in the Resources tab to investigate the idea of biodiversity through sustainable food production.

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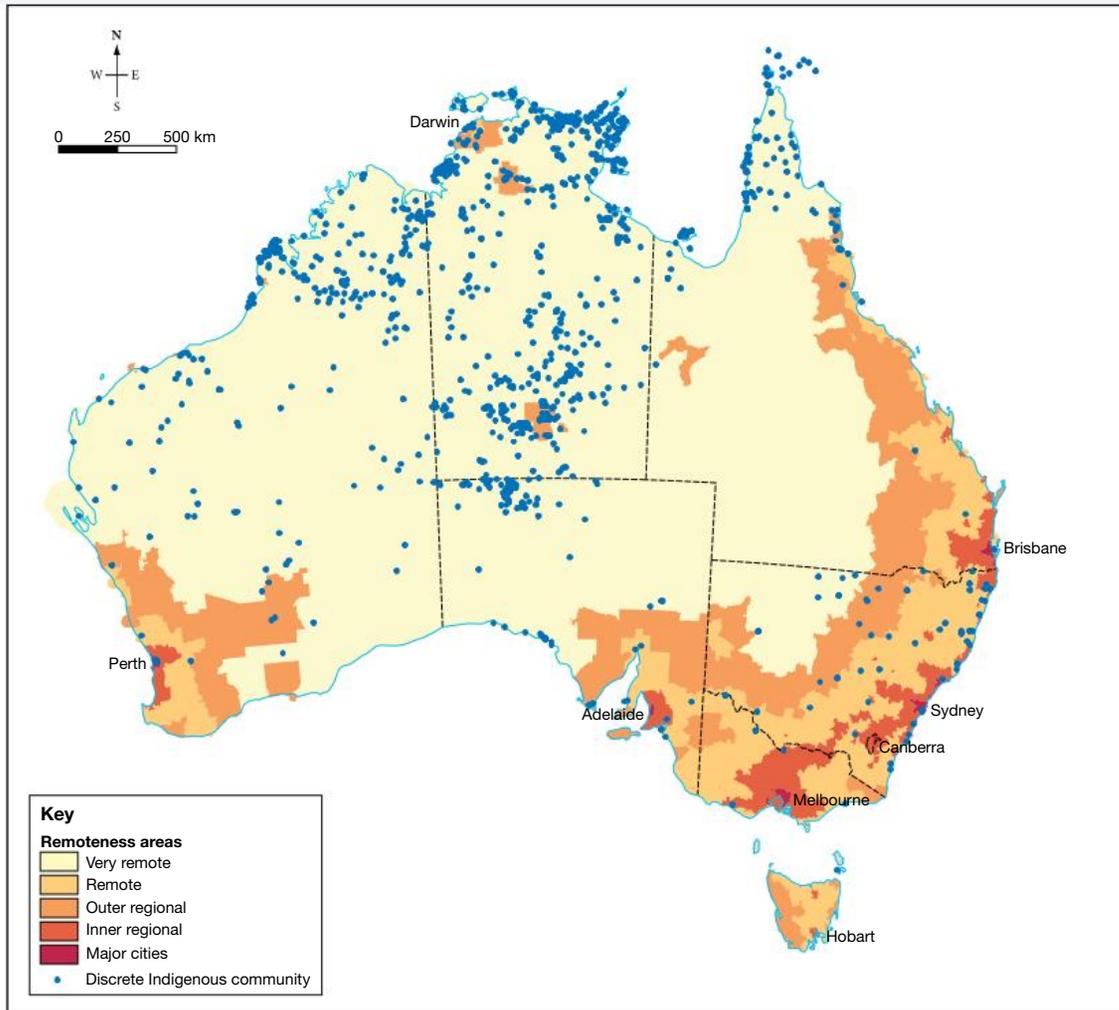
 **Explore more with these weblinks:** Daly River food calendar, United Nations Food and Agriculture Organization (UN FAO)

3.15 How can aquaculture improve food security for Indigenous Australian peoples?

3.15.1 Introduction

Aboriginal and Torres Strait Islander peoples reside in various locations around Australia, but they are more likely to live in remote locations than are non-Indigenous Australians (see figure 1).

FIGURE 1 Distribution of remote Aboriginal and Torres Strait Islander communities



Source: Australian Bureau of Statistics

Access to affordable and nutritious food is an ongoing problem in remote communities. These remote areas have a high cost of living and suffer from a general unavailability of fresh fruit and vegetables as well as other high-quality foods. As the main source of food is often limited to the local general store or takeaway outlet there are ongoing risks of food insecurity and consequent health issues related to limited choices of diet. The National Workforce Action Plan Report identified that 31 per cent of Aboriginal and Torres Strait Islander peoples living in remote areas were likely to be in households that had run out of food or could not afford to buy food, compared to 20 per cent for non-Indigenous people.

In these remote communities food is often the first thing to go when there is not enough money. Going without food, or more particularly going without costly nutritious food, has consequences for the general community and more particularly for disabled or chronically ill people as it compounds health issues.

3.15.2 Why is food security difficult in remote communities?

Aboriginal and Torres Strait Islander peoples living in these remote locations are not exposed to the same economic opportunities as people who live in large centres. As well as the high cost of living, limited educational outcomes, insufficient social services and work opportunities, and economic insecurity are often prevalent. This includes a lack of access to infrastructure that supports the development of various business ventures that could lead to financial and employment opportunities for the local community.

FIGURE 2 Some fresh fruit and vegetables that will ensure food security



Historically, Aboriginal and Torres Strait Islander peoples managed their food and water resources carefully to prevent food insecurity by living on their lands sustainably. However, after European occupation they were denied access to their lands and natural resources. This loss of traditional hunting and fishing areas played a role in limiting their access to nutritious and fresh sources of food.

To help alleviate food insecurity, the Federal Government, in conjunction with state and territory governments, has implemented programs aimed at improving food availability and access across various industries that relate to Indigenous Australian peoples' connection to land and place. **Aquaculture** has been identified as one of these industries.

Aquaculture ventures could provide an independent source of food and a source of revenue for further community development, employment and training opportunities. It could also provide a sense of community pride and prospects for future generations, and is in keeping with Indigenous peoples' role as caretakers and traditional custodians of the land.

3.15.3 The mud crab aquaculture venture at Kulaluk near Darwin

The aim of this venture was to establish a long-term sustainable Aboriginal-owned and operated mud crab aquaculture venture on land owned by the Gwalwa Daraniki Association at Kulaluk near Darwin in the Northern Territory.

Mud crabs have always been a traditional food source for Indigenous Australian peoples in coastal regions. The aquaculture farm established by this venture at Kulaluk aims to provide economic and social development opportunities for the local Indigenous community as well as food security for not only local people but the broader communities.

The mud crabs from the farm will primarily be sold directly to restaurants and wholesalers in the local Darwin market to keep transport costs to a minimum. Some produce, however, will be sent directly to other Australian capital cities using air freight (see figure 4).

FIGURE 3 Mud crabs raised at a government aquaculture centre in Darwin



FIGURE 4 Live mud crabs are tied and packed to be flown to Sydney, Melbourne, Perth, Adelaide and Brisbane.



3.15.4 How will the farm promote food security?

The farm will focus on providing development opportunities for people from the Aboriginal community located on Kulaluk land and other Indigenous peoples located in the Darwin area. These opportunities include:

- education and training for the Indigenous community, such as undertaking courses in aquaculture and business management at Charles Darwin University
- employment options working for a commercial aquaculture venture, such as research assistants, farm hands and office workers
- building community capacity for the Indigenous community, such as allocating revenue to support other Indigenous businesses or community development initiatives identified under the community development plan.

Recent government initiatives to improve food security in remote Indigenous communities have supported this mud crab aquaculture venture because it builds demand for healthy food.

Ultimately, the mud crabs venture will promote healthy eating by building, training and supporting a sustainable workforce in remote communities and reduce food insecurity.

3.15 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Identify two issues faced by Indigenous Australian communities living in remote locations.
2. Identify four benefits aquaculture production will provide for Aboriginal and Torres Strait Islander communities.

Explain

3. Explain what we mean when we say 'Indigenous peoples' role as caretakers and traditional custodians of the land'.

Discover

4. Examine figure 1, the map showing the distribution of remote Aboriginal and Torres Strait Islander communities. Describe this distribution.
5. Find out what diseases fresh food and vegetables help to alleviate.

Predict

6. How will aquaculture help to provide food security through economic security for Indigenous Australian peoples and other Australian people?

Think

7. Why is aquaculture suitable as an economic venture to overcome food insecurity in remote and near city areas of Australia?

3.16 Review

3.16.1 Review

Global food crops

1. Refer to figure 1. Describe how the production of food crops has *changed* over time for developing and developed places in the world. Suggest why the production level is higher in the developing regions.
2. 'The intensification of crop production in the developed world began with the Green Revolution'. Discuss this comment with reference to specific examples.

FIGURE 1 World production of major crops, 1961–2009



Source: FAO

3. Refer to figure 1. If food production were to increase in the future, suggest the *places* that might experience this expansion. Use researched examples to suggest the *scale* of the impact this may have on the *environment*.
4. Rice can be grown under a number of environmental conditions, so why is it not grown in the rest of the world to the extent it is in Asian regions?
5. *Environmentally*, cacao grows well in north Queensland. If cacao production was to be increased in this region, there could be costs to cacao farmers in other countries. Suggest examples of economic costs these farmers might face.
6. Cacao trees must be grown in the shade of other trees, such as banana trees, palms and rubber plants. What might be the advantages and disadvantages of this to a cacao farmer?
7. Explain why, with a choice of 50 000 edible plants, people have come to rely on only a small group of staple food crops. Refer to subtopic 3.3 to help you.
8. Keep a diary of the food that you have eaten for a week and identify where these food items might have been grown in Australia. Refer to subtopic 3.9 for additional information about farm types in Australia.

Griffith case study

Refer to subtopic 3.10 to answer the following questions.

9. What aspects of the Australian *environment* would John Oxley have found different from the English countryside?
10. What has been the key to the agricultural success of the Griffith region?
11. Refer to figure 2 in subtopic 3.10 (see doc-11566 in the Resources tab). In what ways has the environment been modified for farming in this area?
 - (a) What is the highest point on this map? Give the grid reference and elevation.
 - (b) What is the main land use at higher elevations?
 - (c) Why is this area not used for farming?
12. What are the requirements needed for growing (a) grapes and (b) oranges? Conduct research to find the types of irrigation methods used and why.
13. Why is the Griffith region suitable for rice farming?

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 Complete this digital doc: Topographic map of Griffith, New South Wales (doc-11566)

3.16.2 Reflect

Tonle Sap lake and floodplains

Tonle Sap of Cambodia is classified as a Biosphere Reserve, and is the largest freshwater body in South-East Asia. It is home to one of the world's largest freshwater fisheries and, when combined with associated rice fields, it provides most of the staple food of Cambodia. The lake produces over 400 000 tonnes of fish — two-thirds of Cambodia's annual fish catch. Rich biodiversity, abundant sediments and nutrient inflows from the Mekong River makes Tonle Sap and its floodplain biome one of the most productive inland fisheries and rice-producing areas in the world.

However, in the past decade, the fish catch at Tonle Sap has dwindled significantly. It is feared that the lake is losing its attributes due to overfishing and changes to the river floodplain biome. Over 70 per cent of Tonle Sap's water comes from the Mekong River, and it is possible that this inflow is being compromised by the construction of dams.

14. A number of dams have been planned or have already been built on the Mekong River as shown in figure 2. Use the **International Rivers** and **Mekong Times** weblinks in the Resources tab to find out more about the dams on the Mekong River and answer the following questions.
- What **changes** to the availability of water for Tonle Sap would result from the dams on the Mekong River?
 - The Mekong River flows through China, Laos, Cambodia and Vietnam. What issues between nations could arise with respect to dams and water distribution?
 - Why might Cambodia and Vietnam have the 'worst deal' in gaining water from the Mekong River?

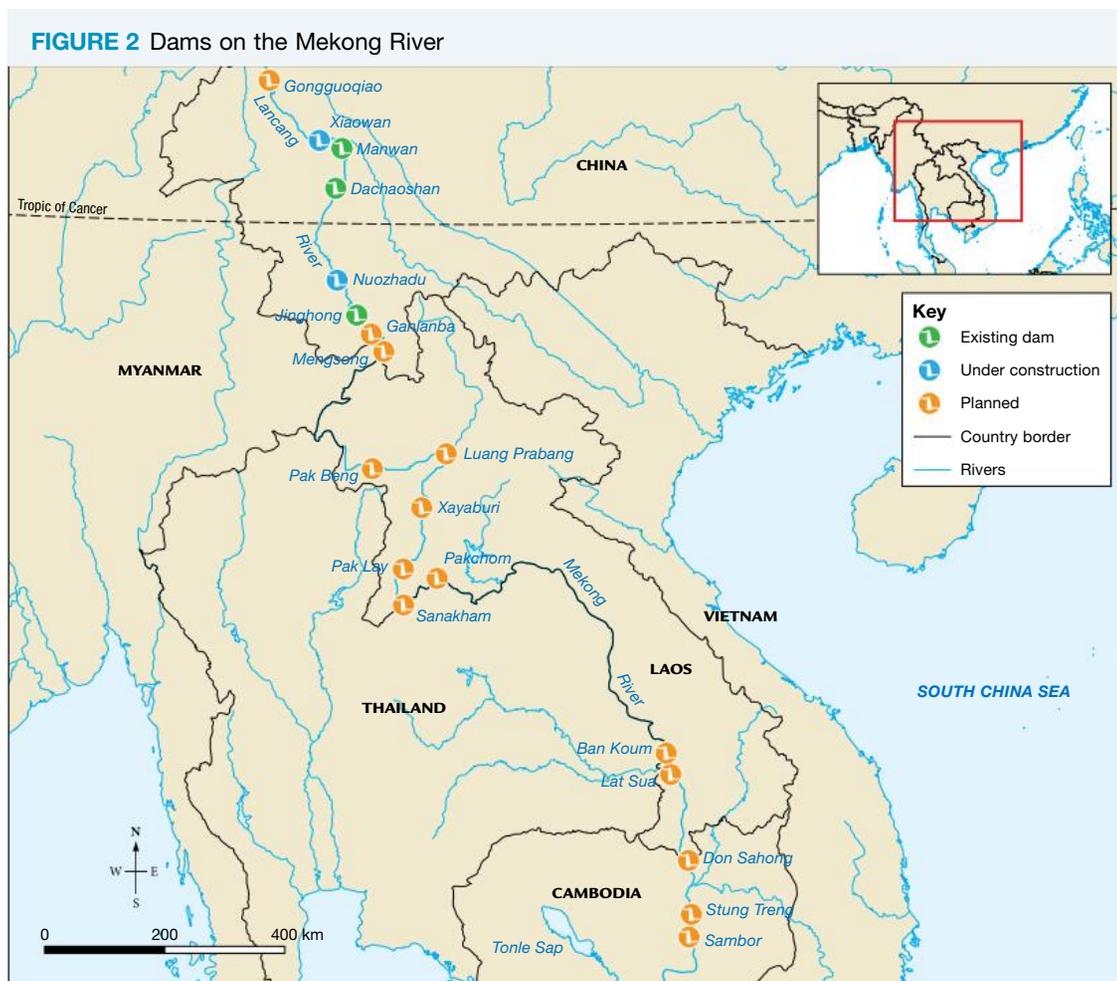
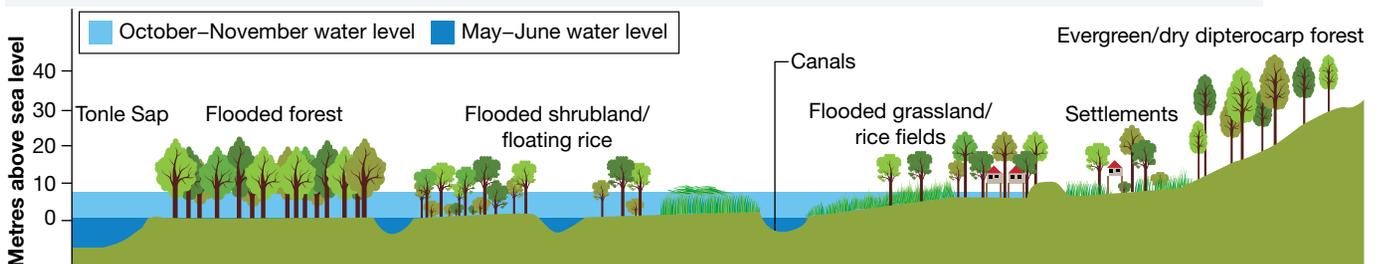


FIGURE 3 Manwan Dam, China



15. Study the diagram in figure 4, showing the Tonle Sap floodplain biome, ecosystem and general *environment*.
- Describe the vegetation and crop structure from the lake to the evergreen/dry forest, and give reasons for the location of the settlements and the rice fields.
 - The floodplain adjacent to the lake is an important breeding ground for fish and crustaceans in the wet season. What *changes* occur to the breeding grounds for fish and to the rice-producing areas when waters from the Mekong River arrive? How would this *change* or help in the production of food sources from fisheries and rice crops?
 - What parts of the Tonle Sap floodplain biome would *change* if water from the Mekong River was lost due to dam construction? How would this affect seasonal production from rice fields and fisheries and their general *sustainability* as a form of agriculture?

FIGURE 4 Diagram illustrating the Tonle Sap floodplain



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🔗 Explore more with these weblinks: [International Rivers](#), [Mekong Times](#)

Global food crops

- Should we be concerned about future food crop supplies, or is this a problem for future generations?
- Should farmers planting food crops be concerned about the *sustainability* of the *environment*, or only about economic factors?
- The Green Revolution was responsible for producing higher-yielding varieties of wheat, rice and maize. It relied on crops being grown with high levels of irrigation, fertilisers and pesticides. These*

often replaced natural resources; for example, fertilisers replaced soil quality management, while herbicides provided an alternative to crop rotations as a means of controlling weeds.

Evaluate these ideas, suggesting whether these strategies would be implemented if the Green Revolution had been introduced in the twenty-first century.

19. In the cacao industry, children often contribute positively to the household income by helping out on the family farm in appropriate work that does not jeopardise their health or education. Unfortunately, also, child labour remains widespread in the cacao sector, with a quarter of children aged between 5 and 17 living in cacao-growing regions involved in its production, mainly on family farms or working with parents. Most of these children are exposed to hazardous conditions, using dangerous tools and carrying heavy loads, with 51 per cent reporting injuries while at work. Should we, in Australia, be concerned about this? What could we do? How is Fairtrade helping to *change* this child labour market?
20. Is it the duty of nations with food surplus to be responsible for feeding the world? Think carefully about the consequences if food aid to nations with food shortages does not occur.
21. What can we learn from the agricultural practices of indigenous people around the world in the way they produce their food (for example: Aboriginal and Torres Strait Islander peoples, the San people and Bedouin people)?

TOPIC 4

What are the impacts of feeding our world?

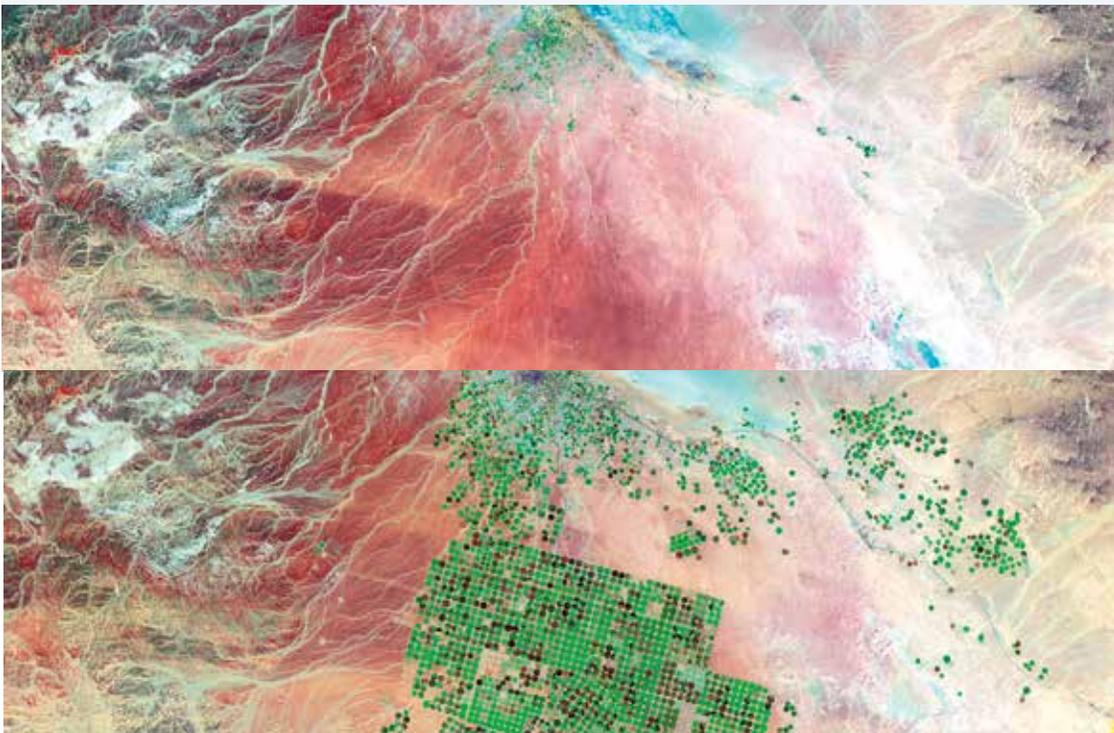
4.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

4.1.1 Introduction

The world's biomes support human life. We depend on these biomes for food, water, fibres, fuel and wood. We also rely on the services they provide, such as purifying air, regulating climate and providing spiritual and aesthetic comfort. However, our ecosystems are under considerable threat, largely as a result of our activities. Increasing population and demand for food have altered many of our biomes. There have been positive benefits, such as improved standards of living, although this has not been consistent across the globe. At the same time, there has been a significant decline in species biodiversity. Unless many of these problems are addressed, there is a growing concern that we may not be able to enjoy food security in future.

False-colour satellite images of the Wadi As-Sirhan Basin, Saudi Arabia, in 1987 (top) and 2012 (bottom). Large-scale irrigation in desert regions to maintain such agricultural fields consumes large quantities of groundwater.



Starter questions

1. How can feeding the world be destroying the world?
2. Do you know where your food comes from?
3. What food items do you eat most of within a typical day? Are they animal-based, plant-based or fish-based?
4. Do you or your family grow any of your own food?
5. Looking at the images on the previous page, how might this irrigation farming affect the desert biome?

INQUIRY SEQUENCE

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4.2 How does producing food affect biomes?

4.2.1 What is our biophysical world?

Food is essential to human life, and over the past centuries we have been able to produce more and more food to feed our growing population. While technology has enabled us to increase production, it has come at a price. Large-scale clearing of our forests, the overfishing of our oceans, and the constant overuse of soils has resulted in a significant decline in our biophysical world.

Planet Earth is made up of four spheres: the atmosphere, lithosphere, hydrosphere and biosphere (see figure 1).

All these spheres are interconnected and make up our biophysical or natural environment. For example, rain falling from a cloud (atmosphere) may soak into the soil (lithosphere) or flow into a river (hydrosphere) before being taken up by a plant or animal (biosphere) where it may be evaporated and returned to the atmosphere.

Natural events, such as storms or earthquakes, or human activities can create changes to one or all of these spheres. The production of food, whether from the land or sea, has the potential to change the natural environment and, in doing so, increases the likelihood of food insecurity. Table 1 shows how food production can affect the biophysical world.

FIGURE 1 The Earth's four spheres

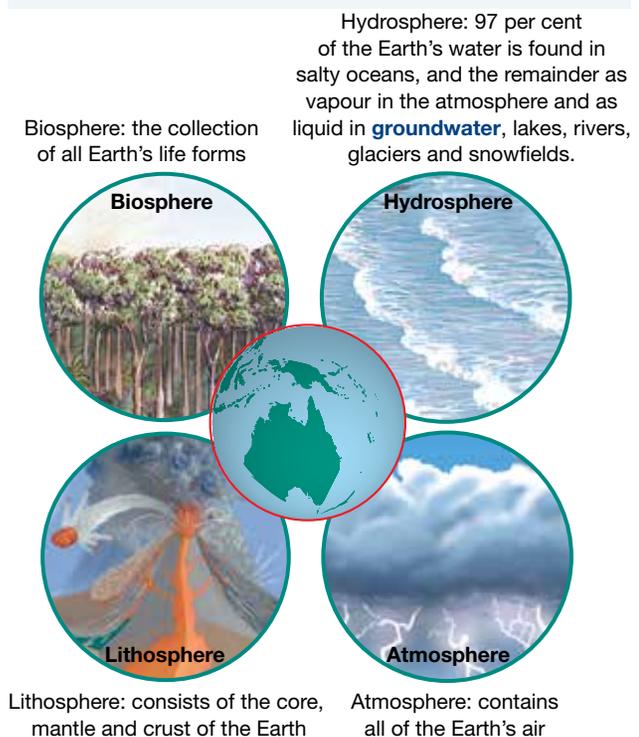


TABLE 1 How food production affects the biophysical world

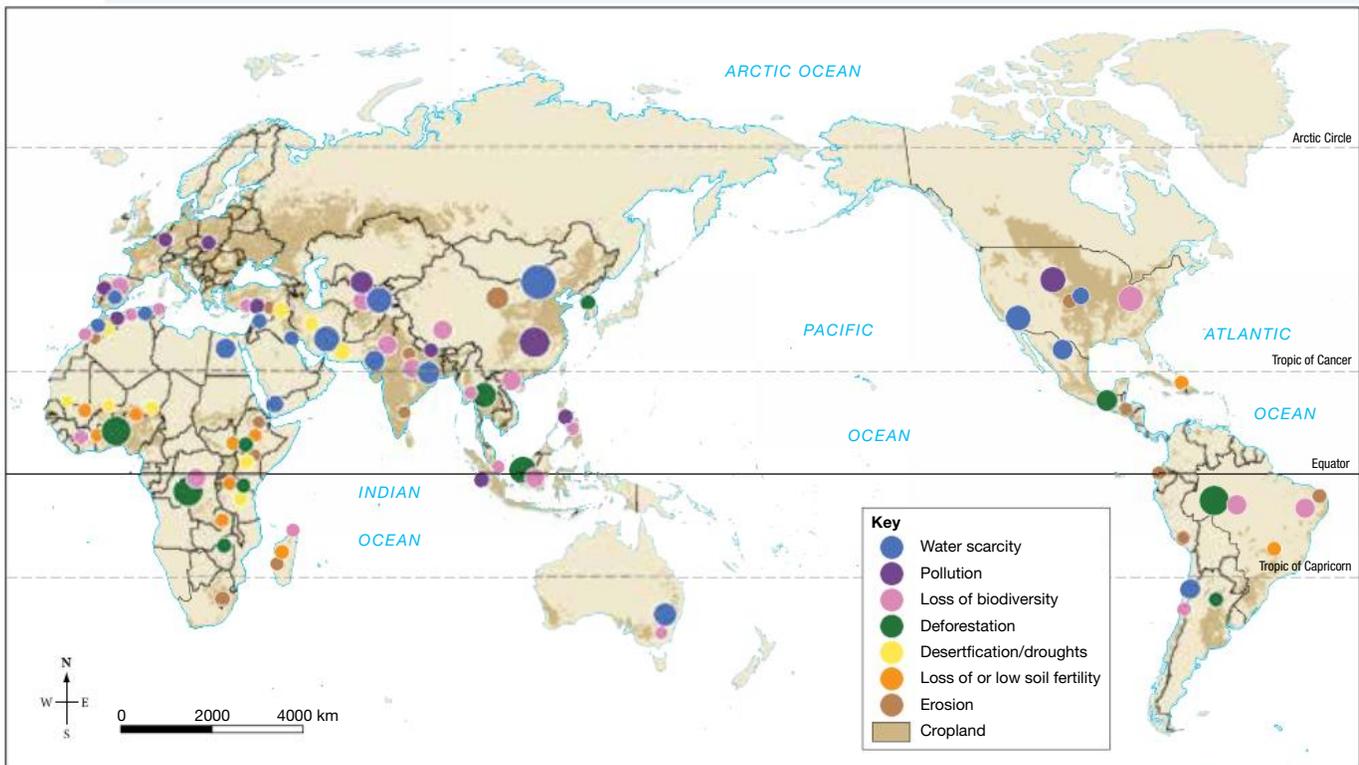
| Activities | Atmosphere | Lithosphere | Biosphere | Hydrosphere |
|--|------------|-------------|-----------|-------------|
| Clearing of native vegetation for agriculture | x | x | x | x |
| Overgrazing animals | | x | x | x |
| Overusing irrigation water, causing saline soils | | x | x | x |
| Burning forests to clear land for cultivation | x | x | x | x |
| Run-off of pesticides and fertilisers into streams | | x | x | x |
| Producing greenhouse gases by grazing animals and rice farming | x | | | |
| Changing from native vegetation to cropping | | x | x | x |
| Withdrawing water from rivers and lakes for irrigation | x | x | x | x |
| Overcropping soils | | x | x | x |
| Overfishing some species | | | x | |

4.2.2 What has happened to our biophysical world?

Currently, the world produces enough food to feed all 7 billion people. We produce 17 per cent more food per person than was produced 30 years ago, and the rate of food production has been greater than the population growth. This has been the result of improved farming methods; the increased use of fertilisers and pesticides; large-scale irrigation; and the development of new technologies, ranging from farm machinery to better quality seeds.

There have been many benefits associated with this change, especially in terms of human wellbeing and economic development. However, at the same time, humans have changed the Earth’s biomes more rapidly and more extensively than in any other time period. The loss of biodiversity and **degradation** of land and water (which are essential to agriculture) is not sustainable. With an expected population of 9.7 billion in 2050, it has been estimated that food production will need to increase by approximately 70 per cent. The global distribution of environmental risks associated with food production can be seen in figure 2.

FIGURE 2 State of the world’s land and water resources for food and agriculture



Source: Spatial Vision

4.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Describe the **biophysical environment** of your local area.
2. Why has food production increased so rapidly over time?

Explain

3. Explain, with the use of figure 1 how a bird might **interconnect** with the four Earth spheres.
4. Select one example from table 1. Describe how human activity can **change** the biophysical world.
5. Refer to figure 2 and your atlas.
 - (a) What are the main **environmental** issues facing Australia's food production?
 - (b) In which **places** in the world is deforestation a major concern?
 - (c) Which continents suffer from water scarcity?
 - (d) What do you notice about the location and distribution of regions that do not have **environmental** problems relating to food production?

Discover

6. Select one agricultural product in Australia and conduct research to find data on how much is produced and how this has **changed** over time.

Think

7. Use the following labels to create a flow diagram showing how the clearing of native vegetation can affect all four of the Earth's spheres.
 - Soil left bare and exposed to wind and water erosion
 - Less evaporation of water from vegetation
 - Loss of habitat for birds, animals and insects
 - Increased water runs off from exposed land
 - Increased sediment builds up in streams
8. Refer to figure 2.
 - (a) How would you rank these environmental impacts on a scale from the least to the most serious of impacts?
 - (b) What criteria could you use to help make this decision?

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 Try out this interactivity: Degrading our farmland (int-3323)

4.3 Where have all the trees gone?

4.3.1 Why are forests important?

Thirty per cent of the world's land surface is covered in forest. This is nearly one-third less than existed in prehistoric times, when humans did not have the technology to fell trees in large numbers. Large-scale deforestation has occurred as the need for timber products and land for food has increased over time. In the decade from 2000 to 2010, over 13 million hectares of forest was cleared each year. Cultivated land now covers one-quarter of the Earth's land surface.

Forest biomes offer us many goods and services, ranging from wood and food products, to supporting biological diversity. They provide habitat for a wide range of animals, plants and insects. Forests contribute to soil and water conservation, and they absorb **greenhouse gases**.

4.3.2 Why do we clear forests?

By clearing forests, valuable trees can be harvested for timber and paper production, while mining ores and minerals can be accessed below the Earth's surface. Sometimes, forests are flooded rather than cleared in order to construct dams for hydroelectricity. Forests may also be cleared for food production, such as small-scale subsistence farming, large-scale cattle grazing, and for **plantations** and crop cultivation. Figure 1 illustrates the main causes of deforestation in the Amazon rainforest during the peak period of deforestation. In recent years, the scale of deforestation in the Brazilian Amazon has been reduced due to an improved economy and the growing awareness of the value of preserving forests.

Road construction, usually funded by governments, also plays a part in changing rainforest environments (see figure 2). Roads help to improve access and make more land available, especially to the landless poor. They also reduce population pressures elsewhere by encouraging people to move to new places. At the same time, businesses benefit from improved access to mine resources and forest timbers, and are better able to establish large cattle ranches and farms.

FIGURE 1 Main causes of deforestation in the Brazilian Amazon, 2000–2005

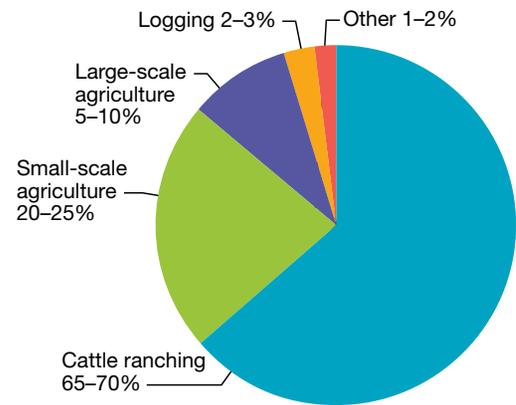
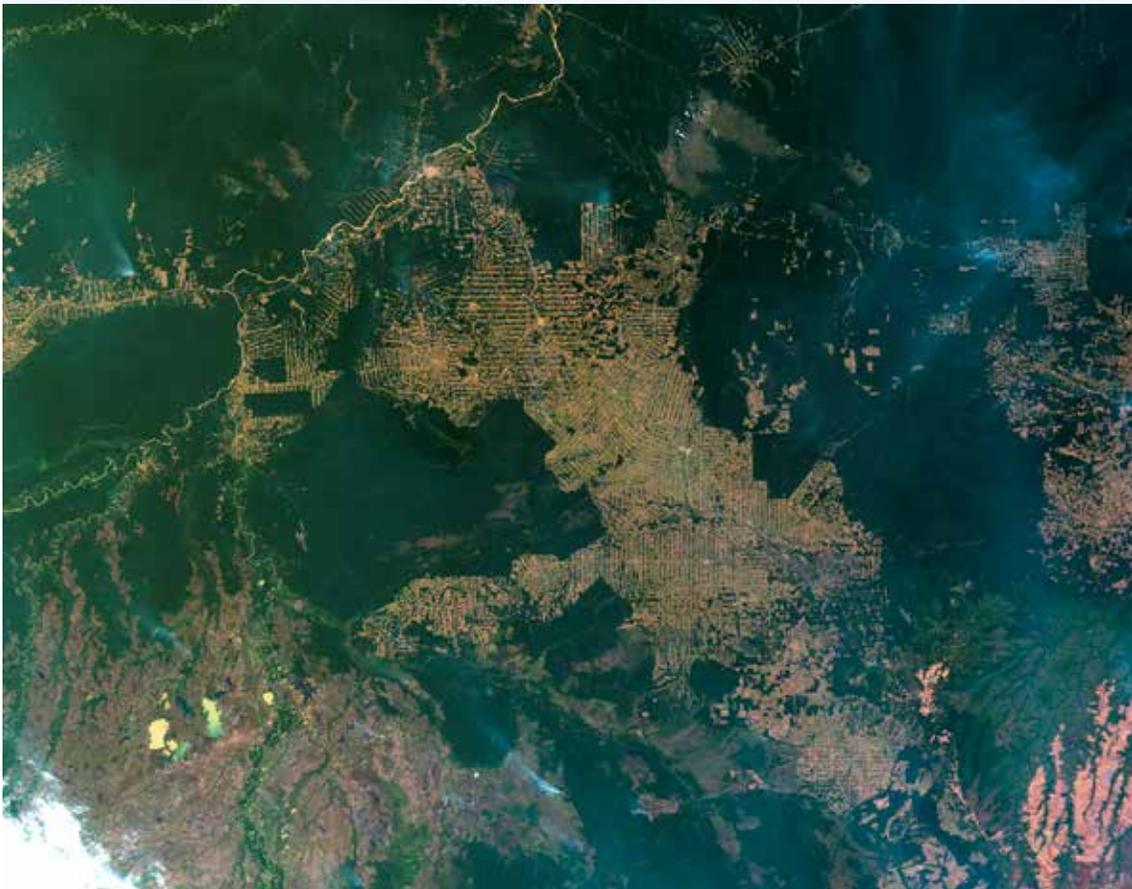


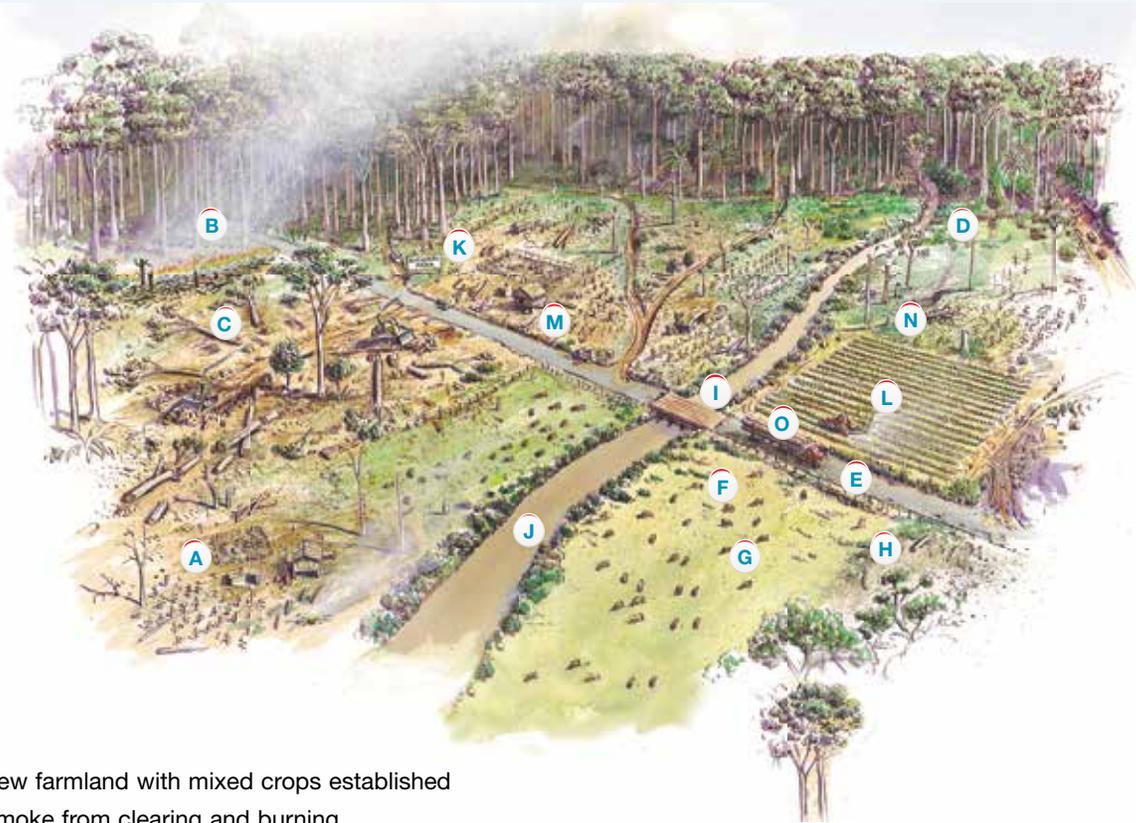
FIGURE 2 The effects of road building in the Amazon. Settlements tend to follow a linear pattern along the roads and then gradually move inland, opening up the forests.



4.3.3 What happens when forests are cleared?

Figure 3 illustrates some changes that forest clearing in the Amazon can have on the environment.

FIGURE 3 Impacts of clearing the Amazon rainforest



- A** New farmland with mixed crops established
- B** Smoke from clearing and burning
- C** Newly cleared land, trees cut down and burned. This is called slash-and-burn agriculture.
- D** Weeds and exotic species invade edges of remaining forest
- E** New road gives access to more settlers and to animal poachers
- F** Large cattle ranch
- G** Introduced cattle erode the fragile topsoil with their hard hooves.
- H** Erosion of topsoil increases, caused by rain on exposed soils.
- I** Flooding increases as stream channel is clogged with sediment
- J** The river carries more sediment as soil is washed into streams.
- K** Fences stop movement of rainforest animals in search of food.
- L** Pesticides and fertilisers wash into river
- M** Farm is abandoned as soil fertility is lost
- N** Weeds and other species dominate bare land
- O** Harvesting of timber reduces forest biodiversity.

4.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. What are the three main causes of deforestation in the Amazon?
2. What are the advantages and disadvantages of road building in the Amazon?

Explain

3. Why would subsistence farming in the Amazon be referred to as slash-and-burn farming?
4. In what ways would the **environmental changes** of small-**scale** subsistence farming differ from those of large-**scale** soya bean cropping?

Discover

5. Research soya bean farming in the Amazon. How does it compare with cattle ranching in terms of **environmental sustainability**?

Predict

6. Examine the illustration of rainforest destruction shown in figure 3. Draw a sketch of what you predict the area will look like in ten years' time. Use labels and arrows to show important features.

Think

7. Opening up the rainforest with roads can lead to fragmentation of the forest. What might the effect of this be on:
 - (a) native animals
 - (b) local indigenous populations?
8. Compare how a small-scale farmer from the Amazon and an environmentalist from another country might view the resources of a rainforest.



Deepen your understanding of this topic with related case studies and questions.
● Forest environments



4.4 SkillBuilder: GIS – deconstructing a map

online only

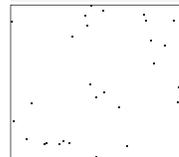
WHAT IS GIS?

A geographical information system (GIS) is a storage system for information or data, which is stored as numbers, words or pictures.

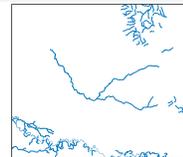
Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

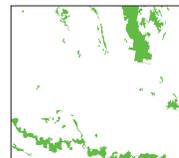
FIGURE 1 GIS allows information to be displayed in a succession of map layers.



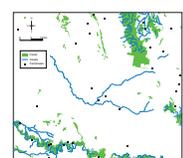
Point features marked on first layer of tracing paper.



Line features of rivers and creeks are traced onto a second layer.



The polygon data of forests are traced onto a third piece of tracing paper.



The three layers of tracing paper are now combined, and BOLTSS are added.

-  **Watch this eLesson:** Deconstructing a map using GIS (eles-1730)
-  **Try out this interactivity:** Deconstructing a map using GIS (int-3348)
-  **Complete this digital doc:** Topographic map of Griffith, New South Wales (doc-11566)

4.5 Paper profits, global losses?

online only

Access this subtopic at www.jacplus.com.au

4.6 Should we farm fish?

4.6.1 Why are we overfishing?

The ocean biome has always been seen as an unlimited resource of food for humans. In fact, overfishing is causing the collapse of many of our most important marine ecosystems, and threatens the main source of protein for over one billion people worldwide. **Aquaculture** is a possible solution but, at the same time, it contributes to the decline in fish stocks.

Overfishing is simply catching fish at a rate higher than the fish species can replace themselves. It is an unsustainable use of our oceans and freshwater biomes.

Massive improvements in technology have enabled fish to be located and caught in larger numbers and from deeper, more inaccessible waters. The use of spotter planes, radar and factory ships ensures that fish can be caught, processed and frozen while still at sea.

FIGURE 1 Global protein demand, 1980–2030 (million tonnes)

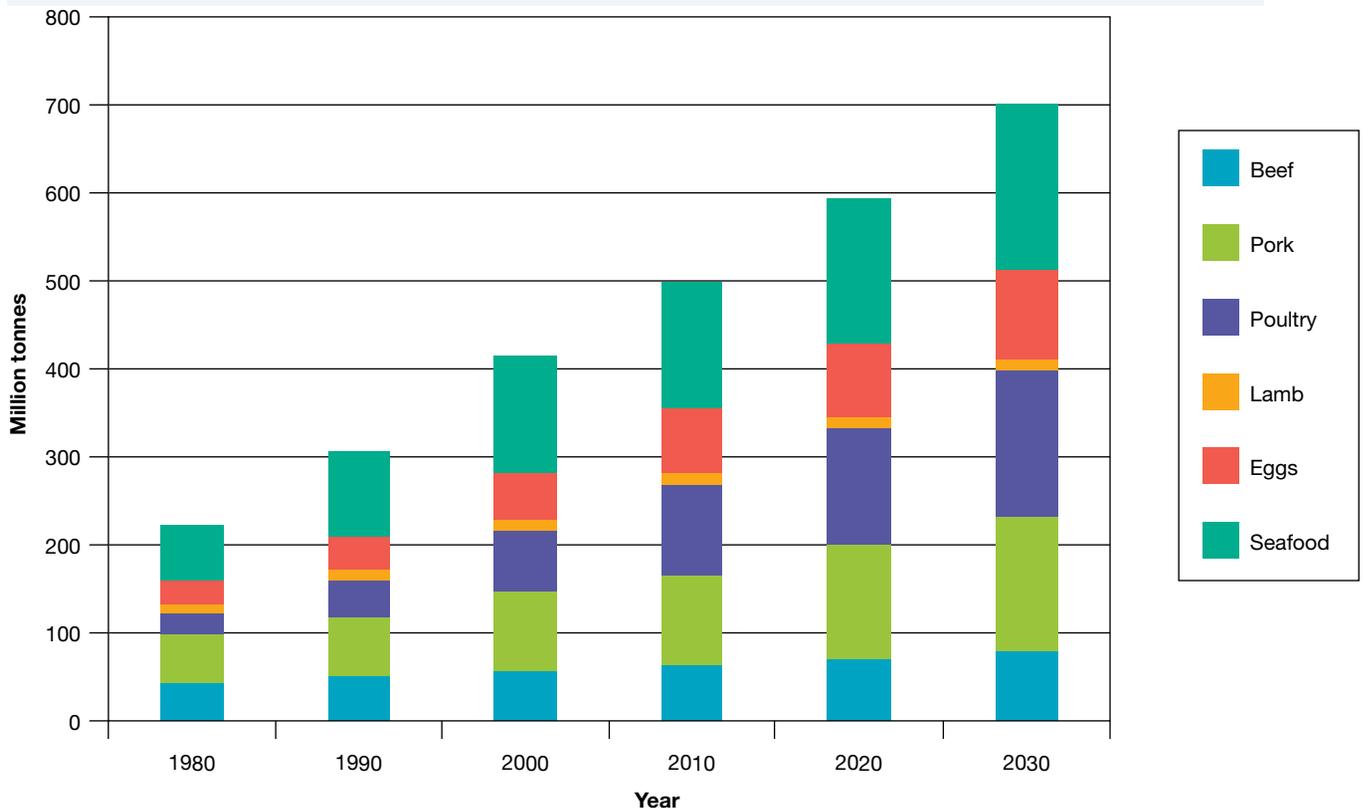


FIGURE 2 Unsustainable fishing



Globally, fish is the most important animal protein consumed (see figure 1). Historically, a lack of conservation and management of fisheries, combined with rising demand for fish products, has seen a ‘boom and bust’ mentality (see figure 2). The larger fish species are targeted and exploited and, after their populations are decimated, the next species are fished. Examples of these include blue whales, Atlantic cod and bluefin tuna.

4.6.2 What happens when we overfish?

- With overfishing there are often large quantities of by-catch. This means that juvenile fish and other animals, such as dolphins and sea birds, are swept up in nets or baited on hooks before being killed and discarded. For every kilogram of shrimp caught in the wild, 5 kilograms of by-catch is wasted (see figure 3).
- Destructive fishing practices such as cyanide poisoning, dynamiting of coral reefs and bottom trawling (which literally scrapes the ocean floor) cause continual destruction to local ecosystems.
- A large quantity of fish, which could have been consumed by people, is converted to fishmeal to feed the aquaculture industry, and to fatten up pigs, chickens and pet cats (see figure 4).
- Coastal habitats are under pressure. Coral reefs, mangrove wetlands and seagrass meadows, all critical habitats for fish breeding, are being reduced through coastal development, over-fishing and pollution.

FIGURE 3 Up to 80 per cent of some fish catches is by-catch.



4.6.3 Shark attack!

Many species of sharks are now threatened with extinction due to excessive overfishing. Their fins are often used to make shark fin soup, an expensive Chinese delicacy and status symbol, and a sign of wealth and prosperity. When sharks are caught, their fins are removed. The live sharks are then thrown overboard and they drown because they cannot swim without fins. This process is known as ‘finning’. The United Nations Environment Programme (UNEP) estimates that up to 73 million sharks are killed each year to supply the shark fin market. One consequence of this is that nearly one-third of all

ocean-going sharks are now on the internationally recognised list of threatened species. Some populations of hammerhead sharks have declined by 99 per cent in heavily fished regions such as the Mediterranean Sea and the north-west Atlantic Ocean.

Sharks are prone to overfishing because they tend to grow and mature slowly and produce relatively few young. They are also often accidentally caught up in tuna fishing nets.

The practice of finning is banned in many countries, such as the United States, the European Union and Australia. Instead, the sharks must be brought back to shore before the fins are removed and the bodies must be discarded. This limits the size of catches due to the amount of space available on the boat as well as the need for refrigeration. However, the value of the fins is much higher than the shark meat. For example, an Australian fisherman might only earn \$17 per kilogram for flake (shark meat that is filleted and frozen) compared to \$880 per kilogram for shark fins, which are simply dried and stacked without refrigeration.

Changing trends

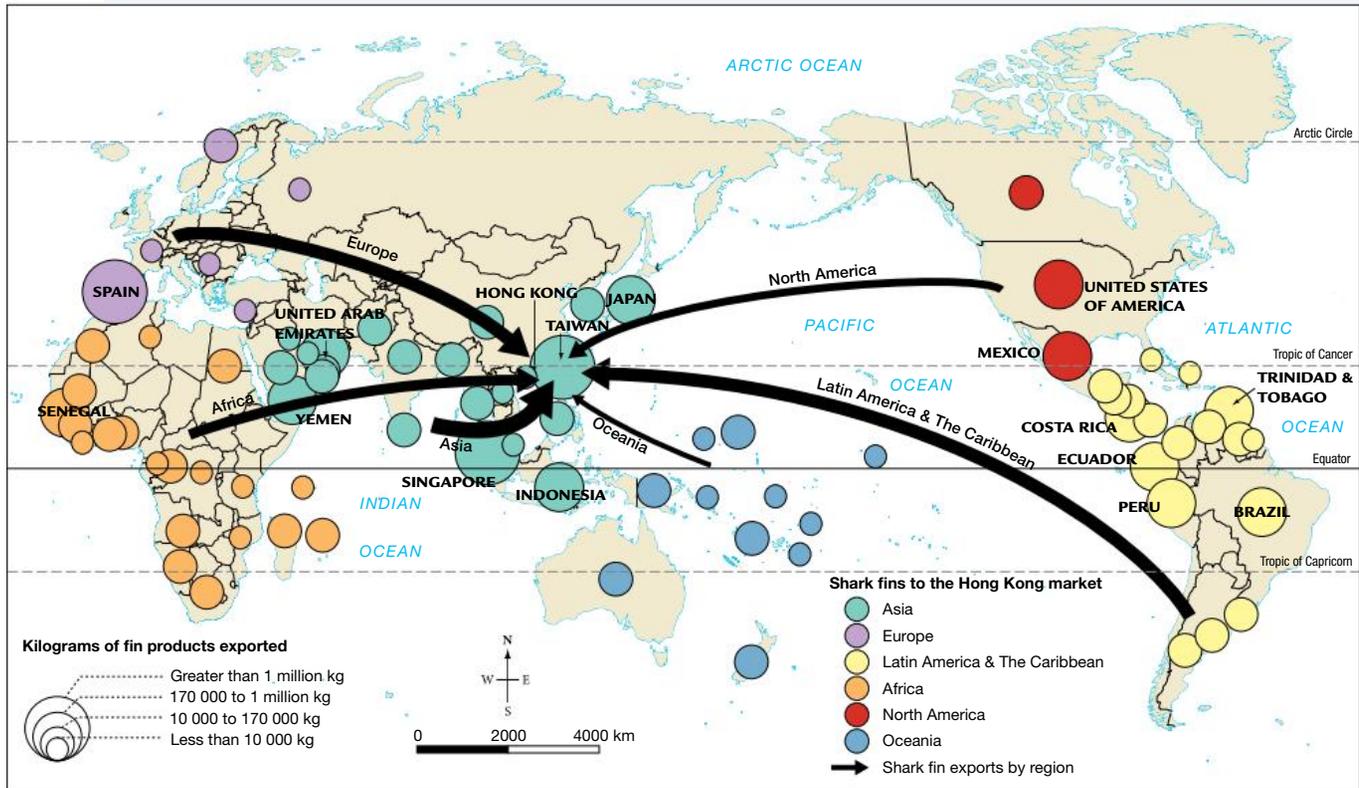
Hong Kong and China have always been the major importers of shark fin, as seen in figure 5, with supplies coming from more than 70 countries across all continents. However, in the past decade the demand and price for fins has decreased by approximately 25 per cent, particularly in China. This decline has been attributed to two main changes. First, in 2013 the Chinese Government banned shark fin soup and other unsustainable seafood from all official events; and second, there has been a major push from environmental organisations such as WildAid to educate people and discourage the consumption of shark fin.

A survey discovered that 75 per cent of Chinese were unaware that the soup, known as ‘fish wing soup’ was actually made of shark fin, and more than 19 per cent of people interviewed believed that the fins would grow back after being removed. The success of the public awareness campaign has led to more people rejecting finning and shark fin soup.

FIGURE 4 In Australia, the average cat eats 13.7 kilograms of fish a year compared with the average Australian, who eats 1 kilogram a year.



FIGURE 5 Imports of shark fins into Hong Kong in 2012



Source: Spatial Vision

What is being done to protect sharks?

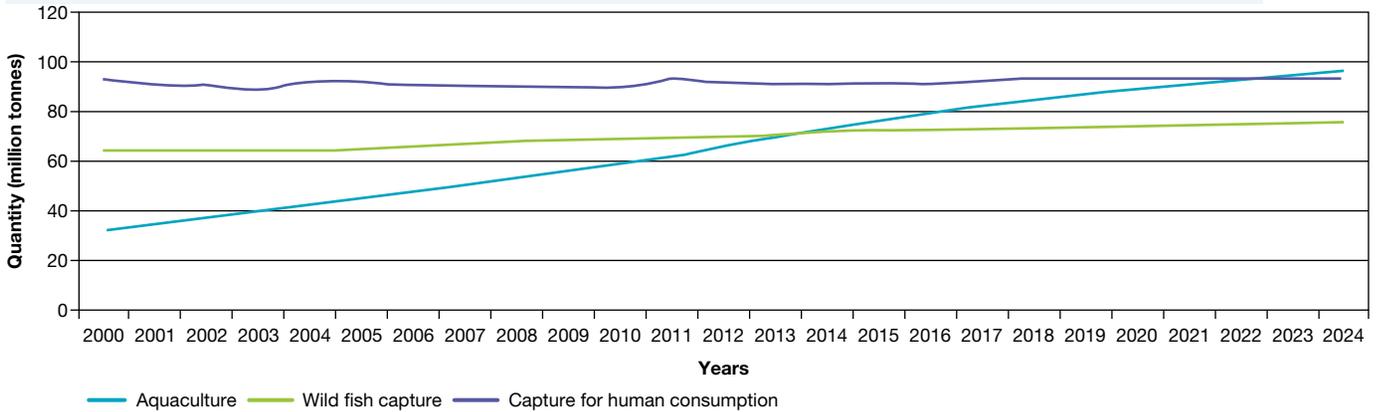
- More than 30 airlines are refusing to carry fins as cargo and 15 international hotel chains have dropped the soup from their menus.
- While finning is banned in Australia, it is legal to import, sell and export the fins. Eighteen thousand kilograms were imported in 2015, mostly from New Zealand, Hong Kong, China and the Philippines.
- Shark fishing is legal in India, but the export of fins is banned. Fishermen in coastal India are reliant on shark meat as a low cost protein source. The export of fins brings in much needed money, and fishermen argue that since shark populations have not changed in recent years, the export ban should be lifted.
- Palau, a small country of 22,000 people located 800 kilometres east of the Philippines has become the first nation to ban the fishing of sharks and create a shark sanctuary in its surrounding waters. Economically, more can be gained from the tourism industry, particularly scuba diving, than harvesting sharks for meat and fins.
- Mexico, Honduras, the Maldives and other Pacific countries are also in the process of establishing or have already established protected areas for sharks.

4.6.4 Is fish farming the solution?

Aquaculture is one of the fastest growing food industries, providing fish for domestic and export markets. It brings economic benefits and increased food security (see figure 6).

Over 50 per cent of fish consumed by people comes from aquaculture. This is predicted to rise to 60 per cent by 2030. While aquaculture is often seen as a sustainable and eco-friendly solution to overfishing, its rapid growth and poor management in many places has created large-scale environmental change. Some of these changes are described on the next page.

FIGURE 6 Aquaculture and wild fish capture, 2000–2024



- *Pollution.* Many fish species are fed a diet of artificial food in dry pellets (see figure 7). Chemicals in the feed, and the massive waste generated by fish farms, can pollute the surrounding waters.
- *Loss of fish stock.* Food pellets are usually made of fish meal and oils. Much of this comes from by-catch, but the issue is still that we are catching fish to feed fish. It can take 2 to 5 kilograms of wild fish to produce one kilogram of farmed salmon. Other ingredients in the food pellets include soybeans and peanut meal — products that are suitable for human consumption and grown on valuable farmland.
- *Loss of biodiversity.* Many of the fish species farmed are selectively bred to improve growth rates. If accidentally released into the wild, they can breed with native species and so change their genetic makeup. This can lead to a loss of biodiversity. Capture of small ocean fish, such as anchovies, depletes food for wild fish and creates an imbalance in the food chain.
- *Loss of wetlands.* Possibly the greatest impact of aquaculture is in the loss of valuable coastal wetlands. In Asia, over 400 000 hectares of mangroves have been converted into shrimp farms. Coastal wetlands provide important ecological functions, such as protecting the shoreline from erosion and providing breeding grounds for native fish.

FIGURE 7 Feeding fish in pens, Thailand



4.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 2. How important is fish as a source of protein compared with other sources? Use figures in your answer.
2. (a) What is by-catch?
(b) Examine closely the photograph in figure 3, and describe the by-catch that you see.

3. Refer to figure 6. With the use of figures, compare the predicted growth of wild capture and aquaculture production to 2024.
4. Suggest one reason why wild capture will not increase greatly in the future.
5. Refer to figure 5. Who are the three major exporters of shark fins to Hong Kong? Use figures in your answer.

Explain

6. Explain how overfishing can lead to a loss of biodiversity.
7. (a) What other food items are you aware of that are regarded as status symbols in different cultures?
(Hint: Consider luxury items.)
(b) How do you think food items become status symbols in a culture?

Discover

8. Investigate and write a newspaper article on the collapse of the Atlantic cod in Newfoundland. What lessons in the **sustainability** of fishing can be learned from the case of the Atlantic cod?
9. Collect photographs and other information to create an annotated poster showing one of the destructive fishing practices mentioned above.

Predict

10. What do you think the future of aquaculture might be?

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 Try out this interactivity: Hook, line and sinker (int-3324)

4.7 SkillBuilder: Interpreting a geographical cartoon

online only

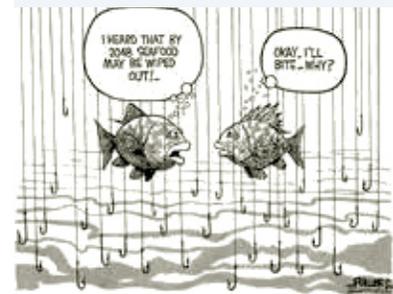
WHAT ARE GEOGRAPHICAL CARTOONS?

Geographical cartoons are humorous or satirical drawings on topical geographical issues, social trends and events. A cartoon conveys the artist's perspective on a topic, generally simplifying the issue.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Cartoon on overfishing



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 Watch this eLesson: Interpreting a geographical cartoon (eles-1731)

 Try out this interactivity: Interpreting a geographical cartoon (int-3349)

4.8 How do we lose land?

4.8.1 What is land degradation?

Land is one of our most basic resources and one that is often overlooked. In our quest to produce as much as possible from the same area of land, we have often failed to manage it sustainably. Land degradation is the result of such poor management.

Land degradation is a decline in the quality of the land to the point where it is no longer productive. Land degradation covers such things as soil **erosion**, invasive plants and animals, **salinity** and desertification. Degraded land is less able to produce crops, feed animals or renew native vegetation. There is also a loss in soil fertility because the top layers, rich in **humus**, can be easily eroded by wind or water. In Australia, it can take up to 1000 years to produce just three centimetres of soil, which can be lost in minutes in a dust storm.

Globally, degradation has caused the loss of more than 350 million square kilometres of the Earth's surface. In Australia, of the five million square kilometres of land used for agriculture, more than half has been affected by, or is in danger of, degradation.

4.8.2 What are the causes of land degradation?

Land degradation is common to both the developed and developing world, and results from both human and natural causes.

Human causes

Human causes of land degradation involve unsustainable land management practices, such as:

- land clearance — deforestation or excessive clearing of protective vegetation cover
- overgrazing of animals — plants are eaten down or totally removed, exposing bare soil, and hard-hoofed animals such as cows and sheep compact the soil (see figure 1)
- excessive irrigation — can cause watertables to rise, bringing naturally occurring salts to the surface, which pollute the soil
- introduction of exotic species — animals such as rabbits and plants such as blackberries become the dominant species
- decline in soil fertility — caused by continual planting of a single crop over a large area, a practice known as monoculture
- farming on marginal land — takes place on areas such as steep slopes, which are unsuited to ordinary farming methods.

FIGURE 1 Soil erosion as a result of overgrazing in Australia



Biophysical causes

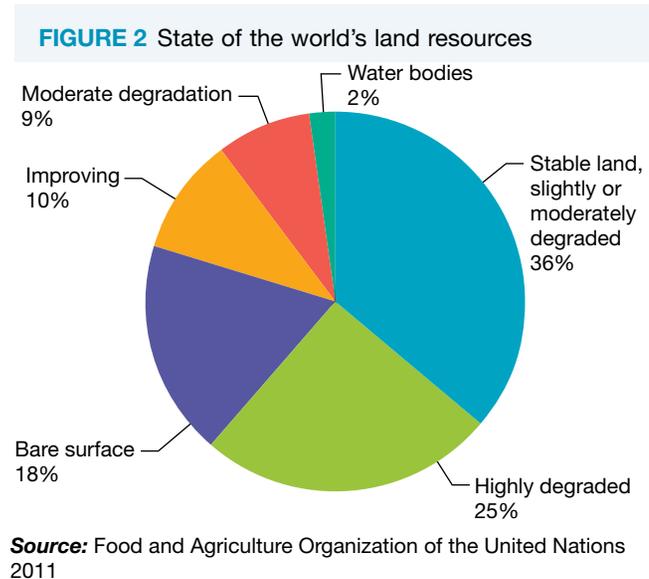
Natural processes such as prolonged drought can also lead to land degradation. However, land can sometimes recover after a drought period. Topography and the degree of slope can also influence soil erosion. A steep slope is more prone to erosion than flat land.

4.8.3 What are the impacts of land degradation?

As land becomes degraded, productivity, or the amount of food it can produce, is lost. Some countries in Sub-Saharan Africa have lost up to 40 per cent productivity in croplands over two decades, while population has doubled in the same time period. Farmers may choose to abandon the land, try to restore the land or, if the pressure to produce food is too great, they may have no choice but to continue using the land. Unproductive land will be exposed to continual erosion or weed invasion.

If extra fertilisers are applied to try to improve fertility, the excessive nutrients can create pollution and algae build-up in nearby streams. Airborne dust creates further hazards for both people and air travel. Land degradation is a classic example of human impact on all spheres of the environment — atmosphere, biosphere, lithosphere and hydrosphere.

Figure 2 shows the total amount of land across the Earth's surface (not just farmland) and the extent of land degradation. About 40 per cent of degraded lands are found in places that experience widespread poverty, which is a contributing factor to food insecurity. Poor farmers with degraded land and few resources often have little choice but to continue to work the land.



4.8.4 Are we turning drylands into deserts?

Desertification is an extreme form of land degradation. It usually occurs in semi-arid regions of the world, and the result gives the appearance of spreading deserts. Desert biomes, or arid regions, are harsh, dry environments where few people live. In contrast, semi-arid regions, or drylands, occupy 41 per cent of the Earth's surface and support over two billion people, 90 per cent of whom live in developing nations. While traditional grazing and cropping has taken place in dryland regions for centuries, population growth and the demand for food has put enormous pressure on land resources. Overclearing of vegetation, overgrazing and overcultivation are a recipe for desertification.

4.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. List two human and two natural causes of land degradation.
2. Refer to figure 2. What percentage of the world's land resources are classified as moderately to highly degraded?
3. Which biome supports more life: desert or drylands? Why?

Explain

4. Create an annotated sketch to show the **interconnection** between plants and soil. Use the following points as labels on your sketch.
 - Plant roots help hold soil together.
 - Decomposing plants add nutrients to the soil.
 - Plants shade the topsoil and reduce evaporation.
 - Plants reduce the speed of wind passing over the ground.

5. Explain how land degraded by drought may recover, whereas land degraded by cultivation may not.
6. Study the photograph in figure 1. Why would it be difficult to either graze animals or grow crops on this land?

Discover

7. Investigate an area in Victoria that is suffering from land degradation. Identify the location, causes and impacts of the degradation. Are any steps being taken to reduce the impacts?

Think

8. Examine the photograph in figure 1 again. If this was your property and your livelihood, what steps would you take to reduce the erosion problem?

learn on RESOURCES – ONLINE ONLY

 Try out this interactivity: Losing land (int-3325)

4.9 Irrigation: success or failure?

4.9.1 What is the purpose of irrigation?

Food production and security is directly related to water availability. As population increases, so too does demand for water. Moreover, there are always competing demands for water from the domestic, industrial and environmental sectors. In many places in the world, water is becoming increasingly scarce. Consequently, the development of water resources is becoming more expensive and, in some cases, environmentally destructive.

Most of the world's food production is rain-fed; that is, dependent on naturally occurring rainfall. Only a small proportion of agricultural land is irrigated, yet **irrigation** is now the biggest user of water in the world, consuming 70 per cent of the world's freshwater resources. Irrigation brings many benefits, such as:

- supplementing or replacing rain, especially in places where rainfall is low or unreliable. In many parts of the world, it is not possible to produce food without irrigation.
- increasing crop yields, up to three times higher than rain-fed crops. Only 20 per cent of the world's farmland is irrigated but it produces over 40 per cent of our food.
- enabling a wide variety of foods to be grown, especially those with high water needs, such as rice, or with high value, such as fruit and wine grapes
- flexibility, being used at different times according to crop needs; for example, during planting and growing or close to harvest time.



FIGURE 1 Irrigation allows for pasture to be grown in times of drought. Compare the irrigated with the non-irrigated paddocks.

4.9.2 What are the impacts of irrigation on the environment?

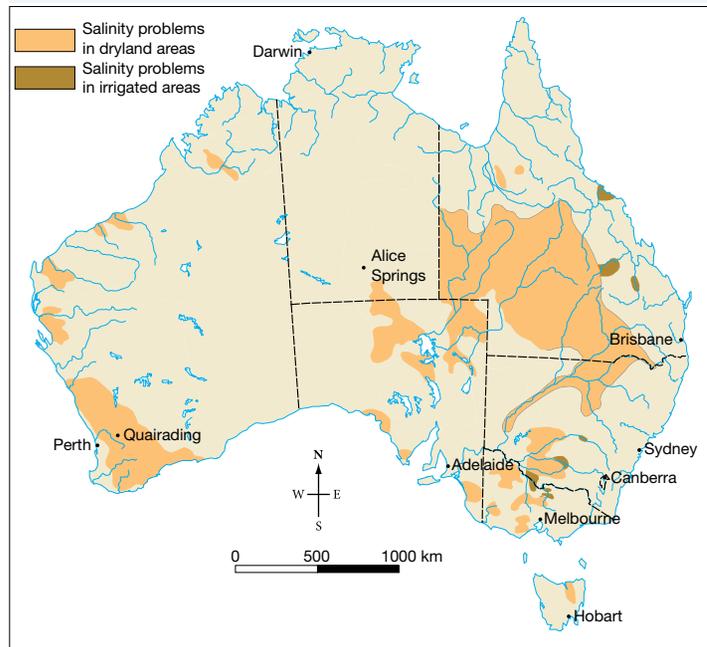
The benefits of irrigation have resulted in increased food production and greater food security. But irrigation has created major changes to the biomes where it is used. Irrigation changes the natural environment by extracting water from rivers and lakes and building structures to store, transfer and dispose of water. The topography or shape of the land is often changed too, as occurs when terraces are built for paddy fields. In addition, irrigation water is often applied to the land in much larger quantities than naturally occurs, which can then change soil composition and cause **waterlogging** and salinity problems.

How does irrigation create salinity problems?

On irrigated land, salinity is the major cause of land being lost to production, which is an area the size of France or 62 million hectares of lost productive land worldwide. It is also a major cause of land degradation in Australia (see figure 2).

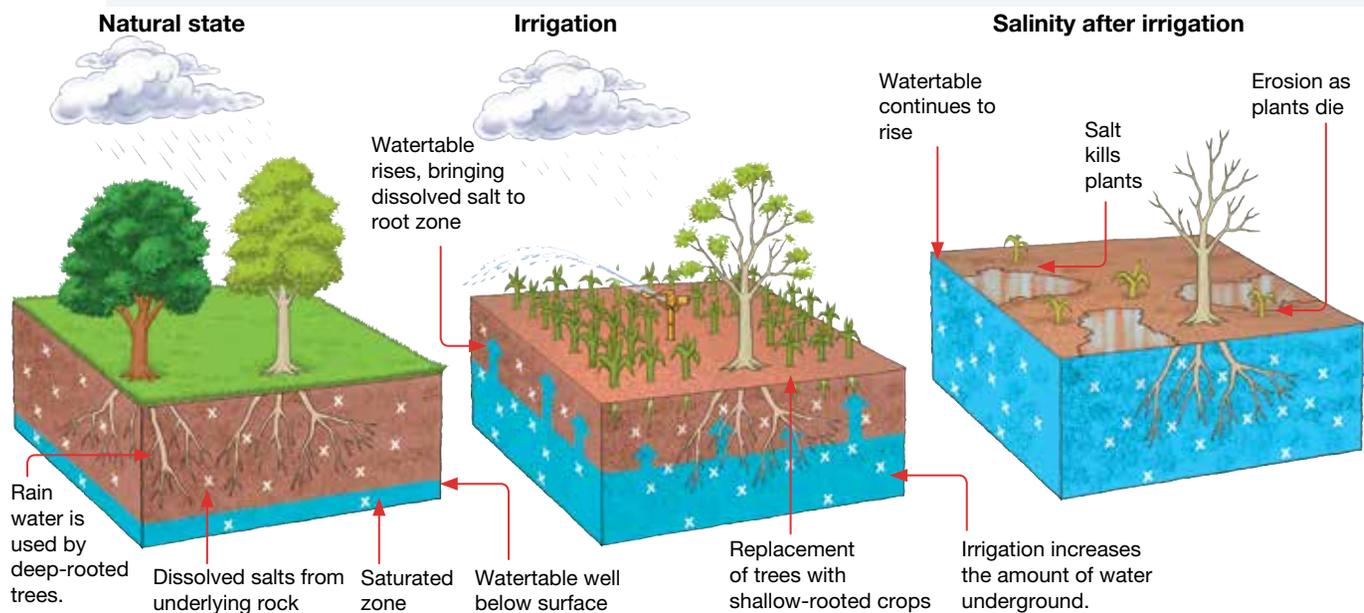
Overwatering of shallow-rooted crops adds excess water to the **water table**, causing it to rise (see figure 3). If the subsoils are naturally salty, much of this salt can be drawn to the surface. Most crops and pasture will not grow in salty soils, so the land becomes useless for farming. Land that is affected by salinity is also more prone to wind and water erosion.

FIGURE 2 The distribution of salinity in Australia



Source: Spatial Vision.

FIGURE 3 The development of irrigation salinity



4.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is meant by the term *waterlogging*?
2. What percentage of the world's fresh water is consumed by irrigation? What would be the other main uses of water?

Explain

3. (a) Study the map in figure 2, showing the distribution of salinity in Australia. Estimate the approximate percentage of each state affected by salinity.
(b) Why do you think dryland salinity covers a larger area than irrigation salinity?
4. Use figure 3 as a model and create a similar sketch. Annotate your drawing with suggestions on how to reduce the effects of irrigation salinity.
5. What **changes** to the **environment** are needed in order to irrigate a large region?

Discover

6. Investigate methods used in Australia to reduce the **environmental** effects of salinity.

Think

7. Soil salinity was not a problem when Indigenous Australian peoples were the land's sole caretakers. What does this suggest about land management practices in this country since 1788?
8. Has irrigation been a success or failure? Write a paragraph expressing your viewpoint.

4.10 Does farming use too much water?

online only

Access this subtopic at www.jacplus.com.au

4.11 Why is global biodiversity diminishing?

4.11.1 The loss of biodiversity

The last few centuries have seen the greatest rate of species extinction in the history of the planet (see figure 1). The population of most species is decreasing, and genetic diversity is declining, especially among species that are cultivated for human use. Six of the world's most important land biomes have now had more than 50 per cent of their area converted to agriculture (see figure 2).

In those places where there has been very little industrial-scale farming, a huge variety of crops are still grown. In Peru, for example, over 3000 different potatoes are still cultivated. Elsewhere, biodiversity as well as agricultural biodiversity (biodiversity that is specifically related to food items) is in decline. In Europe, 50 per cent of all breeds of domestic animals have become extinct, and in the United States, 6000 of the original 7000 varieties of apple no longer exist. How has this happened?

- Industrial-scale farming and new high-yielding, genetically uniform crops replace thousands of different traditional species. Two new rice varieties in the Philippines account for 98 per cent of cropland.
- Converting natural habitats to cropland and other uses replaces systems that are rich in biodiversity with monoculture systems that are poor in diversity (see figure 3).
- Industrial-scale farming and new high-yielding, genetically uniform crops replace thousands of different traditional species. Two new rice varieties in the Philippines account for 98 per cent of cropland.

FIGURE 1 Extinctions per thousand species per millennium

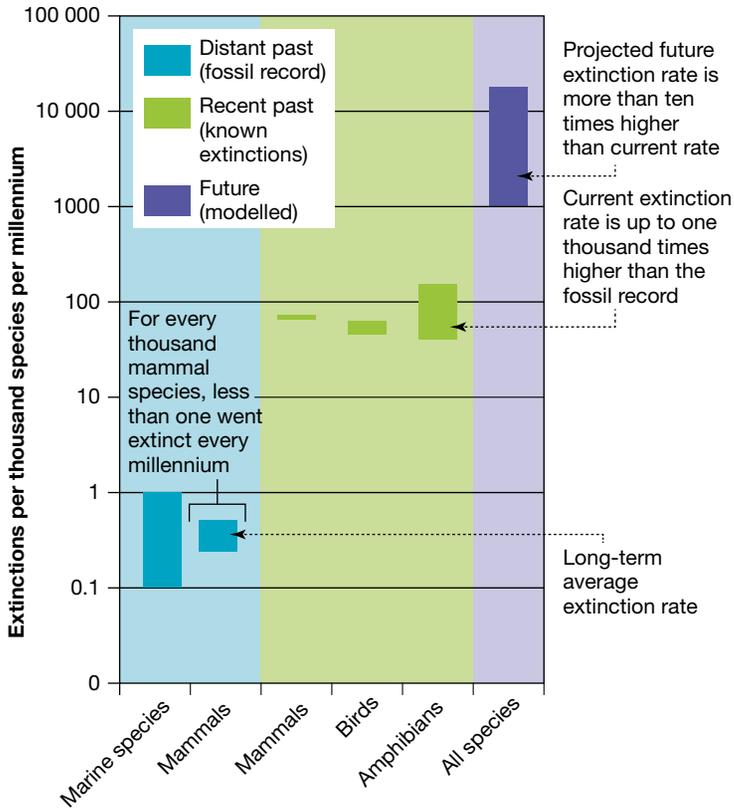


FIGURE 2 Percentage of biomes converted to agriculture over time

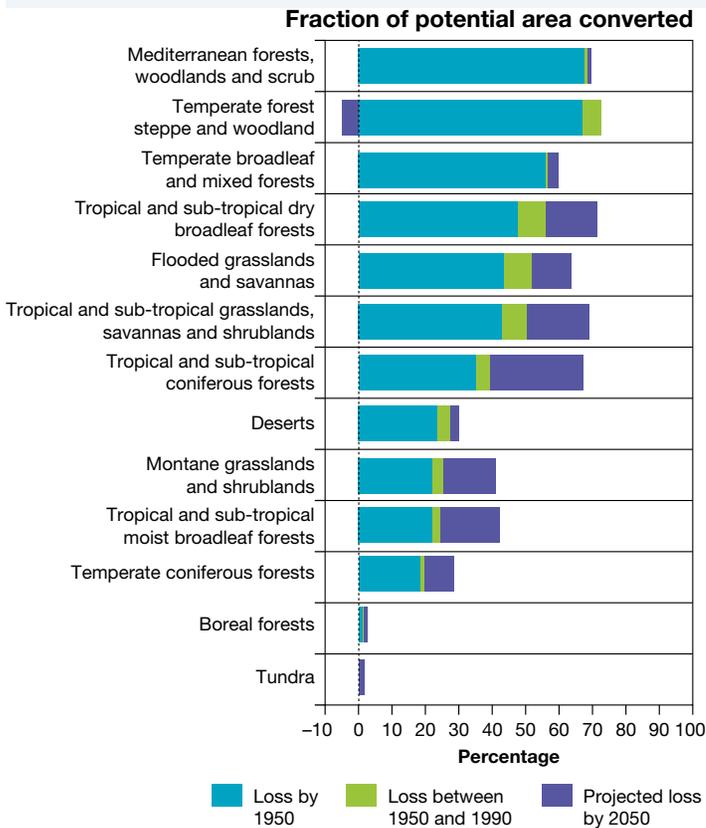
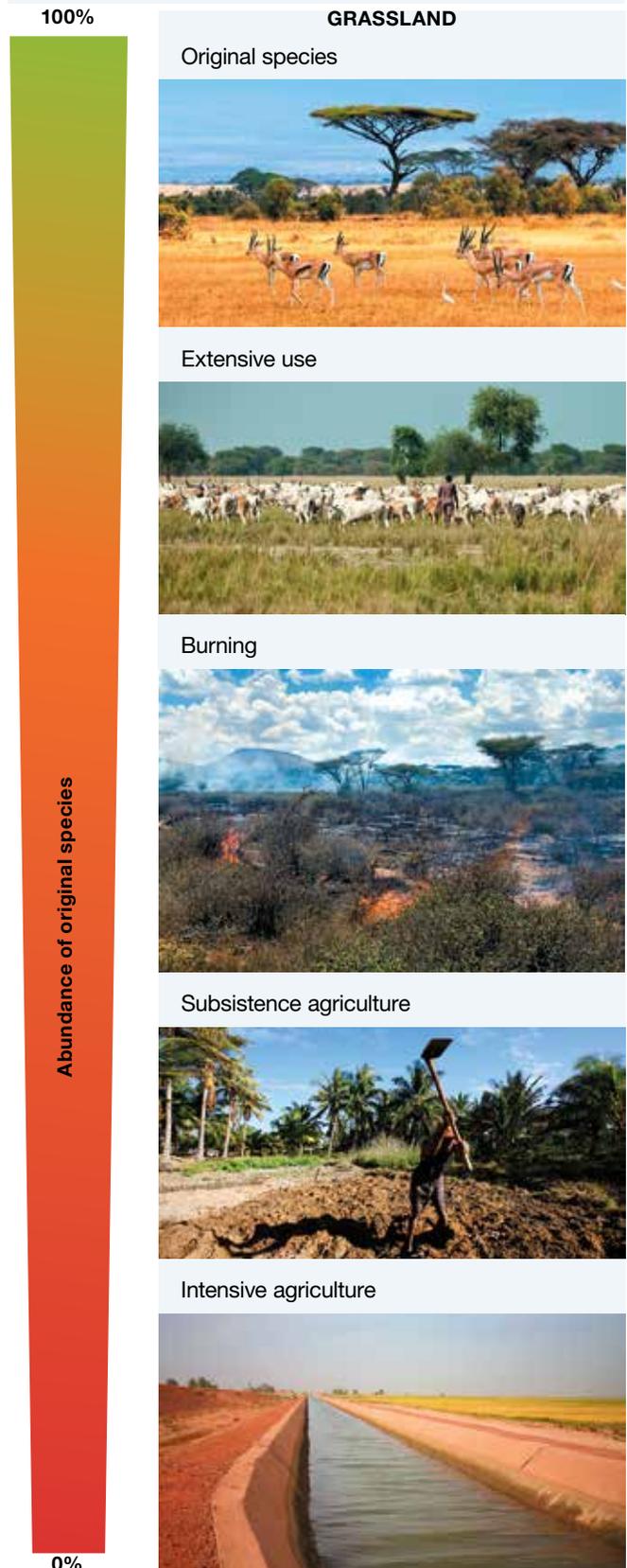


FIGURE 3 Changes to percentage of original species according to changes in biomes for food production

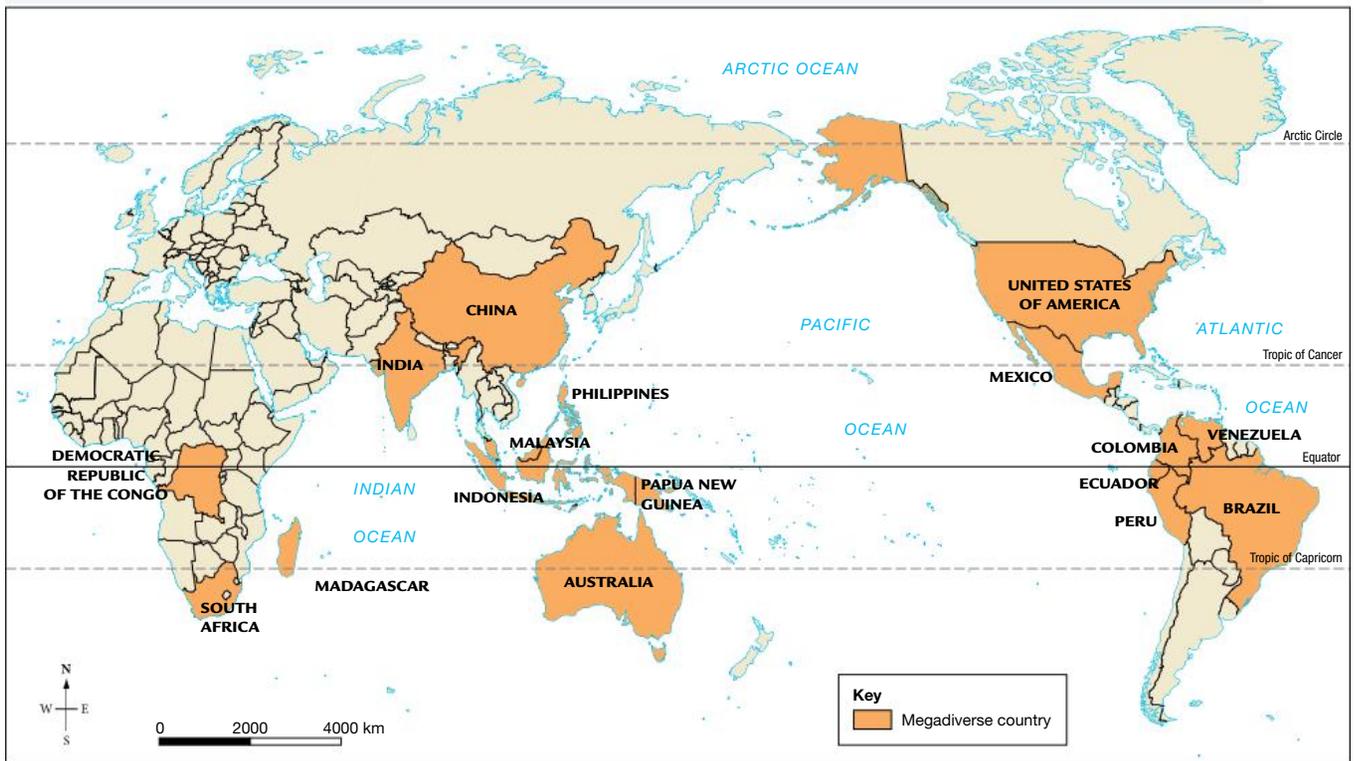


- Uniform crops are vulnerable to pests and diseases, which then require large inputs of chemicals that ultimately pollute the soil and water. Traditional ecosystems have many natural enemies to combat pest species.
- The introduction of modern breeds of animals has displaced indigenous breeds. In the space of 30 years, India has lost 50 per cent of its native goat breeds, 30 per cent of sheep breeds and 20 per cent of indigenous cattle breeds.

4.11.2 Australia's biodiversity

Australia has a high number of **endemic** species, and 7 per cent of the world's total species of plants, animals and micro-organisms. That makes Australia one of only 17 countries in the world that are classified as megadiverse — having high levels of biodiversity. These 17 nations combined contain 75 per cent of the Earth's total biodiversity (see figure 4). Australia's unique biodiversity is due to its 140 million years of geographic isolation. However, Australia has experienced the largest documented decline in biodiversity of any continent over the past 200 years. It is thought that 50 species of animals (27 mammal species and 23 bird species) and 48 plant species are now extinct.

FIGURE 4 Distribution of megadiverse countries



Source: Spatial Vision

4.11 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Describe the ways in which human activities can lead to a loss in biodiversity.
2. What is a megadiverse country? Why is Australia considered a megadiverse country?

Explain

3. (a) Study figure 2. Which three biomes have seen the greatest percentage **change** in areas converted to cultivation? Use figures in your answer.
(b) Suggest why these three have had the most **change**.
4. Study the information in figure 3. Describe the **changes** to the grassland biome as seen over time.

Think

5. In what ways would the Indigenous Australian peoples' practice of rotational land occupation have helped maintain biodiversity before European occupation?
6. Does it matter that we have fewer species of apples or goats?

4.12 Does farming cause global warming?

Access this subtopic at www.jacplus.com.au



4.13 Review



4.13.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

4.13.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

4.4 SkillBuilder: GIS – deconstructing a map

4.4.1 Tell me

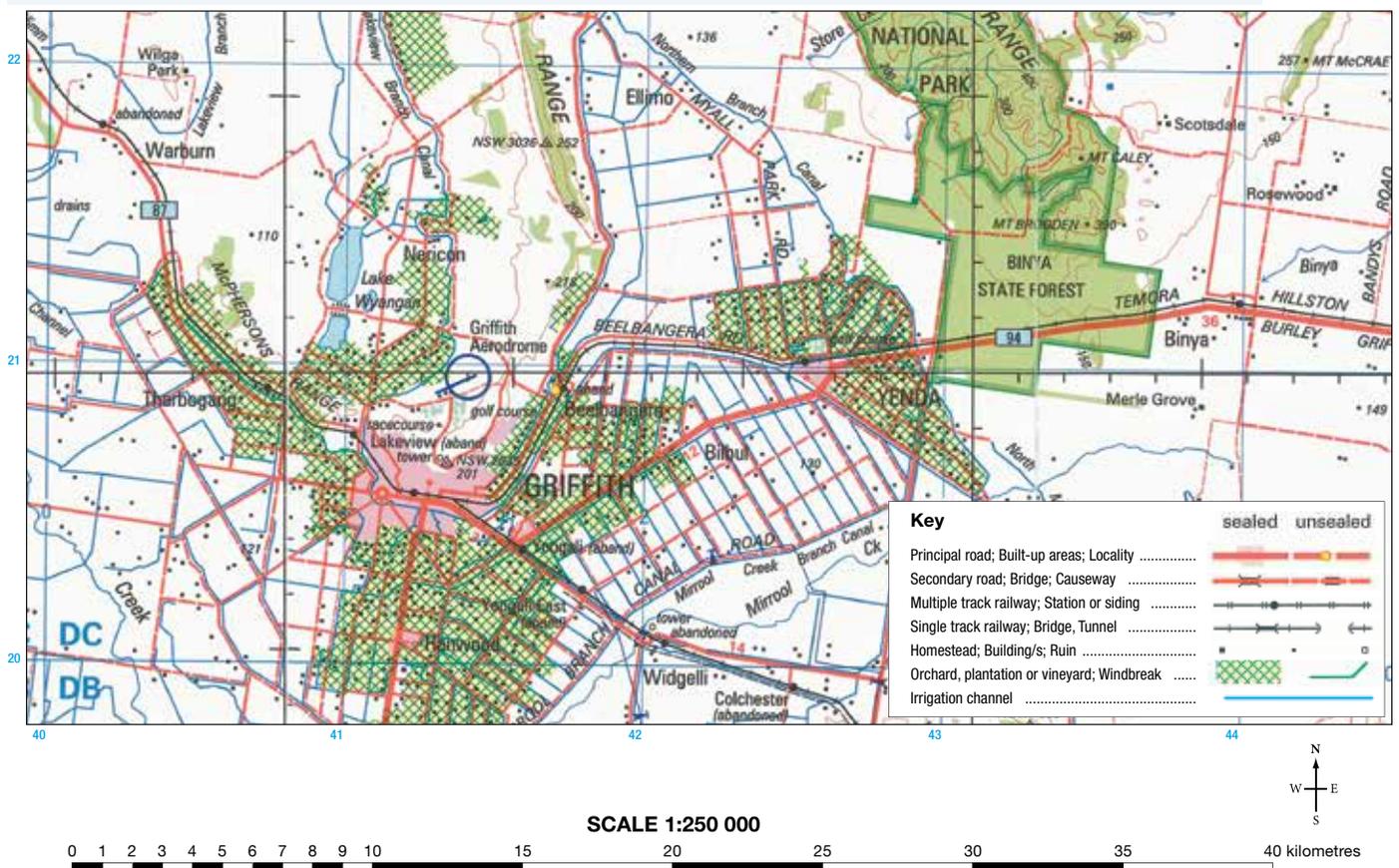
What is GIS?

A geographical information system (GIS) is a storage system for information or data, which is stored as numbers, words or pictures. The data has the location attached so that it may be viewed as a map or as an image. GIS can process huge amounts of information to produce maps that would take a long time to draw by hand. Specialised computer programs produce maps from the data.

In this SkillBuilder, map layers will be created in a similar way to that used by cartographers and GIS specialists when making digital maps, but with much simpler tools and processes.

Model

FIGURE 1 Example of a section of a topographic map



Source: Geoscience Australia

Why is GIS useful?

Analysing large amounts of information using a computer is much faster than doing it manually, and provides a much deeper understanding of the information. GIS allows multiple series of information to be displayed in a succession of map layers. The spatial distribution of the data and the relationship to other data may be compared. GIS is used in many professions wherever maps are required, such as in urban planning, logistics, resource management, the police force and public health.

FIGURE 2 Example of a satellite image (called a raster image in GIS). This shows a section of the area that appears in figure 1.



Source: © Geoscience Australia

A GIS stores data in three ways: as points, lines or polygons (called vector data); as tables (called tabular data); and as pixels in an image (called raster data). A satellite image, for example, would be called a raster image in GIS. A GIS program:

- stores similar information together
- stores data attached to points, lines and polygons in separate files
- stores the location of each point, line or polygon digitally
- includes tables of data in which each row is linked to a location and each column stores information as numbers or words
- includes information about the source of the data — known as metadata.

A breakdown of maps such as a GIS:

- traces each set of point, line and polygon data onto three pieces of tracing paper
- uses appropriate colours for the features
- layers the features, with points on top, lines underneath and polygons on the bottom
- includes BOLTSS.

4.4.2 Show me

How to deconstruct maps to build a simple GIS

You will need:

- a topographic map
- three pieces of tracing paper
- coloured pencils.

Procedure

STEP 1

Point features on the map have a location that may be defined using either a grid reference or latitude and longitude. The map of Griffith shown in figure 1 (doc-11566 in the Resources tab) has many point features, such as spot elevation (height), bores, wells, buildings, gates and stock grids.

Overlay one piece of tracing paper on the topographic map and, using an appropriate colour, mark the homesteads (point data) on the tracing paper.

FIGURE 3 Point features marked on first layer of tracing paper

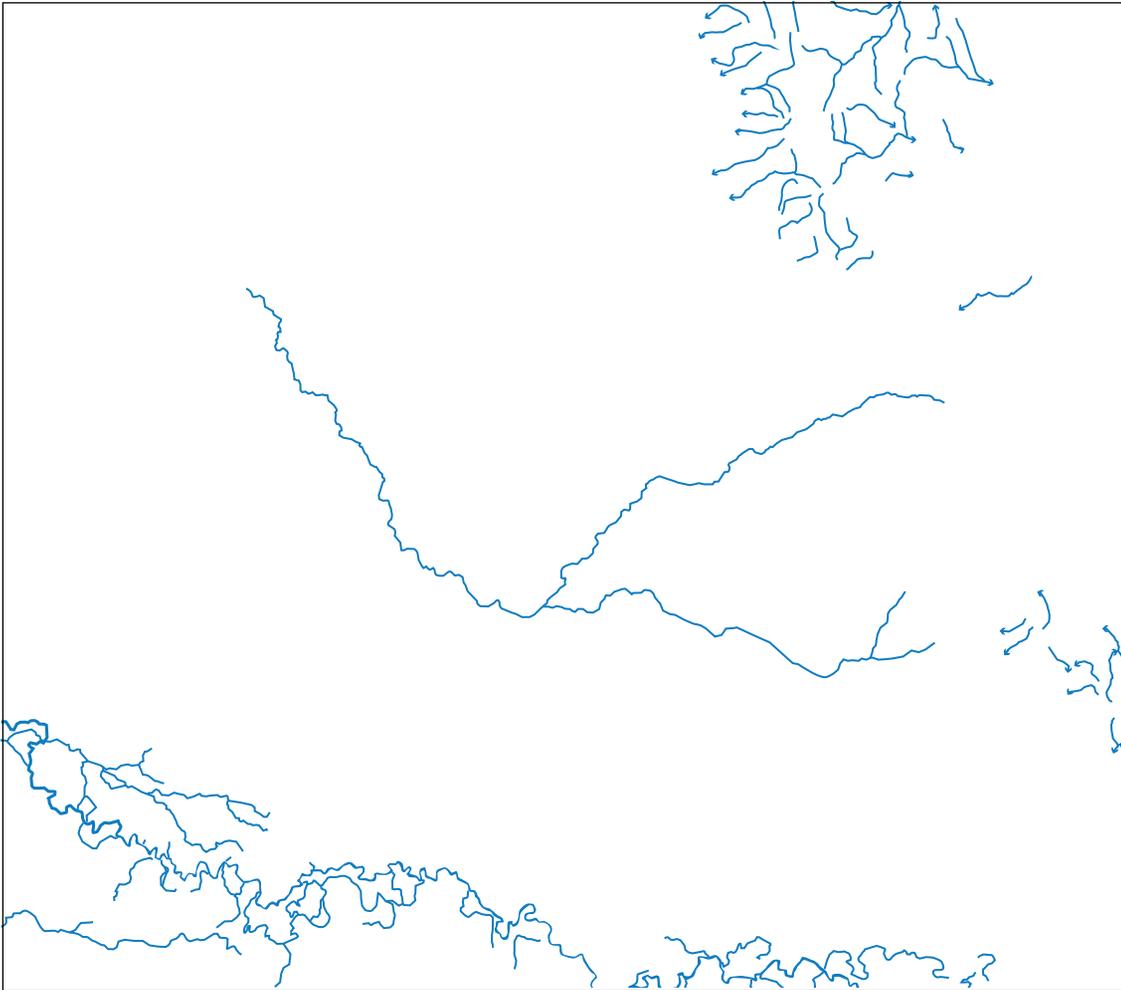


STEP 2

Line features on the map may be straight or winding. Their location is determined by joining multiple points. Figure 1 has many line features, such as roads, railway lines, rivers and creeks, irrigation channels and power lines.

Overlay a second piece of tracing paper on the topographic map and, with an appropriate colour, trace the rivers and creeks (line features).

FIGURE 4 Line features of rivers and creeks are traced onto a second piece of tracing paper.



STEP 3

A polygon is a shape that has many sides. Its location on the map is determined by joining multiple points. Figure 1 has many polygon features, such as orchards, vineyards, national parks, lagoons, swamps and forested areas.

Overlay a third piece of tracing paper on the topographic map and, with an appropriate colour, trace the forests (polygon data).

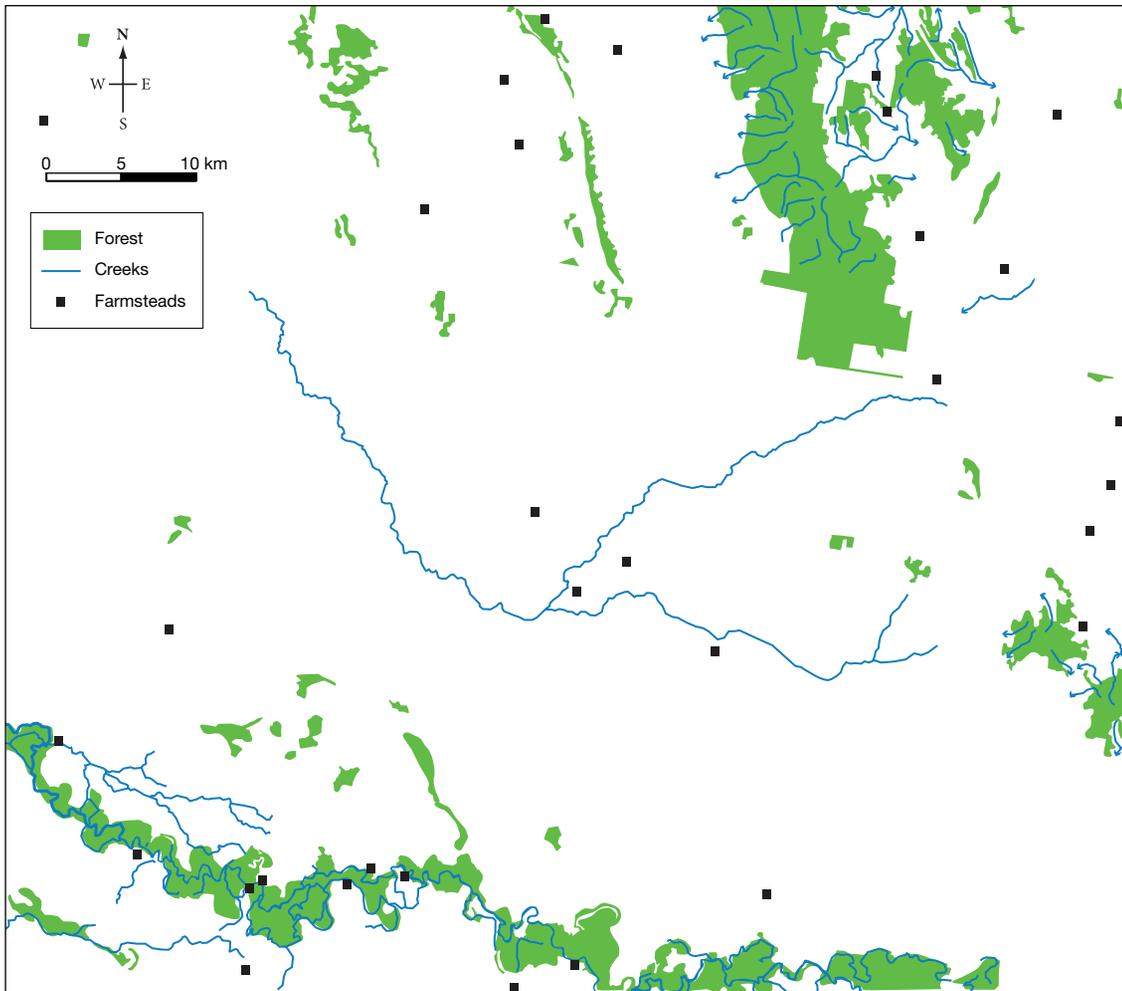
FIGURE 5 The polygon data of forests are traced onto a third piece of tracing paper.



STEP 4

Place the three tracing paper layers in the following order: point features on top, line features underneath, and polygon features at the bottom. Provide BOLTSS for your map. In GIS, the finished map would be called a layout.

FIGURE 6 The three layers of tracing paper are now combined, and BOLTSS is added.



4.4.3 Let me do it

Developing my skills

Use the figure 1 map of Griffith again. Choose one point feature, one line feature and one polygon feature and create three tracing paper overlays. Organise the layers appropriately and add BOLTSS to your map.

Questions

1. What is the name of the district through which the Murrumbidgee River flows?
2. The original biome for this area is likely to have been forest. What has happened to this biome and how would you describe the distribution of forest in the area today?
3. Compare the number of creeks in the map in figure 1 with the number of channels. What is the purpose of the many channels and canals?
4. Figure 1 shows a part of Australia that has undergone change. Using Google Earth and the map, identify the area where there has been the least change and the area where there has been the most change. Explain your choice.
5. This area is an example of intensive farming. What does this mean? Provide at least one piece of evidence from both the map in figure 1 and the satellite image in figure 2 (or Google Earth) to support this statement.
6. Maps and satellite photographs show different ways of recording information. Identify two pieces of information visible in figure 2 (or Google Earth) that are not shown on the figure 1 map.

Checklist

I have:

- traced each set of point, line and polygon data onto three pieces of tracing paper
- used appropriate colours for the features
- layered the features, with points on top, lines underneath and polygons on the bottom
- included BOLTSS.

Skills questions

1. True or false? A GIS stores three sorts of data: vector, raster and tabular data.
2. To view information in a GIS, it is best to place the layers in the following order:
 - (a) lines above points, with polygons below
 - (b) polygons above lines, with points below
 - (c) points above lines, with polygons below
 - (d) points above polygons, with lines below.
3. Which statement about GIS is false?
 - (a) Placing the information in layers helps to compare the distribution of features.
 - (b) Raster images store data in tables.
 - (c) GIS is a way to view and analyse data that is spatial in nature.
 - (d) A GPS may be used to collect data for a GIS.
4. What is metadata?

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-  **Watch this eLesson:** Deconstructing a map using GIS (eles-1730)
-  **Try out this interactivity:** Deconstructing a map using GIS (int-3348)
-  **Complete this digital doc:** Topographic map of Griffith, New South Wales (doc-11566)

4.5 Paper profits, global losses?

4.5.1 How do we use paper?

Look around you — how many different things can you see that are made out of paper? Paper is a renewable, recyclable material, and yet something so common and so useful also poses significant environmental consequences on biomes at all stages of its usage cycle.

Biomes enable us to produce the food we eat and they also supply many of the raw materials for manufacturing, such as minerals, ores and fibres. We are able to make cloth from cotton and wool using grassland biomes, while forest biomes give us wood for construction and **pulp** for making paper products. There are thousands of everyday items made from paper, ranging from toilet paper to disposable nappies, packaging, money, tickets and writing paper (see figure 1).

FIGURE 1 Different paper products



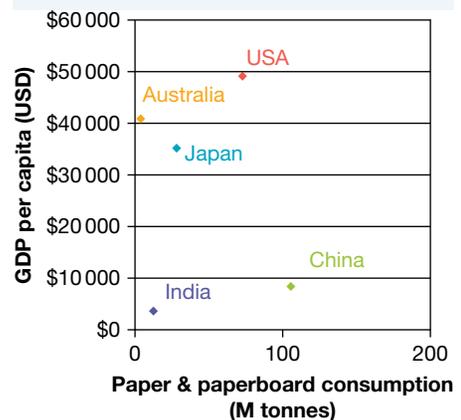
Traditionally, paper has provided us with the means to record ideas, news, knowledge and even works of art. Paper is interconnected with social development as it aids in literacy and communication. Despite the advent of modern electronic communication, plastic bags and the ‘paperless office’, paper still remains an essential part of our homes and workplaces.

4.5.2 Are we a paperless society?

We have become very dependent on paper products, but in the wealthier countries paper is generally discarded soon after purchase. Wrapping and packaging accounts for 54 per cent of the paper used today, followed by printing and writing (26 per cent), household and sanitary products (8 per cent) and newspapers (7 per cent). There is a strong interconnection between a country’s level of wealth and the amount of paper consumed, as shown in figure 2. While India has 17 per cent of the world’s population it only consumes 3 per cent of the world’s paper. Conversely, the United States has 55 per cent of the world’s population and consumes at least 30 per cent of the planet’s paper.

The global consumption of paper has increased by 400 per cent in the past 40 years. Today the world consumes 300 million tonnes of paper annually, and this is expected to rise as developing countries in Asia increase their consumption. China has now passed the United States as the largest consumer of paper products at 72 kilograms per person, compared to the global average of 57 kilograms per person.

FIGURE 2 GDP per capita and paper consumption for selected countries



With technological advancements, paper has now become a cheap, disposable product. This has resulted in a high level of both use and waste.

4.5.3 How does making and using paper affect biomes?

Pulp and paper production has been ranked as one of the most resource-intensive and highly polluting of all manufacturing industries. Besides wood fibre, the main inputs into the paper-making process are water, energy and chemicals needed for breaking down fibres and bleaching to create clean, white paper. The paper industry uses more water to produce one tonne of product than any other industry. It takes 10 litres of water to produce just one A4 sheet of paper.

Pulp and paper is the third largest industrial polluter of air, land and water in both Canada and the United States, releasing over 100 million kilograms of toxic waste each year. Paper's impact on biomes starts at the forest stage with the activity of logging the timber, and continues with the conversion of the timber to pulp and paper. Environmental impacts continue even after paper has been used and discarded. Today, more than 34 per cent of municipal waste in the United States is made up of paper and cardboard. As paper decomposes, it releases methane, a dangerous greenhouse gas. Figure 3 illustrates how biomes are affected by paper production.

FIGURE 3 Environmental consequences of paper production

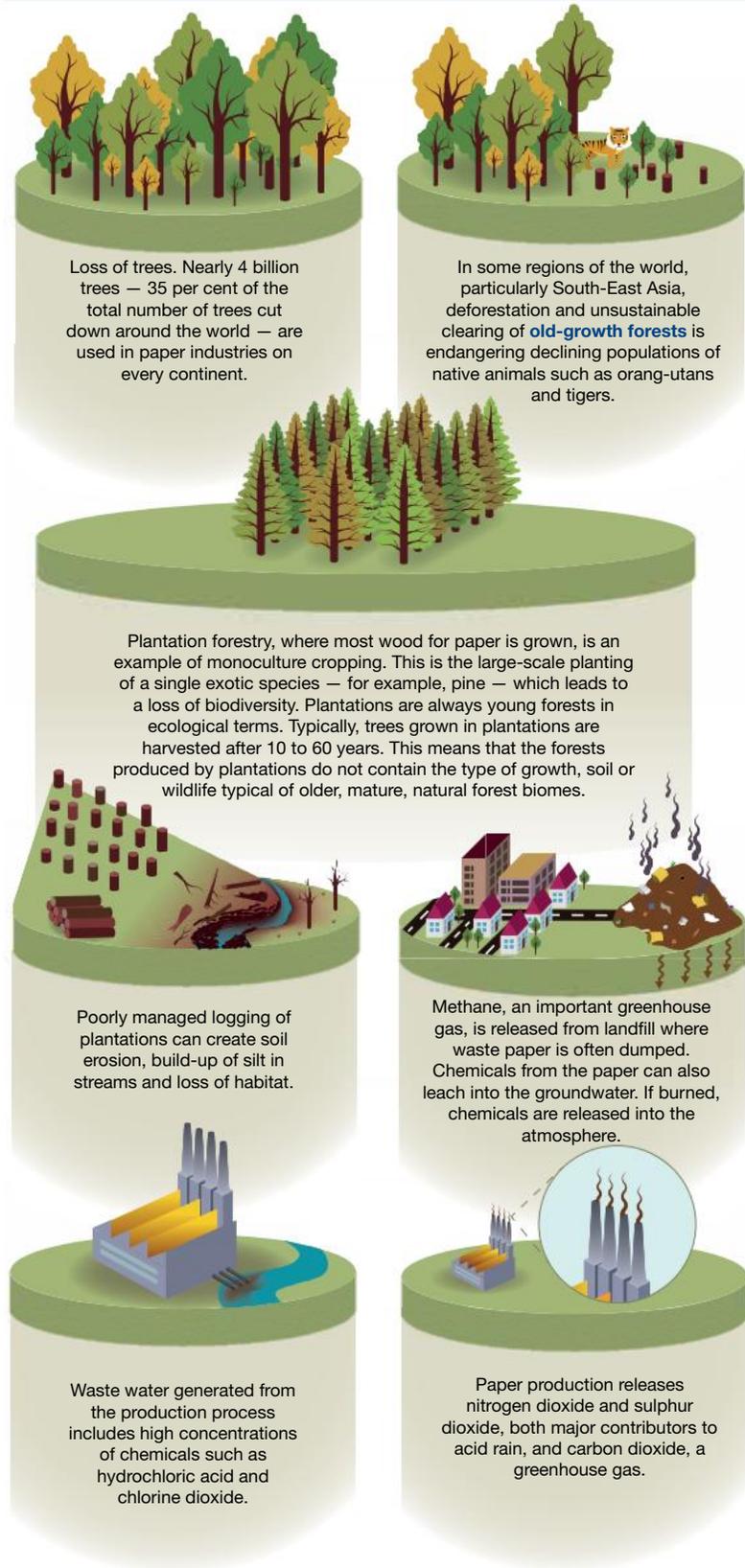


FIGURE 4 Environmental effects of harvesting plantation timber



4.5.4 Is there a sustainable future for paper?

There has been an increase in environmental awareness and government legislation in recent years — this is helping to make the paper industry and people’s use of paper more environmentally friendly, thus reducing the negative impacts on biomes. The Australian timber industry follows the Forest Code of Practice, which sets out rules and regulations regarding logging on slopes and protecting streams and habitat trees.

There has been considerable research conducted into the use of non-wood products, for example bamboo, sugarcane, hemp and **kenaf**, to provide fibre for paper. Currently, these non-wood products make up 5 to 10 per cent of the fibre used in paper-making globally.

In some places, tree plantations are able to grow on land that is unsuitable for other forms of agriculture or is badly degraded, in which case there is likely to be an *increase* in habitat and biodiversity.

For the paper industry, the goals are to reduce fuel and energy requirements and reduce emissions. China, with its relatively new paper industry, is leading the way in this field. For everyday citizens, it is about making sensible choices, and reducing our use of paper and recycling (see figure 5). Products made from recycled paper can include masking tape, hospital gowns, bandages, egg cartons and even lampshades. However, paper can be recycled only 5 to 7 times, after which the fibres become too short and weak to bond together.

FIGURE 5 Paper recycling factory



For every tonne of paper *not* consumed, the following savings are made:

- 18 trees
- 67 500 litres of water
- 9500 kilowatt hours of power
- 3300 kilograms of greenhouse gas emissions.

How can you and your classmates reduce your paper consumption?

4.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Construct a list of the ten most important paper items in your day-to-day life. How does your list compare with that of someone else in your class? Are there similarities and differences? Why is this?
2. (a) Refer to figure 2. Using the data, compare the differences between Australia and India in terms of GDP and paper consumption.
(b) What reasons can you give for any differences? Why is this?
3. Refer to figure 4. List the **environmental** effects of clearing a pine plantation that you can see in this photograph.

Explain

4. To what extent is there a link between a country's level of development and its consumption of paper? Note, you may wish to consult the World Statistics in your atlas.
5. What is *old-growth forest*? Why is it important to protect these types of biomes from being cleared?
6. How might the structure and biodiversity be different in an old-growth forest compared with a tree plantation?

Discover

7. Use the **Paper production** weblink in the Resources tab and study the interactive map. Create a list of some of the **environmental** concerns of paper production in Asia, Latin America and Russia.

Think

8. Is there such a thing as a paperless society? Do you think perhaps there might be in the future? Give your viewpoint.
9. Does your school have a paper recycling program? How effective do you think it is? How could it be improved?

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Explore more with this weblink: Paper production

4.7 SkillBuilder: Interpreting a geographical cartoon

4.7.1 Tell me

What are geographical cartoons?

Geographical cartoons are humorous or satirical drawings on topical geographical issues, social trends and events. A cartoon conveys the artist's perspective on a topic, generally simplifying the issue.

Why are cartoons useful?

Cartoons promote an interest in a topic or issue, and encourage discussion and debate. The cartoonist's message about a geographical topic is evident. Our feelings, attitudes and values are expressed in our response to the cartoon. Your response to geographical cartoons encourages discussion and evaluation of alternative responses as you take in other people's viewpoints and perspectives.

Cartoons are useful for:

- showing the key points of a geographical topic
- exaggerating the key points of an issue
- creating a response to an issue, whether in agreement or disagreement with the cartoonist
- presenting information, or an issue, or a viewpoint in an interesting way.

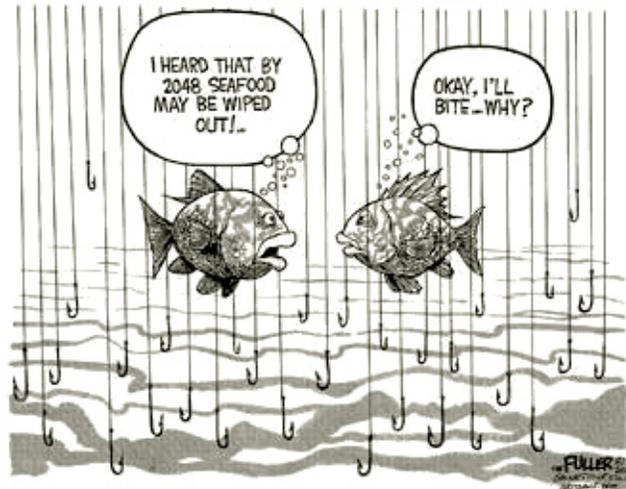
Model

The cartoon shown in figure 1 is about overfishing our oceans. The cartoonist suggests that by 2048 there will be no more fish left in the oceans. It is not clear why the cartoonist chose this date (2048; perhaps they randomly chose a date well into the future). The cartoon uses exaggeration, as there will be fish, but the quantities may not make it economical to fish using the techniques currently available. The string of hooks in this cartoon is also unrealistic, as this is not the way commercial fishing is undertaken. Our wider perspective on the topic tells us that actual fishing techniques are trawling and purse-seine netting to maximise the catch at any one time. The cartoon plays on the word *bite*. It can mean (a) that a fish bites a hook or (b) that someone reacts or responds to something. Thus, the second fish reacts to the first fish's statement and asks the question *why*, but it might also bite one of the many hooks that surround it. The answer to the *why* question is obvious to the viewer — the fish will be caught because it will be impossible to avoid capture. This cartoon makes us think about the issue of taking fish from the ocean, and it questions the sustainability of the fishing industry: too many people are fishing for a limited resource.

A good interpretation of a cartoon:

- recognises the issue
- analyses the components of the cartoon
- identifies the cartoonist's personal opinion or message
- states your personal response to the geographical topic.

FIGURE 1 Cartoon on overfishing



4.7.2 Show me

How to interpret a cartoon

You will need:

- a geographical cartoon.

Procedure:

STEP 1

Take the time to study the cartoon and carefully look for the overall idea. Next, focus on the artistic work of the cartoonist and any subtleties that have been included. Consider different relative sizes of parts of the drawing, as well as any wording or attitudes expressed in the image. Figure 1 is about overfishing our oceans. In this case, the subtleties are in the words of the fish — what are the fish really saying?

STEP 2

Consider the overarching issue; in this case, overfishing. What is your general knowledge on the topic? In Geography classes, when you are given a cartoon, you know that it relates to the topic you are studying. If you are viewing a cartoon from elsewhere, then you have to think through the issue being portrayed. Things to look for in a cartoon include the following.

- Symbolism — conveying ideas in a concise manner through the use of symbols. In figure 1, the large number of hooks suggests too much fishing.
- Stereotyping — our fixed mental picture of something. In figure 1, the fish are drawn in a stereotypical way. Be wary of stereotyping in a cartoon that involves people.
- Caricatures — overemphasis or distortion of physical features. In figure 1, the fish have large eyes and mouths to draw our attention to their conversation and to give them human qualities.
- Visual metaphors — the artist's means of helping us understand the topic. In figure 1, the large number of hooks and the use of the word *bite* suggest the fish will be caught.
- Exaggeration or distortion — for example, making things appear larger, smaller or greater in number than they really are. The number of fishing hooks is an exaggeration or distortion of commercial fishing techniques.
- Humour — the use of visual or verbal jokes or wit to make the viewer smile or laugh. Irony and satire are commonly used.
- Perspective — the point of view of the cartoonist. In figure 1, it is evident that the cartoonist believes that most fish will be gone by 2048, a date well into the future.
- Captions — text-based content that adds to the visual content. In figure 1, both of the fish have speech bubbles in which they discuss the sustainability of the fishing industry. (A speech bubble usually has a pointed end, like this , but because they are fish and cannot actually talk, the cartoonist has used 'thought bubbles', like this .)

STEP 3

Now systematically approach an analysis of the cartoon. Answer the following three questions.

- What issue does the cartoon convey? In figure 1, the issue is overfishing.
- What geographical concepts are related to the issue in the cartoon? In figure 1, the concepts of environment (the ocean), space (global), change (commercial fishing causing a decline in fish numbers), scale (global), interconnection (fishing techniques and human demand decreasing fish resources) and sustainability (the future) can be mentioned.
- What are the geographical implications of the cartoon? The cartoon in figure 1 implies that the future of the fishing industry could be at risk.

STEP 4

Complete your writing with a concluding statement on how you feel about the topic of the cartoon. The text below figure 1 states that ‘This cartoon makes us think about the issue of taking fish from the ocean, and it questions the sustainability of the fishing industry: too many people are fishing for a limited resource’.

4.7.3 Let me do it

Developing my skills

Using the cartoon in figure 2 in subtopic 4.6 of your textbook, write a paragraph analysing the geographical issue portrayed.

Questions

1. Why is the fishing trawler drawn so small?
2. Has the trawler caught many fish? Explain your answer.
3. Explain the discussion between the two fish.
4. What message do you think is being conveyed in this cartoon?
5. How does this cartoon make you feel?

Checklist

I have:

- recognised the issue
- analysed the components of the cartoon
- identified the cartoonist’s personal opinion or message
- stated my personal response on the geographical topic.

Skills questions

1. Cartoons are used to show:
 - (a) the general public’s opinion on an issue
 - (b) the correct response to an issue
 - (c) the cartoonist’s view on an issue
 - (d) the humour level of the cartoonist.
2. Cartoons are most often based on:
 - (a) known facts
 - (b) questionable data
 - (c) outdated topics
 - (d) controversial topics.
3. Why is it important to know the context, or bigger picture, of the issue in the cartoon?
4. Why do cartoonists exaggerate some aspects of their drawings?

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Watch this eLesson: Interpreting a geographical cartoon (eles-1731)



Try out this interactivity: Interpreting a geographical cartoon (int-3349)

4.10 Does farming use too much water?

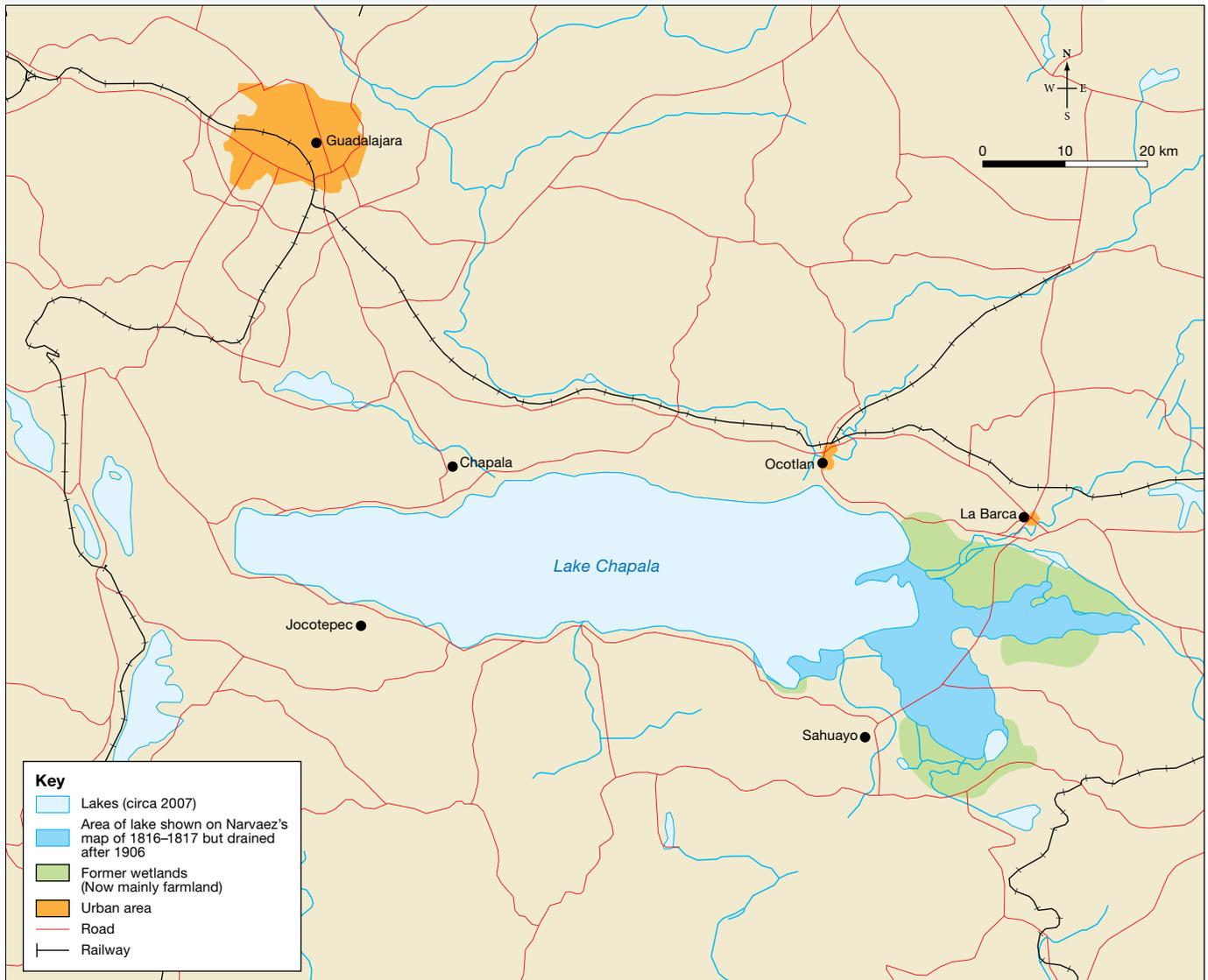
4.10.1 What happens if we divert too much water?

Water is a finite resource but, although there is plenty of water in the world, it is not always located where people are concentrated or where food is grown. Therefore, humans have drawn water from both surface and underground sources to improve food production in areas of high population. This is not sustainable. For countries that have growing populations and limited water resources, water deficits and food insecurity are a growing concern.

For thousands of years, farmers have diverted water from rivers, lakes and wetlands for watering crops and pastures in dry areas. Large-scale irrigation schemes can effectively ‘water’ our deserts but, if too much water is used, wetlands can dry out, rivers cease to flow and lakes dry up. It is estimated that between three and six times more water is held in reservoirs around the world than exists in natural rivers. It is possible that the level of water extraction will nearly double by 2050.

Lake Chapala, Mexico’s largest lake (see figure 1), is shrinking. The amount of water lost through irrigation and domestic use, combined with high evaporation rates, has seen the volume of the lake decrease by 50 per cent.

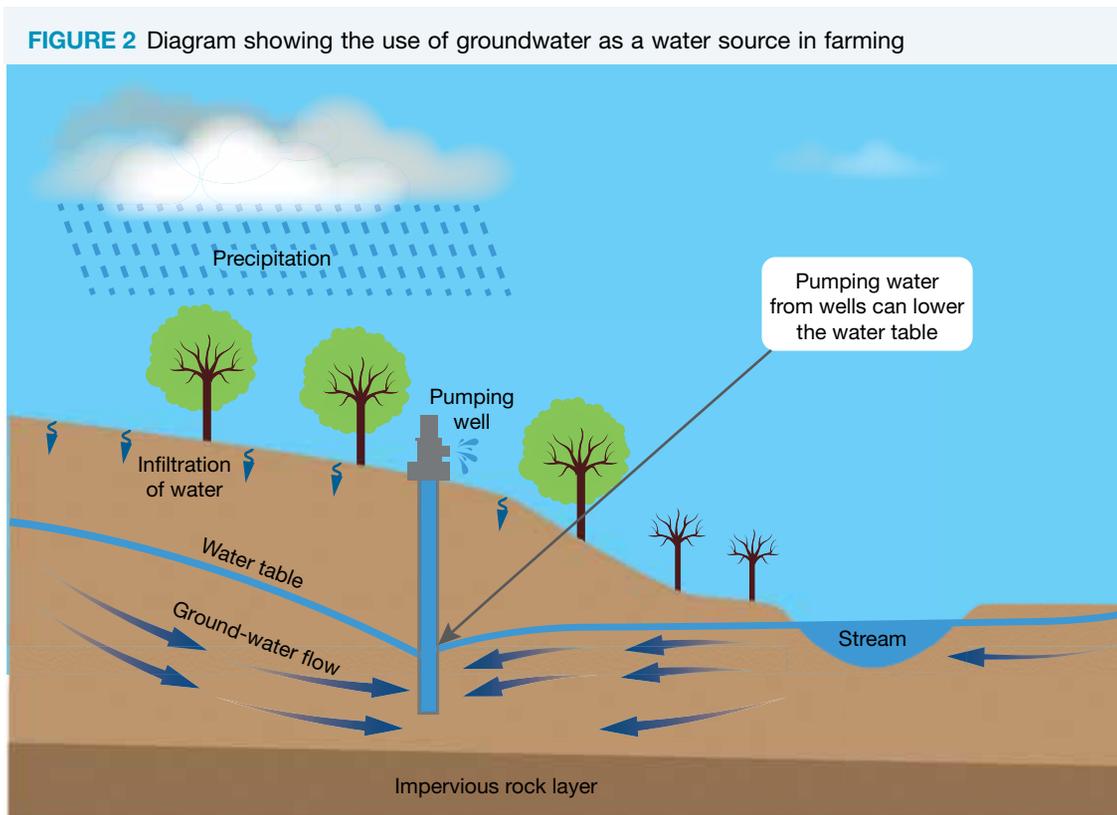
FIGURE 1 Map of Lake Chapala, Mexico. Note the area of land drained for farmland.



Source: Data from Tony Burton. All rights reserved. Map drawn by Spatial Vision.

4.10.2 What happens if we extract too much water?

As surface water resources become fully exploited, people turn to underground water sources. Improvements in technology have also enabled farmers to pump water from **aquifers** deep underground (see figure 2).



Groundwater levels do not respond to changes in the weather as rapidly as rivers and lakes do. If the water is removed unsustainably (at a rate that is faster than the rate of replenishment by rainfall, run-off or underground flow), then **watertables** fall. Water then becomes harder and more expensive to extract. Water stored in aquifers can take thousands of years to replenish. Over-extraction of groundwater can result in wells running dry, reduced stream flow, and even land subsidence (sinking).

The High Plains region of the central United States (see figure 3) is the leading irrigation area in the western hemisphere, producing over \$20 billion worth of food and fibre per year. In all, 5.5 million hectares of semi-arid land is irrigated using water pumped from the huge Ogallala Aquifer. Since large-scale irrigation was developed in the 1940s, groundwater levels have dropped by more than 30 metres. Pesticides and other pollutants from farming have also infiltrated the groundwater. Scientists estimate that the aquifer will be 69 per cent depleted by 2060 and it would take more than 6000 years for it to refill naturally.

FIGURE 3 The size of the Ogallala Aquifer



Source: USGS

FIGURE 4 Irrigated cropland relies heavily on water from the Ogallala Aquifer.



4.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. List the different types of water resources that can be used to supply water for food production.
2. Identify one natural and one human factor that has contributed to the **change** in water levels in Lake Chapala.

Explain

3. Study figure 2. Explain how pumping groundwater can lower watertables.
4. Refer to figure 3. With the use of the **scale** bar, work out the approximate area covered by the Ogallala Aquifer.
5. What are some of the likely effects of draining wetlands for farmland, as has occurred around Lake Chapala, Mexico?
6. Compare the advantages and disadvantages of using groundwater and surface water for farming.

Discover

7. Research the Aral Sea in Asia and write a report to cover:

- location
- development of the issue of over-extraction of water
- impacts of overuse.

Include a location map and labelled photographs in your report.

Think

8. If the Ogallala Aquifer was to run dangerously low, and irrigation was no longer possible, what would be the short- and long-term consequences?
9. Select one of the examples shown in this section and consider what steps water managers could take to reduce the impact of **unsustainable** water use in the region.

4.12 Does farming cause global warming?

4.12.1 How can farming contribute to global warming?

Agriculture and climate change are interconnected processes, both of which take place on a global scale. Global warming will cause changes to what can be grown and where. At the same time, however, many of our agricultural practices may in fact contribute to global warming.

The term ‘global warming’ generally refers to the warming of the planet that is caused by increased emissions of **greenhouse gases** as a result of human activity. The human activity of food production can contribute to global warming in two ways.

- Grazing animals and flooded rice paddies produce the greenhouse gas methane. Livestock are thought to be responsible for 35 per cent of the world’s methane output. The next largest sources, in order, are oil and gas, landfill, rice paddies and wastewater treatment systems.
- Food production changes the surface of the Earth, which then alters the planet’s ability to absorb or reflect heat and light. Large-scale deforestation and desertification can significantly alter the microclimate of a region. Around 80 per cent of global deforestation is caused by clearing the land for grazing, slash-and-burn farming and cropping.

FIGURE 1 A cartoonist’s view of livestock and global warming



4.12.2 What are the biggest polluters?

Cows emit large quantities of methane through belching and flatulence (caused by digestive gases). The gas is produced by bacteria digesting grass in one of the four stomachs that cows have. It has been estimated that one cow could produce somewhere between 100 and 500 litres of methane per day (see figure 2). This amount is similar to the pollution produced by one car in one day. When you consider there are over 1.5 billion cows in the world, this equates to a lot of gas. Scientists today are working on ‘fuel-efficient cows’ — cows that convert feed more efficiently into milk rather than methane.

FIGURE 2 Argentine scientists are strapping plastic tanks to the backs of cows to assess how much methane they produce.



Rice farming is one of the biggest sources of human-produced methane, averaging between 50 and 100 million tonnes per year. The gas is produced in the warm, waterlogged soils of the rice paddies (see figure 3).

FIGURE 3 Methane is released from rice paddies.



The practice of **factory farming**, in which a very high number of animals are concentrated in the one place, produces an unmanageable amount of waste (see figure 4). On a sustainable farm, animal manure can be used as a natural fertiliser but on a factory farm the large quantity becomes a source of methane, because the waste is often mixed with water and stored in large ponds or lagoons. An additional problem can occur if these ponds leak, as they create soil and water pollution. The use of nitrogen-based fertilisers on farms also releases nitrous oxide, another greenhouse gas.

FIGURE 4 Factory farming produces large quantities of waste products.



4.12.3 How does deforestation contribute to global warming?

Trees are 50 per cent carbon, so when they are burned or felled to create land for farming, the CO₂ they store is released back into the atmosphere. On average, 13 million hectares of the world's forests are lost each year, mostly in tropical regions of South-East Asia, Latin America and Africa. Deforestation accounts for 30 per cent of greenhouse gases released into the atmosphere each year. Forests also act as carbon sinks, the most effective way of storing carbon. Large areas of cleared land absorb more heat than native vegetation, which can lead to changes in local weather conditions.

4.12 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What are the three main greenhouse gases?
2. What are two ways in which deforestation can contribute to **changes** in greenhouse gases?
3. What is the biggest global emitter of methane: livestock, cars or rice paddies?

Explain

4. Study figure 4. How does factory farming differ from traditional farming methods? Draw up a table of two columns, one headed 'Key features of a traditional dairy farm' and one headed 'Key features of a factory farm'. List the features of both styles of farming and then compare your lists.
5. Is factory farming a **sustainable** form of food production? Give reasons for your answer.
6. The building of large-**scale** dams and subsequent flooding of forests in the Amazon is also contributing to increases in greenhouse gas emissions. What is the reason for this?

Discover

7. Research the sources of methane gas and find out what percentage each contributes to world methane output. Present your information in a pie or bar graph. Is the biggest source natural or human?
8. If one cow produces 16 kWh energy equivalent per day, how many cows would be needed to power your own home per day? You will need to check your household electricity bill.
9. How might climate **change** affect agriculture? Do some online research to investigate some of the possible effects of climate **change** on food production.

Think

10. With another member of the class, discuss different ideas for reducing agriculture's contribution to global warming.

4.13 Review

4.13.1 Review

The biophysical world

1. Refer to figure 1 in subtopic 4.2. Rank the Earth's spheres according to which are most affected by the production of food. Which sphere is the most affected? Why?
2. Explain how the effects of a poorly managed farm can *interconnect* all four of Earth's spheres.
3. As the world's population has increased, how has food production managed to keep pace?
4. Refer to figure 2 in subtopic 4.2. Name three regions of the world in which deforestation is a major *environmental* concern.
5. Suggest why countries in Africa are less affected by agricultural pollution than countries in Europe and Asia.

Deforestation

6. Look around the room you are in at present. List all the products you can see that are made of wood. How dependent are we on forests? Explain.
7. Where are tropical rainforests found in the world? Refer to a world vegetation map and a world climatic zone map in your atlas. Describe in detail the distribution of tropical rainforests across the world's *space*. Use the following questions to help you.
 - (a) Which continents or regions have rainforests?
 - (b) Rainforests are distributed between which latitudes?
 - (c) What climate zones are rainforests associated with?
8. Describe how the production of biofuels can have an adverse effect on the *environment*.
9. There are several organisations, such as the Worldwide Fund for Nature (WWF), which are now involved in rescuing and protecting endangered orangutans in South-East Asia.
 - (a) Investigate one organisation, and report on its:
 - aims
 - strategies.
 - (b) Do you think this organisation will be successful in achieving its aims? If so, why? If not, why not? What needs to be done?

Overfishing

10.
 - (a) What is meant by the term *boom and bust* when referring to resource use?
 - (b) Think of other examples or resources that have gone through the boom and bust stage.
 - (c) Is this a *sustainable* practice? Explain your answer.
11. Investigate either the large-*scale* methods of catching fish or the role of factory ships in world fishing.
12. The prestigious Peninsula Hotel in Hong Kong has taken shark fin soup off its menu in protest against shark finning. Is this *scale* of protest enough? What else could be done?

Land degradation

13. Make a list of the types of human activities that can contribute to land degradation.
14. Would land degradation in urban areas be similar to or different from land degradation in rural areas? Give a detailed answer.
15. Conduct research about another *place* that is threatened by desertification, such as Mongolia, Patagonia, southern Spain, the Aral Sea or the Sahel in Africa. Research questions could include the following.
 - (a) Describe the location.
 - (b) What factors have contributed to desertification?
 - (c) What are two consequences of desertification in this *place*?
 - (d) What is being done to reduce the consequences?

Water

16. What are some of the advantages of irrigated farming over rain-fed farming?
17. How has technology allowed us to access more water for food production? Construct a list and write a brief note on how each invention has *changed* water availability.
18. Is the increasing use of groundwater a *sustainable* option for future farming? Justify your answer.

Biodiversity

19. Refer to figure 1 in subtopic 4.11. Compare the extinction rates of all species for the past, present and future. What trend do you notice?
20. In what ways has food production influenced the world's biodiversity?
21. Use the following data to construct a bar graph showing the worldwide percentages of threatened species.
 - Plants 70 per cent
 - Invertebrates 51 per cent
 - Fish 39 per cent
 - Amphibians 31 per cent
 - Reptiles 30 per cent
 - Mammals 22 per cent
 - Birds 12 per cent
22. How has food production contributed to the number of threatened species?

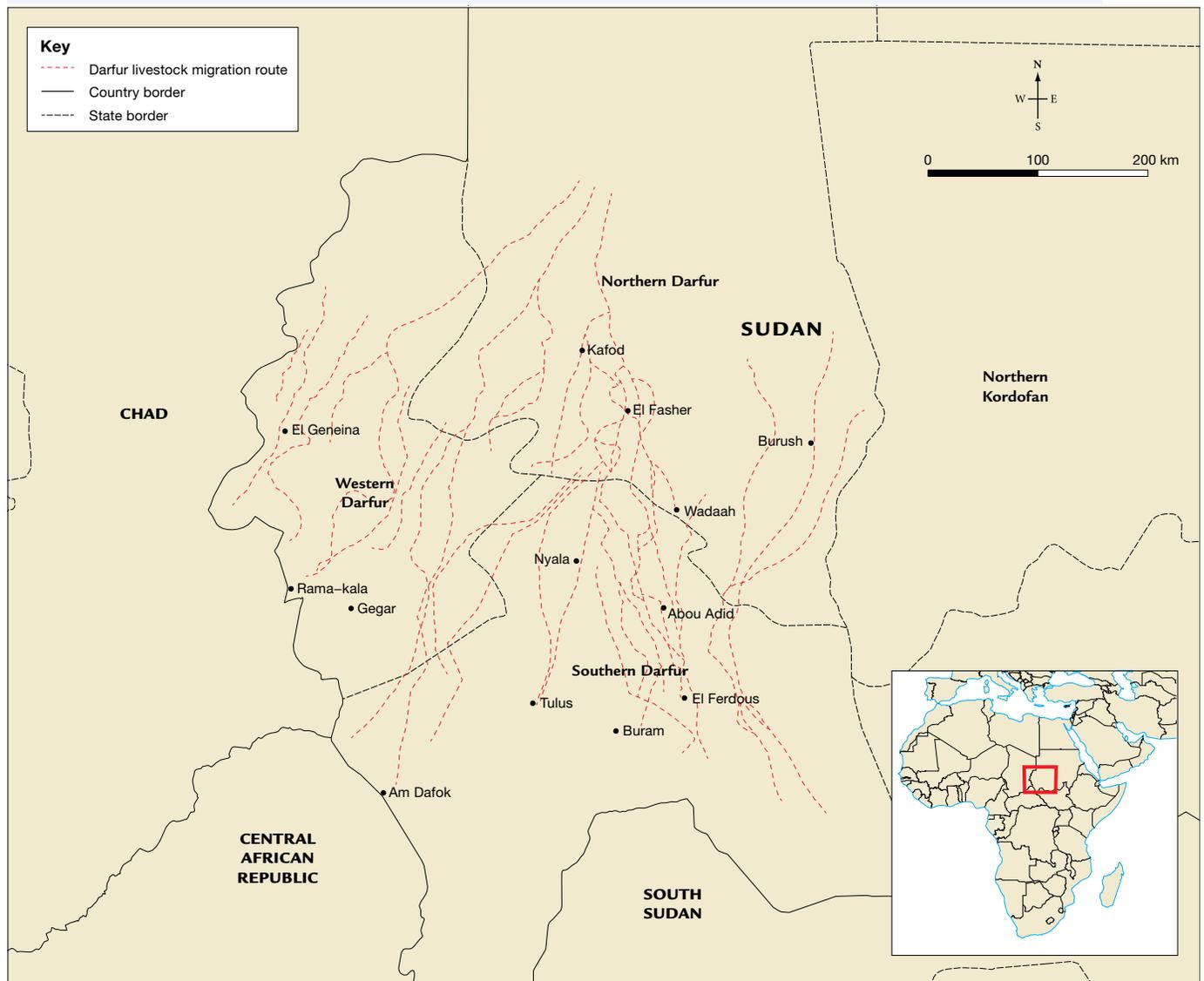
4.13.2 Reflect

23. In parts of the Sahel region of Africa, nomads traditionally moved their flocks of goats and camels around in search of water and feed. Over time, their range area has been reduced and political borders tightened up. Governments have installed wells to provide a more reliable water source for grazing animals but these in turn have created land degradation problems. Refer to figures 1, 2 and 3, which show the effects of overgrazing in Sudan, Africa, to answer the questions that follow.
 - (a) Describe the traditional patterns of livestock migration. Use distances, directions and regional borders in your answer.
 - (b) How might conflict between the different regions of Sudan influence nomadic herdspeople?
 - (c) Study figure 2. What *changes* do cattle bring to the areas around waterholes?
 - (d) What is the extent of degradation shown occurring around Bara in figure 3? Use the *scale* on the satellite image to estimate the size of the area affected by degradation.
 - (e) Predict what might happen if the areas of sand dune encroachment (spreading) and active desertification enlarge.
 - (f) How might this affect available food supplies for Bara?
24. How can you provide assistance to people and their livelihoods and yet prevent *environmental* damage?
25. *Desertification is not caused by any one thing, but rather by a combination of factors.* Do you agree or disagree with this statement? Explain your viewpoint.
26. Palau, a small country of 22 000 people and 200 islands, is located 800 kilometres east of the Philippines. It is the first nation in the world to create a shark sanctuary. Estimates have shown that catching 100 reef sharks would be worth a one-off \$18 000. Those same reef sharks, as a tourist and diving attraction, currently bring in \$18 million annually. It took some effort to convince Palauans to protect sharks, but they are now responsible for managing and enforcing shark-fishing restrictions.
 - (a) How do you view the decision of the Palau government?
 - (b) Is this the best way to reduce the *environmental* threat of overfishing of a species?
27. In Western Australia, there are plans to export shark fins that have a 'green stamp'; that is, they are caught and processed in a *sustainable* manner. Demand for *sustainably* caught fish would be very high, and they could earn up to \$100 per kilogram (presently \$10 to \$20 per kilogram). Is this type of *sustainable* fishing acceptable to you? Give your opinion.

The paper industry

28. Create a table listing all the paper products that you might use in a day. In a second column, for each product suggest ways in which you could reduce your usage or substitute other more environmentally friendly products.
29. Construct a flow diagram to illustrate the different impacts that paper production and use has on the atmosphere, biosphere and lithosphere.

FIGURE 1 Major historical migration routes used by nomadic herders in Sudan, Africa, in the past. Currently, the borders with Chad and the Central African Republic are closed, and even borders between provinces in the Sudan are closed, so herders must stay within their own province.



Source: Spatial Vision

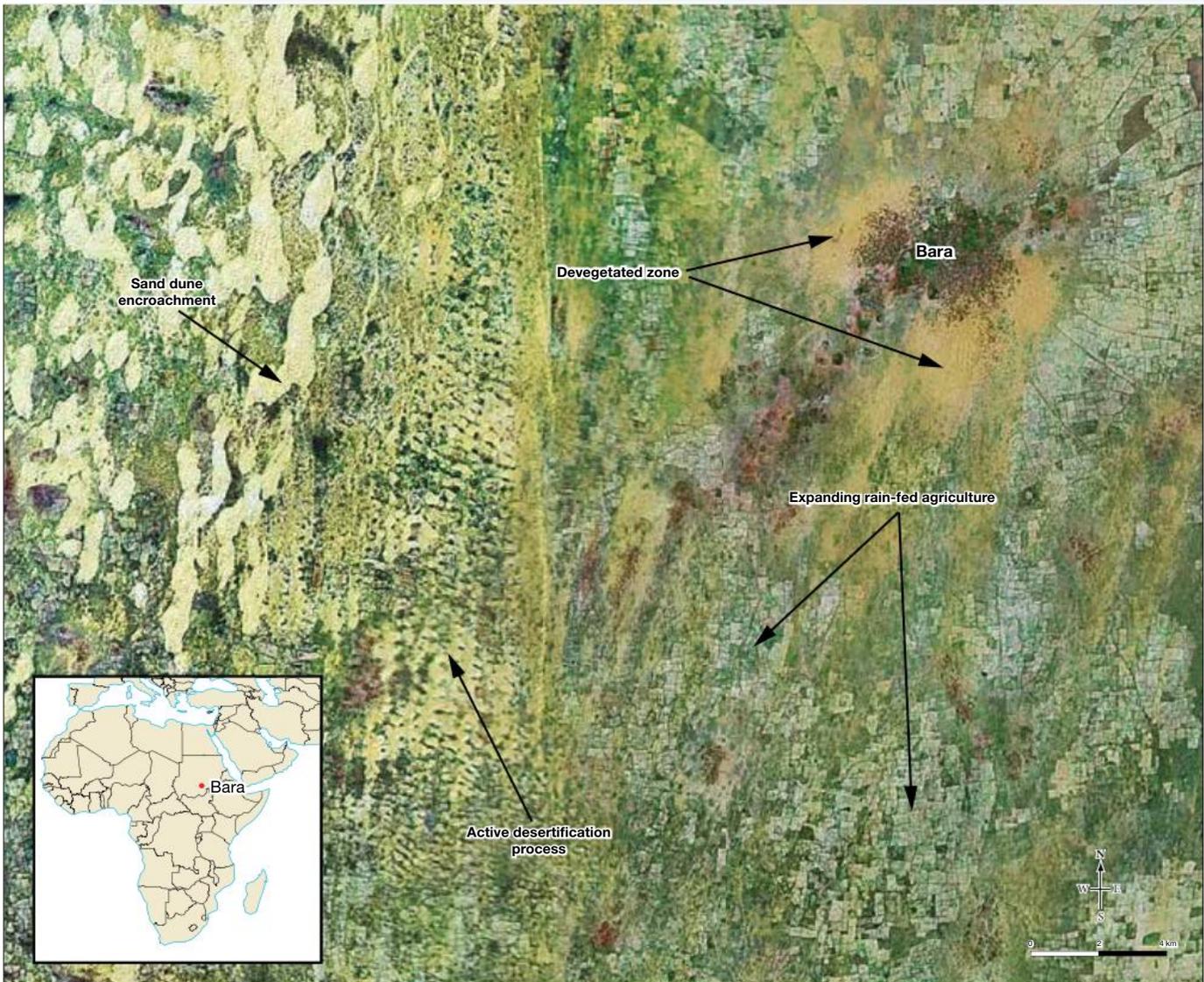
Notes:

1. Livestock migration from north to south is in February–March and from south to north in May.
2. The routes shown on this map are major historical routes that have some degree of official and local recognition. However, routes can change over time and the legitimacy and impacts of many routes are a source of local and regional tension.
3. Since the beginning of the Sudanese conflict, all livestock routes have been disrupted.

FIGURE 2 Cattle grazing around a waterhole in Sudan



FIGURE 3 False-colour satellite image showing the effects of agriculture and overgrazing in Sudan, Africa

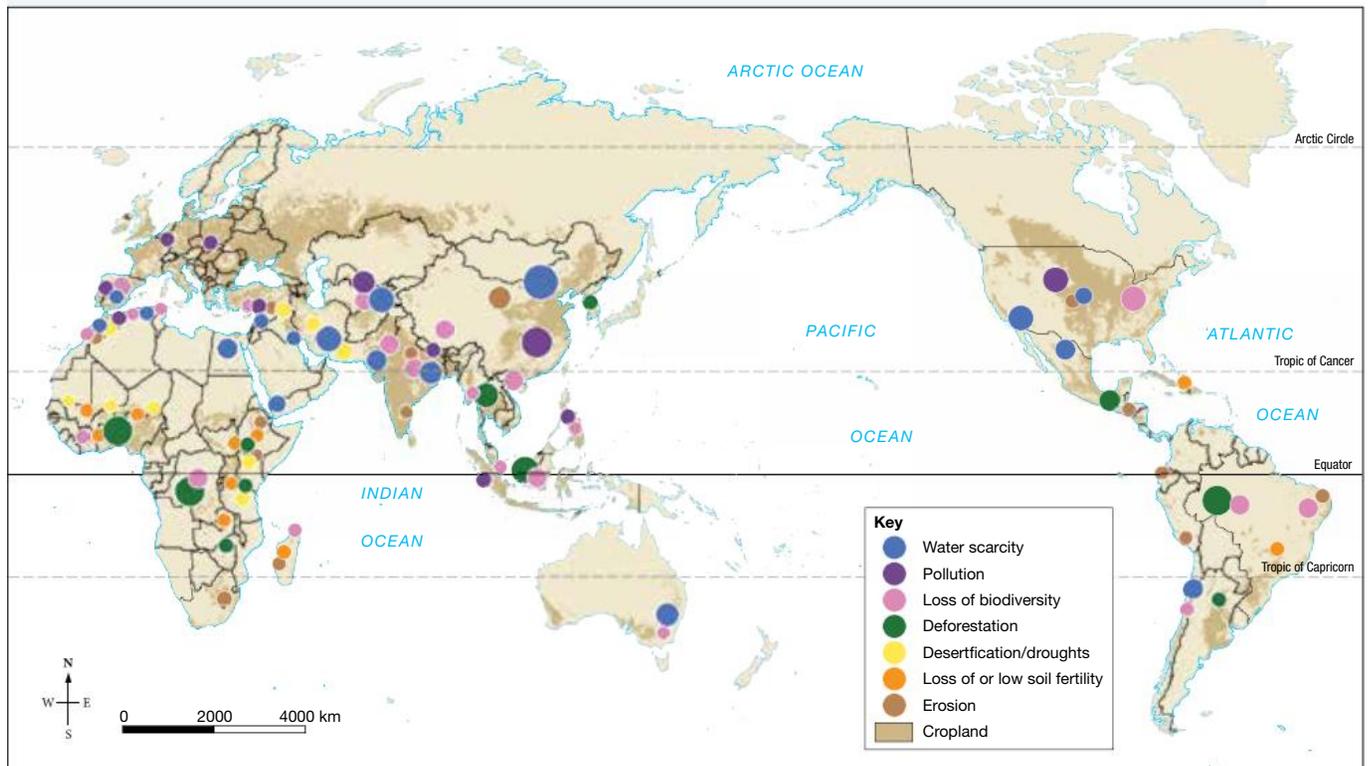


Source: Spatial Vision

Food production: environmental risks

30. Rank what you consider to be the three most serious environmental issues shown in figure 4.
- What criteria did you use to make your decisions? (For example: extent of area covered, number of people affected, economic impacts)
 - Share your list with at least two other students. What were the similarities and differences in the rankings?
 - Would you now change your own ranking? Why or why not?

FIGURE 4 The environmental risks associated with food production



Source: Spatial Vision

Whaling

31. Investigate the issue of whaling and the conflicting viewpoints held by Australia and Japan. What were the factors (reasons) involved in:
- Australia's decision to ban whaling
 - Japan's decision to continue whaling?
- How do you suggest both groups could come to a resolution?

TOPIC 5

Are we devouring our future?

5.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

5.1.1 Introduction

There is enough food produced in the world today to feed every man, woman and child, so why is it that one in nine people, or 795 million, will go to bed hungry tonight? What is stopping everyone getting enough to eat? If this is the current situation, what is going to happen in the future?

For these children, in a tent camp for people displaced by flooding in northern India, the only kind of food security is in the form of aid.



Starter questions

1. How long has it been since you had anything to eat?
2. How many different food items have you eaten today?
3. How many of these did your family grow?
4. Do you know when and where your next meal is coming from?
5. Do you feel secure in knowing that you have food in your home?
6. How would your answers to these questions compare with those of the people shown in the photograph on the previous page?
7. Why do you think we have so many people hungry when there is enough food produced in the world?
8. How will the world feed its future population?

INQUIRY SEQUENCE

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| 5.2 Who's not hungry? | 89 |
| 5.3 Who is hungry? | 92 |
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| 5.5 How does a famine develop? |  95 |
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5.2 Who's not hungry?

5.2.1 What is food security?

Very few Australians, by choice, would go to bed at night hungry. We live in a country where there is a plentiful supply and wide range of food items available. Our relatively high standard of living enables most of us to afford to purchase, store and prepare food, or even dine out. Most of us are secure in the knowledge that there will be food at the next meal time.

Food security exists when all people, at all times, have physical and economic access to enough safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle.

Source: Food and Agriculture Organization

Food security for you, as a student, means that your family either grows its own food, has sufficient income to purchase food, or is able to barter or swap food. Similarly, food security for a country means that it is able to grow sufficient food, or it has enough wealth to import food, or it combines the two. Not all people in the world are able to achieve this. For example, consider the range of foods available in the two markets in figures 1 and 2.

FIGURE 1 The fresh produce section of a supermarket in a developed economy



FIGURE 2 A food market in a developing economy



5.2.2 Who has food security?

Figure 3 shows the countries of the world regarded as having low risk of food insecurity shaded in dark green. This is based on a range of 12 different **indicators**, including the:

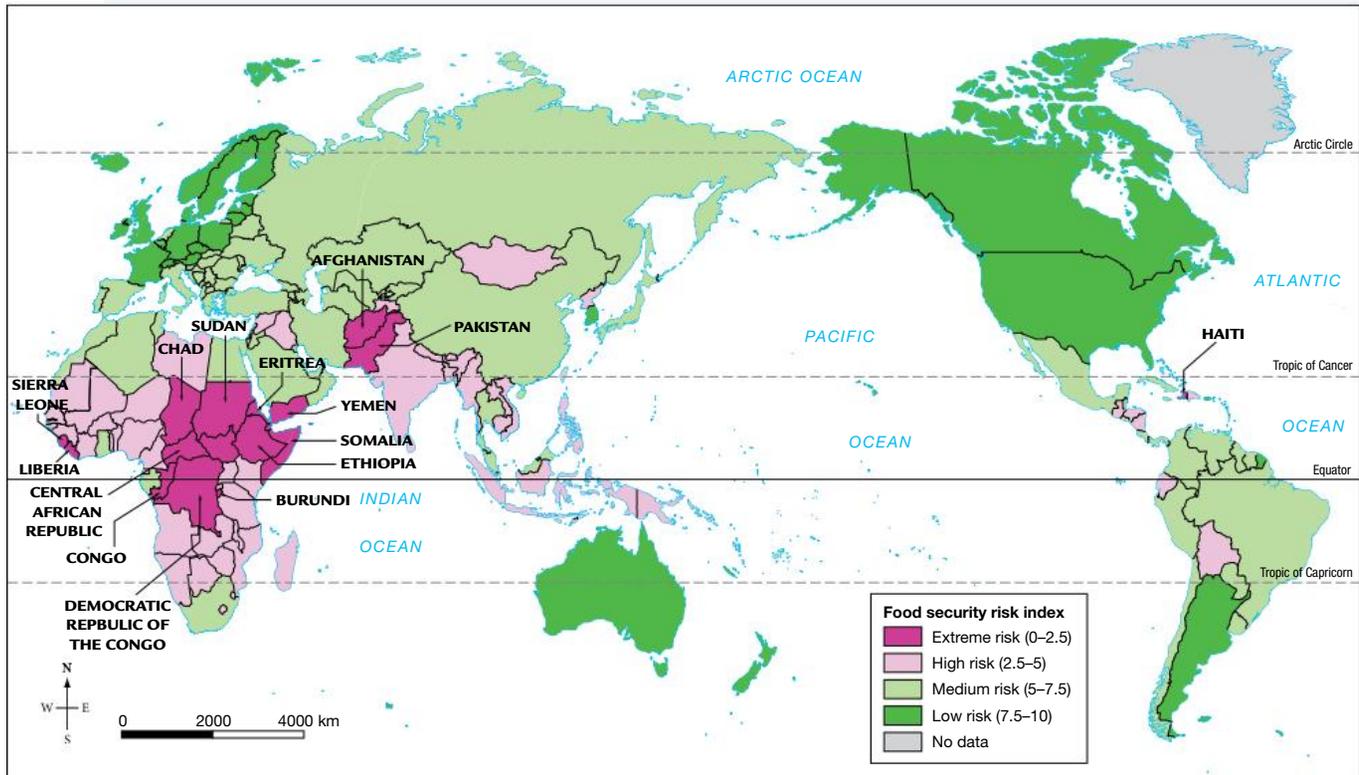
- affordability of food
- accessibility of food
- nutritional value of food
- safety of food
- nutritional and health status of the population.

The map shows only those countries that have low risk of food insecurity. These countries are able to produce more food than they require, so they can export their surplus; or they are able to afford to import all their needs, as is the case for the United Arab Emirates, for example.

Australia, for instance, produces three times as much food as it consumes, and is a major exporter of both fresh and processed food. We can trade competitively in cereals, oil seeds, beef, lamb, sugar and dairy products. Ninety per cent of our food is grown in Australia. Of the remaining 10 per cent that we import, many foods are either processed or out of season; oranges are an example. Global trade is an important component of food security because it is almost impossible to exactly match food production to food demands.

As a country, Australia does not have a problem feeding its population but it has a humanitarian interest in the food security of developing nations. As a major food producer, Australia does face future challenges. There is declining growth in agricultural productivity, the threat of climate change, and increasing competition for land and water.

FIGURE 3 The Food Security Risk Index, 2013



Source: Verisk Maplecroft – Verisk Maplecroft’s Food Security Index provides a quantitative assessment of risks to the continued availability, stability and access to sufficient food supplies. The index also considers the nutritional outcomes of each country’s relative food security.

5.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is meant by the term *food security*?
2. How do you give your pet food security?
3. Refer to figure 3 and your atlas.
 - (a) List five examples of countries, from different regions of the world, that are considered to have low risk of food insecurity.
 - (b) Would you classify these countries as developing or developed?
 - (c) What does it mean for people who live in a country with low risk of food insecurity?

Explain

4. Compare the two photographs in figures 1 and 2.
 - (a) What are the similarities and differences between the two markets? Do you think all food groups would be available in both markets? Why or why not?
 - (b) List 10 food items (not including water) that you could live on for a week, while still maintaining a balanced diet. You are not allowed anything else.
5. The Food Security Risk Index was based on evaluating five different indicators. Why do you think indicators such as accessibility and safety were included?

Discover

- (a) Use the **Australian food statistics** weblink in the Resources tab to construct a graph of the 10 largest food imports and exports in terms of dollar value.
- (b) Describe your completed graph, using figures in your answer.

Predict

- How do you think climate **change** might affect Australia's food security?
- What natural or human events could disrupt our food security?

learn on RESOURCES – ONLINE ONLY

 Explore more with this weblink: [Australian food statistics](#)

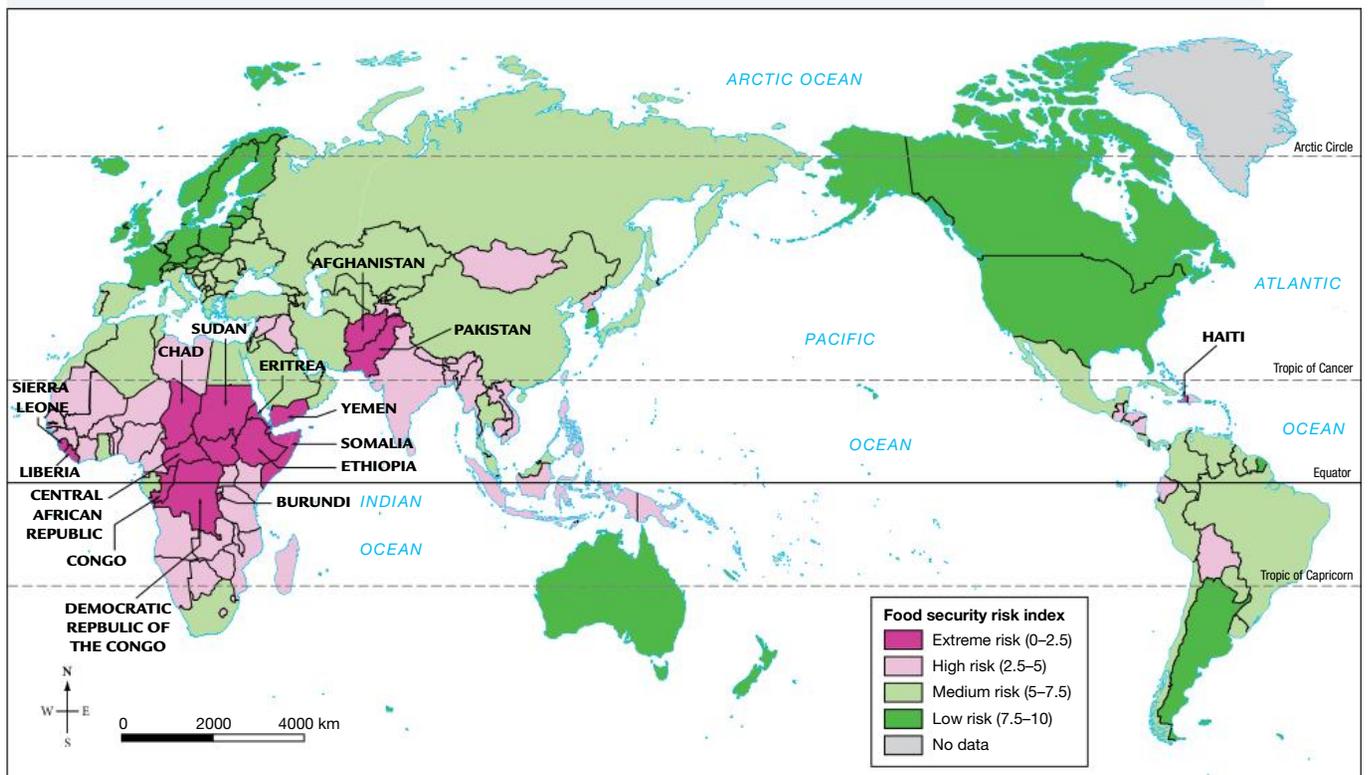
5.3 Who is hungry?

5.3.1 Who is at risk of food insecurity?

Have you ever felt hungry? How long since you last had a meal? How long before your next meal? How easy is it to open the fridge or cupboard for a snack? But what if there was no food in the house, no money to purchase food with and very little food available in the shops? If that was the case, you would be just one of the hundreds of millions of other people in the world in a similar position.

Figure 1 highlights those countries that are most at risk of not having reliable access to food. Seventy five per cent of all hungry people live in rural areas, mainly in rural environments of Asia and Africa. These people are often totally dependent on agriculture for food, and have no alternative source of work or income. Consequently they are vulnerable to food insecurity.

FIGURE 1 The Food Security Risk Index, 2013



Source: Verisk Maplecroft – Verisk Maplecroft's Food Security Index provides a quantitative assessment of risks to the continued availability, stability and access to sufficient food supplies. The index also considers the nutritional outcomes of each country's relative food security.

5.3.2 What happens when people do not have food security?

For the 800 million people who do not have enough to eat, the issue of finding sufficient and nutritious food must be faced daily. At least 2 billion of the world's people are **undernourished**, with diets that are minimal or below the level of sustenance. People who do not have a regular and healthy diet often have shortened life expectancy and an increased risk of disease. Children are especially vulnerable to poor diet, and their growth, weight, and physical and mental development suffer. In India, 29.4 per cent of children are underweight while 38.4 per cent have stunted growth, indicating they are **malnourished**. In the previous decade this figure was closer to 48 per cent of the child population.

FIGURE 2 An old man in Delhi suffering from a lifetime of malnutrition



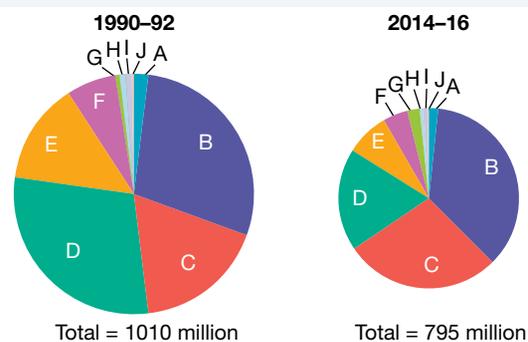
5.3.3 Why is there food insecurity?

Global food production now provides 17 per cent more calories per head than 30 years ago, despite the world's population increasing by 70 per cent. There is, however, unequal access to **arable** land, technology, education and employment opportunities. In the past decade the actual number of undernourished people in the world has fallen by 216 million, mostly due to large-scale improvements in the highly populated countries of India and China. Improvements in food production and economic development have not always occurred in those places experiencing rapid growth in population. Food is redistributed around the world via trade and aid but neither is a long-term or large-scale solution to food insecurity. Regional variations still occur in the distribution of hunger as can be seen in figure 3.

Some of the reasons for food insecurity include:

- poverty
- population growth
- weak economy and/or political systems
- conflict
- natural disasters such as drought.

FIGURE 3 The changing distribution of hunger in the world: numbers and shares of undernourished people by region, 1990–92 and 2014–16



| | Number (millions) | | Regional share (%) | |
|--|-------------------|------------|--------------------|------------|
| | 1990–92 | 2014–16 | 1990–92 | 2014–16 |
| A Developed regions | 20 | 15 | 2.0 | 1.8 |
| B Southern Asia | 291 | 281 | 28.8 | 35.4 |
| C Sub-Saharan Africa | 176 | 220 | 17.4 | 27.7 |
| D Eastern Asia | 295 | 145 | 29.2 | 18.3 |
| E South-Eastern Asia | 138 | 61 | 13.6 | 7.6 |
| F Latin America and the Caribbean | 66 | 34 | 6.5 | 4.3 |
| G Western Asia | 8 | 19 | 0.8 | 2.4 |
| H Northern Africa | 6 | 4 | 0.6 | 0.5 |
| I Caucasus and Central Asia | 10 | 6 | 0.9 | 0.7 |
| J Oceania | 1 | 1 | 0.1 | 0.2 |
| Total | 1 011 | 795 | 100 | 100 |

Note: The areas of the pie charts are proportional to the total number of undernourished in each period. Data for 2014–16 refer to provisional estimates. All figures are rounded.

Source: FAO

5.3.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What factors make people vulnerable to food insecurity?
2. What is the difference between undernutrition and malnutrition?
3. Use the **Malnutrition** weblink in the Resources tab and watch the video. What is the link between malnutrition in children and the mother's health?

Explain

4. Refer to a map of conflict in your atlas or online. Is there an **interconnection** between those countries that have a high or extreme risk of food insecurity and those countries that are experiencing conflict? Include country names in your answer.
5. Explain how conflict can lead to food insecurity.

Discover

6. Research and find out the causes and effects of one of the conditions caused by dietary deficiency, such as deficiency in iron, vitamin A or vitamin C.
7. Select one of the **places** mapped in figure 1 as being extreme risk. Find out the main factors that contribute to its food insecurity.
8. Refer to figure 3. Compare the three regions of the world that had the highest number of undernourished people in 1990–92 and 2014–16.
 - (a) Which region of the world has shown the greatest decrease in the percentage of undernourished people?
 - (b) Which region has shown the greatest increase in the percentage of undernourished people?

Predict

9. With a partner, develop five steps you think would reduce a country's risk of food insecurity. Give reasons for your choices.
10. How can Australia best help another country that is at high risk of having insufficient food for its people?

Think

11. At the turn of the twentieth century, the total worldwide spending on agricultural research was US\$23 billion. Compare this to \$1.5 trillion on weapons. Do we have our priorities right? Write a short letter to the editor outlining your viewpoint.

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Explore more with this weblink: Malnutrition



Try out this interactivity: Nothing to eat (int-3326)

5.4 SkillBuilder: Constructing and describing complex choropleth maps

online only

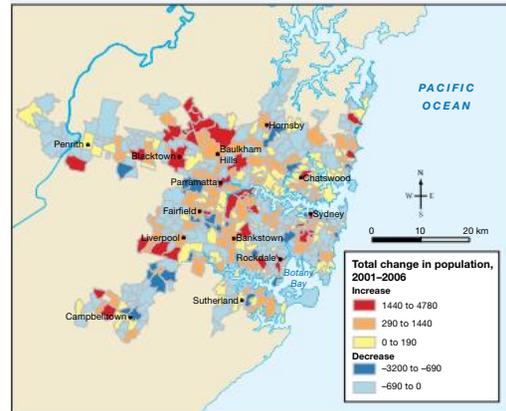
WHAT IS A COMPLEX CHOROPLETH MAP?

A complex choropleth map is a map that is shaded or coloured to show the average density or concentration of a particular feature or variable, and it shows an area in detail.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Population change in Sydney, 2001–2006



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Watch this eLesson: Constructing and describing complex choropleth maps (eles-1732)

Try out this interactivity: Constructing and describing complex choropleth maps (int-3350)

5.5 How does a famine develop?

online only

Access this subtopic at www.jacplus.com.au

5.6 Will land loss lead to food shortages?

5.6.1 How is land lost?

Land is absolutely essential for food production, and the world has more than enough arable land to meet future demands for food. Nevertheless, we need to find a balance between competing demands for this finite resource.

The loss of productive land has two main causes. First, there is the degradation of land quality through such things as erosion, **desertification** and salinity. Second, there is the competition for land from non-food crops, such as biofuels, and from expanding urban areas. As figure 1 shows, the growth in world population is inversely proportional to the amount of arable land available. This does not even take into consideration the land that is degraded and no longer suitable for growing food.

Land degradation

Although there have been significant improvements in crop yields, seeds, fertilisers and irrigation, they have come at a cost. Environmental degradation of water and land resources places future food production at risk.

The main forms of land degradation are:

- erosion by wind and water
- salinity
- pest invasion
- loss of biodiversity
- desertification.

Land degradation occurs in all food-producing biomes across the globe. Some degradation occurs naturally; for example, a heavy rainstorm can easily wash away topsoil. However, the most extensive degradation is caused by overcultivation, overgrazing, overwatering, overloading with chemicals and overclearing (see figure 2). Currently, 25 per cent of the world's land is highly degraded, while only 10 per cent is improving in quality. In South-East Asia, 50 per cent of cultivated land has severe soil quality problems, which prevent increases in food production. The Ministry for Agriculture in China estimates that 3.3 million hectares of arable land is polluted with chemicals and heavy metals, mostly in regions that grow grains.

Competition for land

There has been a growing global trend to convert valuable cropland to other uses. Urban growth, industrialisation and energy production all require land. For example, in less than 16 years, China lost more than 14.5 million hectares of arable land to other land uses. This land no longer produces food, which then puts pressure on existing land resources to make up the loss.

Growing fuel

Traditionally, the main forms of biofuel have been wood and charcoal. Almost 90 per cent of wood harvested in Africa and 40 per cent harvested in Asia is used for heating and cooking. Today, people are seeking more renewable energy sources and wanting to reduce CO₂ emissions associated

with deforestation, so there is greater demand for alternative energy sources. Consequently, the use of agricultural crops to produce biofuels is increasing. Ethanol (mostly used as a substitute for petrol) is extracted from

FIGURE 1 Comparison of world population growth and arable land per capita

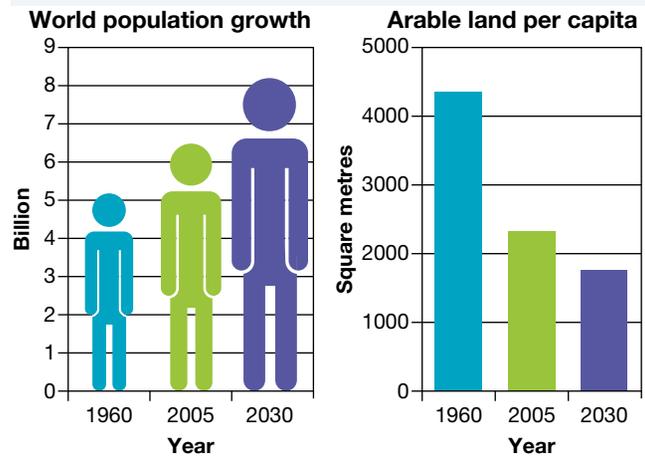


FIGURE 2 Land degradation caused by deforestation in Madagascar



crops such as corn, sugar cane and cassava. Biodiesel is derived from plantation crops such as palm oil, soya beans and **jatropha**. The growth of the biofuel industry has the potential to threaten future food security by:

- changing food crops to fuel crops, so less food is produced and crops have to be grown on **marginal land** rather than arable land
- increasing prices, which makes staple foods too expensive for people to purchase
- forcing disadvantaged groups, such as women and the landless poor, to compete against the might of the biofuel industry.

Creeping cities

Cities tend to develop in places that are agriculturally productive. However, as they expand, they encroach on valuable farmland.

FIGURE 3a Satellite image of the city of Tehran in 1985



FIGURE 3b Satellite image of Tehran in 2009 — the expansion of the city has taken over valuable arable land.



Land grabs

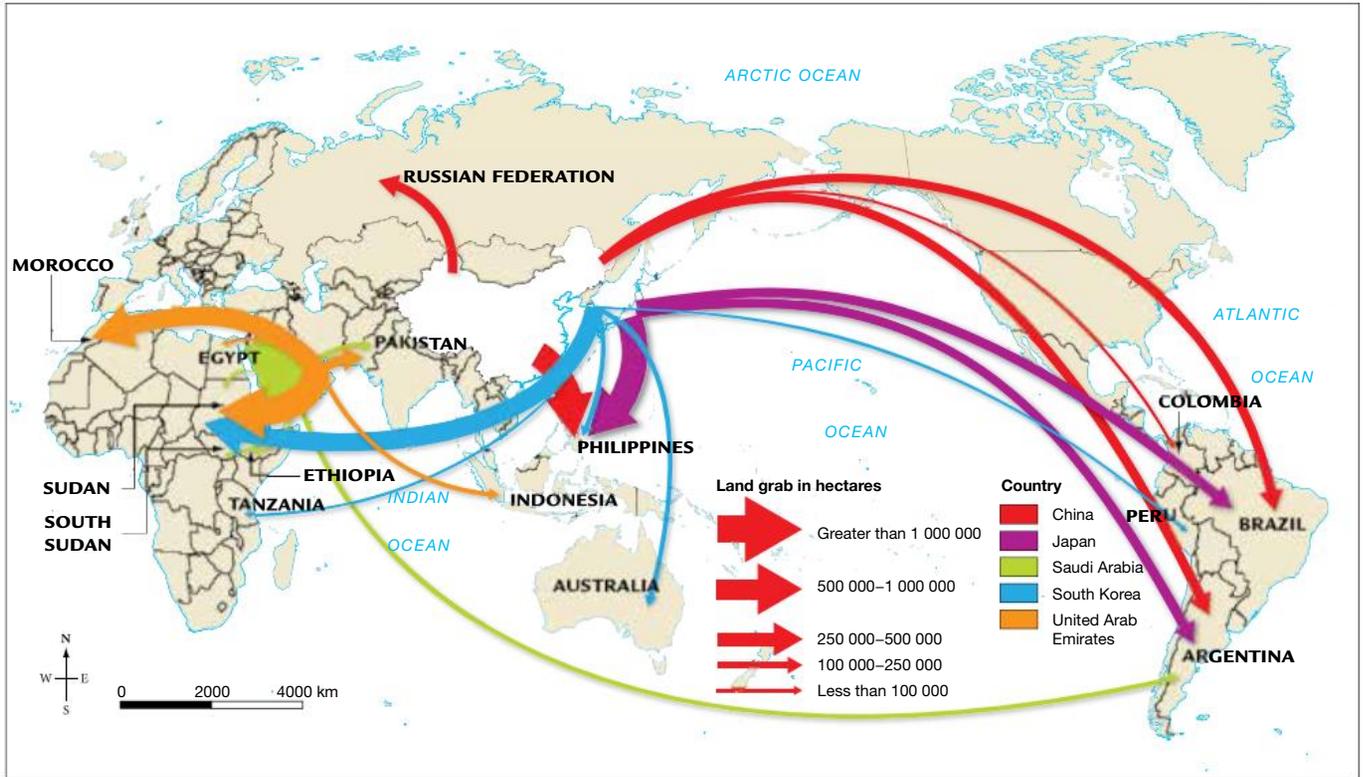
A growing challenge to world food security is the purchase or lease of land, largely in developing nations, by resource-poor but wealthier nations. Large-scale ‘land grabs’, as they are known, have the potential to improve production and yields but at the same time there is growing concern over the loss of land rights and food security for local populations. Since 2002, over 36 million hectares, an area bigger than Victoria and Tasmania combined, has been purchased or leased by foreigners around the world, with another 15 million hectares being negotiated. By and large, the land buyers are dominated by four regions: western Europe, North America, the Middle East and the expanding economies within Asia. China has land in 33 different countries, the United States in 28 and the United Kingdom in 30. Australia has land in nine different countries, while 13 countries have control over land in Australia.

The regions where land is purchased tend to be located in Africa, South America, eastern Europe and parts of South East Asia. Ethiopia ‘exports’ land to 21 different countries, while Madagascar and the Philippines export to 18 countries. Figure 4 shows the global scale of land grabs.

The rise of land grabs came about as a result of the ‘triple-F’ crisis — food, fuel and finance.

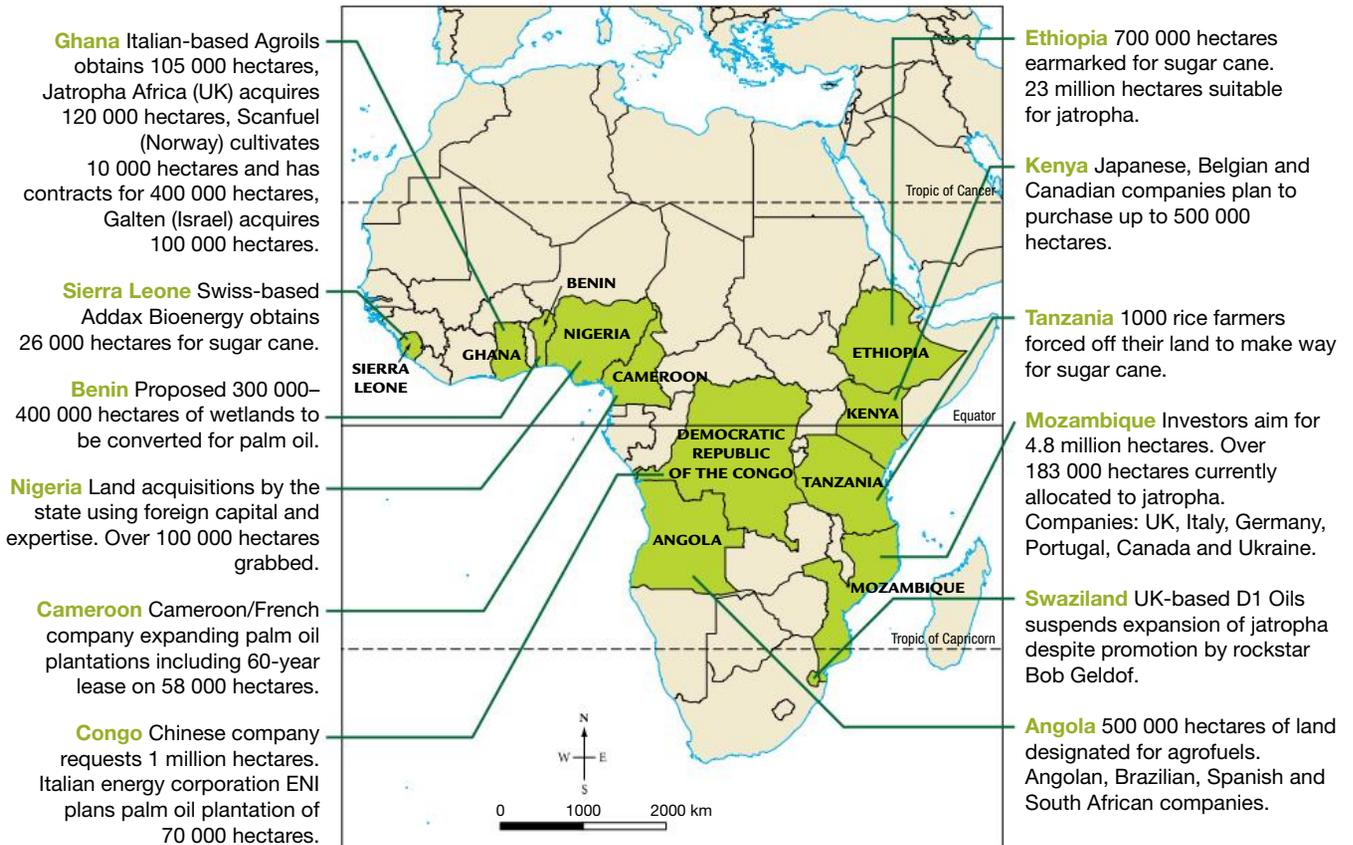
- *Food crisis*: massive increases in world food prices in 2007–08 emphasised the need for those countries heavily reliant on importing food, such as Saudi Arabia and China, to improve their food security by obtaining land in other countries to produce food to meet their own needs.
- *Fuel crisis*: rising and fluctuating oil prices in 2007–09 created an incentive for countries to acquire land to produce their own biofuels (see figure 5).
- *Financial crisis*: the global financial crisis in 2008 saw organisations switch from investing in stocks and shares to land in overseas countries, especially land that could be used to generate food and fuel crops.

FIGURE 4 Land grabs — who's buying where



Source: Spatial Vision

FIGURE 5 Countries in Africa where land is being bought by other nations for biofuel crops



Source: Friends of the Earth

The risk to food security

Investors in farmland are, understandably, seeking large expanses of land that has fertile soils and good rainfall or access to irrigation water. Often, land that is purchased is already occupied and used by small-scale farmers, in particular women who rarely benefit from any compensation. Prices for land can be much lower and there is frequently corruption, with much money going to local and government officials. People can also be forced off their land by governments keen to make deals with wealthy governments and corporations. Many land grabs have neglected the social, economic and environmental impacts of the deals.

With the purchase of land can come the right to withdraw the water linked to it and this can deny local people access to water for fishing, farming and spraying animals. Withdrawal of water can reduce flow downstream. The Niger River, West Africa's largest river, flows through three countries and sustains over 100 million people, so any large-scale water reductions create significant impact to downstream environments and people. One country the Niger River flows through is Mali. By the end of 2010, about 500 000 hectares had been leased by foreign companies and countries in Mali. Although Mali has limited arable land and two million people are underfed, a high percentage of land bought by foreign owners will be used for biofuel crops.

It has been estimated that the land taken up by foreign investors could feed as many as 190 to 370 million people, or even more, if yields are raised to the level of industrialised western farming. As well, there are environmental risks associated with monoculture farming and the loss of biodiversity in the region.

5.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What are the two main ways that productive farmland can be lost?
2. Why is the use of corn as a biofuel a threat to food security?
3. What is meant by the term **land grab**?

Explain

4. Refer to figure 1.
 - (a) Describe the **changes** in population growth and the arable land per person between 1960 and 2030, making use of figures.
 - (b) What do these graphs suggest about food security?
5. Compare the advantages and disadvantages in developing and developed nations of using traditional biofuels, such as wood and charcoal, instead of oil and gas.
6. Refer to figure 4.
 - (a) Which three countries are the largest purchasers of overseas land? Use figures in your answer.
 - (b) Why do you think South Korea has invested in so many countries in such different **places**?

Discover

7. What is jatropha? What are the benefits of growing this rather than corn and other biofuels?
8. What is happening in Australia? Investigate which foreign companies own farmland here, what they are using it for and where it is located.

Predict

9. Do you think Australia will need to purchase farmland overseas? Give reasons for your answer.

Think

10. Are land grabs an effective solution for establishing a country's food security? Discuss your point of view.

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 Try out this interactivity: Who is grabbing land? (int-3327)

5.7 SkillBuilder: Interpreting satellite images to show change over time

online only

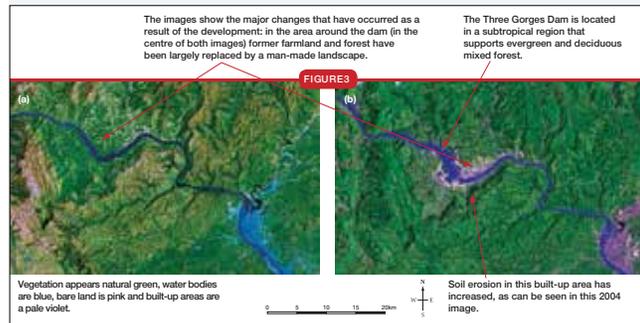
WHAT IS A SATELLITE IMAGE?

A satellite image is an image taken from a satellite orbiting the Earth. Satellite images allow us to see very large areas — much larger than those that can be visualised using vertical aerial photography.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Change over time on the Yangtze River, China



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 **Watch this eLesson:** Interpreting satellite images to show change over time (eles-1733)

 **Try out this interactivity:** Interpreting satellite images to show change over time (int-3351)

5.8 Are we running dry?

5.8.1 Why are we running low on water?

There is no substitute for water. Without water there is no food, and agriculture already consumes 70 per cent of the world's fresh water. Every type of food production — cropping, grazing and processing — requires water. Thus, a lack of water is possibly the most limiting factor for increasing food production in future.

To feed an additional two billion people by 2050, the world will need to generate more food and use more water. The two main concerns that threaten future water security are water quantity and water quality (see figure 1).

In theory, the world has enough water; it is just not available where we want it or when we want it, and it is not easy to move from place to place. We already use the most accessible surface water, and now we are looking for it beneath our feet. Underground **aquifers** hold 100 times more water than surface rivers and lakes. However, groundwater is not always used at a sustainable rate, with extraction exceeding natural recharge, or filling. This occurs in many of the world's major food-producing places, in countries such as the United States, China and India.

FIGURE 1 Water scarcity is a serious threat to food security.



Water insecurity is connected with food insecurity. Figure 2 shows the predicted number of people who will face **water stress** and water scarcity in the future. A more complex view is seen in figure 3, which shows an interconnection between increased demand for water and predicted climate change, population increase and greater industrialisation in the 2050s.

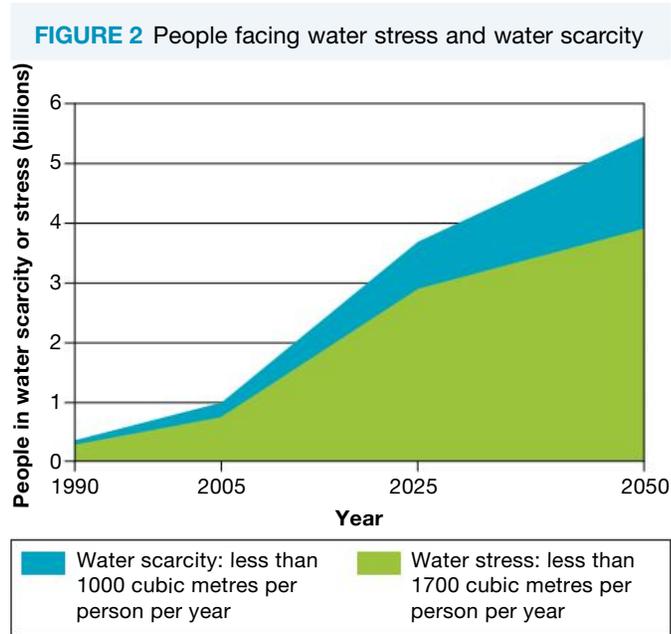
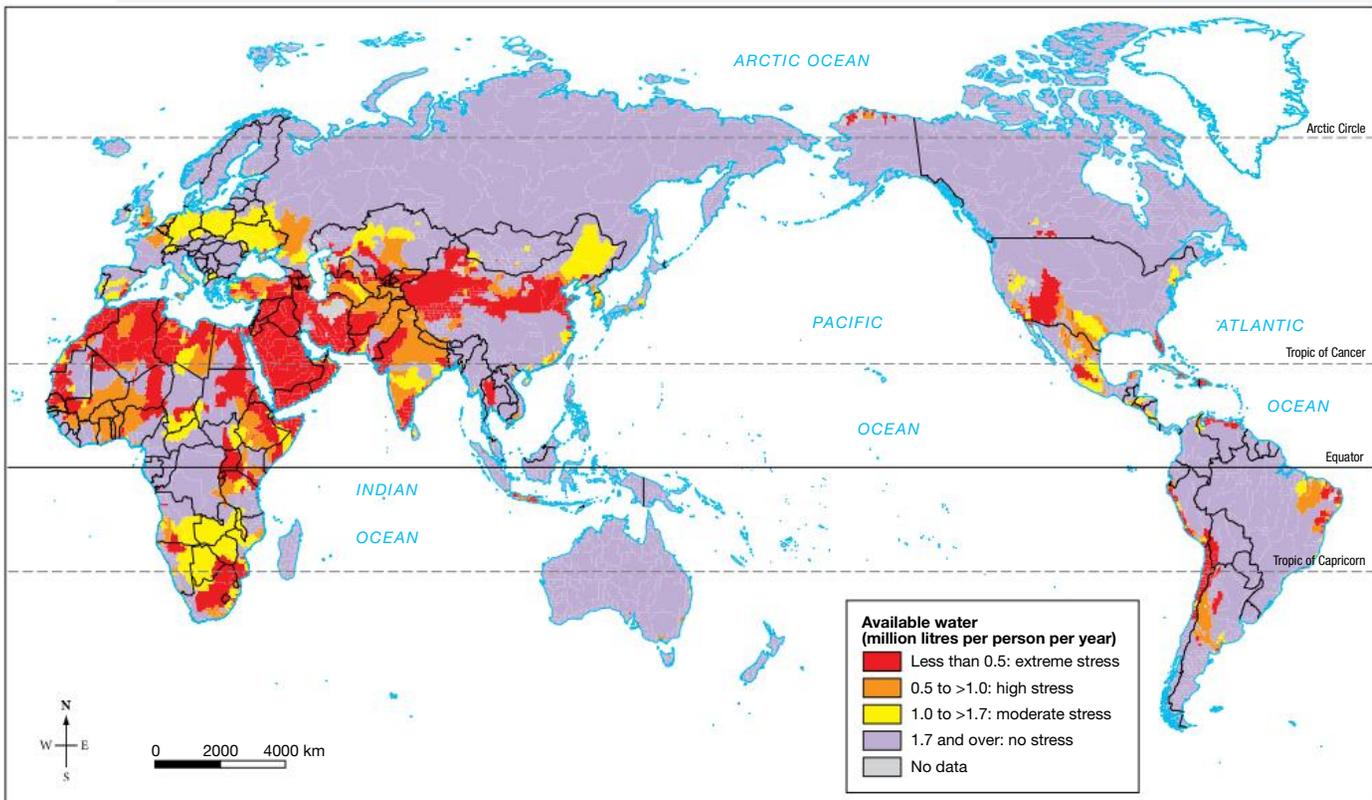


FIGURE 3 How water availability may change with temperature, population and industrialisation increase, 2050s



Source: Spatial Vision

When water availability drops below 1.5 million litres per person per year, a country needs to start importing food, although that makes the country susceptible to changes in global prices. Developing countries that experience water stress cannot afford to import food. They are also more vulnerable to environmental disasters. Seventy per cent of food emergencies in developing countries are brought on by drought.

The main causes of the growing water shortage are outlined below.

- *Food production.* It is estimated that an additional 6000 cubic kilometres of fresh water will be needed for irrigation to meet future food demand. Changes in diet, especially increased meat consumption, require more water to grow the crops and pasture that feed the animals. A typical meat eater's diet requires double the amount of water that a vegetarian diet requires.
- *Growth of urban and industrial demand.* Water for farming is diverted to urban populations, and productive land is converted to urban use.
- *Poor farming practices.* Water is wasted through inefficient irrigation methods and cultivating water-hungry crops such as rice. Poorly maintained irrigation infrastructure, such as pipes, canals and pumps, creates leakage.
- *Over-extraction.* Improved technology and cheaper, more available energy have enabled us to pump more groundwater from deeper aquifers. This is not always done at a sustainable rate, so as water is removed, less is available to refill lakes, rivers and wetlands.
- *Poor management.* Governments often price water cheaply, so irrigation schemes use water unsustainably. Some countries may have available water but lack the money to develop irrigation schemes.

5.8.2 Why is water quality deteriorating?

Agriculture is a major contributor to water pollution. Excess nutrients, pesticides, sediment and other pollutants can run off farmland or leach into soils and groundwater. Excessive irrigation can cause waterlogging or soil salinity. This salty water not only poisons the soil but also drains into river systems. Industrial waste, untreated sewage and urban run-off also pollute water that may be used to irrigate farmland. Food that is irrigated with polluted water can actually pass on diseases to people. Pollution is an important contributor to the scarcity of clean, **potable** water.

5.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. (a) Examine figure 2 and describe the projected **changes** in the number of people affected by water stress between 1990 and 2050. Use figures in your description.
(b) How do these **changes** compare with figures for water scarcity?
2. If a country has an average of 0.5 to <1.0 million litres of water per person, per year, would they be considered to be water stressed? Why?
3. Why is agriculture both a contributor and a victim of water pollution?

Explain

4. (a) Refer to figure 3. Describe those **places** in the world that are predicted to be in high to extreme water stress in the 2050s.

- (b) Compare your answer with a map of world average rainfall. Are areas that are predicted to be suffering high to extreme stress by 2050 also areas of low rainfall?
- (c) How could you explain why **places** like eastern Europe could face water scarcity?

Discover

5. Use the **Water use** weblink in the Resources tab to select a country and find out more about its water usage. Using the data on this website, construct a table to compare water usage for four countries — one from each continent of Europe, Africa, Asia and South America. (Try to select different countries from those chosen by other students.) Write a paragraph to summarise your findings.

Predict

6. Use the **Water availability** weblink in the Resources tab and scroll to the 2020s map. Compare this with the map for 2050. What are the three most significant **changes** you can see?

Think

7. What do you think water managers could do to help prevent water scarcity affecting future food security?

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-  **Try out this interactivity:** The last drop (int-3328)
-  **Explore more with these weblinks:** Water use, Water availability

5.9 Climate change: freeze or fry?

5.9.1 How will food security be affected by climate change?

The impacts of climate change on future world food security are a case of give and take. Some regions of the world will benefit from increases in temperature and rainfall, while others will face the threat of greater climatic uncertainty, lower rainfall and more frequent drought. In either case, food production will be affected.

Agriculture is important for food security, because it provides people with food to survive. It is also the main source of employment and income for 36 per cent of the world's workforce. In heavily populated countries in Asia, between 40 and 50 per cent of the workforce is engaged in food production, and this figure increases to over 63 per cent in sub-Saharan Africa.

It is difficult to predict the likely impacts of climate change, because there are many environmental and human factors involved (see figure 1), as well as different predictions from scientists (see figure 2). Use the **How to feed the world in 2050** weblink in the Resources tab to find out more about this topic.

FIGURE 1 Possible impacts of climate change on food production

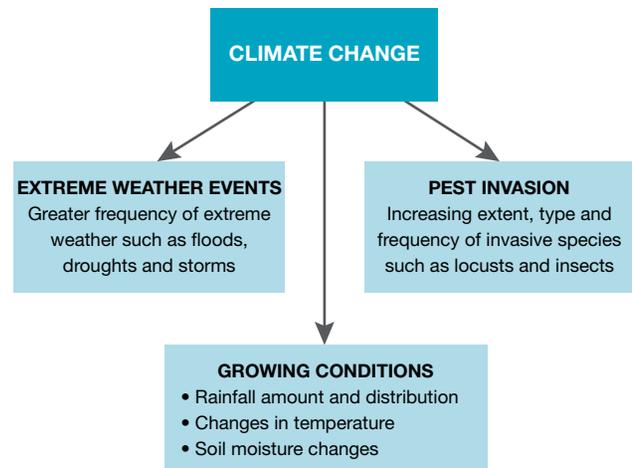
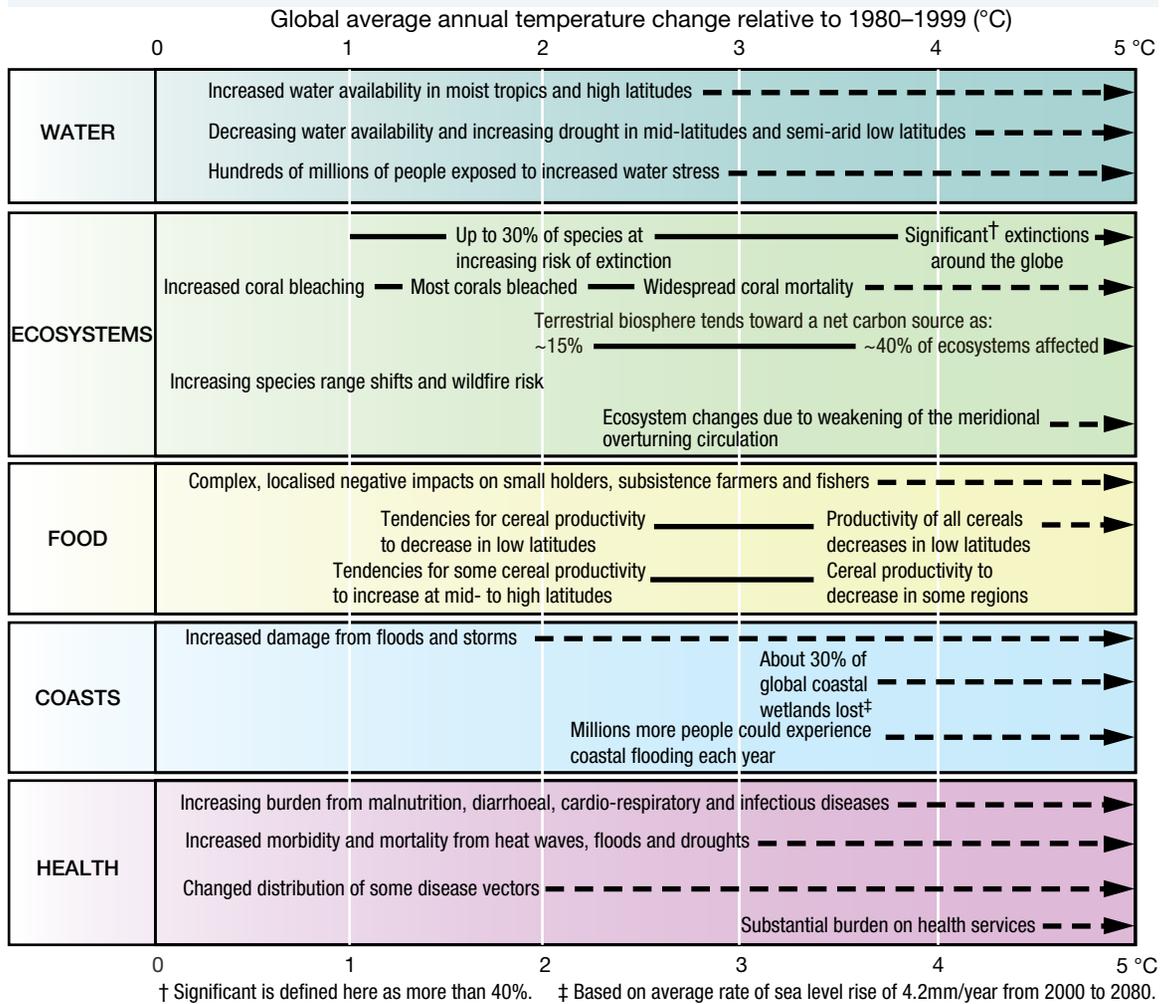


FIGURE 2 Projected consequences of climate change



There is a wide range of possible impacts of climate change. Sea-level rises may cause flooding and the loss of productive land in low-lying coastal areas, such as the Bangladesh and Nile River deltas. Changes in temperatures and rainfall may cause an increase in pests and plant diseases. However, agriculture is adaptable. Crops can be planted and harvested at different times, and new types of seeds and plants, or more tolerant species, can be used. Low-lying land may be lost, but higher elevations, such as mountain slopes, may become more suitable. The loss in productivity in some places may be balanced by increased production in other places. Figure 3 demonstrates the effects of climate change on cereal crops, while figure 4 shows the range of potential impacts across the European Union.

Essentially, hundreds of millions of people are at risk of increased food insecurity if they have to become more dependent on imported food. This will be evident in the poorer countries of Asia and sub-Saharan Africa, where agriculture dominates their economy. There is also a risk of greater numbers of **environmental refugees** or people fleeing places of food insecurity.

FIGURE 3 Predictions of the effects of climate change on cereal crops

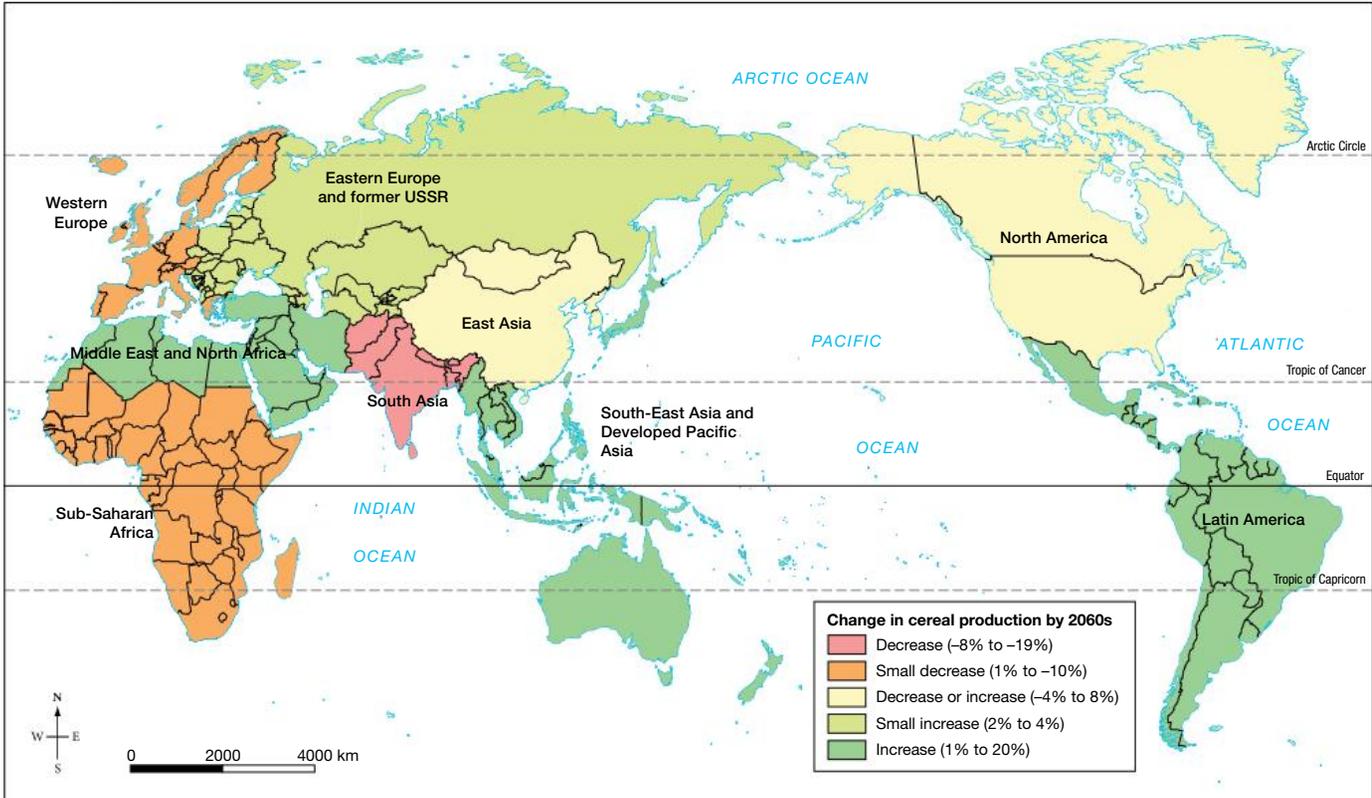
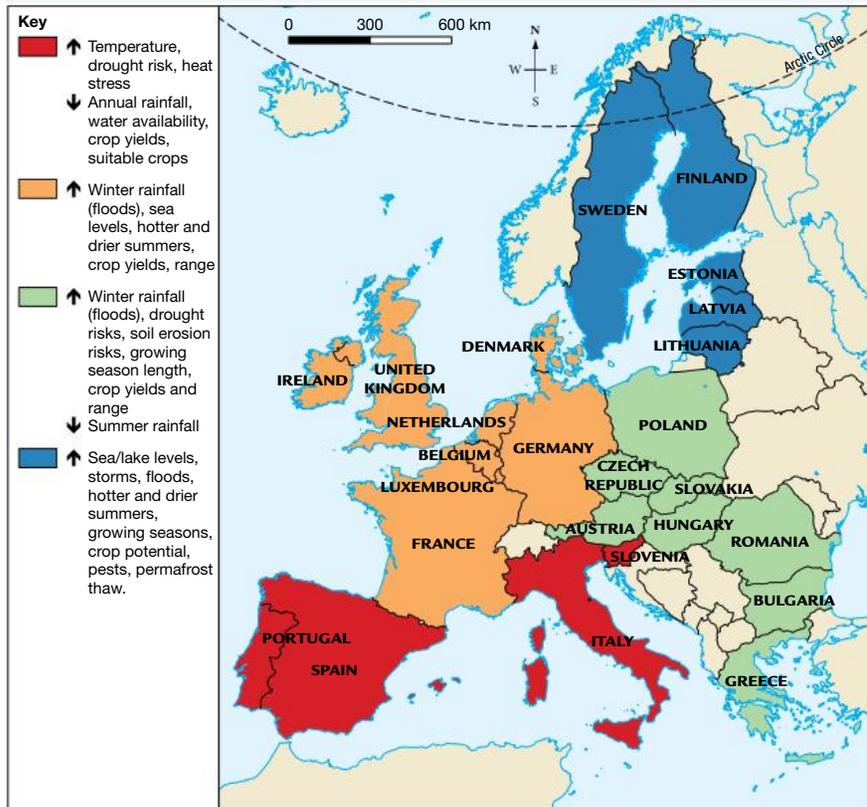


FIGURE 4 Examples of potential consequences of climate change in the European Union



5.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 2 and decide whether the following statements are true or false.
 - (a) If temperatures increase by 3 °C, you would expect to see crop yields rising around the equator.
 - (b) **Changes** in extreme weather events are unlikely unless temperatures increase by at least 1 °C.
 - (c) Food insecurity will be felt greatly in developing regions if temperatures rise more than 4 °C.
 - (d) **Places** that are likely to experience decreasing crop yields will be found in the higher latitudes.

Explain

2. (a) Refer to figure 3. Which **places** have the potential to be grain exporters and which **places** are likely to become dependent on grain imports? Use data in your answer.
(b) What are the economic and social implications of this for countries in these regions?
3. (a) Refer to figure 4. Which countries of Europe will benefit from climate **change** in terms of food production and which countries are likely to suffer negative outcomes?
(b) Would increased irrigation be a **sustainable** solution to growing food in Spain? Explain your answer.
4. Describe the **interconnection** between **environmental** refugees and climate **change**.

Discover

5. Research potential impacts of climate **change** on Australia. Create an annotated map to illustrate your findings.

Predict

6. How might a country such as Australia best prepare its food production systems to cope with potential **changes** in climate?

Think

7. How might food be shared more equitably around the world? Discuss with a group and report your suggestions back to the class.

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 Explore more with this weblink: [How to feed the world in 2050](#)

5.10 Why is food being wasted?

online only

Access this subtopic at www.jacplus.com.au

5.11 Review

online only

5.11.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

5.11.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

5.4 SkillBuilder: Constructing and describing complex choropleth maps

5.4.1 Tell me

What is a complex choropleth map?

A complex choropleth map is a map that is shaded or coloured to show the average density or concentration of a particular feature or variable, and it shows an area in detail. The collector areas of data are smaller, so they show the mapped information more precisely. The key or legend shows the value of each shading or colouring. The densest or highest concentration is usually the darkest shade. The least dense or lowest concentration is usually the lightest shade. Average values are attached to the colour shadings in the key or legend. In constructing your own choropleth map, you need to determine the values that relate to each shade within a colour range.

Why are complex choropleth maps useful?

A complex choropleth map is used to show values in a pictorial way. It allows the viewer to quickly identify where the values are highest (darkest) and lowest (lightest) and to note any patterns over space. However, the information is based on averages, and precise data is not given for a particular place or region within the map. Areas can contain within them wide variations from the average value mapped.

Complex choropleth maps are useful for showing:

- the distribution of a feature across a city or country
- the extent of a feature across a region
- patterns, which are indicated by the changing colours of the map
- conglomerations of data in specific locations.

Model

The change in Sydney's population between 2001 and 2006 has been very uneven. The areas of greatest increase (1440 to 4780) are scattered across the city, with most of this found on the urban fringes.

Most areas that have experienced the greatest increase are clustered together — for example, around Baulkham Hills, Blacktown and Parramatta in the west and north-west, and Liverpool and Campbelltown in the south-west. There are relatively few census areas that show minimal increase (0 to 290 people).

The areas of greatest decrease (–3200 to –690) are also scattered across the city. Most of these decreases are found on the urban fringes, especially in the west and south-west of Sydney, between Liverpool and Campbelltown.

The areas with the smallest change (0 to 290 increase) tend to be found in areas about 5 to 15 kilometres from the city. Clusters are found on the north shore around Chatswood, north-east and south-east of Parramatta, and around Penrith.

The most common kind of change is moderate decline (–690 to 0). Clusters of this change are found around Penrith and Botany Bay, north and south-east of Hornsby, and north of Campbelltown.

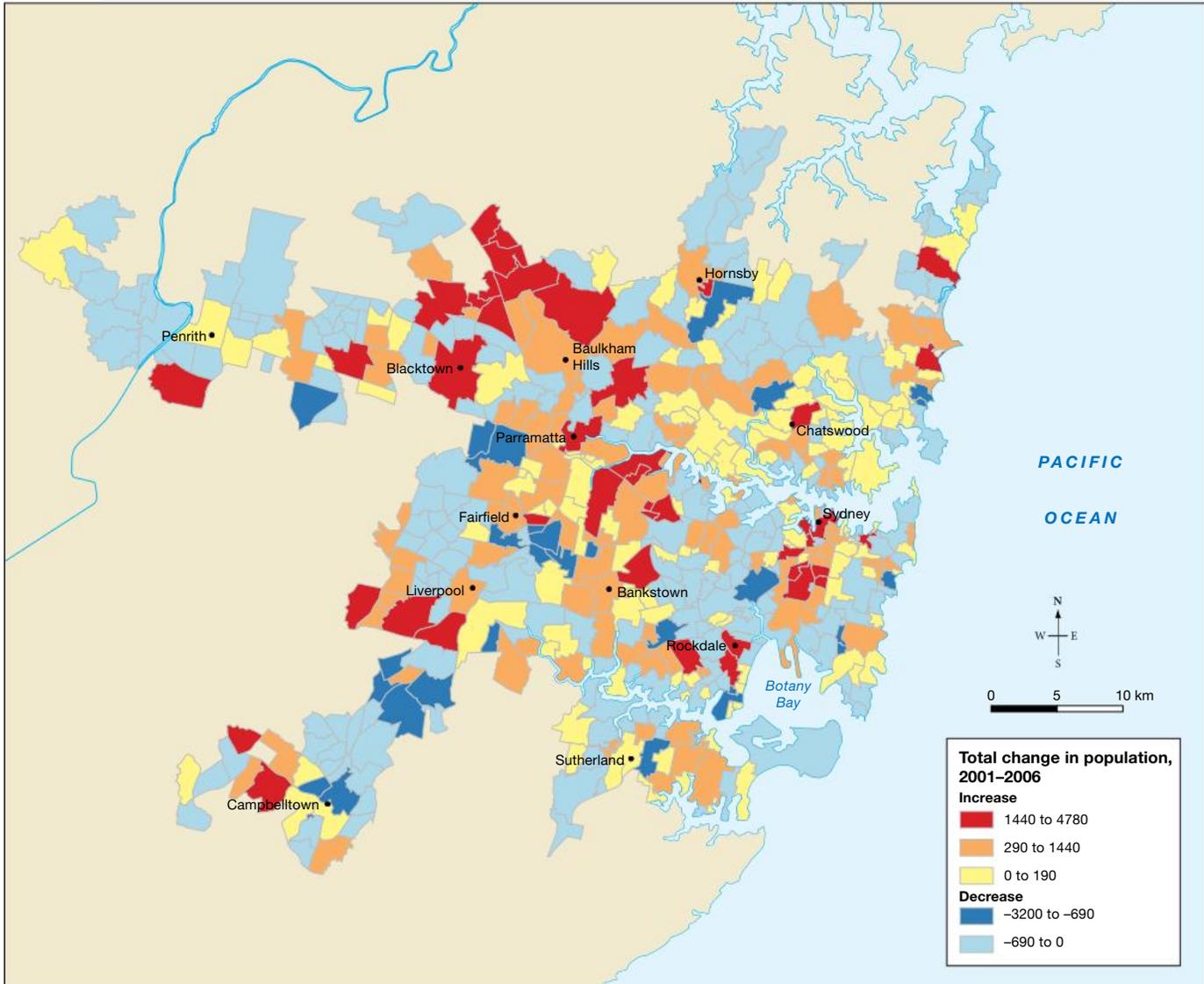
A good complex choropleth map:

- uses a base map
- has clearly determined values for each colour
- uses shades within a colour spectrum
- is neatly coloured
- includes a clear title.

A good description of a complex choropleth map:

- looks for a pattern and subtleties within a broad pattern
- notes any anomalies
- uses quantities
- refers to the title and legend.

FIGURE 1 Population change in Sydney, 2001–06



Source: Spatial Vision

5.4.2 Show me

How to construct and describe a complex choropleth map

You will need:

- a set of data specific to a range of places
- a base map to match the places
- coloured pencils with a range of shades
- a ruler.

Procedure:

Constructing a choropleth map

STEP 1

Select a set of data to map, and ensure that you have a base map to match the area. In figure 1, the ABS data is based on small regions across Sydney, and the base map shows the boundaries of those regions. The ABS website will provide you with the names of these areas.

STEP 2

Look at the range of data you have to plot. In figure 1, there were positive and negative numbers to consider, but this is not always the case. You should try to divide the data into approximately five categories — too many categories will spread the data too thinly, while too few categories will show few variations in the data. For each category, select a colour shade where the darkest colour represents the greatest value and the lightest colour represents the lowest value. Create a key on the base map.

STEP 3

Now very carefully colour all areas on the base map with the highest value. It is a good idea to go through the list of data and colour code each place before you begin.

STEP 4

Check that the geographical conventions are complete: border, orientation, legend, title, scale and source.

Describing a choropleth map

STEP 5

To interpret the colours, you need to comment on where the deepest or most intense colours occur. Can you discuss the map by areas? For example, in figure 1 the areas of greatest change (1440 to 4780 people), represented by a deeper colour, are scattered across the city but are most likely to be found on the urban fringes, indicating the growth of the city's boundaries.

STEP 6

To further interpret the colours, you need to comment on where the lightest or least intense colours occur. Can you discuss the map by areas? For example, in figure 1 most of the areas that have shown only moderate increase (0 to 290) are found 5 to 15 kilometres from the city.

STEP 7

To identify a subtle change, you need to look for a change of colour within an area that is predominantly one colour. In figure 1, in the middle of the northern area of 1440 to 4780 increase there are two census areas that show 290 to 1440 increase.

STEP 8

Are there any coloured areas that stand out from the rest as being unusual? That is, is there a colour among a mass of other colour that isn't expected? This is called an anomaly, and needs to be discussed. Identify the place that is different from the surrounding places. For example, there are no areas of 1440 to 4780 increase in the Sutherland Shire, south of the river that flows into Botany Bay.

5.4.3 Let me do it

Developing my skills

Use the data from table 1 (showing official development assistance to agriculture in sub-Saharan Africa in 2010) and a base map of Africa (use doc-12012 in the Resources tab) to construct a choropleth map.

Describe what is shown on your map.

Questions

1. Which regions of sub-Saharan Africa receive the most agricultural assistance?
2. Which regions of sub-Saharan Africa receive the least agricultural assistance?
3. Which countries within southern Africa (south of 10°S) received quite different agricultural aid from that of their neighbours?

TABLE 1 Official development assistance to agriculture in sub-Saharan Africa, 2010

| Country | (US\$ million) |
|--------------------------|----------------|
| Angola | 27 |
| Benin | 21 |
| Botswana | 1 |
| Burkina Faso | 71 |
| Burundi | 96 |
| Cameroon | 62 |
| Cape Verde | 3 |
| Central African Republic | 3 |
| Chad | 9 |
| Comoros | 2 |
| Congo | 1 |
| Cote d'Ivoire | 93 |

(continued)

4. Are there any parts of the region that you think should receive more aid? Can you think of a reason why aid might not be going to these countries? Look at the food security risk map in figure 1 in section 5.3.1 to support your ideas.
5. Will aid make a difference to the figures produced in 10 years' time? Explain your answer.

Checklist

In drawing a complex choropleth map, I have:

- used a base map
- included clearly determined values for each colour
- used shades within a colour spectrum
- coloured neatly
- included a clear title.

In describing a complex choropleth map, I have:

- looked for patterns and subtleties within a broad pattern
- noted the anomalies
- used quantities
- referred to the title and legend.

Skills questions

1. Complex choropleth maps are used to show:
 - (a) the height of the land across a region
 - (b) a range of colours
 - (c) the distribution of one factor
 - (d) the detailed distribution of one factor.
2. A complex choropleth map includes information about:
 - (a) numbers
 - (b) colours
 - (c) species
 - (d) ground cover.
3. Why should you use a carefully selected colour spectrum?
4. Why does your map need to be neat?

TABLE 1 (continued) Official development assistance to agriculture in sub-Saharan Africa, 2010

| Country | (US\$ million) |
|---|----------------|
| Democratic Republic of Congo | 100 |
| Eritrea | 13 |
| Ethiopia | 222 |
| Ethiopia (People's Democratic Republic) | 28 |
| Gabon | 15 |
| Gambia | 126 |
| Ghana | 8 |
| Guinea | 10 |
| Guinea-Bissau | 323 |
| Kenya | 0 |
| Lesotho | 36 |
| Liberia | 19 |
| Madagascar | 79 |
| Malawi | 223 |
| Mali | 11 |
| Mauritania | 0 |
| Mauritius | 72 |
| Mozambique | 14 |
| Namibia | 43 |
| Niger | 69 |
| Nigeria | 68 |
| Rwanda | 3 |
| Sao Tome and Principe | 256 |
| Senegal | 1 |
| Seychelles | 75 |
| Sierra Leone | 1 |
| Somalia | 20 |
| South Africa | 145 |
| Sudan | 6 |
| Swaziland | 36 |
| Togo | 198 |
| Uganda | 132 |
| United Republic of Tanzania | 36 |
| Zambia | 81 |
| Zimbabwe | 3 |

Source: Food and Agriculture Organization of the United Nations, 2012, FAO, *The State of Food and Agriculture 2012*, <http://www.fao.org/docrep/017/i3028e/i3028e.pdf>

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-  **Watch this eLesson:** Constructing and describing complex choropleth maps (eles-1732)
-  **Try out this interactivity:** Constructing and describing complex choropleth maps (int-3350)
-  **Complete this digital doc:** Blackline master: Map of Africa (doc-12012)

5.5 How does a famine develop?

5.5.1 Why did Somalia have a famine?

While many countries across the globe face food insecurity, it is rare for a country or region to be officially declared in **famine**. At the same time that countries in the Horn of Africa were suffering drought, much of southern Australia was similarly affected. Yet we did not suffer from food insecurity, nor was a famine declared. Why is there such a difference?

Somalia is located in the Horn of Africa. It is an arid place with less than two per cent **arable** land. For twenty years, the country suffered almost continual hardship. A combination of political, economic and environmental factors combined to create an acute food crisis. The United Nations declared a famine in two parts of southern Somalia in July 2011, and a month later the famine spread to four more regions. Figures 2 and 3 show the progression of the famine across the country. In all, 42 per cent of the population needed emergency life-saving assistance over the six months of the declared famine.

FIGURE 1 Famine in Somalia, May 2011



What contributed to the famine?

- The country experienced the worst drought in 60 years, which led to failed harvests.
- Prices of both local and imported foods soared; cereal prices increased up to 190 per cent.
- Since the 1990s, there have been 14 failed attempts to achieve peace and reconciliation within the country.
- The militant Islamist al-Shabaab group banned most Western aid agencies and expelled the Red Cross from areas it controlled.
- Somalia had not had a functioning central government for more than 20 years.
- Conflict and a shortage of food caused people to flee rural areas, creating large-scale displacement.
- Half of all food aid sent to Somalia was stolen.
- Somalia was dependent on imports for over 60 per cent of its food supply (mostly rice and wheat flour).
- The country lacked good road and rail infrastructure, so food could not be moved around and delivered easily. Frequent militia-run checkpoints made travel dangerous.

- Shipping was affected by increased pirate attacks in the Gulf of Aden. This further increased the shortage and cost of imported foods.
- The main port could only deal with small ships. Larger ships had to offload into smaller ones in Dubai or Oman, which increased the costs of food items.

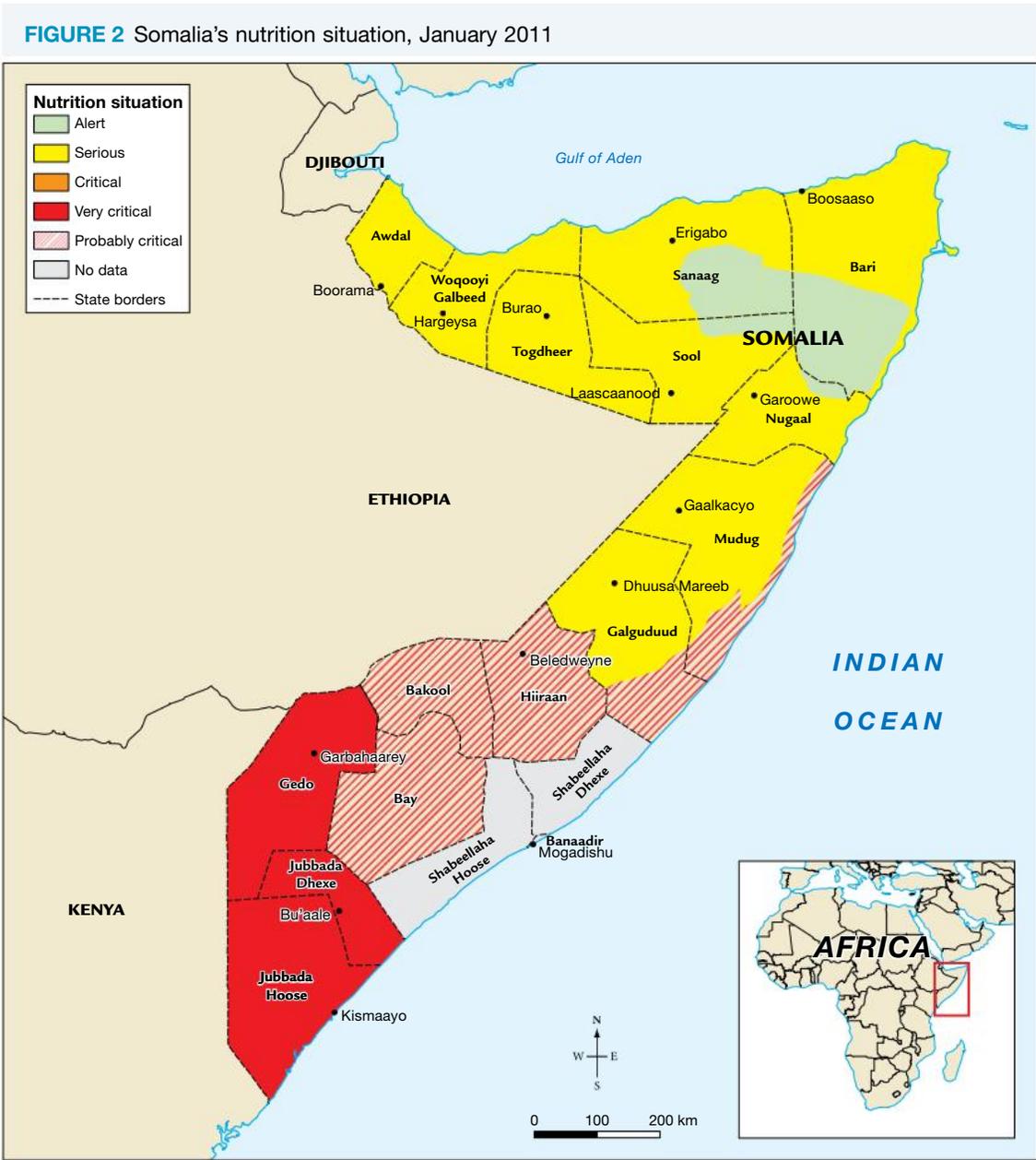
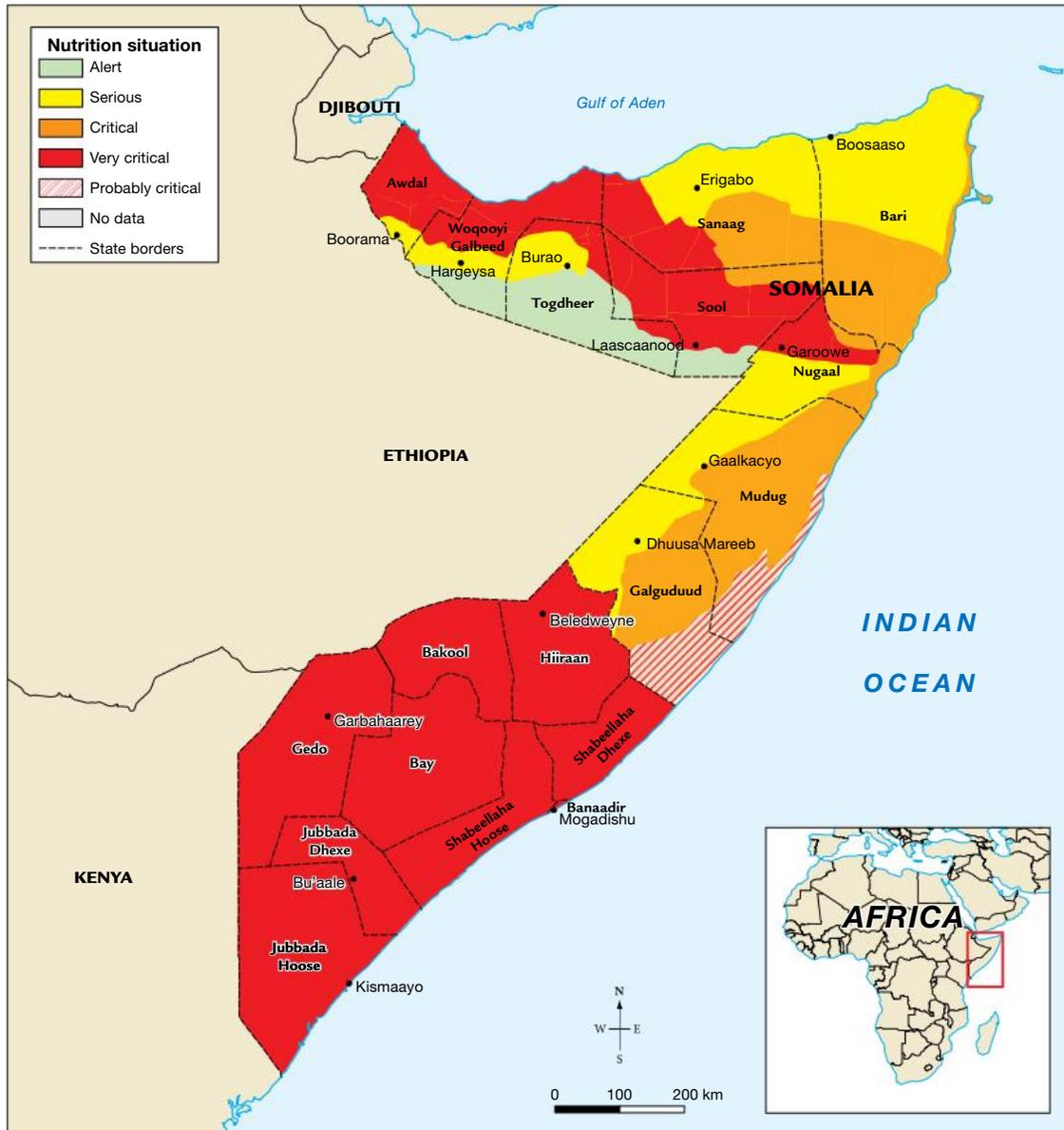


FIGURE 3 Somalia's nutrition situation, August 2011



Source: Data from FAO, Food Security and Nutrition Analysis Unit.

5.5.2 What were the impacts of famine?

- More than 260 000 people died, and more than half of these were children under the age of five.
- Approximately 30 000 children died in just four months, from April to July 2011.
- Three million people in southern Somalia became food insecure.
- Along with displaced people, around 25 per cent of urban populations were affected by high food costs and food shortages.
- The United Nations estimated that over 1.4 million people became IDPs (internally displaced persons). Over 900 000 became refugees, fleeing to Ethiopia and Kenya in search of food.
- Livestock was decimated.
- Due to the high costs of purchasing food, diets were reduced to less than four food groups per day, mostly grain and oil, and the number of meals per day was reduced.

What is happening now?

The famine was officially declared over by February 2012. This was due to a combination of good rainfall (allowing crop harvests to double that of the previous 17 years' average) and large-scale **humanitarian aid**. Twelve months later, however, 3.8 million people still needed emergency support in the form of food, clean water, shelter and help in restocking their land with seeds and grazing animals. Other assistance included drilling more water bores, supplying irrigation pumps, and providing cash-for-work projects to upgrade irrigation channels.

In 2015, Somalia was still considered to be in a 'critical' state, with continuing high levels of malnutrition and food insecurity. It is estimated that 855 000 people were in need of help, with 215 000 children classified as malnourished. Poor rains had impacted on harvests, and at least one million people were still internally displaced and reliant on food aid.

5.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. When does a food crisis become a famine?

Discover

2. Refer to figures 2 and 3.
 - (a) Construct a table to compare the approximate percentages of the country classified as: on alert, serious, critical, very critical, and likely critical.
 - (b) Describe the **changes** over time in the spread of the famine.
3. With the help of your atlas, identify the direction and countries that most refugees flee to.
4. Refer to figure 1 and use the **Fleeing Somalia's drought** weblink in the Resources tab to watch a slideshow on the Somalian famine.
 - (a) Make a list of all of the belongings of the family in figure 1 in the refugee camp.
 - (b) Describe the **environment** around the camp and the living conditions there.
5. List the difficulties that aid agencies might have when faced with getting aid to people.

Predict

6. (a) What might happen when you get a relatively sudden and large-scale movement of people fleeing from one country and crossing the border into another?
 - (b) What happens to the refugees? What can the new host country do?

Think

7. Much of Australia was in an extended period of drought for over ten years, yet we did not experience food insecurity. Why?

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Explore more with this weblink: [Fleeing Somalia's drought](#)

5.7 SkillBuilder: Interpreting satellite images to show change over time

5.7.1 Tell me

What is a satellite image?

A satellite image is an image taken from a satellite orbiting the Earth. Satellite images allow us to see very large areas — much larger than those that can be visualised using vertical aerial photography. A satellite image often does not use the natural colours that we expect. This is referred to as using false colours, and these are applied in the computer processing of the images in order to highlight spatial patterns more clearly.

Why is a satellite image useful?

A satellite image is useful because its size allows us to see trends and patterns, interconnections and relationships. Cartographers are able to increase the intensity of colours and use false colours to distinguish one feature from another. Satellite images are enhanced photography. Comparing satellite images can provide information about change over time. You will gain a lot of information from a satellite image that cannot be gained from a topographic map or aerial photograph, so your knowledge of an environment is enhanced.

Satellite images are useful for:

- identifying changes in heat patterns from different surfaces
- assessing vegetation modifications
- identifying urban sprawl
- tracking data across international boundaries.

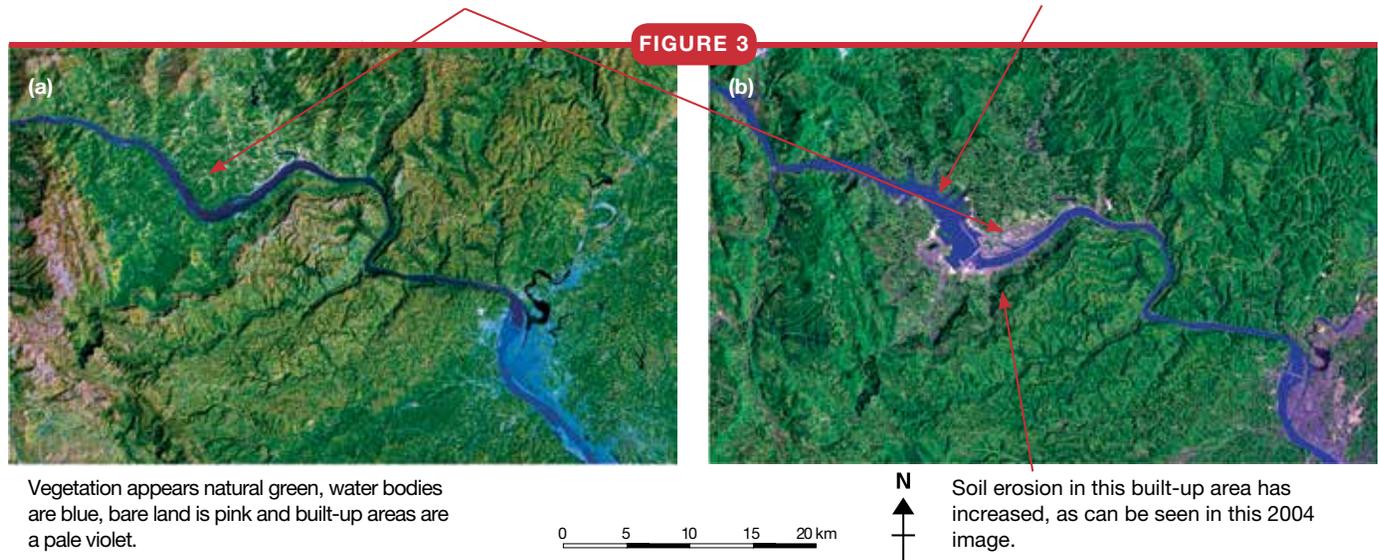
Model

The Yangtze River in 1987 was a natural river running through a deep gorge. In the satellite image from 1987, the area is surrounded by high, barren hills and areas of dense subtropical forest (natural green).

FIGURE 1 Change over time around the Yangtze River, China: (a) in 1987 and (b) in 2004, after the building of the Three Gorges Dam

The images show the major changes that have occurred as a result of the development: in the area around the dam (in the centre of both images) former farmland and forest have been largely replaced by a man-made landscape.

The Three Gorges Dam is located in a subtropical region that supports evergreen and deciduous mixed forest.



Source: Geoscience Australia

By 2004, the Three Gorges Dam wall (pale violet) had been built across the river. The water (blue) filled behind the two-kilometre dam wall and spread across the gorge floor, flooding back up the river about eight kilometres. New urban areas (pale violet) developed east and west of the dam wall on both sides of the river. In the 17 years since the first satellite image was taken, a town has developed on the low-lying land in the south-east covering an area of about 36 square kilometres.

A good interpretation of a satellite image:

- translates the false colours
- identifies patterns
- makes logical inferences
- uses distance and direction to locate places.

5.7.2 Show me

How to interpret satellite images to show change over time

You will need:

- two satellite images of the same place, taken at different times
- an atlas.

Procedure:

STEP 1

Determine the dates for the satellite images. Consider how many years it is between the images. In figure 1, the time span is 17 years. Check that the satellite images are at the same scale. Note that in figure 1, the 1987 and 2004 images show slightly different areas, but at the same scale. The central area of interest is covered by both images.

STEP 2

Study the satellite images carefully, identifying the key features of the place. In satellite imagery, true colours are not always used. It is helpful to learn the colours commonly used in false-colour imagery.

TABLE 1 Colours commonly used in false-colour satellite imagery

| Colour | Ground feature |
|---------------------------|---|
| Green | Vegetation |
| Dark blue | Water — the deeper the water, the darker the colour |
| Bright blue to mauve/grey | Housing and industrial areas |
| White to cream | Beaches and sands |
| Yellow | Barren areas, heavily grazed or fallow land |
| Pink to red | Recent plant growth, suburban parklands |
| Red | Flourishing vegetation, including forests (mangroves appearing brown) |

In the description in figure 1, the colours have been included to help you see the patterns evident in the satellite images.

STEP 3

To interpret the colours, you need to comment on where the various colours appear. Use compass directions, scale or features identifiable on the satellite image, such as roads and rivers, to help reference the place that you are discussing. For example, the text below figure 1 says ‘The water (blue) filled behind the two-kilometre dam wall’.

STEP 4

Use the same feature in each of the satellite images as a reference point for identifying change. It may be the road system, a railway line passing across the region, a river flowing through the area or a town

established in the earliest dated image. For example, in figure 1 the Yangtze River is a key feature that allows you to identify points by the bends in the river.

STEP 5

It may be possible to make inferences from the satellite image. You may be able to see changes in topography, and these may relate to changes in land use. For example, in 1987 the area of the present-day dam was surrounded by high, barren hills and areas of dense subtropical forest; by 2004 a human-constructed landscape surrounded the dam.

5.7.3 Let me do it

Developing my skills

Refer to the satellite images for Tehran in 1985 and 2009 shown in figures 3a and 3b in section 5.6.1. Write a description of the change over time that has occurred to the boundaries of Tehran.

Questions

1. Is Tehran a growing or declining city? Explain your answer.
2. The colouring indicates large areas of barren land. Why is this the case on the outskirts of Tehran?
(*Hint: Where is Tehran?*)
3. How has the vegetation cover of the area changed?
4. How has the road pattern changed by 2009?
5. Why do you think Tehran has not expanded into the south-east corner of the satellite image?
6. How has the growth of Tehran affected food security in the area?

Checklist

I have:

- translated the false colours
- identified patterns
- made logical inferences
- used distance and direction to locate places.

Skills questions

1. Satellite images are used to show:
 - (a) the height of the land at a place
 - (b) details of a small area
 - (c) rainfall intensity
 - (d) information for a vast area.
2. Interpreting satellite images includes being able to understand:
 - (a) a legend
 - (b) false colours
 - (c) natural colours
 - (d) contours.
3. Why are false colours often used on satellite images?
4. When looking for change over time, why might it be important to look at a satellite image carefully before making an interpretation?

learn on RESOURCES – ONLINE ONLY

 **Watch this eLesson:** Interpreting satellite images to show change over time (eles-1733)

 **Try out this interactivity:** Interpreting satellite images to show change over time (int-3351)

5.10 Why is food being wasted?

5.10.1 What is the link between waste and food security?

What food have you thrown out today? Across the world, one-third of all food produced is wasted. In 2015 this food waste was valued at \$750 billion! Around 1.3 billion tonnes is dumped or left to rot. And yet, over one billion people go hungry every day. If we could reduce our waste by half, it would be the equivalent of a 15 to 25 per cent increase in the amount of food available. That would go a long way towards improving food security.

To meet the growing demand for food by the middle of this century, it has been calculated that the world will need to produce as much food as has been produced over the past 8000 years. The world does produce sufficient food for everyone, but distribution and affordability prevent it from getting to everyone who needs it. However, dealing with wasted food would certainly help to reduce food vulnerability.

Food wastage also represents a waste of the resources used in production, such as land, fertiliser and energy. Waste can increase prices, making food less affordable. The World Bank has calculated that in sub-Saharan Africa, a region prone to food insecurity, a reduction of only one per cent wastage could save \$40 million per year, with most of this saving going to the farmers.

A consequence of food wastage is the need to dispose of the waste, usually by dumping or burning. The greenhouse gases given off from global landfill sites amount to 3.3 gigatonnes per year. This figure is slightly less than the total greenhouse gases given off from the United States or China.

Developed nations alone waste over 222 million tonnes per year — only slightly less than the 230 million tonnes of food produced annually in the countries that make up sub-Saharan Africa.

FIGURE 1 Surplus tomatoes dumped in Tenerife, Canary Islands



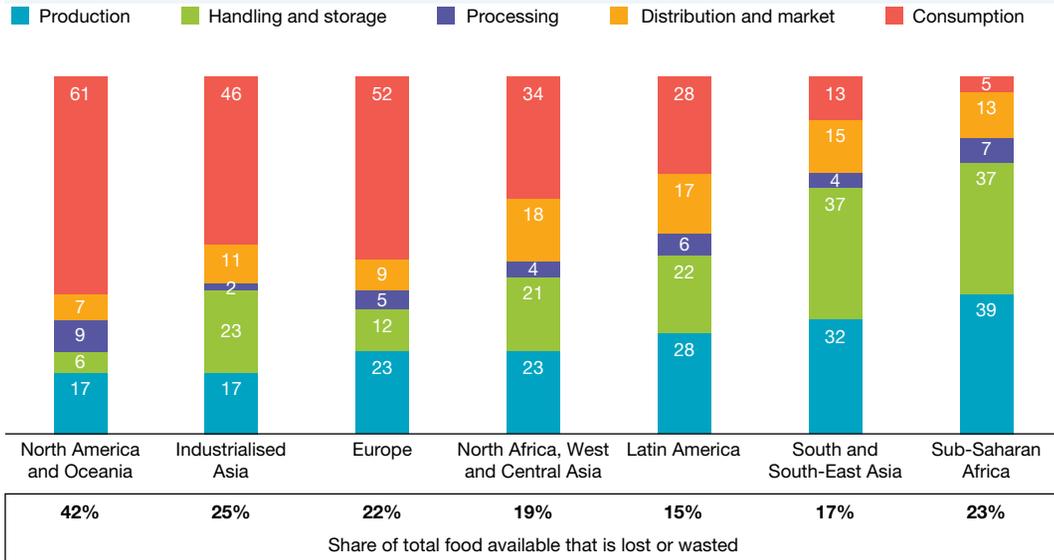
Where and why is food being wasted?

Food waste exists across all countries, regardless of their levels of development, although the causes of wastage vary. Figure 2 shows the breakdown of food wastage on a regional basis.

In developing nations, food losses are mostly related to a lack of food-chain infrastructure and a poor knowledge of, or investment in, storage technologies on farms. Other causes of waste are: lack of refrigeration; limited or non-existent road and rail networks to deliver food to markets; and a shortage of processing and packaging facilities. In India, up to 40 per cent of fresh food is lost due to a lack of cold storage in wholesale and retail outlets. Over one-third of the rice harvest in South-East Asia can be destroyed by pests or spoilage. Even if farmers can produce a surplus and store it, they are often forced to sell it to raise cash.

In contrast, in the developed world, food waste is more evident at the retail and home stages of the food chain. In this case, food is relatively cheap so there is little incentive to avoid waste. Consumers are used to purchasing food that is visually appealing and blemish free, so retailers end up throwing out perfectly edible, if slightly damaged, food. More and more people rely on ‘use by’ dates, so despite the food still being suitable to eat, it is discarded. Waste is also a part of the growing culture of ‘supersize’ or ‘buy one get one free’ advertising. Further waste can occur if the discarded food is sent to landfill when it could be used for animal feed or even compost.

FIGURE 2 World per capita food losses and waste by region (measured in kilograms and rounded to the nearest whole number). The average North American or European consumer wastes 95 to 115 kilograms per year, especially fruit and vegetables. The average level of food waste in sub-Saharan Africa or south and South-East Asia is only 6 to 11 kilograms per year. Poverty and limited incomes make food waste unacceptable.

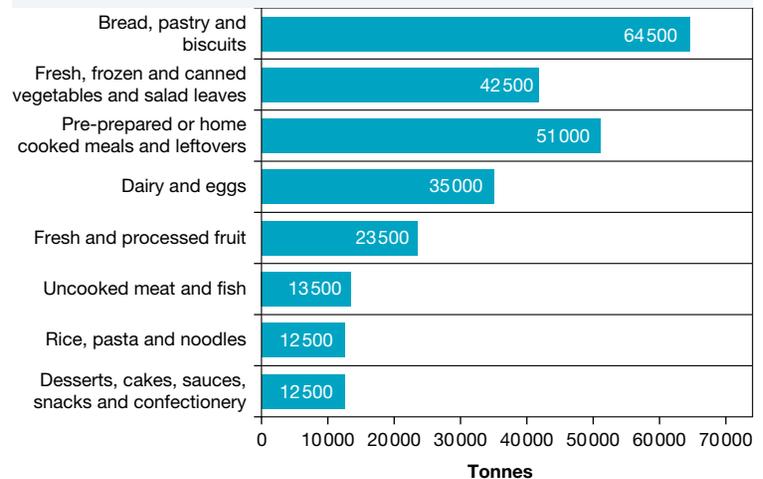


What is wasted in Australia?

Each year a minimum of 250 000 tonnes of food is wasted. If Melbourne’s tallest building, the Eureka Tower, was a rubbish bin, this amount of waste would fill it. Each household effectively throws away \$2200 per year. This could feed 367 000 families budgeting on \$207 per week. Imagine the food that could be bought for that amount in a food insecure place!

Figure 3 represents some of the contents of the ‘Eureka bin’.

FIGURE 3 Household food waste in Victoria



What can be done about food waste?

Reducing global food waste is a part of the new Sustainable Development Goals, a set of targets designed to develop a more sustainable future for the world. The specific target is to cut per capita food waste by 50 per cent by 2030. If this can be achieved, food security will be improved, greenhouse gases can be reduced and valuable land and water resources will not be wasted.

Here is a snapshot of what is happening around the world:

- In the United States, approximately one-third of the nation’s food supply is thrown away annually. The government, in partnership with charities and the business sector, is targeting a 50 per cent cut in edible food waste per year. Reducing food waste by even 15 per cent could feed 25 million Americans each year; more than half of these people already live in food-insecure households. Large corporations such as Kellogg’s and Nestlé have committed to slashing food waste in their manufacturing and retail systems.

- In France, an estimated 7.1 million tonnes of food is wasted each year: 67 per cent by consumers, 155 by restaurants and 11 per cent by shops. At the same time, 3.5 million French people are dependent on food handouts from charities. A new law now forces restaurants to provide a ‘doggy bag’ or containers in which customers can take home uneaten food. Shops are also banned from destroying food products and supermarkets must give away unsold food that has reached its use by date for distribution to charities.
- Seoul in South Korea has taken a different approach in an effort to reduce its food waste by 20 per cent. It is trialling a program whereby people are charged according to the weight of the garbage they produce. The more kilograms generated, the higher the bill. Newly designed bins with built-in scales are activated with ID cards.
- In 2011, Sweden decided to convert its food waste into a resource, with a national plan to convert 50 per cent of its food waste into biogas by 2018. The city of Malmo is already fuelling its fleet of 177 buses with 62.5 per cent of its biofuel requirements.

5.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Discover

1. In groups, and wearing disposable gloves, conduct a survey of the school rubbish bins after lunch. You may need to lay out newspaper, onto which you can tip the contents of the bins. Some groups could also deal with food litter around the grounds.
 - (a) Construct a table so that you can record the different food types, such as fruit, cakes, biscuits and so on.
 - (b) Collate your results with the other groups in your class, and then graph your data.
 - (c) Write a summary of your findings. What food types were most and least represented and why?
 - (d) If your school has a canteen, ask the manager to address the class and talk about issues such as waste-age, use-by dates and health department regulations.
2. You could also do a home bin audit and follow the same procedure.
3. Visit a local food store, such as a supermarket, fresh food market, greengrocer or butcher. Interview them and find out what happens to their food waste. Report back to the class.
4. Design a poster or short animation to inform other school members about the issue of food waste.
5. Write a letter to the local newspaper voicing your thoughts on this matter.

5.11 Review

5.11.1 Review

Food security

1. Refer to figure 1 in subtopic 5.3 and a map of the world (you can use doc-11392 in the Resources tab).
 - (a) Construct a three-colour bar graph to list the number of countries in each world region (Europe, North America, South America, Central America, Asia, sub-Saharan Africa, North Africa, Middle East and Oceania) that have a low, medium or high to extreme risk of food insecurity.
 - (b) Which regions of the world are most represented in the low-risk category?
 - (c) Which regions of the world are most represented in the high- to extreme-risk category?
 - (d) Compare those *places* at extreme risk shown in figure 1 in subtopic 5.3 with an atlas map of world GDP and an atlas map of infant mortality or life expectancy. Write a detailed summary of your observations, using country names and data in your answer.
2. Each member of the class should select a country in Africa that is shown to be at high or extreme risk in figure 1 in subtopic 5.3. Conduct research to find out the leading causes of their food shortages. Collate the results, and then, using a series of symbols, create a map of Africa to show the main factors contributing to food shortages in these countries. Summarise your map with a written description.

Famine in Somalia

3.
 - (a) Refer to section 5.5.1 on the famine in Somalia. Create a mind map diagram to show the *interconnections* between the different factors contributing to the famine.
 - (b) Of the range of factors contributing to the famine, which do you consider to be the three most influential? Rank the top three and justify your ranking.
4. Use the **Fleeing Somalia's drought** weblink in the Resources tab to watch a slide show about Somalia's famine. Select three images and write annotations for these based on what you have learned from the case study on Somalia.

Land

5.
 - (a) Refer to figures 3a and 3b in section 5.6.1. Describe three *changes* that have taken place in Tehran over time.
 - (b) What is the *interconnection* between urbanisation and food security?
6. Read the article extract below, then answer the questions that follow.

Paving devours farmland faster than foreign buyers

by Natasha Bitá

Australians have lost five times more farmland to urban sprawl than to foreign buyers, with 89 million hectares vanishing in a generation.

Housing subdivisions, national parks, forestry plantations and mining leases have chewed up 18 per cent of Australia's agricultural land since 1984.

The Planning Institute of Australia has warned a federal government taskforce drafting the nation's first 'food plan' that the conflict over rural land is 'one of the most significant issues facing food production'.

'Urban development is paving over farmland on the edge of our metropolitan cities,' the institute says in its submission.

'Australia's agricultural land is a scarce and finite resource. There is a need to ensure that the land that grows the food is preserved for that purpose.'

Foreigners have almost doubled their stake in Australian farms, with full or part-ownership of 11.3 per cent of farmland in 2010 compared with 5.9 per cent . . . in 1984.

'Two thirds of the perishable vegetables grown in Australia are grown on the metropolitan fringe of the capital cities and the coastal areas of Queensland. That's where the best soil is, and we're running out of land to grow food.'

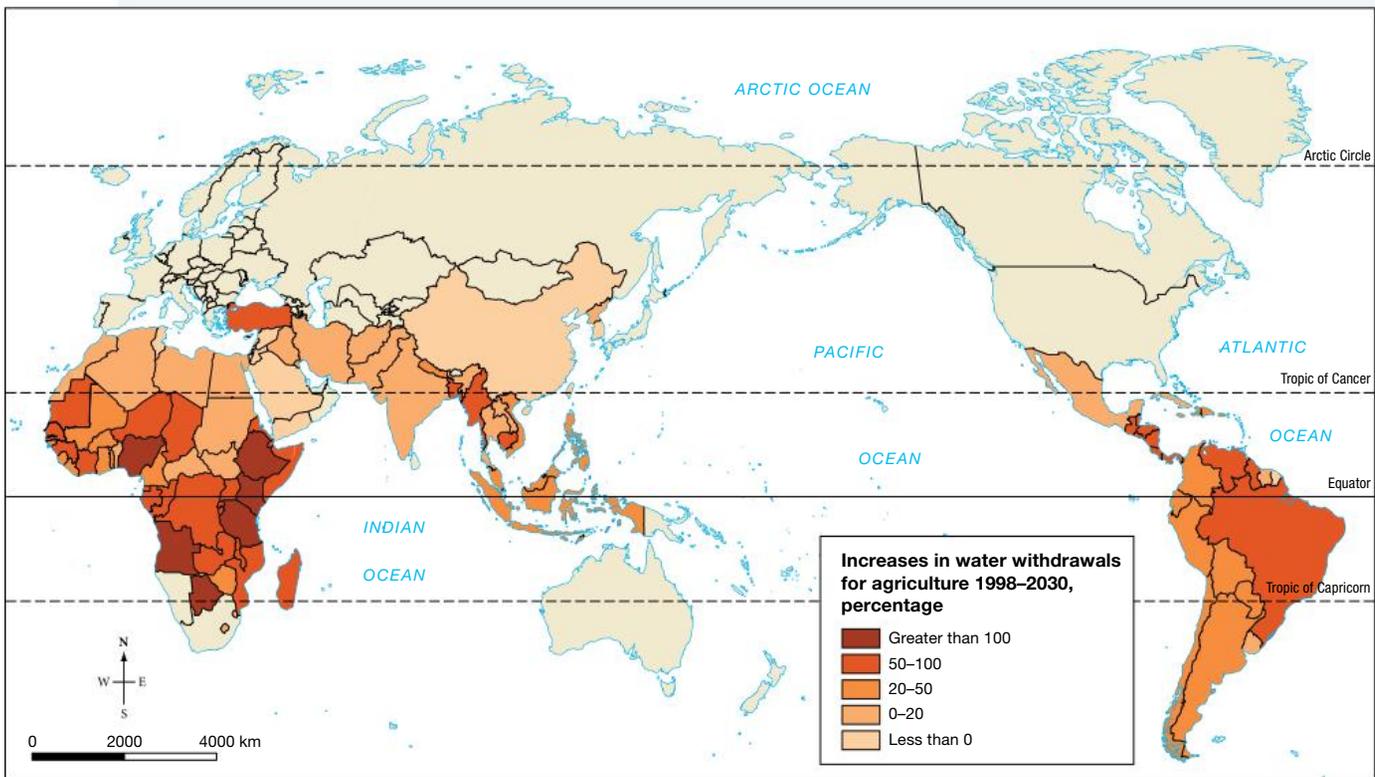
The Australian, 21 January 2012

- (a) What land uses have taken over from farmland since 1984?
 - (b) What types of crops need to be grown close to cities?
 - (c) Why do you think Australia's agricultural land is a scarce and finite resource?
7. Foreign investment in Australian farmland increased from 5.9 per cent in 1984 to 11.3 per cent in 2011. How might foreign owners benefit from owning farmland in Australia? How might Australia benefit?
 8. Refer to figure 2 in subtopic 5.6. The original land use for this location was tropical rainforest.
 - (a) Why might this area have been cleared?
 - (b) Is this a suitable landscape for such extensive clearing? Explain your answer.

Water

9. Approximately 20 per cent of the protein that humans eat comes from animal-based products. Scientists suggest that if people reduce their meat consumption to five per cent of their daily diet, this will allow more water to be available for plant-based food production. Keep a record of your daily food intake over several days and calculate (using an online kilojoule counter) what percentage of your diet is made up of meat. How does this compare with others in your classroom? Now plan a three-day menu in which only five per cent of your diet is made up of meat-based products.
10. Study the information in figure 1.

FIGURE 1 Predicted increases in water use for agriculture 1998–2030. There will be increases greater than 100 per cent in six countries, and increases less than 20 per cent in 41 countries.



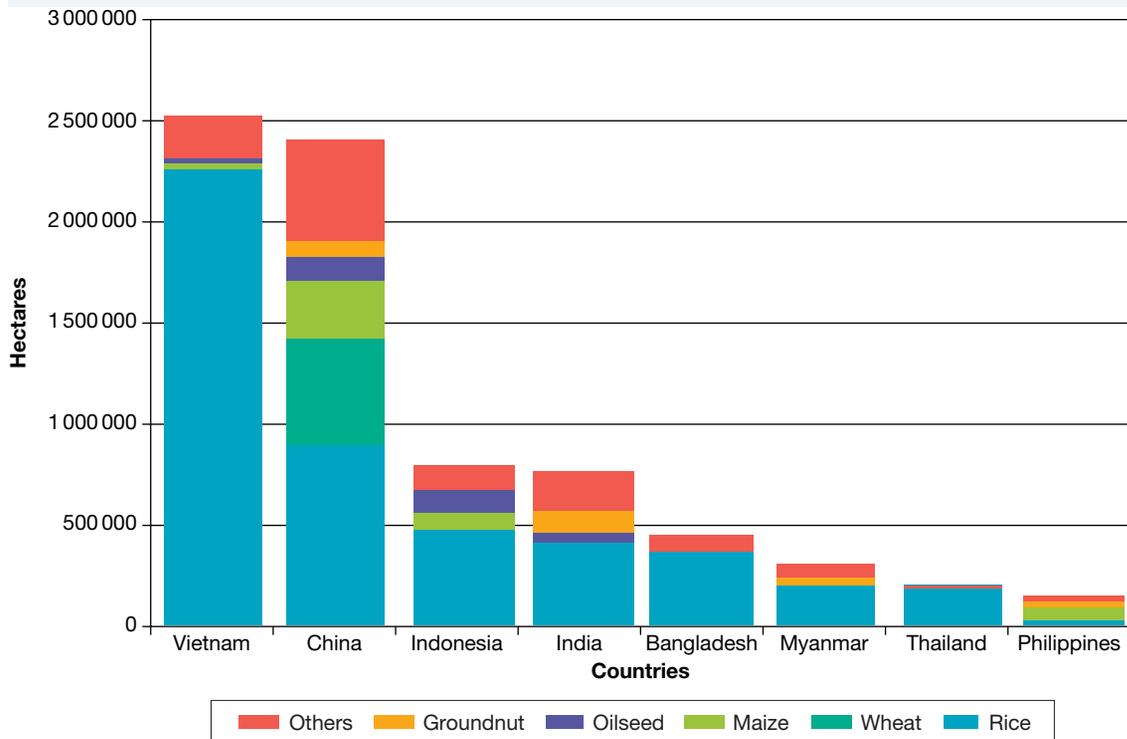
Source: Spatial Vision

- (a) Describe the distribution pattern of countries that are predicted to withdraw over 100 per cent more water in the years to 2030.
- (b) Suggest a reason why Australia, the United States and countries in Europe are not in this category.

Climate change

11. Refer to figure 2 to answer the questions that follow.

FIGURE 2 Countries in Asia and the Pacific that will lose over 100 000 hectares of cultivated cropland if there is a one-metre rise in sea level



Source: © Asian Development Bank

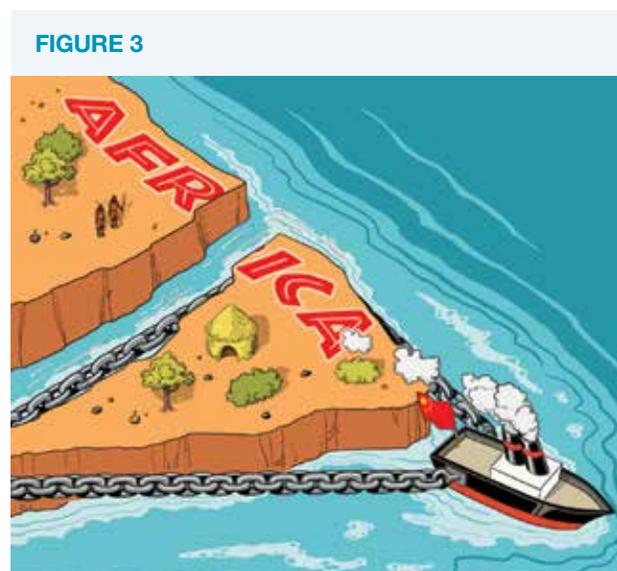
- Which type of cropland is predicted to be the most *changed* by a one-metre rise in sea level in Asia?
- Using data in your answer, list the three countries that will be most at risk of losing cropland.
- What might be some of the repercussions for food production in those countries?

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-  Explore more with this weblink: Fleeing Somalia's drought
-  Complete this digital doc: Blackline master: World map (doc-11392)

5.11.2 Reflect

- What is the cartoon in figure 3 trying to tell us?
- What would you suggest a host country should do to ensure its own food security?
- Land grabs are the solution to establishing a country's food security.*
Provide an argument for this viewpoint and an argument against this viewpoint. Ensure that your argument is supported with evidence and is logical.
- Australia's dinner plate can often represent a multinational society. In general we produce, import and can afford a wide range of food items.*
To what extent is this statement true? Review the foods your family commonly eats. Explain.



TOPIC 6

2050 — food shortage or surplus?

6.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

6.1.1 Introduction

Currently we produce enough food to adequately feed everyone in the world. However, it is estimated that in 2015 about 795 million people or almost one in seven went hungry. The world's population is expected to grow by another two billion people in the next 30 years. If we want to stop the number of hungry people from increasing, we will need improvements in food production, new sources of food, better aid programs, and different attitudes to food consumption and waste.



- Twenty-five per cent of people in sub-Saharan Africa are undernourished.
- Use of fertilisers will expand in Latin America, East Asia, North America and South Asia.
- We can act to decrease hunger in developed and less developed regions.
- Could Australia become the food bowl of Asia?
- Should farmers be stewards of the environment?
- Chinese people now eat a quarter of the world's supply of meat.
- Poor nutrition causes 45 per cent of all deaths in children under five in developing nations.
- Home-grown vegetables do not necessarily have a smaller carbon footprint than those from a supermarket.
- Biofuel opportunities will mostly occur in developing regions, providing many jobs.
- Can we feed the 9.5 billion people expected to live on the planet in 2050?

Starter questions

1. Look at the photo and annotations on the previous page. Make some predictions about the type of food you might eat in the year 2050 and how it might be produced.
2. Ask your parents or grandparents what type of food they ate when they were young. Did they grow any of their own food?
3. Does your family produce any of its own food? Why or why not?
4. Do you think we have food shortages in Australia? Why or why not?
5. Which countries in the world face food shortages today?

INQUIRY SEQUENCE

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6.2 Can we feed the future world population?

6.2.1 What is the problem of hunger?

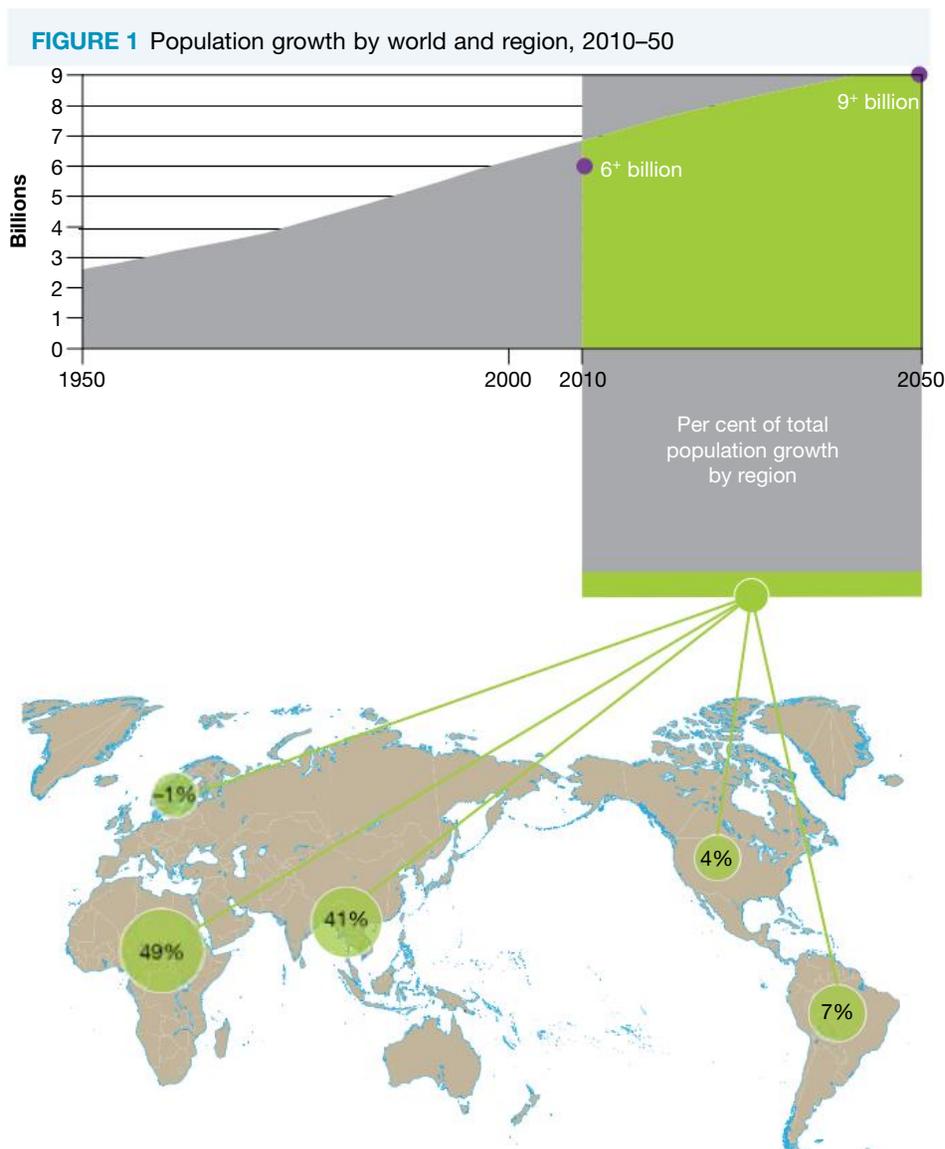
One in seven people in the world does not have enough food to lead an active and healthy life, yet over one billion people are overweight. How can we best manage the challenge of ensuring that everyone in the world has access to a healthy and adequate diet?

6.2.2 What are the impacts of hunger?

The distribution of the world's population and the availability of arable land per person is uneven. Regions with the fastest growing future populations are also those where there is limited arable land per person (see figure 1).

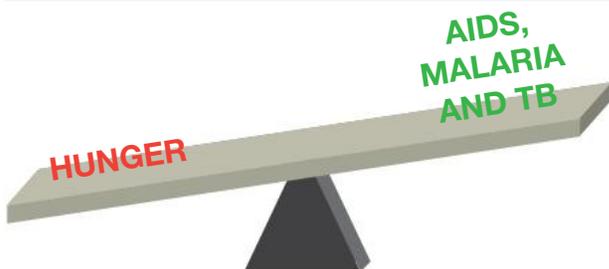
The impact of hunger on people cannot be overstated. Hunger kills more people each year than disease (see figure 2). It is estimated that we will need to produce between 70 and 100 per cent more food in order to feed future populations. New ideas, knowledge and techniques will be needed if we do not want millions more people to suffer malnourishment, starvation and vulnerability to disease. The challenge, though, is to do this in a way that is also sustainable. However, population growth and limited supplies of arable land will affect how much food can be produced.

One solution to feeding people who live in crowded spaces, such as Asia, or in environmentally challenging spaces, such as sub-Saharan Africa, is to increase the amount of trade in food products. This will involve moving food from places with crop surpluses (North America, Australia and Europe) to regions that are crowded or less productive. This means there will be an increase in the interconnection between some countries.



Source: Re-drawn from an image by Global Harvest Initiative (2011 *GAP Report®: Measuring Global Agricultural Productivity*), data from the United Nations.

FIGURE 2 Hunger is the world's number one health risk, killing more people each year than AIDS, malaria and tuberculosis combined.



6.2.3 Plumpy'nut — a short-term solution to malnutrition

In 2005 a revolutionary approach to treating malnutrition was released. This is a ready-to-use therapeutic food (RUTF) called Plumpy'nut. It is a sweet, edible paste made of peanut butter, vegetable oils, powdered milk, sugar, vitamins and minerals. Its advantages are that it:

- is easy to prepare
- is cheap (a sachet costs about \$2.50)
- needs no cooking, refrigeration or added water
- has a shelf life of two years.

Children suffering from malnutrition can be fed at home without having to go to hospital. It is specially formulated to help malnourished children regain body weight quickly, because malnutrition leads to stunting of growth, brain impairment, frailty and attention deficit disorder in children under two years of age.

Plumpy'nut is not a miracle cure for hunger or for malnutrition; it only treats extreme food deprivation, mainly associated with famines and conflicts. It is not designed to reduce chronic hunger resulting from long-term poor diets or malnutrition. Since its introduction, Plumpy'nut has lowered mortality rates during famines in Malawi, Niger and Somalia. Most of the world's peanuts are grown in developing countries, where allergies to them are relatively uncommon. Manufacturing plants have been established in a dozen developing countries, including Mali, Niger and Ethiopia. These factories provide employment and ensure ease of access when needed. The patent for Plumpy'nut is owned by Nutriset, a French company. There are some concerns that this gives Nutriset the power to entirely control the production and distribution of Plumpy'nut. Nutriset has been asked by Médecins sans Frontières (Doctors without Borders) to remove its patent, which would allow open production and distribution of this life-saving product.

FIGURE 3 Plumpy'nut benefits children.



6.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

- Examine figure 1.
 - Which region is predicted to decrease in population by 2050?
 - Which two continents are expected to have the greatest increase in population?
 - What is the predicted world population in 2050?
 - How does a growing world population put pressure on food shortages?

Explain

- Explain why you think hunger may threaten people's health and be responsible for so many deaths.
- What other geographic factors can cause shortages of food?
- Outline the advantages and disadvantages of using Plumpy'nut or other RUTFs to treat childhood malnutrition in developing countries.
- What may need to happen to ensure there is enough food in the future for people who live in **places** with growing populations and limited arable land?

Discover

- As well as affecting people's health, a shortage of food can have social and political effects. Undertake research into the series of food riots that occurred in a number of countries around the world in 2015.
 - Where did these riots occur?
 - What were the causes of these riots?
 - Why might governments need to prevent this situation from occurring again?
- What foods are commonly used as food aid worldwide?

Predict

- Lack of food has been a factor in pushing people to leave their homes and go to cities in search of employment and food. Predict the **places** of the world where this is most likely to happen.

Think

- Draw a poster or advertisement that informs Australians about Plumpy'nut and seeks donations for its use.

6.3 Can we improve food production?

6.3.1 How can we improve food production?

Over 70 per cent of the world’s poor live in rural areas, and improving their lives would create greater food security. If poor farmers can produce more food, they can feed themselves and provide for local markets. Improved infrastructure, such as roads in rural regions, would enable them to transport their produce to market and increase their incomes. Preventing hunger on a global scale is important, but action is also needed on a local scale.

Future changes to food production

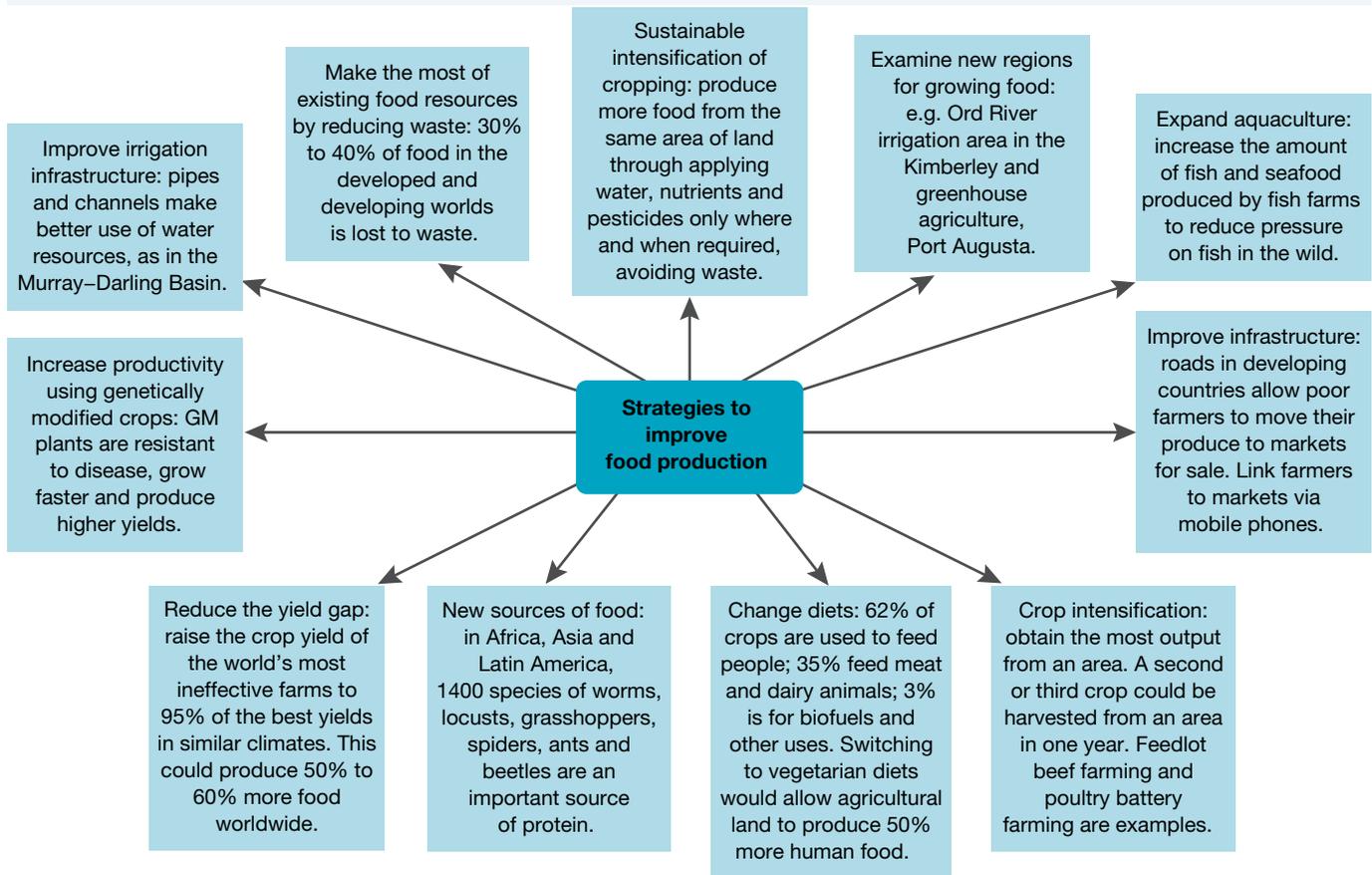
Farming is a complex activity, and farmers around the world face many challenges in producing enough food to feed themselves and to create surpluses they can sell to increase their incomes. As urban areas grow, the amount of arable land available decreases. According to the United Nations Food and Agriculture Organization (FAO), the world has an extra 2.8 billion hectares of unused potential farmland. This is almost twice as much as is currently farmed. However, only a fraction of this extra land is realistically available for agricultural expansion, owing to inaccessibility and the need to preserve forest cover and land for infrastructure.



In Australia there are hopes to expand the agricultural output from the Ord River irrigation scheme in the Kimberley region of Western Australia.

The growing populations of the future will be found in places where expansion of agricultural land is already limited. Consequently, increased food production will need to come from better use of current agricultural areas, better use of technology, and new ways of thinking about food production and approaches to farming. Figure 2 outlines some strategies that may be used to improve food production.

FIGURE 2 Strategies for improving sustainable food production



Strategies for improving food production

The strategy that is likely to be the most important in increasing future crop production is called closing the **yield gap**. This means that farmers who are currently less productive will need to increase their yields so that their outputs are closer to those of the more productive farmers. There is a serious yield gap in more than 157 countries. If this were achieved, larger amounts of food would be available without needing more land. There are wide geographic variations in crop and livestock productivity. Brazil, Indonesia, China and India have all made great progress in increasing their agricultural output. Much of the increase has been achieved through more efficient use of water and fertilisers.

The use of **genetically modified** (GM) foods has increased, and this has increased crop yields. However, there is some opposition to GM crops because of concerns about:

- their safety
- loss of seed varieties
- potential risks to the environment and people's health
- the fact that large companies hold the copyright to the seeds of GM plants that are food sources.

6.3.2 Solving problems and coming up with solutions

Because agriculture uses 60 to 80 per cent of the planet's increasingly scarce fresh water resources, any method that can produce food without needing fresh water at all is a great advance.

Port Augusta is located in a hot, arid region of South Australia, and is not normally associated with agriculture. However, one company, Sundrop Farms, is using this region's abundant renewable resources of sunlight and sea water to produce high-quality, pesticide-free vegetables, including tomatoes, capsicums and cucumbers, and it does so all year round.

Large mirrors concentrate the sun's energy and the collected heat creates steam to drive electricity production, heat the greenhouse, and desalinate sea water, producing up to one million litres of fresh water a day for crop irrigation.

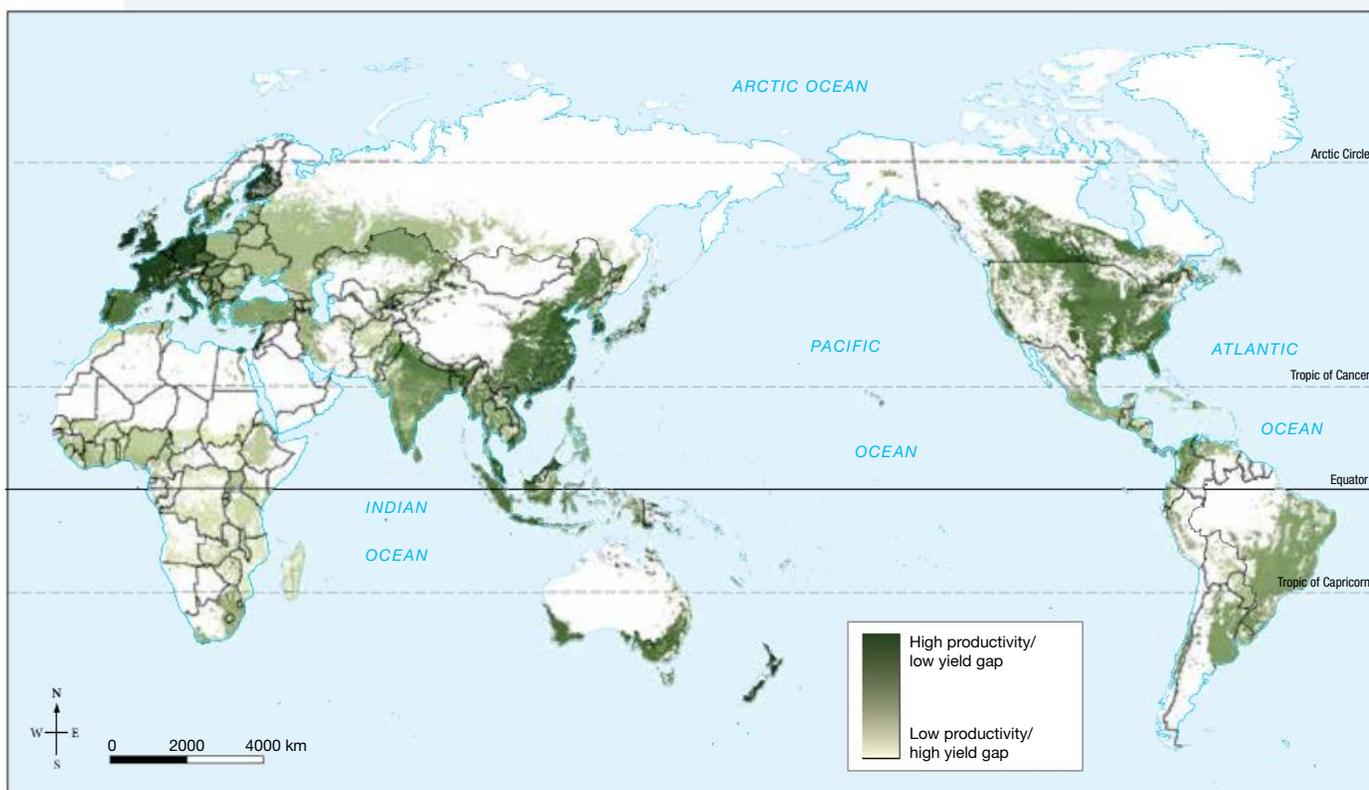
Experimental greenhouse in Port Augusta

The current experimental greenhouse, covering 2000 square metres, is operating on a small scale. A new \$150 million greenhouse will be completed approximately 10 kilometres from the site in 2017. This new project aims to produce approximately 15000 tonnes of truss tomatoes per year, which equates to about 10 per cent of Australia's demand. The new greenhouse uses renewable energy to be not just carbon and water neutral, but positive. It is hoped that this type of technology can be used in many more places in Australia and around the world that have hot, arid climates previously unsuitable for horticulture. The technology has the potential to supply millions of people with healthy food in a sustainable manner while also using limited fossil fuel resources.

Australian farmers see technology as a means of decreasing production costs and increasing crop production. Additional technologies in Australian agriculture include the following.

- Robots are being tested to determine whether they can be used in complex jobs such as watering or harvesting. This would be of advantage in the horticultural sector, which is the third largest sector in agriculture, with an export trade worth \$2.1 billion in 2014–15.
- Technology such as satellite positioning is being used to determine the optimal amounts of fertiliser to use on crop farms, which could increase profitability by as much as 14 per cent.
- Robots and an unmanned air vehicle have passed field tests at an almond farm in Mildura, Victoria. They are fitted with sensors, vision, laser, radar and conductivity sensors — including GPS and thermal sensors.

FIGURE 3 Yield gap for a combination of major crops, 2015



Source: Food and Agriculture Organization of the United Nations

FIGURE 4 Global area of genetically modified crops in industrial and developing countries 1996–2014 (millions of hectares)

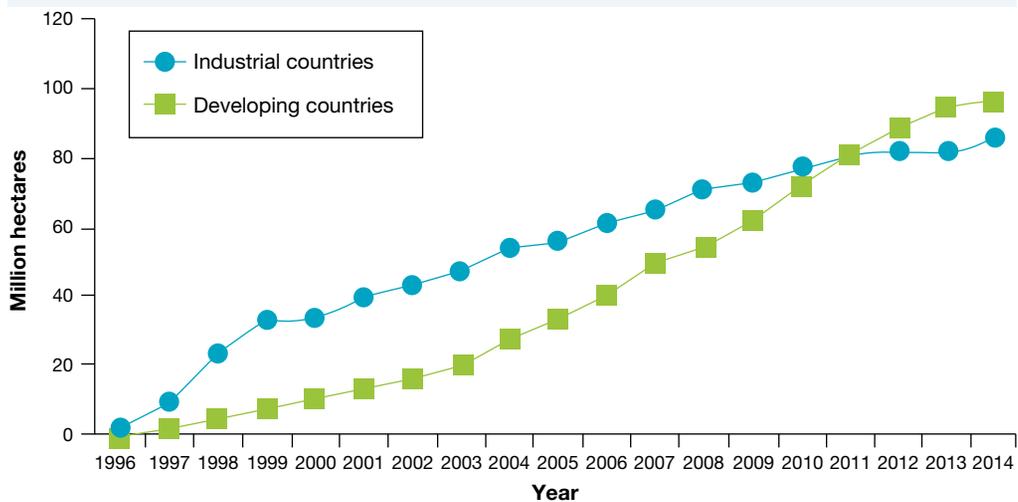


FIGURE 5 The world's first Sundrop Farm is situated in Port Augusta, South Australia



6.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. List three different strategies, other than closing the yield gap, for improving food production.
2. What is meant by the term *yield gap* and why is it important that this gap be narrowed to increase future crop yields? See figure 3.

3. What is meant by the term *genetically modified* (GM)?
4. Examine figure 4. What **changes** have there been in the production of genetically modified foods in (a) developed countries and (b) developing countries? Use the data from the graph to support your answer.
5. (a) Referring to figure 3, which **places** have the highest gap yields?
(b) Which places in figure 3 have the lowest gap yields?

Explain

6. Explain the advantages and disadvantages of locating the large greenhouse near Port Augusta. You may need to consult your atlas.
7. Select one of the strategies outlined in figure 2 that can be used to improve food production. Explain this strategy in your own words and outline some of the strengths and weaknesses of this strategy.
8. Use the **Vertical farming** weblink in the Resources tab to watch a video clip on this topic. What is being suggested about **environmentally sustainable** farming in the future? Draw a diagram to show what a future vertical farm might look like. How might a vertical farm help in feeding future populations?

Predict

9. Many Australian cities have large housing estates on their outskirts. This land was often used for market gardens or farmland. What impact might the loss of this productive land have on the price of food?
10. Predict what the impact might be on people and **places** if the greenhouse method of farming shown in figure 5 were to become more readily available. What might be the effects on **places** where the yield gap is large compared to **places** that are currently more productive?

Think

11. Annotate key aspects of the Port Augusta landscape (greenhouses, solar collector, sandy soil, flat and barren landscape) shown in the photograph in figure 5.
12. Some areas of Australia that are currently national parks or marine parks may be sought after as agricultural land in future. Outline your views on this.

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-  Try out this interactivity: More, or less, food (int-3329)
-  Explore more with this weblink: Vertical farming

6.4 What food aid occurs at a global scale?

6.4.1 Who needs food aid and how is it delivered?

The World Food Programme (WFP) is a voluntary arm of the United Nations. It reaches more than 80 million people, in more than 92 countries, with food assistance after disasters and conflicts. Food aid is food, money, goods and services given by wealthier, more developed nations to less developed nations for the specific purpose of helping the poor.

FIGURE 1 How the WFP works



People who need food aid include:

- poor people who cannot buy food even if it is available, as they are often trapped in a cycle of hunger and poverty
- people who have fled violence or civil conflict
- people devastated by natural disasters.

The WFP provides different types of food aid to people after natural disasters such as cyclones, floods and earthquakes. Some relief aid is provided in the short term as emergency food. Project food relief is often required over lengthy periods, typically after civil war or prolonged drought.

Project food aid is geared towards future disaster prevention. Program food aid is organised between national governments.

6.4.2 Who gives food aid?

The major donor countries to the WFP in 2015 are shown in table 1.

TABLE 1 Major funding contributors to WFP in 2015 (US\$)

| All donors & funding sources | | |
|------------------------------|---------------------|---------------|
| 1 | USA | 2 008 800 185 |
| 2 | United Kingdom | 456 855 096 |
| 3 | Germany | 329 258 331 |
| 4 | Canada | 261 645 796 |
| 5 | European Commission | 250 347 378 |
| 6 | Japan | 196 773 084 |
| 7 | UN CERF | 159 928 948 |
| 8 | Saudi Arabia | 151 249 675 |
| 9 | Netherlands | 101 464 033 |
| 10 | Private Donors | 98 332 463 |

Figures current as at 24 July 2016

6.4.3 Who receives food aid?

In 2014–15, the WFP worked on six simultaneous Level 3 emergencies including providing food assistance to 2.2 million people affected by conflict in Iraq; more than one million people affected by Typhoon Haiyan in the Philippines; over two million people in South Sudan; more than million people disrupted by the Ebola outbreak in Guinea, Sierra Leone and Liberia; and over 4.9 million people displaced by war in Syria. The WFP directly helped over 66.8 million women and children, 14.8 million internally displaced people and over 68 million refugees. In total, the WFP provided more than 3.3 million tonnes of food aid.

CASE STUDY

Cash vouchers and school feeding programs

Where food is available but people simply cannot afford to buy it, aid in the form of cash vouchers from the WFP can be exchanged for food and other essential commodities. They allow recipients greater choice in the types of food and other commodities they obtain. Cash has benefits for local economies because the money is spent within the community. Recently, cash voucher programs have been enhanced through the use of mobile phones, which have been used to provide instant payments to both beneficiaries and the shopkeepers who redeem vouchers. In 2014–15, the WFP provided school meals to over 17 million children.

Another program provides school children with either full meals (breakfast and/or lunch) or nutritional snacks, such as high-energy biscuits. In some cases, school meals are provided alongside take-home rations that benefit the whole family and provide an additional incentive for sending children to school.

In 2015, Australia funded school feeding programs in Bangladesh, Myanmar, Laos and Cambodia. These have had strong positive impacts on both the children and the wider community. School rates of enrolment increased and regular attendance improved. Households also benefited through a reduced need to purchase food. Australia will contribute more than \$167.5 million of funding through the World Food Programme from 2015 to 2020. This includes funding provided for the food crises after Tropical Cyclone Pam in Vanuatu and the Nepal earthquake.

6.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. How many countries received food aid in 2014?
2. Refer to table 1. How much food aid did Japan give to the WFP in 2015?
3. Refer to figure 1. Which regions of the world receive the greatest food aid? Suggest reasons for this.

Explain

4. Explain why the WFP is so active in school feeding and emergency aid programs.
5. Refer to the case study 'Cash vouchers and school feeding programs'.
 - (a) Locate the recipient countries on a world map.
 - (b) List the advantages and disadvantages of cash vouchers.
 - (c) Use the **World Food Programme** weblink in the Resources tab to help you explain the benefits of food aid shown here.

Discover

6. Select a major donor of food aid from table 1. What are the main population characteristics of this country, such as life expectancy, literacy levels and death rates? Discuss your findings in class.
7. Use the **World Food Programme** weblink in the Resources tab to help you explain WFP's involvement in Syria and surrounding *places* since 2012. What action is the WFP taking there and why?

Predict

8. How might food aid *change* when a donor country experiences a major economic downturn?
9. Predict the likely consequences for children who suffer from malnutrition. Present your information in an appropriate diagram.

Think

10. Should Australia's food aid commitment be increased? Write a letter to your federal member of parliament, outlining your views on increasing Australia's food aid contribution.

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 Explore more with this weblink: World Food Programme

6.5 SkillBuilder: Constructing a box scattergram

online only

WHAT IS A BOX SCATTERGRAM?

A box scattergram is a table with columns and rows that displays the relationship between two sets of data that have been mapped. Box scattergrams are a useful way of summarising data from maps.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 A box scattergram showing the relationship between undernourishment and aid received per person

| Hunger level (% undernourished) | Aid received per person (US\$) | | | |
|---------------------------------|--------------------------------|--|--|---|
| | No data | Less than 20 | 20–99 | Over 100 |
| 35 + | | | | <ul style="list-style-type: none"> • Congo • Mozambique |
| 25–34 | | | <ul style="list-style-type: none"> • Chad • Angola | |
| 15–24 | | | | |
| 5–14 | | <ul style="list-style-type: none"> • Nigeria | <ul style="list-style-type: none"> • Niger | |
| Less than 5 | | <ul style="list-style-type: none"> • South Africa • Algeria • Libya | | |
| No data | | | | <ul style="list-style-type: none"> • Mauritania |

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 Watch this eLesson: Constructing a box scattergram (eles-1734)

 Try out this interactivity: Constructing a box scattergram (int-3352)

6.6 Do Australians need food aid?

6.6.1 Who needs food aid in Australia?

In 2015, it was estimated that about 2.5 million, or 13.9 per cent, of Australians are living below the internationally accepted poverty line. This includes almost 603 000 children or 17.7 per cent of the total Australian child population. The prices of essentials — food, health, education, housing, utilities and transport — have climbed so much in recent years that people who are already struggling are unable to cope. They may need food aid. The economic climate saw people turning to charity who would never have dreamed of seeking such support in the past. It is not just traditionally vulnerable groups, such as the homeless, who are seeking food relief; it is also the aged, single parents and the ‘working poor’.

In 2014 it was reported that:

- one in 10 Australians on unemployment benefits was unable to obtain a substantial meal each day
- two million people across the country could not secure enough food for their families
- nine out of 10 welfare agencies, from 600 interviewed, claimed they could not meet the demand for food, and there had been an 11 per cent increase in welfare agencies seeking food
- 105 000 Australians were homeless
- between 2010 and 2012, poverty increased by over 1 per cent
- 40.1 per cent of people on social security payments were living below the poverty line
- one in four pensioners lived close to the poverty line
- food banks provided enough food for 32 million meals per year.

Redistributing food through collection and food agencies is a good way to make better use of food resources.

The services of groups such as Meals on Wheels may be in greater demand as Australia’s population ages (see figures 1 and 2). In 1997, the **median age** was 34 years, but this is projected to be 44–46 years in 2051. In 1997, people aged 65 years and over comprised 12 per cent of the population, and this is projected to rise to 24–26 per cent in 2051.

FIGURE 1 Australia’s population pyramid, 2016

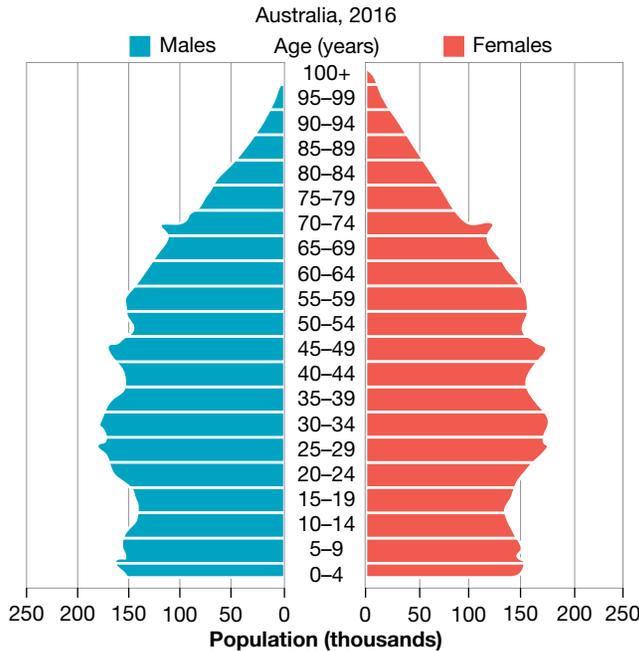
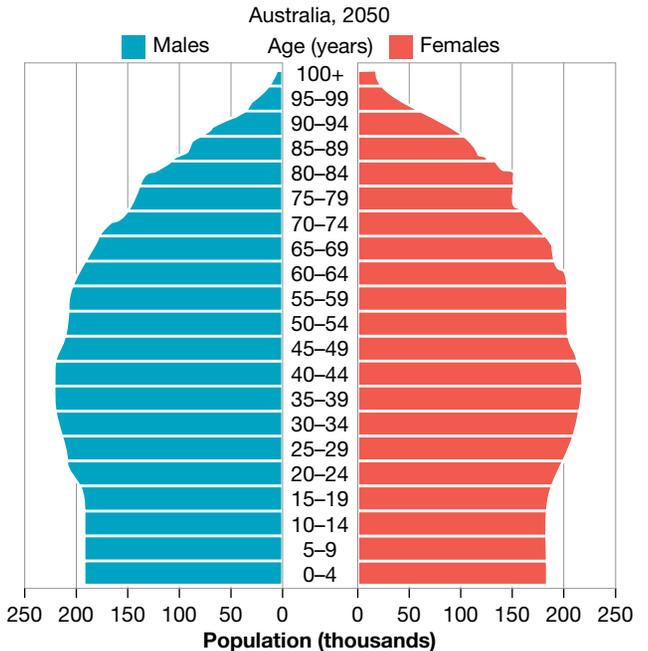


FIGURE 2 Australia’s projected population pyramid, 2050



CASE STUDY 1

SecondBite

SecondBite rescues and redistributes food to agencies that service people in need. Food is donated from the farm gate, wholesalers, markets, supermarkets and caterers.

SecondBite has rescued more than 20 million kilograms of food nationally and redistributed this food free of charge to more than 1200 community food program partners.

FIGURE 3 A SecondBite delivery truck, which is used to deliver donated food to people in need



CASE STUDY 2

Meals on Wheels

Meals on Wheels began in the United Kingdom during World War II. In Australia, it began in Melbourne in 1952, and it plays an important role in helping aged and disabled people to remain in their homes. Some people may not be able to get out and about, so over 78 000 volunteers help to deliver meals to them. By providing nutritious, relatively cheap meals, costing between \$4.50 and \$9.00, Meals on Wheels helps to make it possible for people to maintain their independence. Some 14.8 million meals are served annually to 53 000 people across the nation. The social interaction and regular visits are an important part of this service.

FIGURE 4 Volunteers for Meals on Wheels



CASE STUDY 3

Outback Australia

In September 2011, Indigenous Australian peoples in South Australia were suffering food shortages because they could not afford to buy food. The Red Cross and the South Australian Government were forced to send pallets of food to impoverished people living in the Anangu Pitjantjatjara Yankunytjatjara (APY) lands in South Australia's far north. Shops in the APY lands were full of food, but people were going hungry because of the high cost of freighted food. In June 2010, essential foods in remote community stores were more than double the price of those in Adelaide. One suggested strategy for improving food security in such places is the establishment of community gardens.

APY lands program

Since 2014, the APY lands program has been funded solely by non-government organisations (NGOs). The program now focuses on improving freight efficiency, stores management, cold storage upgrades and the supply of more generators for a reliable source of power.

6.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Examine figures 1 and 2.
 - (a) How many Australians were over 65 years of age in 2015?
 - (b) How many are expected to be over 65 years in 2050?
2. How many people were living in poverty in Australia in 2014?
3. How many meals are served each year by SecondBite?

Explain

4. Explain why there might be difficulties with access to food in 2050 if 25 per cent of the population is over 65.
5. Explain the importance of volunteers in food redistribution.
6. Explain how Australia's size could lead to food shortage in some **places**.

Discover

7. Conduct your own research into a local organisation that provides food aid. Present your findings in an appropriate format.
8. Use the **Australian poverty** weblink in the Resources tab to discover other aspects of poverty in Australia.

Predict

- Predict whether Meals on Wheels will experience an increase or decrease in its future clientele. Apart from the ageing population, what other factors might **change** the demand for SecondBite or Meals on Wheels in future?
- What would be your family's reaction if the cost of food doubled because of freight costs? What steps could improve the situation in outback areas?

Think

- Have your attitudes to redistributing food **changed** as a result of your reading and class discussion?
- 'When bills have to be paid, food becomes a **discretionary item**' (Food Bank Australia 2011). If household bills have to be paid before buying food, what are the likely consequences for families and organisations supplying food aid?

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[Explore more with this weblink: Australian poverty](#)

6.7 Is trade fair?

6.7.1 Why is trade not fair for everyone?

As people become more concerned about the level of poverty and hunger in the world, they sometimes seek ways to improve the situation. Trade is the way countries sell what they have produced and buy what they need. On a global scale, this does not mean that trade is mutually beneficial. Trade usually favours countries that are the strongest economically, and it disadvantages those countries that are poor.

Trade is not a level playing field. It favours the strongest countries, often to the disadvantage of the poor and weak. Strong or developed countries are able to:

- stockpile or dump crops so that they sell for a maximum price
- negotiate some political advantage
- refuse to sell crops if they have a shortage, so some nations go hungry
- dump crops of low quality onto poorer nations.

In contrast, fair trade is a consumer-driven movement to promote fair prices and reasonable conditions for producers in developing regions. It tries to ensure, for example, that a group of farmers is able to sell its crop for a guaranteed price. Fair trade is seen by some as **active consumerism**. In addition to the general movement known as fair trade, there is an organisation called Fairtrade International. This is a group of 25 organisations trying to ensure a better deal for producers.

FIGURE 1 Advertising for Fairtrade

1.65 MILLION FARMERS & WORKERS IN 70 COUNTRIES

1.5 HECTARES IS THE AVERAGE SIZE OF THE PLOT CULTIVATED BY A FAIRTRADE FARMER

3000+ FAIRTRADE PRODUCTS AVAILABLE IN AUSTRALIA & NEW ZEALAND

WHY SHOULD I CHOOSE FAIRTRADE?

FAIRTRADE

6.7.2 Why do small farmers turn to Fairtrade certification?

In Ghana, cocoa farmers with 2- to 3-hectare plots of land face a number of problems.

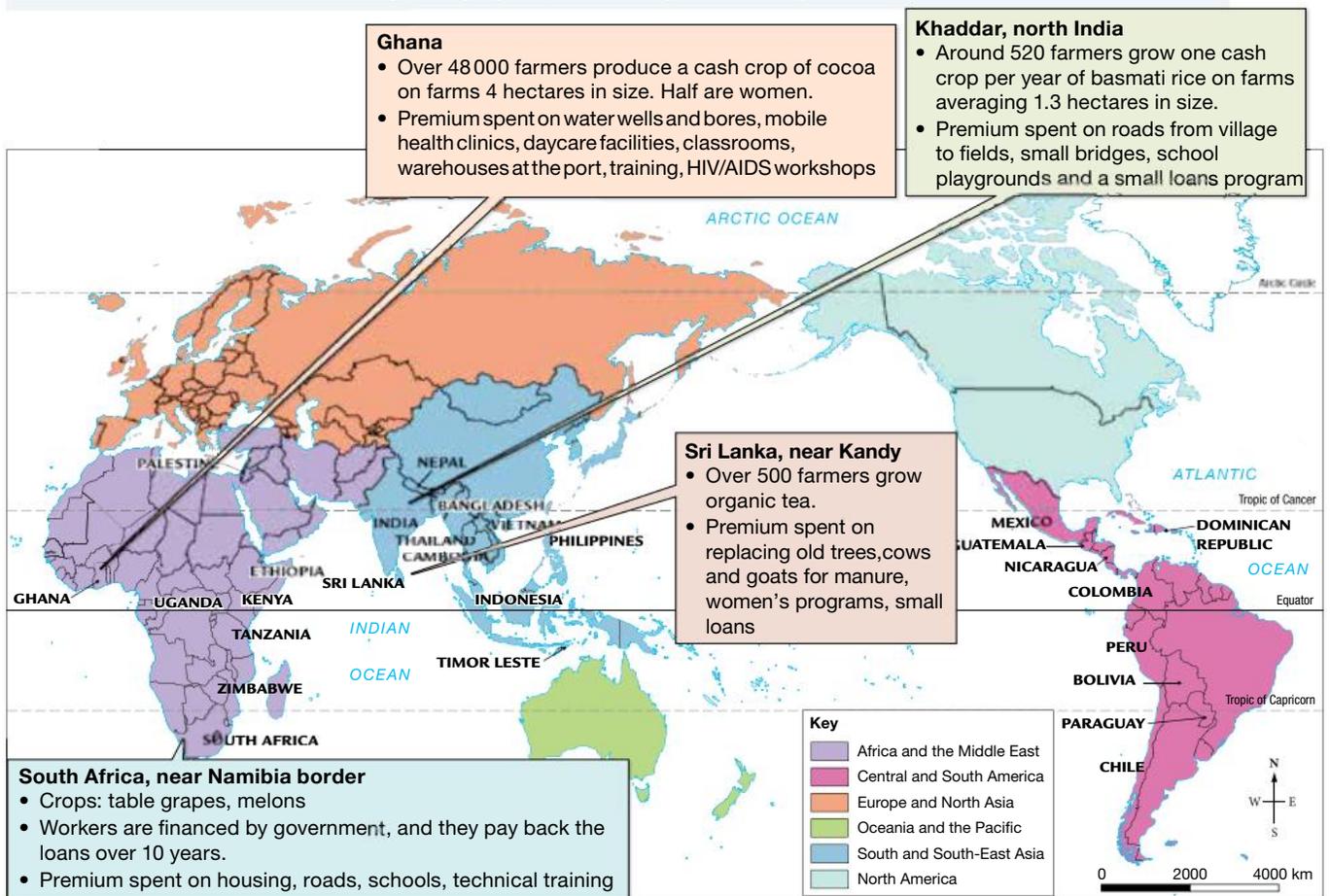
- They may grow one main cash crop for low prices that do not even cover the costs of production; they may also grow some vegetables for family use and extra income.
- They face expensive production inputs (tools, fertilisers and pesticides) and family costs (education, medicine, food and clothes).
- Poor education makes it difficult for them to try different crops that could earn them more money.
- The use of child and slave labour is common in cocoa-producing West African countries.
- Technical, financial and scientific advice is limited.
- Credit is a key issue for farmers with **seasonal crops** like cocoa. Farmers need money for food and immediate needs, as well as pre-financing for planting and cultivation of their crop. Most borrow money from family, and a small percentage take a loan.
- There are taxes or tariffs on products.

As a consequence, many farmers are turning to Fairtrade as a means of improving their livelihoods.

Where are Fairtrade farmers found?

Countries with Fairtrade organisations are in the poorer nations. They are frequently found in Asia, Africa and South America (see figure 2). These farmers produce crops such as grapes, cocoa, coffee, tea, dried fruits, bananas, sugar, rice, nuts and handicrafts. The consumers who are likely to buy crops produced by Fairtrade farmers are located in the wealthy nations, because they have the ability to pay a little more to buy their goods.

FIGURE 2 Map showing Fairtrade producer countries. The annotations describe how selected producers use their Fairtrade premium — a sum of money paid in addition to the Fairtrade price, to be invested in social, environmental or economic development projects, decided by farmers or plantation workers.



Do farmers benefit from Fairtrade?

Fairtrade farmers enjoy the certainty of having a fixed price and a guaranteed market for their product. This gives them the ability to undertake farming improvements. The Fairtrade Premium provides money for infrastructure, training, education and medical services. It also allows women farmers access to international trade. In Ghana, training of farmers improved the yield by as much as 50 per cent, and it improved school attendance for children by 26 per cent. Fairtrade also benefits the environment, as many of the farming groups produce organic crops.

6.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 2.
 - (a) Which countries have Fairtrade farmers?
 - (b) On which continents are most Fairtrade consumers found?

Explain

2. In Ghana, improving farmer education led to an increase in crop yield of 30 to 50 per cent, as well as improved school attendance. Explain this connection.
3. Read the annotations on figure 2. What similarities are there between Fairtrade farmers in different **places**?
4. What does being an 'active consumer' mean? Why are some willing to pay more for Fairtrade chocolate?

Discover

5. Investigate your favourite chocolate brand. Who owns the brand, and what are their attitudes to Fairtrade chocolate? Write a letter to them expressing your views about Fairtrade cocoa.
6. Research an example of a Fairtrade crop. What are the advantages and disadvantages of Fairtrade?

Predict

7. Predict the future of Fairtrade. What factors might affect your prediction?

Think

8. Undertake a class debate on the topic, 'Fairtrade farmers will improve the future food supply'.
9. Analyse figure 1. What makes it an effective poster? Alternatively, design a poster about one of the Fairtrade crops. Include **change** or **place** or **sustainability** in your poster.

6.8 SkillBuilder: Constructing and describing proportional circles on maps

WHAT ARE PROPORTIONAL CIRCLE MAPS?

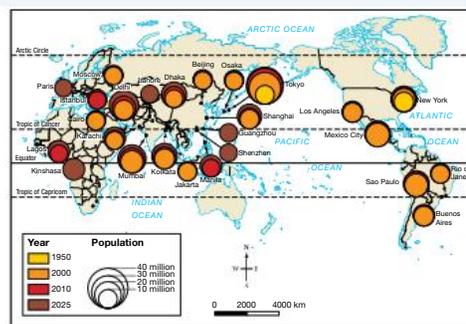
Proportional circle maps are maps that incorporate circles, drawn to scale, to represent data for particular places.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

online only

FIGURE 1 Growth of megacities over time, 1950–2025 (projected)



 **Watch this eLesson:** Constructing and describing proportional circles on maps (eles-1735)

 **Try out this interactivity:** Constructing and describing proportional circles on maps (int-3353)

6.9 How do dietary changes affect food supply?

6.9.1 How are diets changing?

According to the Red Cross, 1.5 billion people in the world are dangerously overweight, while 925 million people are underfed. People in both of these categories have health problems. Diets have changed over time and continue to change. This is especially the case in China and India, where the standard of living is rising and people can afford access to a wider variety of foods.

Modern diets have been changing and are expected to change in future (see figure 1). One-third of the world's grain crop is fed to animals to produce meat. Some people consider this wasteful, as it takes about 11 times as much grain to feed a person if it passes through a cow first. While 1500 litres of water is needed to produce 1 kilogram of cereal, 15 000 litres is needed to produce 1 kilogram of meat.

FIGURE 1 Changing diets in developing countries

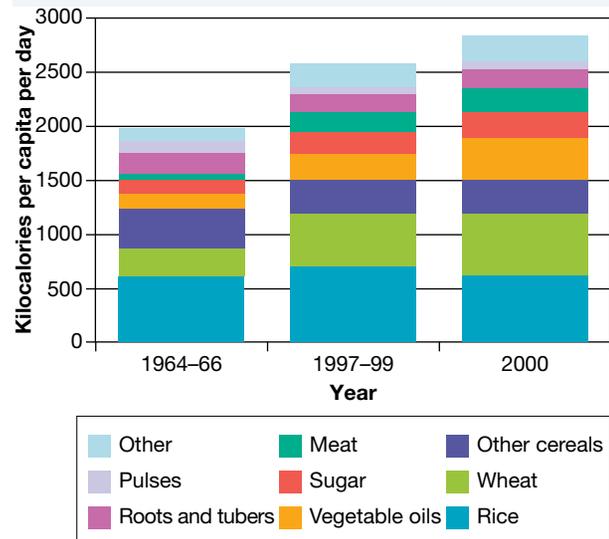
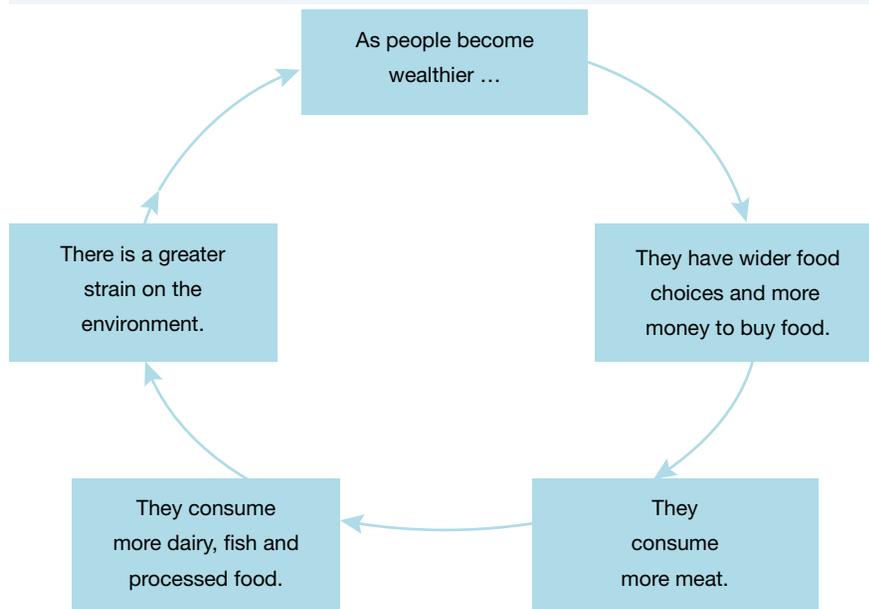


FIGURE 2 Impacts of dietary changes



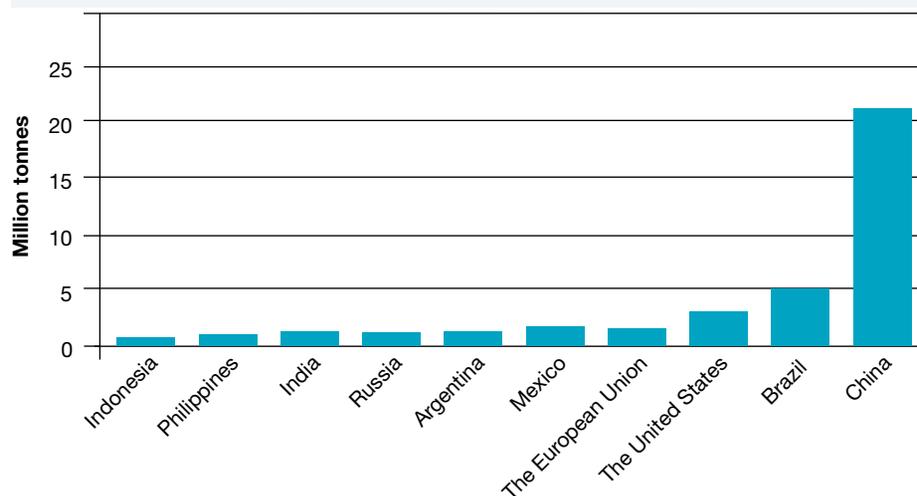
Changing diets in Asia

Rice is a valuable source of protein, but as people's incomes grow, per capita rice consumption is expected to decline. Rice is being substituted by food containing more protein and vitamins and by more processed foods. Japan, Taiwan and the Republic of Korea have already made this dietary change, and the rest of the Asian countries are expected to follow as their economies change and people's incomes increase.

For centuries, the typical Chinese diet was rice and vegetables, occasionally supplemented by small amounts of meat or fish. In 1962, the average Chinese person ate 4 kilograms of meat a

year. By 2005, this figure was 60 kilograms and rising (see figure 3). North Americans currently consume the most meat of any country, eating an average of 312 grams per person, per day. This is significantly more than the global average of 113 grams per person.

FIGURE 3 Forecast growth in meat consumption, 2011–2021



How can dietary change enable sustainable food production?

Meeting the needs of future populations is not just the responsibility of farmers and producers. We as consumers can also contribute. Attitudes may need to change towards what and how we eat.

- If we are to feed nine billion people sustainably in 2050, it is unlikely to be on a **Western-style diet**, which is rich in meat.
- The world produces enough food to feed 10 billion people. However, a significant portion of our crops is used to feed animals or is used as biofuel to produce energy.
- A switch to a diet containing more plant material would allow land currently used to produce animal feed to instead grow crops to feed humans. Although such a huge change is unlikely, even a small shift can have an impact.
- The Meatless Monday campaign encourages people to go without meat for one day per week. This small change would benefit human health and the health of the planet. Meat production requires a large amount of land, water and energy. Cattle are the largest source of methane gas, which is one of the main contributors to greenhouse gases.
- It is estimated that there are 23 000 edible plants that we do not eat yet. Old foods such as quinoa (pronounced *keen-wah*) could be included in our diets. A crop from South America, quinoa was used over 4000 years ago by the Incas. It has high nutritional value, and grows in a wide variety of climatic conditions. Another advantage of the crop is that all parts of it can be eaten. Peru and Bolivia supply 99 per cent of the world's rapidly expanding quinoa demand. Many countries are investigating its suitability for their locations. The FAO designated 2013 as the International Year of Quinoa.

6.9.2 Can Australia be a food bowl for Asia?

By 2020, it is predicted that half of the world's population will be living in countries in Asia. Four billion people across Asia will experience economic growth of about 10 per cent per year, representing unparalleled opportunities for Australian farmers and the Australian economy. As Asian societies become more affluent, the people are requiring higher standards of living and this includes more and varied foods and a

greater quality of fibre. Australian farmers are reported to have clean and green agricultural systems and this, coupled with our location, should provide an economic advantage for our farmed goods.

‘We have the potential for a new golden era of Australian agriculture, given the rise of Asia,’ our prime minister said in 2012. The challenge for Australian farmers will be in meeting this booming global need for food and fibre by increasing production at a time when we have less arable land, less water and fewer people working in agriculture.

6.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. What crops are people eating more of? What crops are they eating less of?
2. Refer to figure 2. What is the **connection** between diet and economic development?
3. Refer to figure 3. Describe the **changes** in meat consumption by North Americans and Chinese over time.

Explain

4. Why have people’s diets **changed** over time?
5. Explain the **interconnection** between food and your family traditions and celebrations.

Discover

6. How has your family’s diet **changed** over time? Ask your parents and family to describe foods and cooking methods from when they were young.

Predict

7. Predict what the consumption of meat in China and the United States might be in 2020. What did you base your prediction on?
8. Predict where your foods might come from in 2050. Could aquaponics or vertical farming be a source of your future food?

Think

9. A United Nations report stated that ‘As **changing** the eating habits of the world’s population will be difficult and slow to achieve, a long campaign must be envisioned, along with incentives to meat producers and consumers to **change** their production and dietary patterns. Healthy eating is not just important for the individual but for the planet as a whole’. Design a television commercial to promote a Meatless Monday campaign.
10. What might be some of the issues confronting Australia as it attempts to become the ‘food bowl of Asia’? What advantages does Australia have in this attempt? How might a farmer react to this suggestion?

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 Try out this interactivity: What are we eating? (int-3331)

6.10 Can urban farms feed people?

6.10.1 What are the advantages of urban farming?

In many industrialised countries, it takes over four times more energy to move food from the farm to the plate than is used in the farming practice itself. Properly managed, urban agriculture can turn urban waste (from humans and animals) and urban wastewater into resources, rather than sources of serious pollution.

In 2000, about 15 to 20 per cent of the world's food supply came from urban gardens; in 2015, over 800 million people practised urban agriculture contributing to more than 20 per cent of all global agricultural production.

Farming is usually associated with rural areas, but a growing trend in food production is urban farming. This involves the growing of plants and raising of animals within and around cities, often on unused spaces — even the rooftops of buildings.

Benefits of urban farming include:

- increasing the amount, variety and freshness of vegetables and meat available to people in cities through sustainable production methods
- improving community spirit through community participation, often including disadvantaged people
- incorporating exercise and a better diet into people's lives, leading to improved physical and mental health
- using urban waste water as a resource for irrigation, rather than making it a source of serious pollution
- spending a smaller percentage of people's income on food.

Urban farming could become more important with rapid urbanisation. By 2020 the developing countries in Africa, Asia and Latin America will be home to 75 per cent of all urban dwellers. They will face the problems of providing enough food and disposing of urban waste.

CASE STUDY 1

Container fish farming

On a smaller scale, a German company has developed a sustainable form of aquaculture that can be used in small spaces in cities. It is called **aquaponics**. Fish swim in large tanks in a recycled shipping container (see figure 1). These structures can be located on rooftops and in car parks. The fish waste fertilises tomatoes, salad leaves and herbs growing in a greenhouse mounted above the tank, and the plants purify the water, which is returned to the tanks.

These sustainably produced fresh vegetables and fish can be delivered to nearby city markets and shops, reducing the distance that the products have to travel. The aquaculture containers can be set up almost anywhere, and farmers only need to feed the fish and to keep the fish-tank water topped up. Electric pumps move the ammonia-rich water into the **hydroponic** vegetable garden in the greenhouse.

FIGURE 1 Urban farming – fish and agriculture



CASE STUDY 2

Kolkata sewage ponds

The East Kolkata wetlands (see figure 2) cover 12 500 hectares and contain sewage farms, vegetable fields, pig farms, rice paddies and over 300 fishponds. With a population of over 14 million, the Indian city of Kolkata produces huge volumes of sewage daily. The wetlands system treats this sewage, and the nutrients contained in the waste water then sustain the fish ponds and agriculture. About one-third of the city's daily fish supplies come from the wetlands, which are the world's largest system for converting waste into consumable products. The wetlands are also a protected **Ramsar site** for migratory birds. However, the area is now under pressure from urban growth and from the subsequent increase in waste that it needs to treat.

FIGURE 2 The Kolkata wetland system



6.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What are the main features of urban farming?
2. What functions do the East Kolkata wetlands perform?
3. How do communities benefit from urban farms?

Explain

4. Suggest what the advantages and disadvantages might be of producing food on the rooftop **spaces** of city buildings. What factors might influence the types of food that could be produced on rooftops?
5. Use the **Aquaponics** weblink in the Resources tab, and outline the advantages of aquaponics presented in the video.

Discover

6. Use the **Vertical farming** weblink in the Resources tab to help you understand vertical farming.
 - (a) Draw an annotated diagram to illustrate vertical farming.
 - (b) Research an urban farming project in a city. Present it as a PowerPoint presentation.

Predict

7.
 - (a) Predict the **places** in the world likely to have vertical farms.
 - (b) Explain why you selected these **places**.
8.
 - (a) Could urban farms encourage agricultural tourism?
 - (b) In future, would you consider visiting an urban farm while on holiday?
 - (c) Examples of urban farms as agritourism already exist. Can you name any such **places**?

Think

9. Write a letter to the minister for planning, suggesting that urban farming **spaces** should be included in every new urban development.
10. Design a new housing estate with a community garden. What would be needed in order to set up a community garden?
11. When investigating urban farms and people's gardening activities in Denver, United States, researchers found that:
 - people's community pride improved
 - graffiti and vandalism decreased
 - gardeners felt a greater **connection** with their local **place**.Are these worthwhile results from urban farming? Explain.

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Explore more with these weblinks: Aquaponics, Vertical farming

6.11 Review

online only

6.11.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

6.11.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

6.5 SkillBuilder: Constructing a box scattergram

6.5.1 Tell me

What is a box scattergram?

A box scattergram is a table with columns and rows which displays the relationship between two sets of data that have been mapped. The distribution becomes clear, although in a generalised way, as there are usually only four to five categories of data.

Why is a box scattergram useful?

Box scattergrams are a useful way of summarising data from maps. You are able to put the data into categories in a table (a series of boxes) and then, when analysing the information, you can discuss the different categories. Using box scattergrams is a technique that allows you to think carefully about features and see the relationships between data. You will find these useful when drawing together data that may initially seem quite complex.

Box scattergrams are useful for:

- summarising data shown on maps
- presenting data during an oral presentation
- planners conveying complex ideas and social differentiation between countries
- economists showing the interconnection between features.

Model

TABLE 1 A box scattergram showing the relationship between undernourishment and aid received per person

| Hunger level (% undernourished) | Aid received per person (US\$) | | | |
|---------------------------------|--------------------------------|--|---|--|
| | No data | Less than 20 | 20–99 | Over 100 |
| 35 + | | | | <ul style="list-style-type: none">• Congo• Mozambique |
| 25–34 | | | <ul style="list-style-type: none">• Chad• Angola | |
| 15–24 | | | | |
| 5–14 | | <ul style="list-style-type: none">• Nigeria | <ul style="list-style-type: none">• Niger | |
| Less than 5 | | <ul style="list-style-type: none">• South Africa• Algeria• Libya | | |
| No data | | | | <ul style="list-style-type: none">• Mauritania |

A good box scattergram:

- is drawn as a table
- has appropriately labelled axes
- accurately displays two sets of mapped data
- includes a clear title.

6.5.2 Show me

How to construct a box scattergram

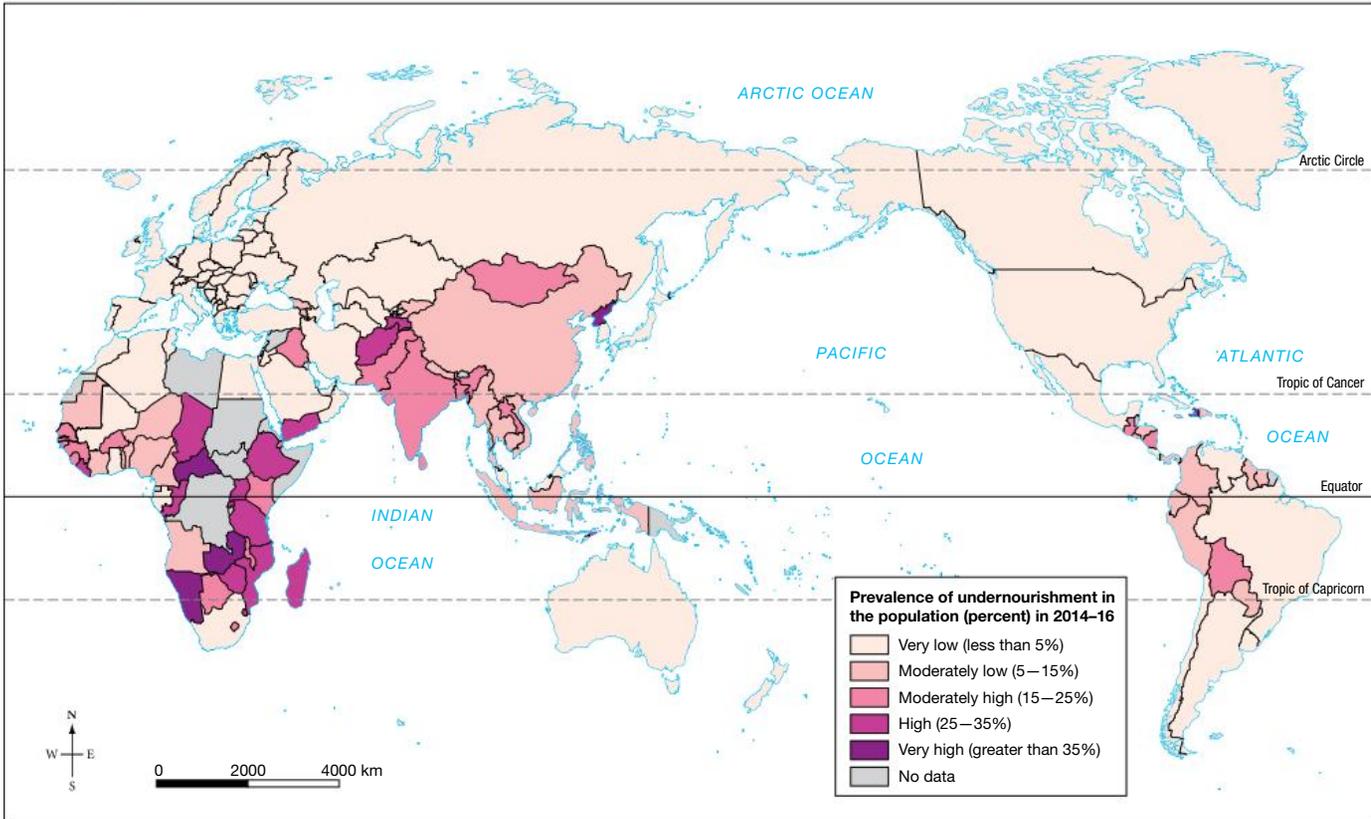
You will need:

- two maps
- a ruler
- an atlas

Procedure:

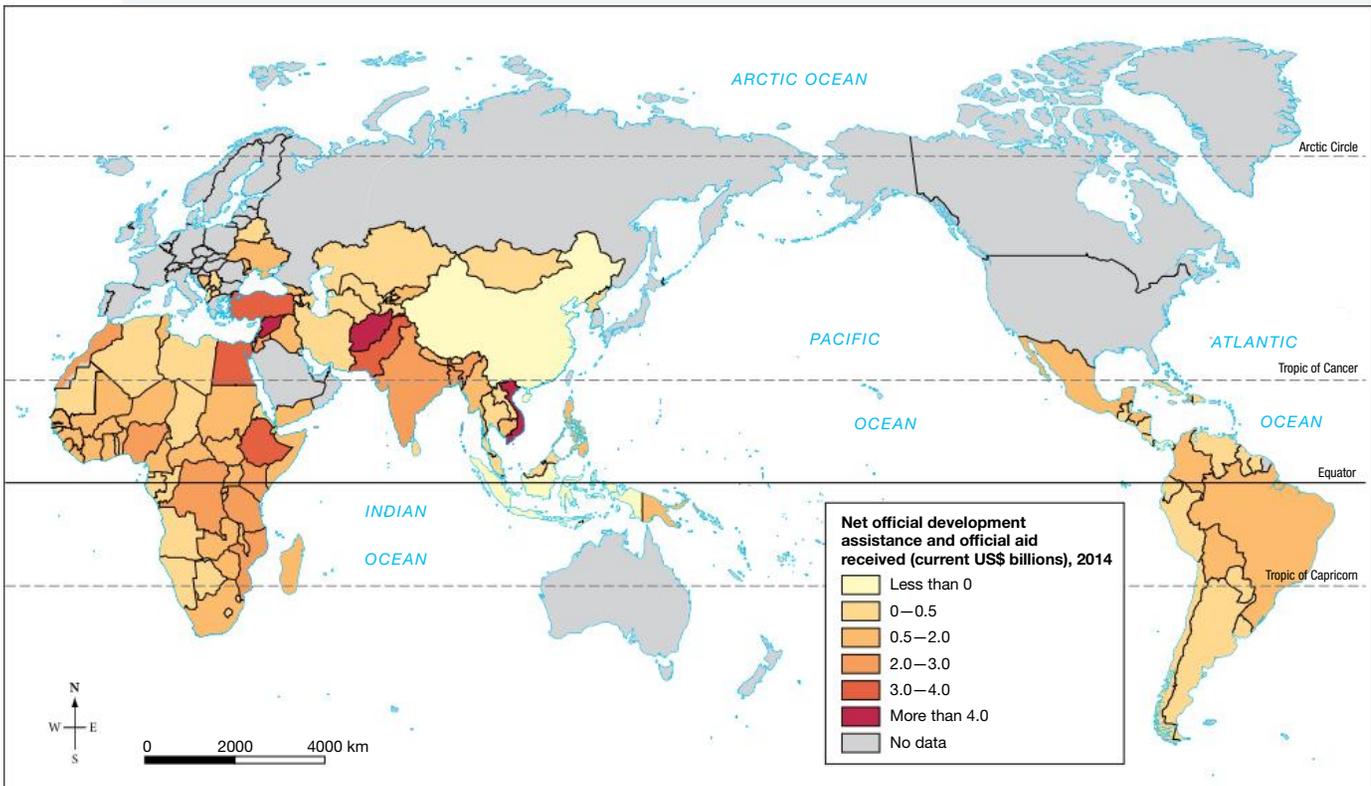
You will need the two maps of data shown in figures 1 and 2.

FIGURE 1 World hunger map, 2015



Source: © FAO, 2015, 2015 World Hunger Map, <http://www.fao.org/hunger/en/>, 8 June 2016.

FIGURE 2 Net official development assistance and official aid received (current US\$)



Source: World Bank

STEP 1

Construct a table or series of boxes with enough spaces for all the titles, columns and rows and all the categories of the data shown in the legends of both maps. Figure 1 has six categories and figure 2 has seven categories.

STEP 2

In the left-hand column, enter the title and units of measurement from figure 1. Table 2 shows this step. Place the lowest numbered category at the base of the column.

TABLE 2 A box scattergram layout

| Hunger level (% undernourished) | Aid received (US\$ billions) | | | | | | |
|------------------------------------|------------------------------|-------------|-------|---------|---------|---------|---------------|
| | No data | Less than 0 | 0–0.5 | 0.5–2.0 | 2.0–3.0 | 3.0–4.0 | More than 4.0 |
| 35 + | | | | | | | |
| 25–34 | | | | | | | |
| 15–24 | | | | | | | |
| 5–14 | | | | | | | |
| Less than 5 | | | | | | | |
| No data | | | | | | | |

STEP 3

In the base row, enter the title and units of measurement from figure 2. Place the lowest numbered category on the left-hand side. This step is shown in table 2.

STEP 4

To plot the data, find the two categories for a place on the map and put the country name in the appropriate square of the table. Continue this with as many countries as necessary. The box scattergram in table 3 shows ten African countries.

TABLE 3 Ten selected African countries, showing the relationship between undernourishment and international aid received per person

| Hunger level (% undernourished) | Aid received (US\$ billions) | | | | | | |
|------------------------------------|------------------------------|-------------|----------|--------------|----------------------------------|----------|---------------|
| | No data | Less than 0 | 0–0.5 | 0.5–2.0 | 2.0–3.0 | 3.0–4.0 | More than 4.0 |
| 35 + | | | Namibia | Zambia | | | |
| 25–34 | | | Chad | | Tanzania | Ethiopia | |
| 15–24 | | | Botswana | | | | |
| 5–14 | | | | | | | |
| Less than 5 | | | Algeria | South Africa | | Egypt | |
| No data | | | | | The Democratic Republic of Congo | | |

STEP 5

Complete the box scattergram with a suitable title. The title for table 1 would be: Relationship between undernourishment and aid received per person.

6.5.3 Let me do it

Developing my skills

Using the data in figure 1, complete a box scattergram showing the distribution of hunger in Asia and the amount of US aid sent to Asia.

Questions

1. Which Asian countries have a hunger level of over 15 per cent but receive less than US\$100 million in US aid?
2. Which countries receive less than US\$10 million in US aid and suffer from hunger within their borders?
3. Why might some countries receive high levels of US aid even though hunger is not a key problem there? Identify the countries that fit this category.
4. Some Asian countries have no difficulty in feeding their population and receive no US aid. Name these countries and suggest why no aid is provided.
5. Describe the pattern of hunger across Asia. Does the US aid pattern correlate with this pattern?

Checklist

I have:

- drawn a table
- labelled each axis appropriately
- shown two sets of mapped data accurately.

Skills questions

1. Box scattergrams are used to show:
 - (a) detailed information about a place
 - (b) unique information about a place
 - (c) generalised information about a place
 - (d) anomalies about a place.
2. A box scattergram always includes mapped information about:
 - (a) two features
 - (b) three features
 - (c) four features
 - (d) five features.
3. Why do you have to take great care when entering data in a box scattergram?
4. What is the value of a box scattergram to your learning?

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Watch this eLesson: Constructing a box scattergram (eles-1734)



Try out this interactivity: Constructing a box scattergram (int-3352)

6.8 SkillBuilder: Constructing and describing proportional circles on maps

6.8.1 Tell me

What are proportional circle maps?

Proportional circle maps are maps that incorporate circles, drawn to scale, to represent data for particular places.

Why are proportional circles useful?

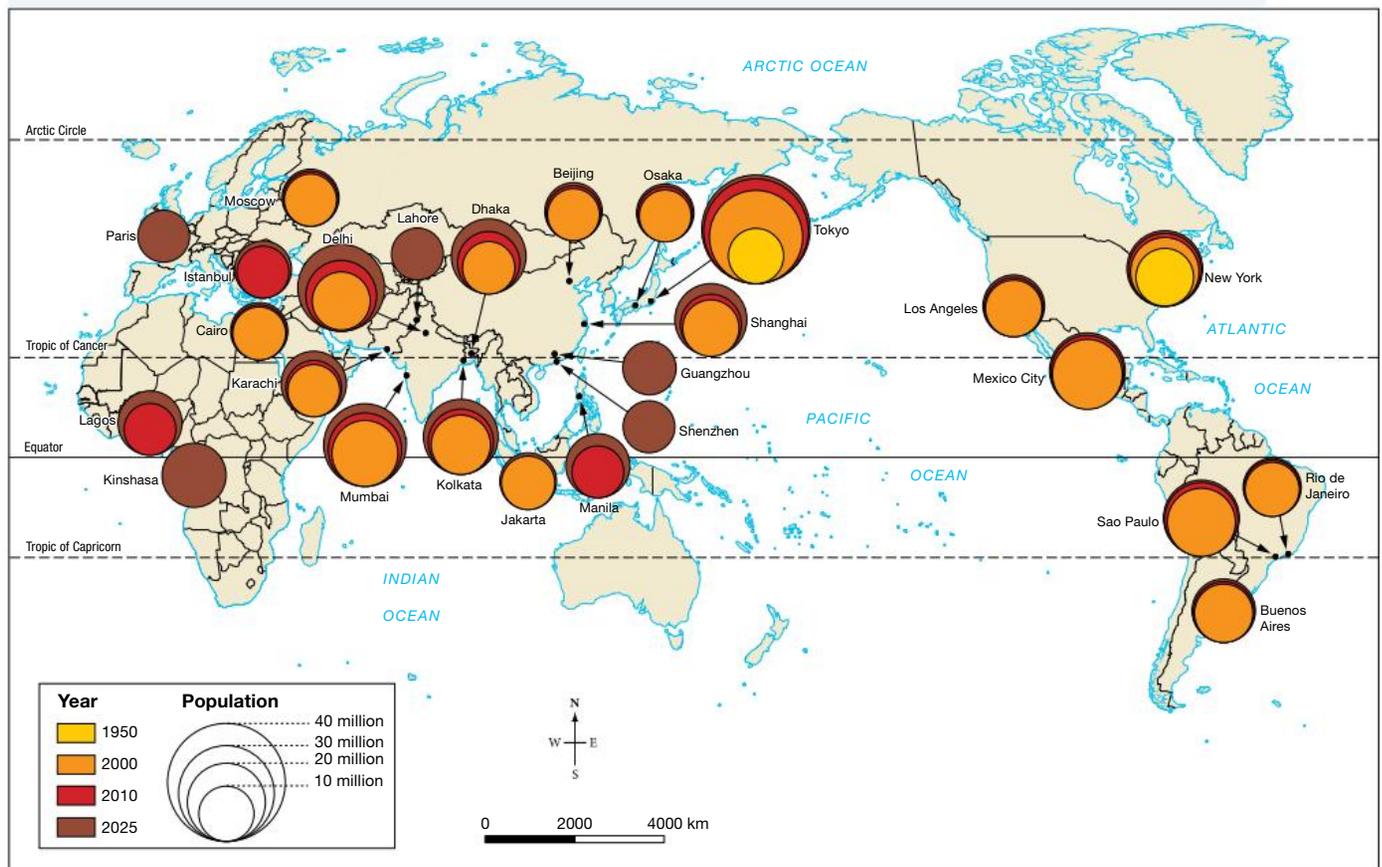
Proportional circles are useful as an immediate visual pattern, especially when the figures being handled are large. Different-sized circles on a map reflect different values or amounts of something. Proportional circles provide an easy way to interpret patterns, give an instant impression and allow us to compare data for different places. In class, you might use these to show population size, agricultural production of a specific crop, or endangered species.

Proportional circles are useful for:

- geography students wanting to gain a quick impression of varying amounts over space
- geography students showing relationships on a map
- economists showing the level of production across a region
- tourism authorities showing the numbers of tourists
- emergency management organisations showing the quantities of water moving through a catchment.

Model

FIGURE 1 Growth of megacities over time, 1950–2025 (projected)



Source: MAPgraphics

The growth of megacities has been most noticeable across Asia, with 11 of the 18 megacities identified in 2000 located in that region. The only megacities in 1950 were Tokyo and New York, and by 2025 Tokyo is predicted to be the largest megacity. By 2025 Asia will have 14 megacities, with Lahore, Guangzhou and Shenzhen reaching megacity status between 2010 and 2025. In 2010, North America and South America each had three megacities, Africa had two and western Europe one. By 2025, Africa will have three megacities. Australia/Oceania had no cities of this size in 2000, and is not predicted to have any by 2025.

A good proportional circle map:

- is drawn in pencil with a mathematical compass
- has circles that are accurately drawn according to the scale provided in the legend
- includes a key/legend to show the proportions of the circles
- has a title.

A description of a proportional circle map:

- effectively communicates differences in values over space
- identifies places
- uses directions.

6.8.2 Show me

How to draw and describe proportional circles

You will need:

- a base map
- a set of data
- a calculator
- a light-grey pencil
- a mathematical compass for drawing circles
- an atlas
- coloured pencils.

Procedure:

To complete a proportional circle map, you need a set of data and a base map onto which to draw the circles.

Constructing a proportional circle map

STEP 1

Study the data and decide how many categories or circle sizes you need in order to include the highest and the lowest values to be represented by the circles. You should have no more than five categories. The key in figure 1 has only four categories: 10, 20, 30 and 40 million. Notice, however, that there are more sizes shown on the map itself. We have to estimate what number, or value, those other sizes represent. For example, Tokyo's population in 2015 is about 35 million. Step 3 shows how sizes are calculated.

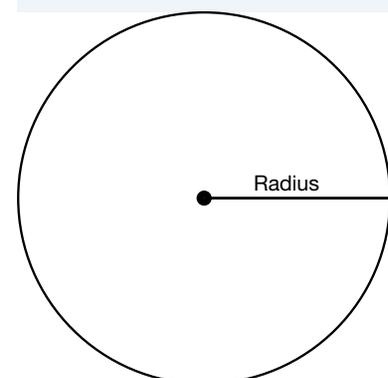
STEP 2

Determine the size of the circles that you wish to use. Don't make these too ridiculous for the map base you are given. They should not be too large and not too small.

STEP 3

Take a table of data and rank the values from highest to lowest. For example, in 2000 the largest megacity, Tokyo, had 26.4 million people. Manila had the lowest population with 10.9 million people. Work out the square root ($\sqrt{\quad}$) of each value, leaving off the millions. For Tokyo the

FIGURE 2 The radius of a circle



square root of 26.4 is 5.1 and for Manila the square root of 10.9 is 3.3. These numbers then give you the measurement of the radius of your proportional circles.

STEP 4

Construct a scaled group of circles as seen in the legend for figure 1. To do this, allow one millimetre to represent one unit. If you were drawing Tokyo's population for figure 1, you would draw your largest circle with a radius of six millimetres to ensure that the largest megacity, Tokyo, could be plotted with a radius of 5.1 (see step 3). Use the mathematical compass and the ruler, and set the compass to six millimetres. On your map base, draw a circle with a six-millimetre radius. Your smallest circle would need a radius of three millimetres to include Manila (see step 3). All other data in the table will fit somewhere between these two sizes.

STEP 5

Map all the megacities on the base map according to these scaled proportional circles. Take care with the use of the mathematical compass to ensure that your circles are accurate and neat. Using an atlas, place circles as close as possible to the location they represent. You may use an arrow if there are too many circles near each other.

STEP 6

You will need to adjust the measurements for the circles according to the data set for each type of map you plot.

STEP 7

Complete the map with the geographical conventions of BOLTSS.

Describing a proportional circle map

STEP 8

To interpret your mapped data, you need to look for patterns. Where are the largest circles? Where are the smallest circles? Are there any groupings of circles? Are there any patterns that can be identified, such as radial, linear, clustered or sporadic?

6.8.3 Let me do it

Developing my skills

Using the data on Fairtrade purchases in table 1, complete a proportional circles map to show the level of Fairtrade purchases across the world in 2010. Describe the distribution pattern revealed by your map.

Questions

1. Which continent has the greatest number of Fairtrade workers?
2. Which continent/s do not have Fairtrade workers?
3. Describe the pattern of Fairtrade worker numbers across the world.
4. Explain why Fairtrade workers are only found in developing countries.
5. Are there any countries in this list that surprise you with the number of Fairtrade workers? Explain your answer.

Checklist

In drawing a map of proportional circles I have:

- drawn in pencil using a mathematical compass
- drawn circles that are accurate according to the scale provided in the legend

TABLE 1 Top ten countries for Fairtrade farmers and workers, 2015

| Country | 2015 (€) |
|---------------|----------|
| Kenya | 295 400 |
| Tanzania | 164 100 |
| India | 139 400 |
| Ethiopia | 138 000 |
| Ghana | 104 400 |
| Peru | 61 300 |
| Colombia | 49 100 |
| Uganda | 47 600 |
| Mexico | 40 300 |
| Cote d'Ivoire | 34 300 |

Source: <http://fairtrade.se/wp-content/uploads/2012/09/150211-Fairtrade-By-The-Numbers-2015-final.pdf>

- included a key/legend to show the proportions of the circles
- included a title.

In describing a map of proportional circles, I have:

- effectively communicated differences in values or amounts of something over space
- identified places
- used directions.

Skills questions

1. Proportional circles are used to show:
 - (a) a value
 - (b) the location of a *place*
 - (c) the *scaled* amounts of a value
 - (d) *places* and times.
2. A proportional circle map always includes:
 - (a) actual total values
 - (b) standards of living
 - (c) patterns represented through *scaled* visuals
 - (d) a global base map.
3. What is the purpose of calculating the square root of the numbers when planning the size of your proportional circles?
4. Why might it be important to have good skills with a mathematical compass?

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Watch this eLesson: Constructing and describing proportional circles on maps (eles-1735)



Try out this interactivity: Constructing and describing proportional circles on maps (int-3353)

6.11 Review

6.11.1 Review

1. Use the **World Hunger Map 2015** weblink in the Resources tab to answer the following questions.
 - (a) How much does it cost to provide enough nutrition to feed a child each day?
 - (b) It has been estimated that the cost of hunger to developing nations is US\$450 million a year. List some of the effects of hunger on people.
 - (c) Into which category of hunger do these countries fit: Australia, Indonesia, Cambodia, Ethiopia, Brazil and France?
2. Name four problems that the world faces when it comes to producing enough food to feed everyone sustainably by 2050.
3. Construct a graphic showing eight cartoon-style people from around the world. Each person will have a speech bubble. In the speech bubbles, place a positive statement to show that it will be possible to feed the world in 2050.

Potato yield

Potatoes are the world's most important non-grain food crop, and they are essential to global food security. China and India are currently the world's largest and third largest producers of potatoes respectively. Together, they account for almost a third of the world's total production. However, crop yield in China and India is relatively low compared to the United States and Europe. In 2008, potato crop yields in the United States were 44 tonnes per hectare — almost three times higher than in China, which had 15 tonnes per hectare. The lower crop yields in China and India are owing to the low quality of their seed potatoes. Less than 20 per cent of China's potato acreage is covered by virus-free seed potatoes. As a result, there is enormous potential for increasing potato crop yields in Asia through genetic improvement.

4.
 - (a) Describe the yield gap between developed and developing countries.
 - (b) What would act as incentives for China and India to *change* their crop yield?
5. Use the **Story of agriculture and the green economy** weblink in the Resources tab to answer the following questions.
 - (a) List five things that you learned from this clip and share them in groups.
 - (b) Identify three suggested ways in which farmers can *change* their farming.
6. Consider requesting *changes* in your school canteen, such as buying Fairtrade chocolate, coffee or tea. Outline reasons you would give to support your request.
7. Use the **World Food Program** weblink in the Resources tab to answer the following questions.
 - (a) Prepare a case study on one of the *places* in which the World Food Program (WFP) is currently working. Check the *Hotspots* section on the website.
 - (b) Outline the actions that the WFP is taking at this *place*.
 - (c) Outline why these actions are necessary.
8. Research the population characteristics of one *place* where Australia has school feeding programs. Consider life expectancy, literacy levels and death rates, or some other indicators you think are important.
9. Write a letter to your local member of parliament, outlining your views on Australia's aid programs.

Sacred Heart Mission

The Sacred Heart Mission is located in St Kilda, Melbourne. It is an example of a local-scale organisation seeking to decrease homelessness and the food shortage associated with it. Sacred Heart Mission aims to ensure that homeless and disadvantaged people have access to life's necessities, including housing, food and health care, and that they can connect with their community. As part of the Mission's service to the homeless, it provides breakfast and lunch free of charge, 365 days a year. A professional kitchen staff of seven and a team of 15 volunteers prepare food each day. The program relies on food donations that come from a wide range of businesses across Melbourne.

10. (a) What might happen to some of the 53 000 people living independently in Australia if Meals on Wheels could not deliver meals to them?
- (b) What types of consequences might this have?
- (c) The hungry are not all located in the world's poorer countries. In your area, undertake an investigation into a charitable organisation, like the Sacred Heart Mission, which helps people to meet their food needs.

The future of food

11. Section 6.3.2 discusses one possible way of improving *sustainable* food supplies: building a greenhouse that uses salt water.
 - (a) What resources are needed to establish this type of agriculture?
 - (b) Undertake research and describe the following characteristics of Port Augusta: location, climate, population and economic activities.
 - (c) Why would this be an important *change* in a *place* such as Port Augusta?
 - (d) Predict what the impact might be on people and *places* if the greenhouse method of farming were to become more readily available.
 - (e) Which water-stressed *places* of Australia might be able to *sustainably* use this type of production?
12. Explain how an individual's choice of diet can influence their own health and the health of the planet.
13. Some countries, such as China, Saudi Arabia and South Korea, which cannot produce enough food for their needs, are buying agricultural land in other countries. Investigate examples of this and outline the advantages and disadvantages of this scheme for the countries involved.
14. Study figure 1 and then answer the questions that follow.

FIGURE 1 The importance of urban farming



- (a) What are examples of urban farming in your locality?
 - (b) Which city has established tourism based on urban farming?
 - (c) How can urban gardens be places of education?
 - (d) Explain why more *space* in cities may need to be set aside — either vertically or horizontally — for urban farming in future.
 - (e) Research and create an annotated map of urban farming in different *places*.
15. Review figure 2. Design and annotate your own vertical urban farm concept for 2050.

FIGURE 2 A possible structure for a vertical urban farm



16. Construct a concept map, using an appropriate computer program, and include the main ideas from this topic. Include any research and fieldwork data as well.

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 Explore more with these weblinks: World Hunger Map 2015, Story of agriculture and the green economy, World Food Program

6.11.2 Reflect

17. There are many controversial issues involved with food supply. What are your opinions on the following issues of interconnection?
- (a) Live animal exports to overseas countries
 - (b) Australia selling farmland to overseas countries
18. Investigate a place in Australia that depends on irrigation to produce food, such as the Murray–Darling Basin or the Ord River region of Western Australia.

- (a) What crops are produced there using the irrigation water?
 - (b) List the positive and negative consequences of this use of irrigation.
 - (c) Is this type of farming environmentally sustainable in Australia?
19. Discuss the issues that may arise as the consequences of a country deciding to slash its overseas food aid program by half.
20. *A Western diet is going to be unsustainable in the future.*
Provide an argument supporting this statement and a counter argument for the statement.

TOPIC 7

Geographical inquiry: Biomes and food security

7.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

7.1.1 Scenario and your task

Everyone in the world depends completely on the Earth's biomes for the services they provide — from our food and water supply to the regulation of our climate. Over the past 50 years, people have had a more rapid and more extensive impact on these biomes than during any other time in human history. Our demand for food, water, fibres, timber and fuel has driven these changes. The results have contributed to improvements in human wellbeing and economic development, but there has also been detrimental change to many of our major food-producing biomes.



Your task

Your team has been selected to create a website that not only grabs people's attention but also informs them of the importance of one particular biome as a producer of food, and the current threats to food production. Looking into the future, you will also suggest more sustainable ways of managing this biome.



7.2 Process

- Watch the introductory video lesson. You can complete this project individually or invite members of your class to form a group.

7.2.1 Process

You will need to research the characteristics of a biome and address the following four key inquiry questions:

- What is the biome and what are its characteristics and distribution across the world's spaces?
- How can we sustainably feed future populations using this biome?
- In what ways has food production changed this biome? Include examples and/or case studies.
- What are the main types of food production in this biome? How are foods produced?

Each group should decide how to divide the workload so that each of the four inquiry questions is studied.

7.2.2 Collecting and recording your information and data

- Once you have chosen your biome and divided the key questions among the team, it is time to start researching information. For your own key question, break it down into several minor questions that can become subheadings to form the structure of your research. As a group, check each person's research structure to ensure that it follows the inquiry sequence.

When researching, look for maps, graphs and images that support your key question or that of another team member. You should also look for data or statistics that you can show visually in the form of maps, diagrams or graphics.



7.2.3 Analysing your information and data

- Once you have researched and collected relevant information, you need to review it, ensure that you understand the material and then use it to answer your key questions. From maps and graphs, describe any patterns or trends that you identify. If using photographs, write clear annotations for each one, highlighting particular features.
- Access the website model and website-planning template from the Resources tab to help you build your website as well as images and audio files to help bring your site to life.
- Use the website-planning template to create design specifications for your site. You should have a home page and at least three link pages per topic. You might want to insert features such as 'Amazing

facts’ and ‘Did you know?’ into your interactive website. Remember the three-click rule in web design — you should be able to get anywhere in a website (including back to the homepage) with a maximum of three clicks.

7.2.4 Communicating your findings

- You will need to access FrontPage, Dreamweaver, iWeb or other website building software to build your website. Remember that less is more with website design. Your mission is to engage and inform people about a topic they may never have thought about. You want people to take the time to read your entire website.

7.3 Review

7.3.1 Reflecting on your work

- Think back over how well you worked with your partner or group on the various tasks for this inquiry. Reflect on your contribution to the team by completing the Reflection template in the Resources tab. Determine strengths and weaknesses and recommend changes you would make if you were to repeat the exercise. Identify one area where you were pleased with your performance, and an area where you would like to improve. Write two sentences outlining how you might be able to do this.
- Print out your Research Report from the Resources tab and hand it in with your website and reflection notes.



UNIT 2

GEOGRAPHIES OF INTERCONNECTIONS

Every text, call, purchase or trip we make connects us to information, other people and places. This interconnection is influenced by people's views or perceptions of these places. Our consumption of goods and services and our travel, recreational and cultural choices all have impacts on the environment. This has implications for future sustainability.

- 8** How do we connect with places? 135
- 9** Tourists on the move 158
- 10** Buy, swap, sell and give 183
- 11** For better or worse? 208
- 12** Fieldwork inquiry: What are the effects of travel in the local community? 232

Planet Earth at night, lit by the rising sun, illuminated by the light of cities. The surrounding network represents the major global air routes.



TOPIC 8

How do we connect with places?

8.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

8.1.1 Introduction

Geography is the study of people and their connections with places. The way we interact with places is dynamic: we change places and places change us. In a world of over seven billion people, we have many different perceptions of what a place is like, how it is used and how it could be improved. More people are on the move, too. Their journeys may be on foot or by plane as they visit and interact with new places. With rapid developments in ICT, some of those places may be imagined. What do our connections look like today, and how will they change tomorrow?

An Elder explains the meaning of an indigenous rock art cave painting in Cooktown.



Starter questions

1. How do we as individuals see or perceive **places**?
2. How do our perceptions differ from those of our friends, our neighbours or people on the other side of the world?
3. How do distance and time play a role in our perception of **places**?
4. Do we make assumptions about **places** and what they are like?
5. How do **places change** us?
6. Is ICT **changing** the way we look at **places**?

INQUIRY SEQUENCE

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8.2 How do we 'see' places?

8.2.1 Perceptions of places

People's **perceptions** of places are rarely the same. A person's view of a particular place or region is coloured by their own culture, experiences and values. The characteristics and significance of a place will be viewed differently by each individual, and our mental maps of the world can change daily as we have new experiences and gain new knowledge.

The biggest influences on the way we perceive places are age, gender, class, language, **ethnicity**, race, religion and values. How important a place is to us may be determined by whether we feel that place belongs to us or not, whether it is part of our tradition or history, or whether the place is totally unfamiliar.

A place can seem exciting, scary, interesting or boring depending on our experience, expectations or mood on a particular day. Our perceptions of places may also change over time according to climatic changes, conflict or economic shifts.

It is important to understand the factors that influence our perceptions of places and regions, as well as the impact that other groups and cultures have on our perceptions. If we can understand those influences, we may be able to avoid the dangers of **stereotypes** and appreciate the diversity that exists around us.

FIGURE 1 The Kaaba in Mecca — sacred, interesting or crowded?



8.2.2 How do we map places?

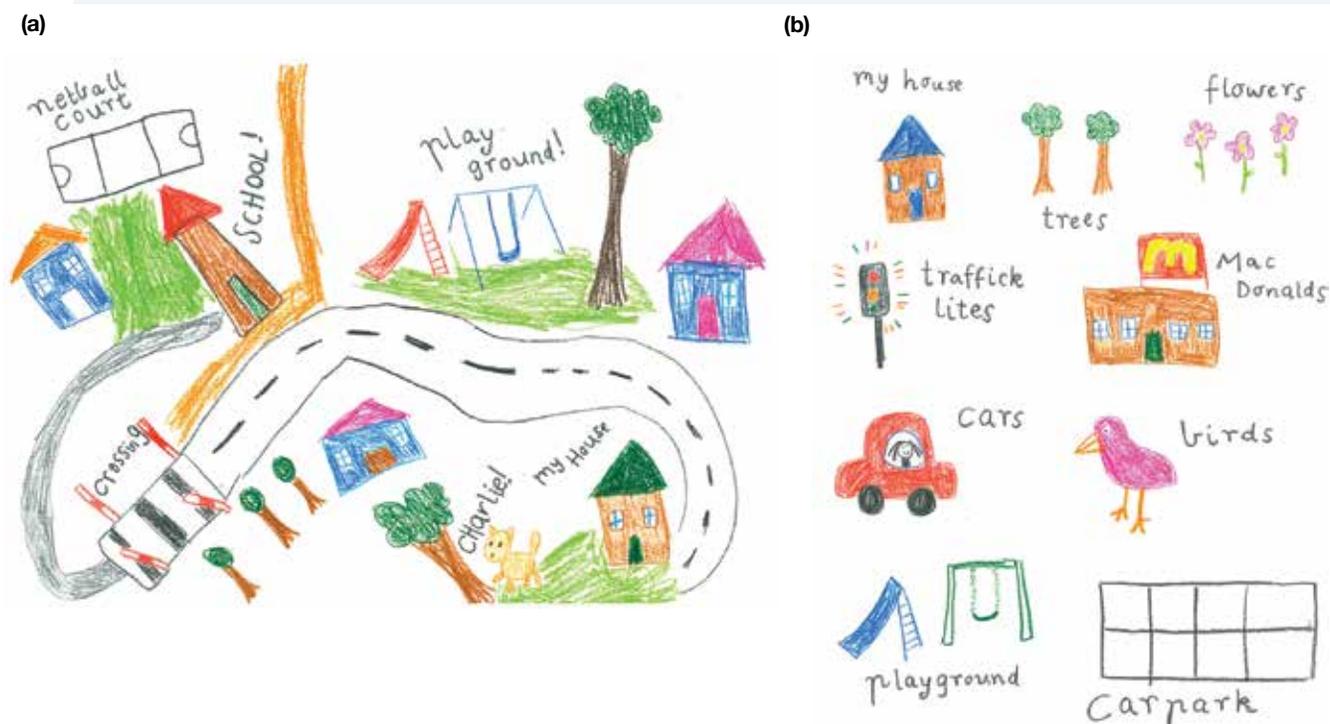
We all form an impression of our physical surroundings — even of places we have never actually been to. These are what geographers call our mental maps.

Mental maps tell us how we order the space around us. There is no such thing as an accurate mental map, but people's mental maps of their immediate environment tend to be more realistic than those of places they have never visited. Think about some of the ways you use mental maps in your daily life. You may direct someone from point A to point B, telling them about landmarks they will see along the way. You may think about the quickest way to get to the city from a friend's house, imagining your route in your mind.

Our mental maps can help document our influences. Those who walk a lot may be more connected with their neighbourhood and surrounding environment, whereas those who drive will have a very different perspective in their mental map. In the 'Streets Ahead' study by VicHealth, children who walked to school drew pictures that included street names and friends' houses, and they were able to describe people and places in detail (see figure 2a). Children who were driven to school tended to separate items from their environment, displaying them in distinct windows (see figure 2b).

Mental maps of places we are unfamiliar with are heavily influenced by the media and stereotypical discussions. Travel helps to counteract the effects of the media and generally increases a person's knowledge of an area, providing them with a better understanding of what a place is really like.

FIGURE 2 (a) Drawing by a child who walks to school (b) Drawing by a child who is driven to school



8.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. List the factors that may influence our perception of *place*.

Explain

2. From your list in question 1, which factor do you think is most influential? Why?
3. Why do you think the two children's maps shown in figure 2 are so different? What does it say about their **interconnection** with their **environment**?

Discover

4. With your class, make a list of the **places** or landmarks in your community that you use on a regular basis. Each student should rate the importance of each on a **scale** of 1 to 3, with 3 being most important. Collate the data to find out which **places** are most and least important to your class. Are the results as you expected? Do they match your own perceptions of how important **places** are, or do you have a different view from your classmates? Explain why there might be similarities or differences.
5. Create a mental map of your journey to school on a blank sheet of A3 or A4 paper. Include as many annotations as you can, such as street names, landmarks, shop names and so on. Once you have finished, compare and contrast the **scale**, size and accuracy of your mental map with a street directory or an ICT mapping tool. Write a paragraph that details some of the differences between your perception and reality.

Think

6. How would the **place** in figure 1 be viewed by different groups? What kind of experiences or influences may affect their view? Try to provide at least three perceptions for the image.
7. The writer Henry Miller once said, 'One's destination is never a **place**, but a new way of seeing things'. What does this quote mean to you, in light of your knowledge of various **places**, your own travels, and what you have learned about perception?

learn on RESOURCES – ONLINE ONLY

 Try out this interactivity: My place (int-3332)

8.3 SkillBuilder: Interpreting topological maps

online only

WHAT IS A TOPOLOGICAL MAP?

Topological maps are very simple maps, with only the most vital information included. These maps generally use pictures to identify places, are not drawn to scale and give no sense of distance. However, everything is correct in its interconnection to other points.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 A tourist map of Paris and its monuments



learn on RESOURCES – ONLINE ONLY

 Watch this eLesson: Interpreting topological maps (eles-1736)

 Try out this interactivity: Interpreting topological maps (int-3354)

8.4 How do we move around our spaces?

Access this subtopic at www.jacplus.com.au



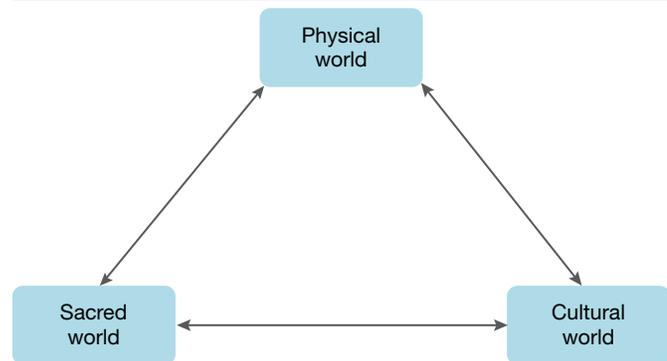
8.5 What does our land mean to us?

8.5.1 Why is land so important?

Land means many things to different people. A farmer sees land as a means of production and a source of income. A conservationist sees land as a priceless natural resource that must be protected. A property developer sees land as an area that can be divided, built upon and sold for a profit. To Indigenous Australian peoples, land is something much, much more — it is a part of their being.

Indigenous Australian peoples have been in Australia since the beginning of the Dreaming (more than 50 000 years by European estimates), adapting to survive and thrive in a changing environment. For Indigenous Australian peoples, the land is at the core of their wellbeing — their relationship with the land is one of interconnectedness across the physical, spiritual and cultural worlds (see figure 1).

FIGURE 1 A simplified view of the Indigenous Australian peoples relationship with the land



8.5.2 How do Indigenous Australian peoples perceive the land?

For Indigenous Australian peoples, land is much more than the soil, rocks, hills and trees. The land is where they come from, and to where they will return. The land, or country, represents a whole environment that sustains Indigenous Australian peoples and their culture and way of life. Indigenous Australian peoples are diverse, made up of over 500 different groups, each with its own separate language (or dialect), laws, beliefs and customs. Language groups are made up of a number of communities, with each community belonging to a territory or traditional land. These places include features of the natural environment such as waterholes and hills, as well as distinct geographical boundaries such as rivers or mountain ranges. Natural features are often represented in Indigenous art (see figure 2).

It is the responsibility of each community to look after their country as it looked after them. The environment holds rich meaning for Indigenous Australian peoples, whose Dreaming Stories (for Aboriginal peoples) and Legends (for Torres Strait Islander peoples) are present throughout the landscape, along with many sacred places for special ceremonies — men's and women's sacred sites (see figure 3) — and resting places for ancestors that must be protected and conserved.

Each community has a **totem** that was a sign of its people's spiritual link to the land. A totem could be an animal, plant or geographical feature such as a weather pattern or rock formation. It is from this totem or land feature that an individual draws their spirituality, and they would feel a special responsibility to protect it. Special ceremonies are performed at these sacred places to show respect for, replenish and celebrate each totem.

8.5.3 Does the land belong to us or do we belong to the land?

Indigenous Australian peoples view themselves as custodians rather than owners of land, for the land will exist long after they have left this world. To them, land cannot be bought or sold. The concept of property or land ownership that arrived with the Europeans contrasted greatly with the indigenous view of place.

FIGURE 2 A traditional Aboriginal dot painting depicting land at Kiwirrkura, 400 kilometres west of Alice Springs



Source: © Donkeyman Lee Tjupurrula Kukatja (c.1921)–1994

Tingari Dreaming at Walawala (1989)

Synthetic polymer paint on canvas, 119.7 × 179.3 cm

Purchased from Admission Funds, 1989

National Gallery of Victoria, Melbourne

© Donkeyman Lee Tjupurrula/Licensed by VISCOPY 2013

When the European colonies were established, many Indigenous Australian peoples were dispossessed of their land and cultural practices were forcibly disrupted. In many cases, indigenous communities were pushed onto marginal lands that were often not their own, not only creating conflict but severing their connection with the land from which they drew their sense of identity. However, even today among groups largely displaced from their traditional estates, that strong link to country is maintained through stories and a sense of place and spiritual connection.

8.5.4 How do you view this land?

To illustrate this difference in viewpoint, figure 3 shows James Price Point on Western Australia's Kimberley coast. The following are three very different views of the same area of land.

- Unremarkable beach — *Colin Barnett, Premier, Western Australia*
- Major heritage site — *WA Department of Aboriginal Sites* ('Major' is the Department's highest category.)
- Secret Aboriginal men's business site — *Goolarabooloo Aboriginal people*

When different people have vastly different views about a place, it can make the management of that land challenging.

FIGURE 3 James Price Point, Western Australia



8.5.5 How did Indigenous Australian peoples move across the land?

Much like the international system of passports and visas to enter other countries, a similar process exists for Indigenous nations. Entry to another nation's or community's lands is by ceremony and negotiation, a practice still commonplace today, recognising the important relationship that Indigenous Australian peoples have with their country. The tradition of a 'Welcome to Country' for visitors issues a shared commitment to protect and preserve the land being visited. After being welcomed, those who walk on another's lands are expected to respect the traditional owners' rules and protocols.

8.5.6 What places do Indigenous Australian peoples connect with today?

In the twenty-first century, 78.6 per cent of Aboriginal and Torres Strait Islander peoples are interconnected with Australia's urban environments; only 21.4 per cent live in remote or very remote areas. Many of those living in urban environments know the stories passed through generations, but not all have visited their traditional lands. AFL footballer and Australian of the Year 2014, Adam Goodes took time out from his career to return to his homeland, to find out more about himself and his people, and to help identify characteristics that made him different.

8.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. How do Indigenous Australian peoples perceive the land?

Explain

2. What does land mean to you? Think about where you live or where you come from to help describe the **interconnection** you have with the land.
3. Brainstorm with other members of your class and construct a list of other examples of different cultural viewpoints to the same object, custom or **place**. Consider such things as music, religious customs and foods.

Discover

4. Refer to figure 3 and conduct internet research to find out more about James Price Point. Answer the following questions.
 - (a) What is involved in the conflict over James Price Point?
 - (b) Create a mind map that shows the various groups involved in the dispute. Beneath each group name, list their interests in the site.

- (c) Consider the viewpoints about James Price Point quoted in this section. How have these individuals or groups perceived the land in this **place**?
- (d) The project at James Price Point has recently been cancelled. From your internet research, why do you think this happened? Share your findings with your classmates. Do they agree?
5. Who are the traditional owners of the land on which you live? Have you witnessed a ‘Welcome to Country’ ceremony? Who performed the ceremony, and what was involved? (It may have included a speech, traditional dance or smoking ceremony.)

Think

6. Given the strong **interconnection** to land, you may think that Indigenous Australian peoples are opposed to land development. Although custodial responsibilities and care of the land are of utmost importance, many land owners strongly support economic development. As a class or in small groups, debate the arguments in favour of and against development of traditional lands.

8.6 How do places change?

8.6.1 A chequered history

Places can change very slowly over time and space, or undergo rapid transformations. Melbourne’s laneways are an excellent example of how a place once perceived as unsanitary and unsafe is now a thriving and popular part of a metropolis.

During the gold rushes of the 1850s, Melbourne’s laneways were well used by people from all walks of life. Then, at the turn of the twentieth century, they began to take a turn for the worse. Criss-crossing the city, their main function was as a place for rubbish disposal. They were dark and dingy, and riddled with disease, crime, gambling houses and brothels. After two World Wars, they became home to many immigrants who had nowhere else to live. The city had lost its shine.

Then, in the late twentieth century, something changed. Perhaps influenced by the potential for regeneration that they had seen in European cities on their travels, people began to see the potential of Melbourne’s neglected laneways. Small businesses such as art and craft galleries, fashion boutiques and music shops opened. Business owners leased cheap properties in the laneways, away from the main streets with their high rents. Public spaces were regenerated, adding to the city’s landscape. Music and entertainment became a reason to go into the city at night.

People are living in the city again, and the CBD is now perceived as a desirable address — its resident population is now approximately 30 000 compared with only 700 in the 1980s. The laneways have helped lead that revival.

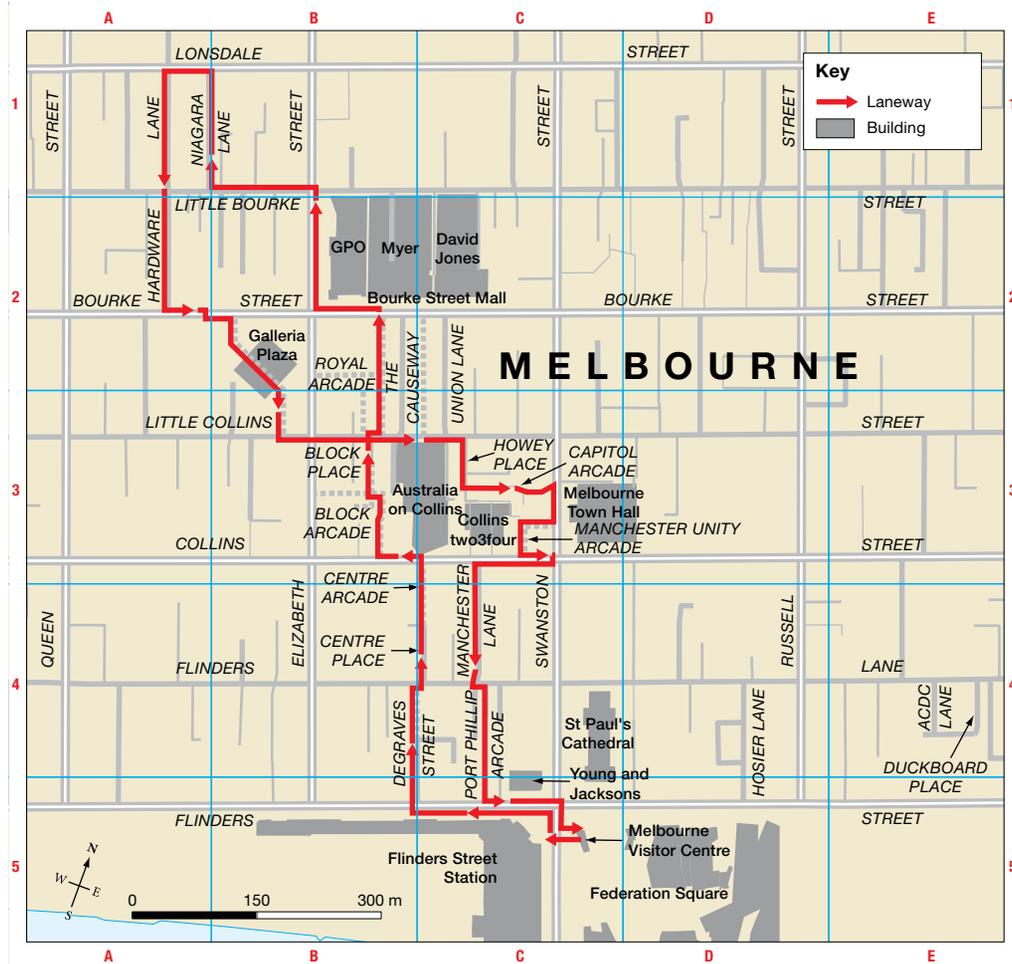
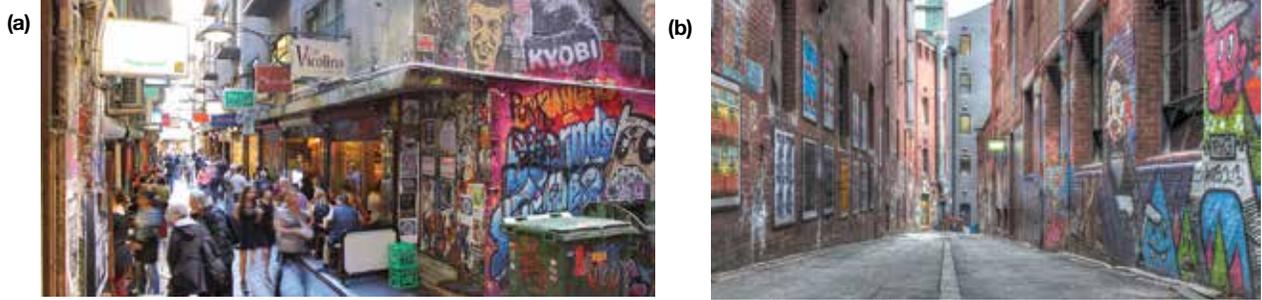
The laneways today

Better lighting, more cleaning and an increased number of people have all contributed to a change in the perception of Melbourne’s laneways. **Street art** tours abound, and many laneway bars, cafés and restaurants are desirable places to see and be seen in. There are laneway festivals, parties and even a ‘Love your Laneway’ project run by the City of Melbourne. The laneways are one of Melbourne’s biggest tourist drawcards, and are particularly famous for the vibrant and colourful street art that adorns their walls. Rather than simple **graffiti** or tagging, these are inspiring artworks from some of Australia’s (and occasionally the world’s) best street artists.

8.6.2. The laneway revival around Australia

The city of Brisbane has also undergone a transformation in the last few years. The Brisbane City Council’s Vibrant Laneways initiative, combined with the introduction of the state government’s small bar licence, has prompted many innovative venues to open their doors. In 2012, Adelaide also announced reduced liquor licensing fees for smaller venues. This initiative is aimed at revitalising the Adelaide CBD, creating a local version of laneway bars and culture akin to Melbourne’s CBD. In New South Wales, the City of Sydney’s Laneway Art Program has sought to encourage a city that buzzes with new art, new business and new life.

FIGURE 1 A map of Melbourne's laneways (a) Centre place, one of Melbourne's revitalised laneways (b) Duckboard place (c) ACDC lane (d) Graffiti in Hosier Lane



Source: Spatial Vision



8.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

1. Explain how the perception and uses of Melbourne's laneways have **changed** over time.
2. How do laneways allow people to **interconnect** with the city?

Discover

3. What other areas in Melbourne, or your city, are now developing a laneway culture? How are they attempting to achieve this? In Melbourne, you may wish to investigate Richmond, the QV building or the Docklands precinct.

Predict

4. What other uses could you propose for laneway **spaces** in addition to those outlined above?

Think

5. Some aspects of laneways that can be improved are:
 - waste management and stormwater run-off
 - amenity and access
 - infrastructure, such as public lighting and road surfaces.
 - (a) Can you think of any other ways in which laneways can be improved for public use?
 - (b) Are there other **spaces** within a CBD **environment** that could be improved in order to provide new **places** for people to enjoy?
 - (c) What would need to happen in order to make the **places** you identified in question 5b functional, safe and accessible?
6. If possible, conduct fieldwork in your city's laneways or complete the Laneway Walk shown in the map in figure 1. Are laneways **sustainable spaces** for people? Give a detailed personal response.

8.7 How do we access places?

8.7.1 Connecting with public transport

Public transport provides a relatively low-cost way for people to interconnect with places, and can reduce traffic congestion and pollution. For students, it is often the only way to get around. Sometimes, however, it can seem like too much bother, perhaps because one service does not connect to another or because there are not enough services running, especially near your house.

Public transport use is considerably higher in capital cities than in other parts of Australia, partly because cities have relatively large populations and better public transport **infrastructure**.

8.7.2 Our changing needs

With any population growth, governments at all levels must consider how they will meet changing transport needs. ICT developments have allowed us to make better decisions for our use of public transport. For example, have you used the internet or an app to find the fastest way to get from A to B? Service quality, frequency and infrastructure are generally the biggest concerns in the provision of a public transport system. However, the affordability of public transport is equally important, because many low-income people depend upon public transport to access jobs, services, education and recreation.

8.7.3 Different forms of public transport have different uses

Public Transport Victoria aims to deliver quality customer service and provide enhanced access across the range of public transport services throughout Melbourne and Victoria via its website, apps and other forms of social media.

Trains move large numbers of people over long distances at high speed in and out of the Central Business District. Travellers' access is heightened by the use of curving routes across the urban area with a minimum number of stops.

Trams operate only in areas of high population density, using high-speed and infrequent stops to maximise access for middle-distance commuters.

Buses provide access where trains and trams do not go and 'infill' access for people by using a range of road levels. Buses are the most flexible of the services able to change routes as there is no fixed rail system involved. Buses, and to some extent trams, ferry people to train stations, adjusting timetables and reorganising routes to match the train network, as seen with the opening of the Regional Rail Link in Melbourne's outer west.

FIGURE 1 Six trains come and go from central Melbourne.



FIGURE 2 Trams take people from the city to suburbs such as Maribyrnong in the north west.



FIGURE 3 Buses and trains interconnect at Glen Waverley station.



8.7.4 How satisfied are we with public transport?

The Transport Opinion Survey is conducted biannually across 1000 adult Australians. In 2015, 37 per cent of those surveyed said public transport was a top priority. Three in five Australians would prefer to see rail developments rather than more bus services, except in Queensland and South Australia, which already have well developed, fast bus systems. Only 9 per cent of those surveyed thought Australia's transport systems would be better within a year; just 7 per cent felt that local public transport would be improved within a year. In five years' time, 22 per cent of those surveyed thought the transport system they were using would be better.

FIGURE 4 Shared pathways are common.



A recent study in the Netherlands revealed that people perceive that their travel time on public transport takes 2.3 times as long as driving a car to make the same journey. People also perceive a continuous journey (involving, say, only one train) as taking less time than a journey that involves transfers and waiting times, even if the second journey is actually shorter. People estimate the waiting time to be about two to three times longer than the actual time. So, a wait of 10 minutes is perceived as 20 to 30 minutes. Factors that influence this perception include:

- uncertainty about when the next bus or train will arrive
- weather conditions
- familiarity with the journey.

Given that travellers tend to consider non-vehicle travel time (walking, waiting, transferring) to be more difficult than in-vehicle travel time, this has consequences when trying to attract people to public transport. If people think their travel time by car is 60 minutes, they perceive their travel time by public transport for that same trip to be almost double: 117 minutes.

8.7.5 Active travel

Cycling and walking to get to work, to visit friends and for the purpose of recreation have become mainstream modes of transport in the twenty-first century. In particular, in Melbourne's inner suburbs 20 per cent of those going to work now choose to use active travel.

Melbourne's bicycle paths and trails continue to grow in number providing increased access to places. Figure 5 maps the 'spiderweb' of pathways around the Melbourne region.

To encourage active travel, railway stations — both new and old — are installing secure bicycle storage areas (called parkiteers, see figure 6). Authorities are revising road layouts and regulations to provide a secure riding environment. Manufacturers are also designing electric bicycles to make access available to a wider range of people. Bicycles for hire, or free, can be picked up at points within the Central Business District of many capital cities.

The choice to access places by public transport, active travel or vehicle keeps people connected and strengthens interconnection in a community.

FIGURE 5 Melbourne's bike paths



Source: Map courtesy the Bike Paths and Rail trail Guide (Victoria) <http://www.bikepaths.com.au>

FIGURE 6 Signage at a railway station encouraging the use of parkiteers



8.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Why is public transport perceived by governments as being very important?
2. Write a definition for the term 'active travel'.

Explain

3. Do you use public transport? Why or why not?
4. (a) How interconnected is the place in which you live? What types of public transport are available to you? What distances do you need to travel to reach a bus stop or a train station?
(b) What types of public transport are required for you to access your closest international airport?
(c) How do you perceive the quality of your public transport? Consider accessibility, timeliness, cleanliness, comfort, ticketing, safety, convenience and information about the service. Explain your answer.
5. Explain how each form of public transport provides access for different groups in our community. Consider students, workers, senior citizens, those with a disability and tourists. Figures 1, 2 and 3 will provide some additional ideas.
6. One of the most significant aspects of public transport is the interconnection between the different forms of transport. Why is interconnection important?
7. See the **Google maps** weblink in the Resources tab for a satellite image of Melbourne's bike paths. Go online and create figure 5. Use the scale tool to measure three distances between places that you are familiar with and three distances between places that you would like to visit. How do you perceive your ability to get to these places by bicycle?

Discover

8. (a) As a class, pick a location on the other side of town. Using your rail, bus or other public transport provider website, find out how long it would take you to travel from your school or home to this point on:
 - a Monday morning at 9 am
 - a Sunday evening at 6 pm.

- (b) What did you notice about the travel times? Were they different? Why do you think this is? Create a map of your journey, using an appropriate key, to show rail, bus and other modes of transport used.
9. Using the interactive **TRAVIC (Transit Visualization Client)** weblink in the Resources tab look at the movement on the public transport system of Melbourne and in regional Victoria in real time. How does this impact on your perception of the role of public transport? If possible, visit this site at different times of the day and night to see how the transport system adjusts to the needs of the people.
10. How safe is it to ride a bicycle in Melbourne? Visit the survey on the internet at BikeSpot to find evidence for your opinion.

Think

11. There are frequent announcements by the Victorian Government on developments with the public transport system. For each public transport type and for each form of active travel, suggest two changes that might occur in the next 10 years. Compare your suggestions with those of others in the class.

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Try out this interactivity: Off the rails (int-3333)



Explore more with these weblinks: Google maps, TRAVIC (Transit Visualization Client)

8.8 To walk or not to walk?

8.8.1 Introduction

Urban planners around the world are focusing on human wellbeing as a key to the structure of new suburbs and revitalisation of existing suburbs. People's perceptions of what will make 'life good' and what makes a 'good place' to live in are being taken into account. Being connected to other places and people is a high priority.

8.8.2 What is the '20-minute neighbourhood'?

Melbourne has been ranked the best city to live in since 2011. The city is unique, with access to coastal areas, a mild climate, a range of topography, distinctive suburbs or places, considerable tree cover and well-designed buildings and streets. As part of 'Plan Melbourne 2016', which aims to help retain that status and enhance the state's capital, the concept of the '20-minute neighbourhood' is being applied.

As figure 1 shows, the '20-minute neighbourhood' is about improving the liveability of a place. This means being able to walk around your neighbourhood and within 20 minutes being able to access your daily needs — for example transport, doctors, primary schools. Factors that make a good neighbourhood walkable are:

- a centre — either as a street or public space
- people — enough people for businesses to be successful and for public transport frequency
- mixed income and mixed use — a range of housing types
- parks and public space — for people to gather and to play
- pedestrian design — foot access (cars parked off street)
- schools and workplaces — close enough to walk
- complete streets — suited to bicycles and walking, and allowing easy movement across the place.

8.8.3 Why is walkability important?

Walkability provides a range of benefits to any community. People's health has been shown to improve if they walk on a regular basis. In particular, the risk of heart disease and diabetes is reduced. When people walk regularly, they are often 2.5 to 4.5 kilograms lighter than they would otherwise be. There is a reduced

FIGURE 1 The components of the '20-minute neighbourhood' concept

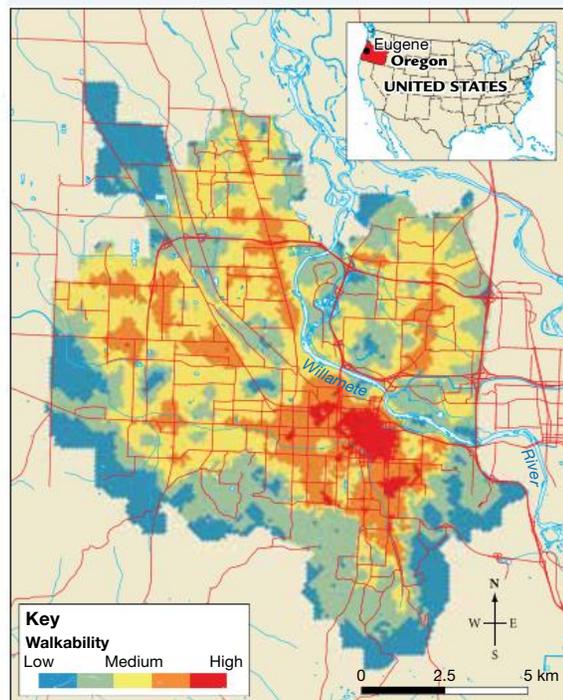


environmental impact with fewer cars on the road, as feet produce zero per cent carbon dioxide emissions! Communities benefit when people have more time available for involvement in community activities. Up to 10 per cent of a person's time spent in a community activity is lost when a car is used for just 10 minutes of commuting. Families also benefit financially as a car is often the second largest household expense and housing prices can increase by 20 per cent when located in places with a high walkability score.

In Eugene, Oregon, in the United States, areas closest to the centre of the city were shown to have a higher walkability rating than those on the rural urban fringe. Key elements considered in the mapping and overlaying (figure 2) were:

- density — the density of the population and the number of employees
- destinations — bus stops, shops, primary schools, corner stores, parks and other goods and services
- distance — intersection density, bicycle facilities, paths

FIGURE 2 Eugene, Oregon walkability ratings with the most walkable areas shown in red



Source: <https://www.eugene-or.gov/1229/Full-Composite-Heat-Map>

- aesthetics — tree cover, road width, condition of properties along routes
- safety and perceived safety — traffic speed, path condition, signalled crossings
- socioeconomics such as distribution of income, education, age and background.

8.8.4 How accessible are Melbourne’s neighbourhoods?

A US company developed a Walkability Index (table 1), which considers a range of features using the Eugene, Oregon experience. According to its scale, the following key assesses the rating of a neighbourhood.

TABLE 1 The classifications within the Walkability Index

| Walkability rating | Access to the neighbourhood | Tasks able to be completed |
|--------------------|-----------------------------|------------------------------------|
| 90–100 | Walker’s paradise | Daily errands do not require a car |
| 70–89 | Very walkable | Most errands done by foot |
| 50–69 | Somewhat walkable | Some errands done by foot |
| 25–49 | Car dependent | Most errands require a car |
| 0–24 | Car dependent | Almost all errands require a car |

Using this Walkability Index there are just 12 suburbs of Melbourne that currently fit the range of 90–100 as a walker’s paradise. These suburbs include Carlton, Fitzroy, Fitzroy North, Melbourne (central area), St Kilda, South Yarra, East Melbourne, South Melbourne, Collingwood, Windsor, Southbank and Richmond.

8.8.5 How accessible will neighbourhoods become?

Property developers across all major cities in Australia and the developed world have realised the importance of human wellbeing. New estates now focus on providing parklands (often with a water feature); local shopping centres; safe and sound surroundings; foot and bicycle paths; and peaceful, clean, green environments. Advertising for these estates centres around building communities, with young families living an active lifestyle.

FIGURE 3 Box Hill is an important transport hub for trains and buses.



FIGURE 4 Development of the Point Cook estate. Central Equity, Featherbrook Point Cook.



Planners and developers in established suburbs are seeking to ‘infill’ the suburbs, creating and recreating to form ‘the 20-minute neighbourhood’ around activity hubs and avoid further encroachment on farming land for urban development. The challenge is to have about a 70 per cent increase in housing and population living in the local area hubs. Community and transport infrastructure will need to be revised to achieve this target. In Melbourne, activity hub development can be found at Box Hill, Broadmeadows, Dandenong, Epping, Footscray, Fountain Gate/Narre Warren, Frankston, Ringwood and Sunshine.

8.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Draw a mind map (see section 8.2) of the distances you have to travel from your home to the bus stop or train station, to school, to the shopping centre, to the park where you meet your friends, to a place for sporting activities, and to any other significant locations in your life. Discuss in class how teenagers perceive the distances travelled.
2. Recall and list the features of ‘the 20-minute neighbourhood’.

Explain

3. Using figure 2, describe the distribution of the different levels of walkability in Eugene, Oregon.
4. Suggest factors that may influence the location of the high level of walkability in Eugene.
5. To avoid expansion of Eugene:
 - (a) Suggest two areas of the city that the city planners and developers might be looking at to improve the level of access. Provide reasons for your choice.
 - (b) Suggest a change that may be able to be implemented in the short term, medium term and long term within the city to improve access.

Discover

6. On a map of Melbourne, find the 12 suburbs with a high walkability rating. Describe the locations of these places.
7. Using the internet for ‘How Walk Score Works’ find:
 - (a) the walkability rating for Australia’s major cities. Comment on their scores.
 - (b) the walkability rating for your place/home. Can you explain why your place has been given its rating?
 - (c) the walkability rating of a rural environment that you know. Explain why rural areas might be more car dependent.

Think

8. Many parents don’t allow their children to walk to school any more. Make a list of the safety issues that parents perceive about access to school.

Predict

9. In a small group, draw a plan for a 20-minute neighbourhood that you would like to access and live in. Discuss and consider each group member’s perception of which features make for wellbeing in a community.

➔ Try out this interactivity: City connections (int-3334)

8.9 SkillBuilder: Constructing and describing isoline maps

online only

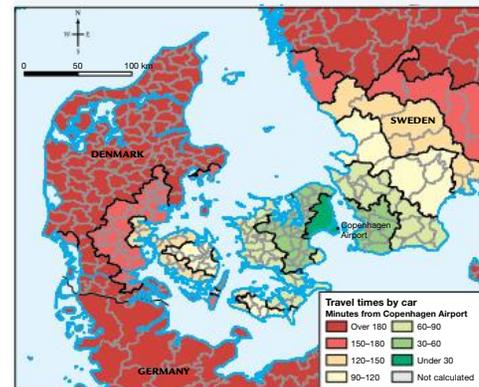
WHAT IS AN ISOLINE MAP?

An isoline map shows lines that join all the places with the same value. Isoline maps show gradual change in one type of data over a continuous area. Isolines show change in the trend of the data being mapped. Isoline maps are easy to understand, especially when coloured between the lines.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 A coloured isoline map showing travel time to Copenhagen airport by car



📺 Watch this eLesson: Constructing and describing isoline maps (eles-1737)

➔ Try out this interactivity: Constructing and describing isoline maps (int-3355)

8.10 Are we all on an equal footing?

8.10.1 How accessible are our cities?

Many of us take it for granted that we can walk to the shops, hop on a bus and go to the city centre, or find out when the next train is departing. Accessibility should mean that people with **disabilities** have the same access to the physical environment, transportation, information and communication technologies, and other facilities and services. Everyone should feel connected with society, rather than separated from it.

Our cities can be a depressing obstacle course for millions of people. For those with a disability, negotiating a flight of stairs, opening a door or even reaching a lift button can be impossible. Have you ever considered how difficult our cities can be for some of their citizens and visitors?

8.10.2 Providing equal access

Almost one in five Australians (18.5 per cent) reported a disability in 2012. Four in 10 Australians over the age of 18 report having a disability or long-term health condition. Equal access, particularly to transport, is essential for equality. Limiting transport can mean limiting people's opportunities.

A disability can take many forms, including:

- walking disabilities — cannot use stairs easily, moves slowly, needs wider spaces (due to crutches, for example)
- manipulatory disabilities — has difficulty in operating handles and ticket machines, for example
- vision impairment — has trouble distinguishing between road and pavement, identifying platform edges, knowing whether a lift has arrived at the correct floor, seeing signs or directions
- hearing problems — has difficulty hearing announcements about delays, cancellations or emergencies, or hearing an approaching vehicle
- intellectual disabilities — is challenged by being in an unfamiliar setting, or coping with cancellations or complex timetables
- psychiatric disabilities — experiences stress, anxiety or confusion in crowded situations or encounters with other travellers
- wheelchair disabilities — difficulty moving about when no ramps are available, when there are insufficient or badly designed parking spaces, or when there is not enough room to manoeuvre equipment.

There are also additional (and sometimes less obvious) disabilities to consider, such as asthma, epilepsy, obesity and diabetes, and temporary disabilities that result from injuries that are rarely classified as disabilities. When considering transport disadvantage, we must also include elderly people, low-income earners, children and outer-urban dwellers, who experience this to some degree as well. Parents with prams or strollers may also be affected.

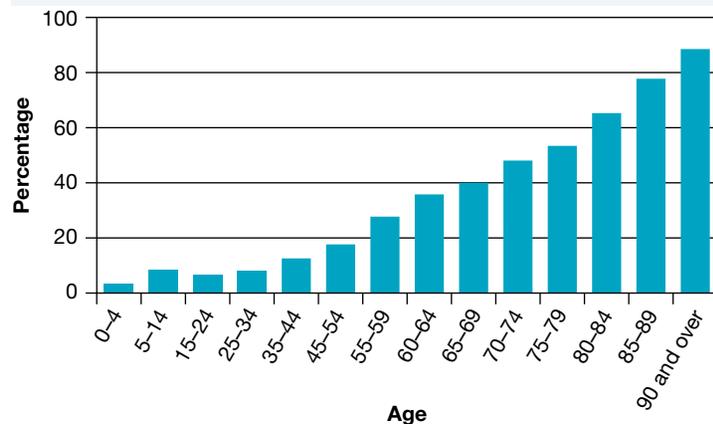
8.10.3 A city for everyone

In 2015, the Swedish city of Borås won the European Union's Access City award — a prize for the European city that is most accessible for people with disabilities. The annual honour aims to award efforts to improve accessibility in the urban environment and to foster equal participation of people with disabilities. People with disabilities and their representative organisations were heavily involved in the planning process. Some of the improvements are that:

- a database has been established of all public buildings with adequate access
- route markers have been laid both indoors and outdoors
- public transport is free on easily accessible buses
- digital 'locks without keys' have been provided for easy access, especially for support services.

All these measures benefit the entire community as well as the economy, because when everyone has access to places of work, people feel included and government social support systems are not overloaded.

FIGURE 1 Percentage of Australians with a reported disability



8.10.4 Accessing cities

The city of Melbourne is keen to have an inclusive environment for all. Its ‘Melbourne for All People Strategy Street 2014–2017’ has six key points:

- connection
- access and inclusion
- safety
- health and wellbeing
- lifelong learning
- having a voice.

FIGURE 2 Providing mobility within the central business district of Ballarat



Source: City of Ballarat

Regional cities in Victoria are also conscious of the need to cater for the disabled. The Rural Access Program undertook work in Ballarat to develop a **mobility** map that showed safe, accessible, easy and enjoyable ways to move and connect with the city.

FIGURE 3 Access for everyone, regardless of mobility, is essential.



8.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What are the various disabilities that may affect someone's access to public transport?

Explain

2. Explain what you understand by the term accessibility regarding people with a disability.
3. Refer to figure 1. Approximately what percentage of people with disabilities are the same age as:
 - (a) you
 - (b) your parents
 - (c) your grandparents?Use figures and percentages in your answer.

Discover

4. Do you know someone with a disability? Explain what types of difficulties they encounter while using public transport.
5. Using the map of the CBD of Ballarat, describe:
 - the accessibility level of Bridge Mall
 - movement around Centrelink
 - travel along Mair Street.How would you rank access in the Docklands area?

Think

6. In small groups, devise a trail in a local **environment** for people with disabilities. You might choose your school or a local park, for example. You might also decide what types of disabilities you are planning for, and travel around the site considering the potential needs of the visitor. Where are hazards located? Which areas might the visitor find difficult to navigate? What **places** might be of interest to them? Draw an annotated trail map (only for users who are not sight-impaired) to highlight these various features. To empathise more fully with the needs of others, students could take it in turns to navigate their way around the designated site on crutches, in a wheelchair or blindfolded.

8.11 How do we connect with the world?

online only

Access this subtopic at www.jacplus.com.au

8.12 Review

online only

8.12.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

8.12.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

8.3 SkillBuilder: Interpreting topological maps

8.3.1 Tell me

What is a topological map?

Topological maps are very simple maps, with only the most vital information included. These maps generally:

- use pictures to identify places
- are not drawn to scale
- give no sense of distance
- give general directions
- exaggerate the size of places
- do not show exact routes.

However, everything is correct in its interconnection to other points.

Why is a topological map useful?

Topological maps are useful as a mental map to help you locate important features. Large areas can be drawn to show the viewer the important points. You could use these in class as summary maps of a topic, or as quick sketch maps to illustrate a point or to clarify something for another student.

They are also useful for:

- giving tourists a snapshot of where features are located
- quickly showing how to get to a place
- showing very large transport routes such as bus and train routes across a city
- planning international flights.

Model

The topological map of central Paris shown in figure 1 is designed for people moving around Paris as tourists. It provides an indication of the major sites that tourists ought to visit, and allows them to see on which side of the river different monuments are found. For example, you would expect to find the Champs Élysées and the Louvre on the same side of the river and quite close to each other. Major routes are given between monuments but these routes may not be the shortest distance, as there is no scale with the map. Thus, it is hard to judge the best way to get from the Eiffel Tower to Notre Dame cathedral. The actual direction from one monument to the other is unlikely to be exact, because the lack of scale causes features to become distorted. This type of map, however, might help a tourist plan their sightseeing, because it gives the user a general idea of where things are located. If going from the Eiffel Tower to the Arc de Triomphe, is it best to stroll along the river and up a major route?

A good interpretation of a topological map:

- identifies and communicates key features
- clearly represents and communicates the data.

8.3.2 Show me

How to use a topological map

You will need:

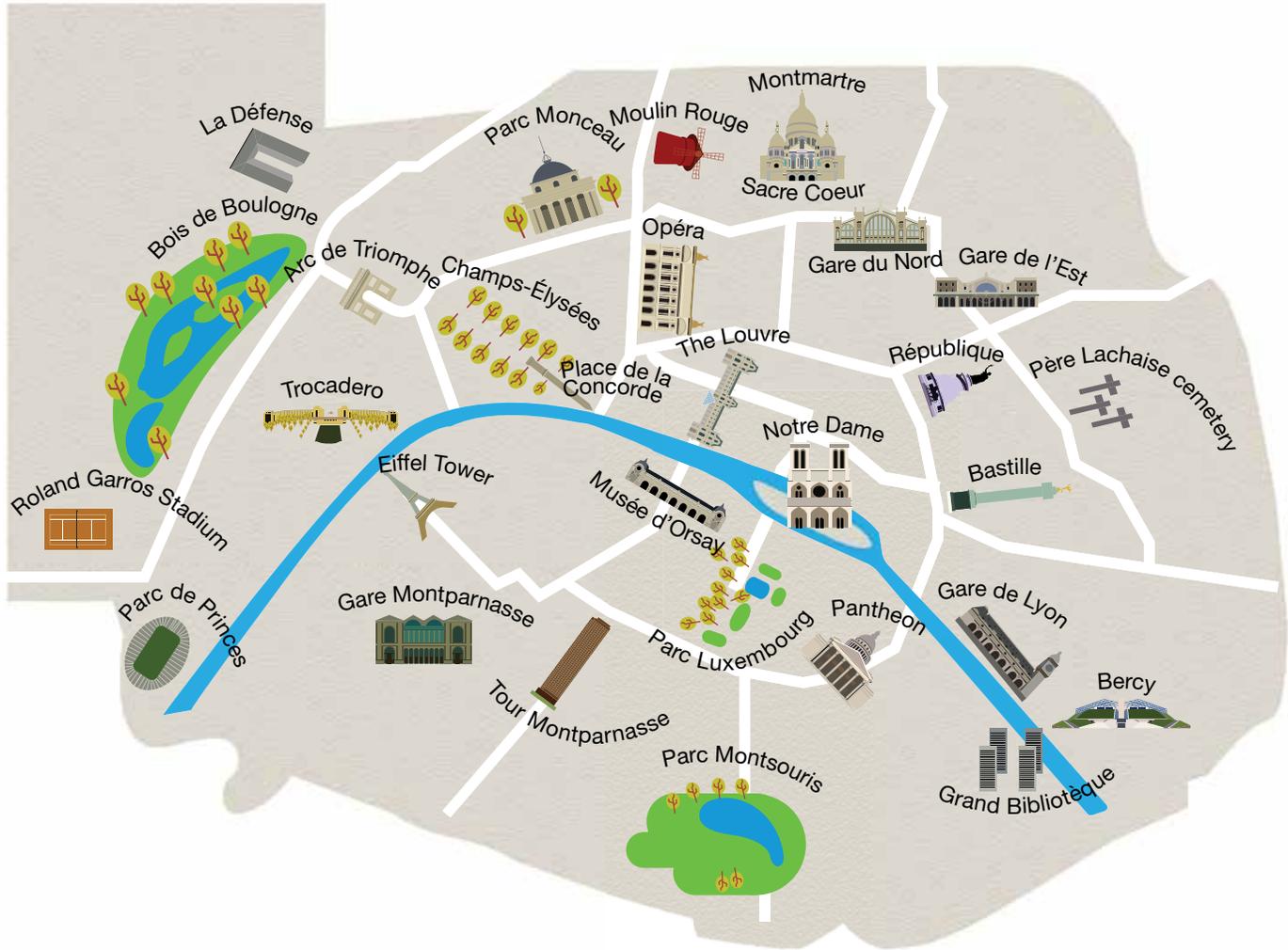
- a topological map.

Procedure:

STEP 1

Look all around the topological map and identify the key features being shown. In figure 1, almost 30 major tourist attractions of Paris are shown as drawings of each place. Some drawings are larger than others to show the significance and the popularity of these places with tourists.

FIGURE 1 A tourist map of Paris and its monuments



STEP 2

Think about the interconnection between features. On the map in figure 1, the interconnection between the places is that each one is a Paris tourist attraction. Roads are shown, but these may not be the optimum route to travel. This pathway represents just one way to connect between the places.

STEP 3

Since there is no scale, could a tourist walk between all these places? Think about possible distances. Consider the distance from the airport to the city centre. A tourist may well have travelled this route and be able to give the map a sense of scale. Could you see all these monuments in a day? The answer to both questions is no. Interpreting a topological map gives a first impression, but it is not an accurate map. It may be useful for moving around an area, but it lacks detail.

8.3.3 Let me do it

Developing my skills

Using the child's map shown in figure 2a in section 8.2.2, describe the route the child takes from home to school.

Questions

1. What is the purpose of this topological map?
2. Describe the pattern of houses along the route.
3. What symbols have been used to show the sporting area of the school grounds?
4. Why do you think this child drew the road at such a size and included the road markings?
5. Describe the environment along the route from home to school.

Checklist

I have:

- identified and communicated key features on the topological map
- clearly represented and communicated the information in the description.

Skills questions

1. Topological maps are used to show:
 - (a) the location of features of a place
 - (b) the distance between places
 - (c) the contours of an area
 - (d) very small areas.
2. A topological map includes information about:
 - (a) scale
 - (b) distance
 - (c) the interconnection of places
 - (d) realistic impressions.
3. Why are topological maps not accurate?
4. What important map information is not provided on a topological map?

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Watch this eLesson: Interpreting topological maps (eles-1736)



Try out this interactivity: Interpreting topological maps (int-3354)

8.4 How do we move around our spaces?

8.4.1 Fieldwork in the schoolground

All too often, students go about their school lives without a second thought for their surroundings. The following fieldwork activity encourages you to start thinking about different aspects of your environment: your likes and dislikes and the feelings associated with particular places. Ultimately you will develop your own set of personal geographies connected with the school grounds. The activities can be used alone or as a foundation for surveying techniques.

8.4.2 Introduction

This section provides a framework for you to conduct fieldwork around your school grounds to identify the movement of people and any issues that may arise from this movement. An ideal place to start is somewhere that you walk through, and to, every day: the school canteen.

You will need to conduct your fieldwork in small groups, sharing tasks and using ICT tools where possible to document your findings and to prepare your final presentation. You may choose to share each task among the group or nominate a group member to handle each section of the task. For example, one person might be responsible for all the mapping tasks and another for compiling the data.

8.4.3 When, where and how

First, you will need to create the base map of your intended area of study. Using an available school map or satellite maps, create a map of the study area. Try to include all entry and exit points for your canteen so that you can monitor foot traffic in and out of the area. Create a key that includes as much detail as possible (such as bins, seating areas, pathways, grass, eroded areas). If a map is not available, you may need to measure and draw the area to create an accurate map.

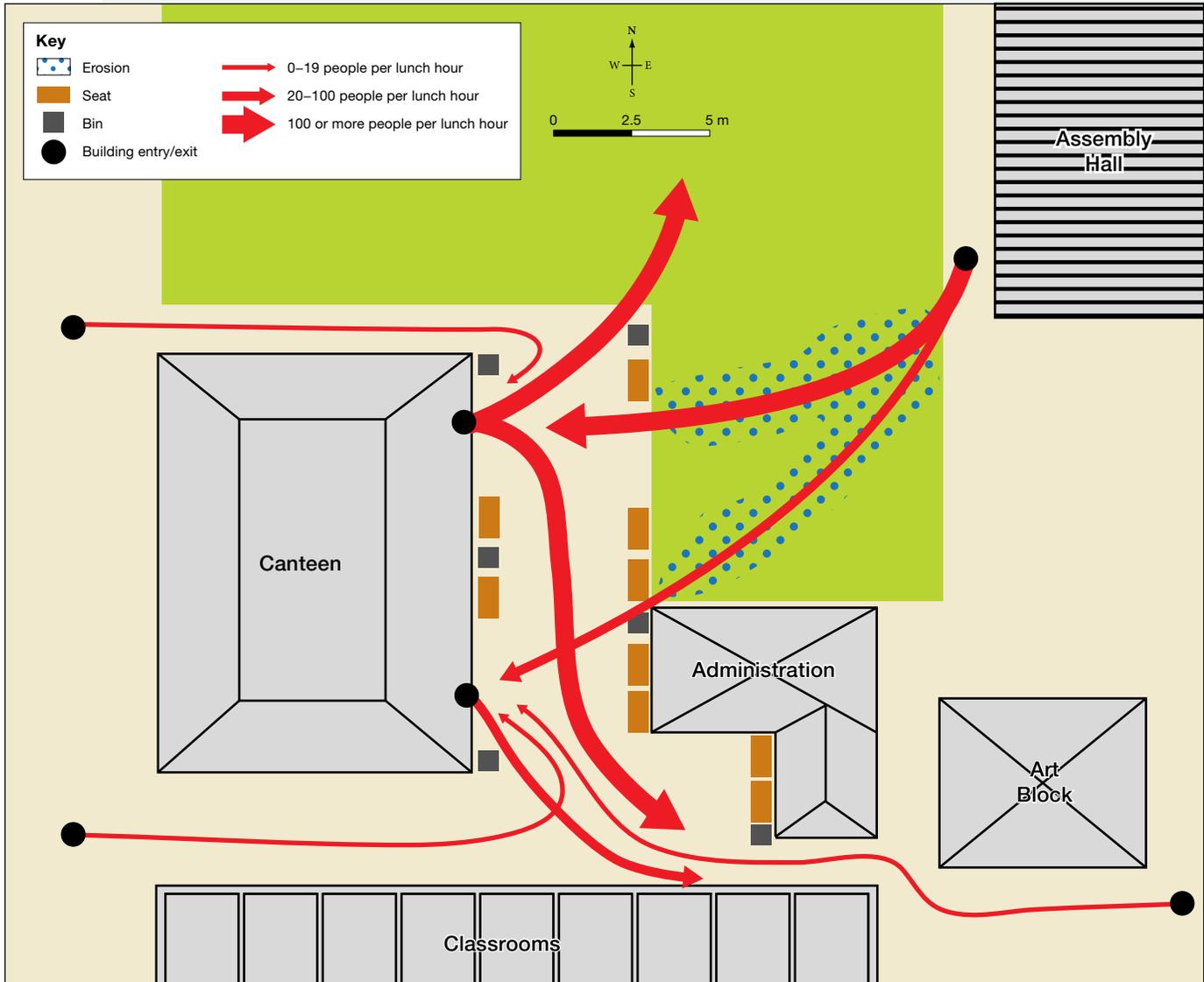
Over the course of one day, monitor the foot traffic to and from the canteen area at the morning break and lunchtime. You may collect your data over the course of a few days; or decide as a class that you will collect your data on one day only; or divide the class into five groups and monitor the area over the course of a week. To count how many people move in and out of the area, station a member of your group at each entrance/exit point (which will also help you to determine your group sizes). You may use a simple tally or 'clickers' to count entrances and exits.

Once you have created the base map and collected the data, you will need to annotate your map with flow lines to represent the movement of people. (Refer to figure 1 and the 'Constructing and describing a flow map' SkillBuilder in subtopic 10.10 for more guidance.) What problems are created by the movement around your school grounds? You can decide as a class which areas to focus your investigation on or your teacher can advise you. See table 1 for a checklist to help you identify what is creating the movement problems.

TABLE 1 Problems and possible solutions related to movement of people

| Areas to investigate | Type of problem created | Likely cause of problem | Possible solutions |
|--|-------------------------------|---|--------------------|
| Eroded grass area on oval | Erosion, run-off | Students taking shortcuts to canteen Poor placement of paths | |
| Litter left outside canteen at end of breaks | Pollution, eyesore | Lazy students Lack of rubbish bins | |
| Queues that extend out of canteen, leaving students exposed to the weather | Cold, wet and hungry students | Too many students approaching canteen at same time Inadequate space for queues | |

FIGURE 1 Sample map of school grounds



Source: Spatial Vision

To help you understand the trends in movement throughout the week, is there any other data you can gather to complement your investigation? For example, when are whole-school events held (such as assembly), which result in large numbers approaching the canteen at the same time, rather than at staggered times? Could you approach the canteen for some data on their sales throughout the week? (See table 2 for an example of the kind of data you might obtain.)

TABLE 2 Canteen sales throughout a week

| Canteen transaction sales | Snacks (drinks, ice creams, fruit etc.) | Cold and hot meals (sandwiches, salads, burgers etc.) |
|---------------------------|---|---|
| Monday | 93 | 177 |
| Tuesday | 89 | 158 |
| Wednesday | 80 | 166 |
| Thursday | 83 | 152 |
| Friday | 102 | 189 |

8.4.4 Develop a management plan

Your completed map and supporting evidence will form part of your management plan document. Your next step is to annotate your map with detailed descriptions of practical solutions for some of the problems you have identified. Your teacher might ask you to present this information to the rest of the class using ICT (such as PowerPoint or Prezi) or as a report that may be shared with your principal or grounds manager. Are your group's solutions cost effective? Ensure you complement your presentation with photographic evidence and data to support your contentions and solutions.

8.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Think

You should graph all data collected before attempting to analyse your findings. Some questions to stimulate your research are provided below.

1. Which areas showed the most congestion? Why do you think this is the case?
2. Did the location of congestion **change** according to the time of day? What factors influence these **changes**?
3. How does the movement of people affect the natural and human **environment** of your school grounds?
4. How do you propose to improve the current situation? What equipment, cooperation or support (or other factors) would be required in order to make these **changes** effective?
5. What **changes** could be made with (a) no cost, (b) minimal cost and (c) unlimited funding?

8.9 SkillBuilder: Constructing and describing isoline maps

8.9.1 Tell me

What is an isoline map?

An isoline map shows lines that join all the places with the same value. Isoline maps show gradual change in one type of data over a continuous area. Isolines do not cross or touch each other. Isolines show change in the trend of the data being mapped. The same difference is always shown between each isoline and the next over the entire map.

Why is an isoline map useful?

Isoline maps are easy to understand, especially when coloured between the lines (see figure 2). These maps do not consider boundaries or borders, as the lines connect all places of the same value. Trends and gradual changes are easily identified. Some isoline maps can show change over time. Excellent examples of isoline maps include daily weather maps (showing places with the same atmospheric pressure), topographic maps with contour lines, and global isotherm maps (places of equal mean surface temperature are connected; such maps are used when discussing climate change).

They are also useful for:

- showing data over large areas
- showing trends in data
- allowing you to identify and describe patterns
- comparing maps over different time periods.

Model

The isoline maps in figures 1 and 2 show that it takes less than 30 minutes of travel time by car to reach Copenhagen airport in Denmark from places closest to the airport, even when it is on a different island or in a different country (Sweden). People living west of central Copenhagen travel similar distances to the airport in similar times (60–90 minutes) to those living in southern Sweden. This suggests that connections such as bridges and tunnels between islands and countries are provided, and cross-border movement is easy. From one island it takes 150–180 minutes to get to the airport, suggesting that a ferry service is probably required to reach the road system by car.

A good isoline map:

- has small dots for data presentation
- has dots joined with a fine line
- is drawn with pencil
- is coloured or shaded between the isolines
- uses BOLTSS.

A good description of an isoline map:

- identifies and communicates key features
- clearly represents and communicates the data.

8.9.2 Show me

How to construct and describe an isoline map

You will need:

- a base map
- a set of data to plot
- a pencil
- an eraser
- an atlas (optional).

FIGURE 1 An isoline map showing places of equal travel time to Copenhagen airport by car



Source: Spatial Vision

Procedure:

Constructing an isoline map

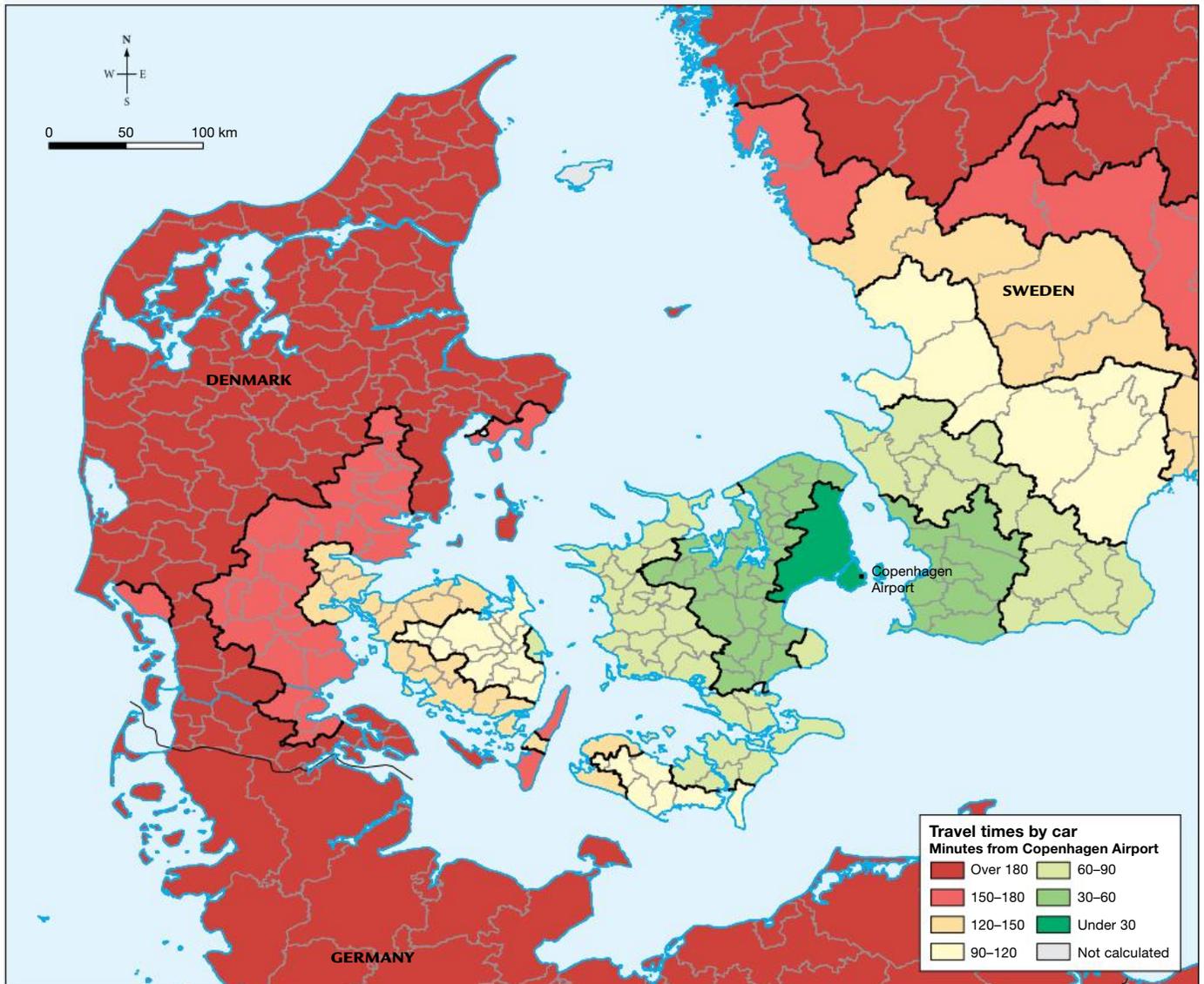
STEP 1

Select a set of data to map, and plot the relevant figure at each of the places listed. Figure 1 is an example of this for travel times by car to Copenhagen airport.

STEP 2

Select a value to use for intervals within the data set. In figure 1, the interval was set at 30 minutes. Draw lines (isolines) joining places of the same value; in this example, that would be 30 minutes, 60 minutes, 90 minutes and so on. You may need to go between some points to show where you think the isoline would be; for example, the 60 minute isoline would pass between a place where the travel time is 50 minutes and another where the travel time is 70 minutes. Remember that isolines will not touch and will not cross at any point.

FIGURE 2 A coloured isoline map showing travel time to Copenhagen airport by car



Source: Spatial Vision

STEP 3

Create a legend for your map with a colour system that indicates a gradation of colour, where the lowest data is the lightest shade and the highest data is the darkest. Shade between the isolines according to the legend. Figure 2 shows a completed coloured isoline map.

STEP 4

Don't forget to apply BOLTSS to your map.

Interpreting an isoline map

STEP 5

First, make sure you know what feature is being mapped by checking the map title or caption. In figure 1, this feature is travel time by car to Copenhagen airport.

STEP 6

Next, check the key/legend so that you understand the value of each isoline and the intervals used between them.

STEP 7

Describe the areas where there are high or low data values that help to form a pattern. You may need to refer to an atlas to check the topography and establish whether any country borders are involved. In figure 1, some of the data is from Sweden as people travel from there to Copenhagen, their nearest airport. People living west of central Copenhagen travel similar distances to the airport in similar times (60–90 minutes) to those living in southern Sweden.

STEP 8

Look for any anomalies that may need explaining. For example, in figure 1 you can see that it takes 150–180 minutes to get to the airport from one island, suggesting that a ferry service is probably required to reach the road system by car.

8.9.3 Let me do it

Developing my skills

Use the data in table 1 and base map provided in figure 3 to construct an isoline map of the travel times by bicycle throughout Copenhagen to the city centre. Use the following steps to help you.

- Plot on the map the number of minutes taken to travel from each place to Copenhagen city centre by writing the number of minutes by the dot beside each place name.
- Draw a line (an isoline) connecting all the places from which it would take 30 minutes to travel to the centre of Copenhagen.
- Draw in additional isolines at 5-minute intervals to show travel times to Copenhagen city centre. Describe the pattern evident on your isoline map.

TABLE 1 Travel times by bicycle across Copenhagen

| Suburb of Copenhagen | Travel time by bicycle to Copenhagen city centre |
|----------------------|--|
| Albertslund | 45 |
| Ballerup | 48 |
| Brøndby | 40 |
| Frederiksberg | 25 |
| Furesø | 50 |
| Gentofte | 33 |
| Glostrup | 40 |
| Gladsaxe | 38 |
| Herlev | 42 |
| Hvidovre | 34 |
| Ishøj | 55 |
| Lyngby-Taarbæk | 45 |
| Rødovre | 35 |
| Tårnby | 30 |

FIGURE 3 A base map of the suburbs around Copenhagen city centre



Source: Spatial Vision

Questions

1. Is Furesø or Hvidovre more accessible to Copenhagen city centre by bicycle? Use figures in your answer.
2. Does Tårnby or Brøndby provide easier bicycle access to the city? Quote the distances involved.
3. From which direction would you have the greatest level of access to the city centre by bicycle? Use figures in your answer.
4. Which part of the map would encourage cyclists to live in the area? Explain your answer using figures.
5. In which area of the city would you prefer to live if you had to cycle to the city centre each day for work? Explain your answer, including figures.

Checklist

In drawing an isoline map I have:

- plotted data using small dots
- joined the dots to create a fine isoline
- drawn using pencil

- coloured or shaded between the isolines
- completed my map with BOLTSS.
In describing an isoline map I have:
- identified and communicated key features
- clearly represented and communicated the data.

Skills questions

1. Isoline maps are used to:
 - (a) locate features of a place
 - (b) show the varied features of a place
 - (c) join places with the same or equal value
 - (d) indicate a key feature of a place.
2. An isoline map includes information about:
 - (a) trends in the values mapped
 - (b) two or more features of an area
 - (c) data at only one place
 - (d) very few data points.
3. Why are isoline maps useful when maps cover large areas?
4. What makes an isoline map easy to read?

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Watch this eLesson: Constructing and describing isoline maps (eles-1737)



Try out this interactivity: Constructing and designing isoline maps (int-3355)

8.11 How do we connect with the world?

8.11.1 How connected are we?

Our world is shrinking. We are more connected than ever before thanks to waterways that drew distant places together with improved shipping access, increased and cheaper flights and the digital age (see topic 11). These have brought the world closer to us.

8.11.2 How do maritime highways connect places?

Technological developments have seen the reduction in time for a ship to travel the world. In 2015, the upgraded Panama Canal, which links the Pacific Ocean and the Atlantic Ocean, opened its new, larger locks to accommodate the super ships now plying the oceans. A second Suez Canal lane opened in 2015 and the original canal was deepened to provide access from the Mediterranean Sea to the Red Sea and Indian Ocean. The Straits of Malacca provide access for about 33 per cent of all European container ships accessing East Asia in response to the demand for raw materials and commodities, in particular in China.

Australia is no longer a sailing time of 6 months from the United Kingdom—with faster, bigger ships the distance can be accessed in about 33 days. Reduced travel times and reduced costs are a boon for the export of Australian agricultural produce and mining resources, and for the import of products to improve our wellbeing, such as bulky, manufactured goods. Reduced transport costs have benefited global trade.

Cruise ships ply the coastlines of many countries and across local regions, taking tourists on a cheap holiday to a variety of places on each voyage. From 2005 to 2015, the cruise industry has doubled in size thanks to advertising campaigns that target lower socio-economic groups and those keen to travel without the inconvenience of packing every few days. Access to places has never been easier.

FIGURE 1 Loading containers for global trade



FIGURE 2 The density of major global cargo shipping routes

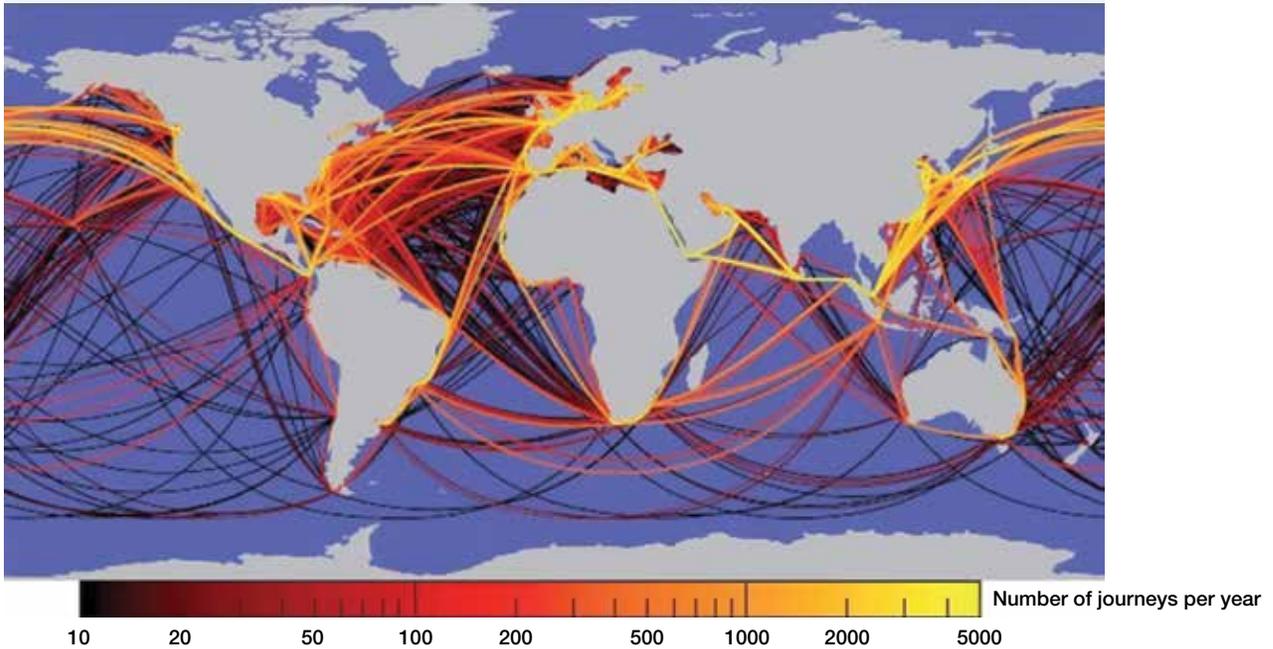


FIGURE 3 Flight patterns vary according to the time of day.



8.11.3 How do we connect through the air?

In 2015, 3.5 billion people flew safely on 37.6 million flights for the purposes of business, tourism or reconnection with relatives. Figure 3 shows how the long-haul aeroplanes, such as the Airbus A380 with its wide body and double-deck carrying capacity of 853 passengers, hub in and out of key airports, leaving smaller jets to distribute passengers across a country using smaller airstrips. These large aeroplanes have reduced the time taken to access places. Airbus is able to access London from Melbourne in about 22 hours with one stop; airlines are vying for a technologically apt aircraft such as the Dreamliner, which will fly long haul, non-stop to London from Australia. Constant monitoring of the success levels of routes sees frequent adjustments to schedules and

discounts offered on flights. Australians are able to access the United States non-stop (Los Angeles, Dallas) with most flights around A\$1000 each way, and often discounted.

Air cargo flights also provide access for trade delivering perishable items quickly around the world. The Netherlands trades about 50 per cent of all cut flowers moved around the world. Asparagus from Victoria is sent to Japan, Singapore, Hong Kong, South Korea and Taiwan; it arrives in Japan by air 30 hours after being harvested. Australia imports by air freight high-value 'just-in-time' manufacturing components such as computer and machinery parts. Online shopping can see an order placed in Melbourne via a US site, with the product air freighted from Hong Kong and delivered in three days!

FIGURE 4 People arrive at Heathrow Airport, London.



8.11 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. How has the opening of the waterways improved access to places for the cargo ships?
2. What is the value of air travel for passengers?

Explain

3. Describe the areas where cargo shipping routes are dense. Is there any connection with the developed world?
4. Australia is circumnavigated by shipping routes. Can you explain why this might be?

Discover

5. Use the internet to watch major airlines hub into major cities across the day on the 'World Traffic Pattern Over a 24 Hour Period'.
 - (a) What do you notice about the places being accessed?
 - (b) Does access change between day and night?
 - (c) Can you explain why international flights leave Australia late at night or early in the morning?

Predict

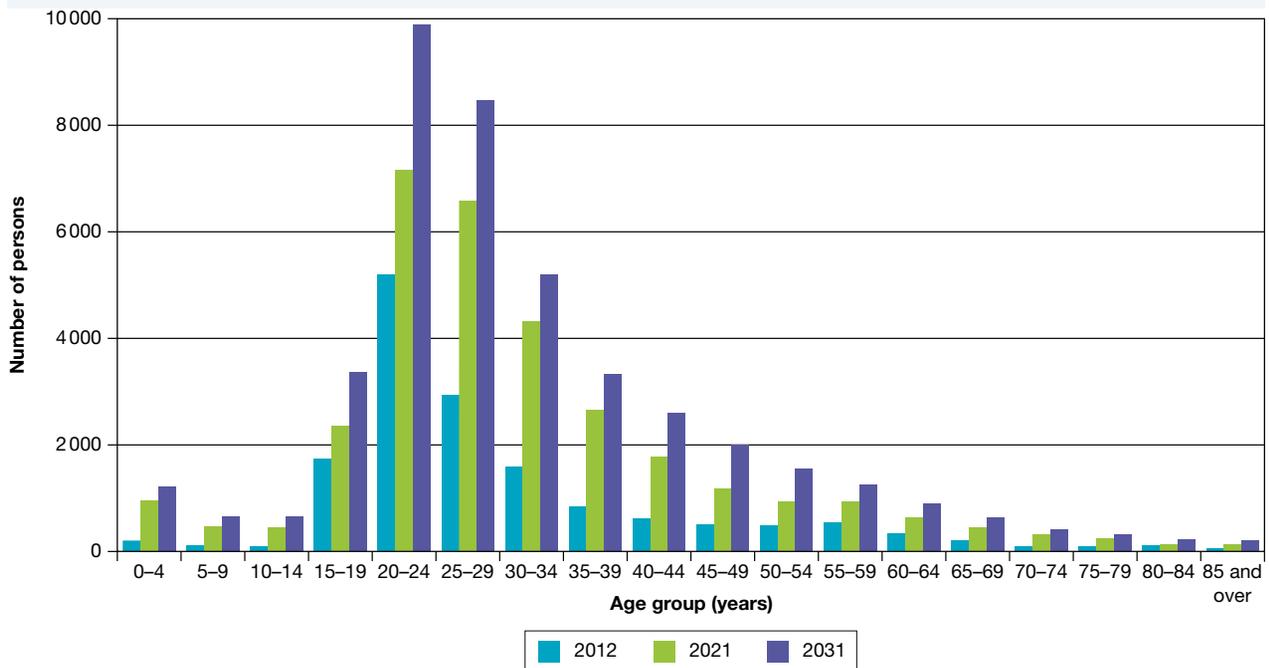
6. Will Australia's perceived remoteness be further reduced by 2030? Suggest how this might be. Using the internet, look at live air traffic in Australia on 'flightradar24' to see the patterns of air travel that currently exist.

8.12 Review

8.12.1 Review

1. What are stereotypes and how can they influence the way we ‘see’ a *place*?
2. We can feel differently about various locations in our own school. On a base map of your school, identify five *places* you like and five *places* you dislike. Compare your map with those of your classmates. Do you notice any similarities or differences? As a class, which is the most liked area and which the most disliked?
3. List the ways in which we see the strong link Indigenous people have with the land in the twenty-first century.
4. What is the difference between graffiti and street art?
5. Refer to figure 1.
 - (a) How is the population of Melbourne’s CBD going to *change* over the next 15 years?
 - (b) Which age groups will make up most of Melbourne’s resident population in 2031? Why do you think this will be the case?

FIGURE 1 Forecast age structure, Melbourne CBD



6. Create a survey on the use of public transport in your community. As a class, conduct a survey of your family and friends (finding ten survey respondents each) about their reasons for using or not using public transport. As a group, and with the guidance of your teacher, design a manageable set of eight to ten questions that can be answered before your next lesson. As a starting point, find out who uses public transport, and why and how they do so. Compile your data on the board, and then individually create tables, graphs or pie charts to demonstrate the results of each question. Conclude your report with a discussion on what your data tells you about the reasons for public transport use in your community. How might you encourage more people to use public transport?
7. What are the benefits for a community that can walk to satisfy its daily needs?
8. What types of disabilities would make it most difficult to travel on public transport? Why?

9. What types of disabilities would make it most difficult to move or navigate through city streets? Why?
10. How connected do you feel to the world? Make a list of the modes of connection you have and compare it with other students' lists.

8.12.2 Reflect

11. Mass media affects how we perceive a *place*, and advertising can play a big role in creating or changing such perceptions. Consider some of the major tourism advertising campaigns in recent years for your state or for Australia. Use the **Australia Tourism** and **Tourism Queensland** weblinks in the Resources tab to answer the following questions.
 - (a) What message were the ads or campaigns trying to convey to the audience?
 - (b) What perceptions of the *place* were the advertisers trying to encourage? Do you think the campaigns were successful?
12. How is your state government meeting the *changing* transport needs in your community? What big infrastructure projects are in place: roads, rail or other? Discuss as a class whether your state government is giving enough attention to public transport, and provide examples to support your conclusion on this question.
13. Make your own map of your city's public transport black spots. Your teacher will provide an A3 map of your city (including as many of the outer suburbs as possible). On this map, trace the lines that represent various forms of public transport (such as rail, bus, tram, ferry) using a different coloured pencil for each. Using the *scale* of the map, shade in the areas that are more than 500 metres from a public transport stop. Describe what your map tells you about public transport in your city, identifying specific suburbs or regions that are not well served by public transport.
14. Come up with a plan for improving transport in your region. In small groups, decide what kind of services you and your community would like. How would you 'brand' your transport plan? How would you reach your goal? Which stakeholders would need to be involved in order to make your dream a reality?
15. These days people can live in remote *places* in Australia due to the high number of *interconnections* that are available within Australia and other *places* in the world. Give examples of the way we are interconnecting through the use of technology.
16. Investigate your local area to discover to what extent people with disabilities have fair and equitable access to community facilities. (You might like to consider such things as car parking, public transport, access to buildings, ease of movement and safety.)

learn **on**

RESOURCES – ONLINE ONLY



Explore more with these weblinks: Australia Tourism, Tourism Queensland

TOPIC 9

Tourists on the move

9.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

9.1.1 Introduction

The World Tourism Organization estimates that by 2030, five million people will move each day. Where will these people go and what will influence their choices? What impact will these choices have on the places they visit?

People move to and from many different places for many different reasons.



Starter questions

1. Make a list of reasons people might travel.
2. The Australian Bureau of Statistics provides figures for arrivals and departures from Australian airports. In which other ways might people travel?
3. (a) Conduct a class survey. Record the last three times you travelled and stayed away from home for at least one night — where, how, why, how far and for how long did you go?
(b) Compile your class results and decide on a suitable method of representing this information visually.
(c) Are there any **places** or types of **place** that have been visited by more than one member of your class?
(d) Discuss why this might be a popular **place** for people to visit.
4. When did you last have a holiday? What **places** did you visit and what did you do in each **place**? What impact do you think your visit had on these **places**? Explain.

INQUIRY SEQUENCE

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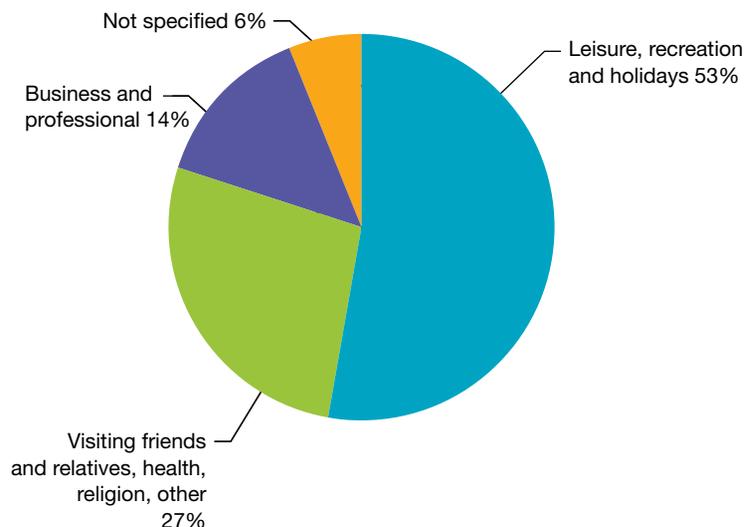
9.2 What is tourism?

9.2.1 Why is tourism important?

The World Tourism Organization defines tourism as the temporary movement of people away from the places where they normally work and live. This movement can be for business, leisure or cultural purposes (see figure 1), and it involves a stay of more than 24 hours but less than one year.

Global tourism increased by 4.7 per cent in 2014: the fifth consecutive year of above average growth. This is despite global economic issues, political change in the Middle East and Africa, and a range of natural disasters. In fact, some of the world's most popular tourist destinations were those affected by global concerns. Figure 2 illustrates why particular destinations are popular. Although tourism

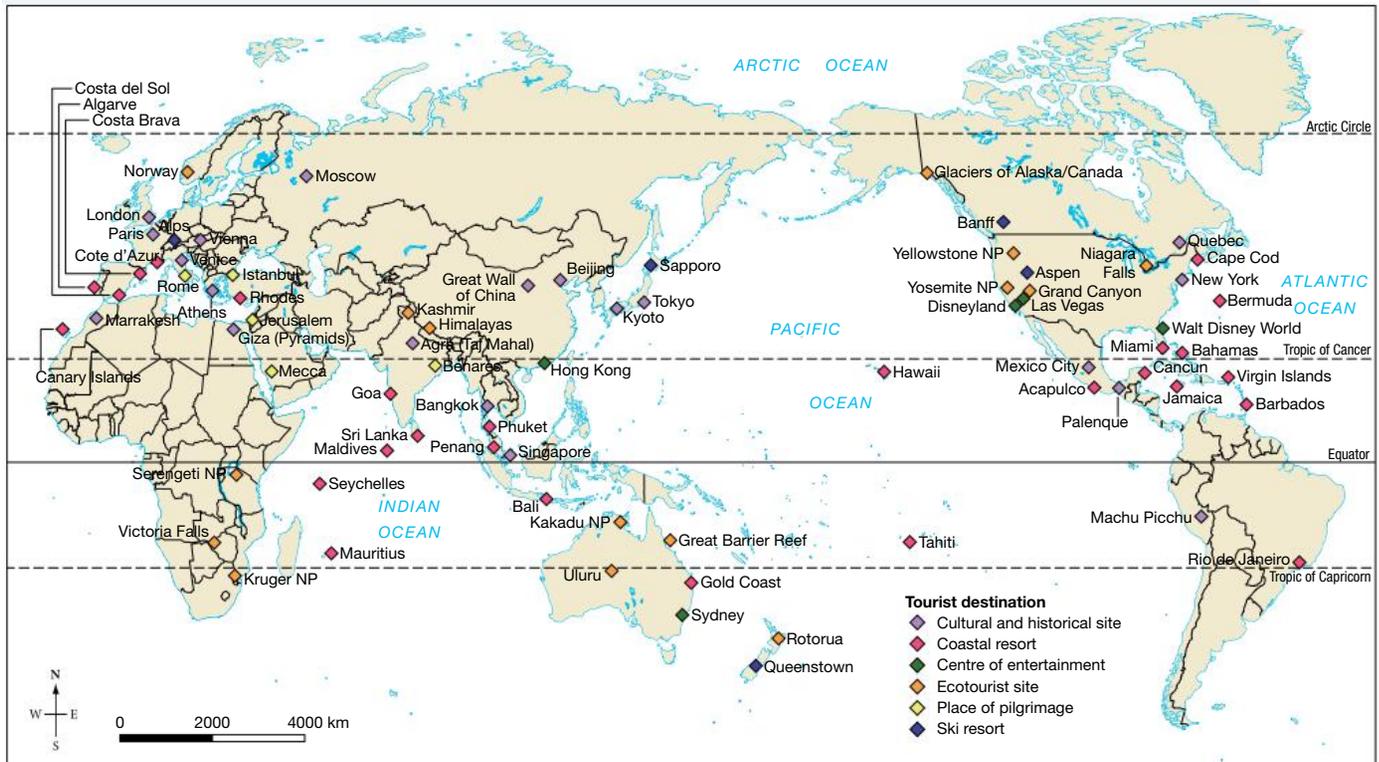
FIGURE 1 Purpose of people's travel, 2014



growth was slower in 2012 (3 per cent), a milestone was reached: there were more than one billion tourist movements in a single year.

Worldwide, 277 million jobs exist because of tourism. Globally, about 9.8 per cent of **gross domestic product (GDP)** is directly linked to the tourism industry, and for many developing countries it is the primary source of income.

FIGURE 2 Types of tourist destinations



Source: Spatial Vision

FIGURE 3 Four kinds of tourist — are all tourists the same?

Organised mass tourist

- Least adventurous
- Purchases a package with a fixed itinerary
- Does not venture from the hotel complex alone; is divorced from the local community
- Makes few decisions about the holiday

The explorer

- Arranges their own trip
- May go off the beaten track but still wants comfortable accommodation
- Is motivated to associate with local communities and may try to speak the local language



Individual mass tourist

- Similar to the organised mass tourist and generally purchases a package
- Maintains some control over their itinerary
- Uses accommodation as a base and may take side tours or hire a car

The drifter

- Identifies with local community and may live and work within it
- Shuns contact with tourists and tourist hotspots
- Takes risks in seeking out new experiences, cultures and places

9.2.2 Why is tourism increasing?

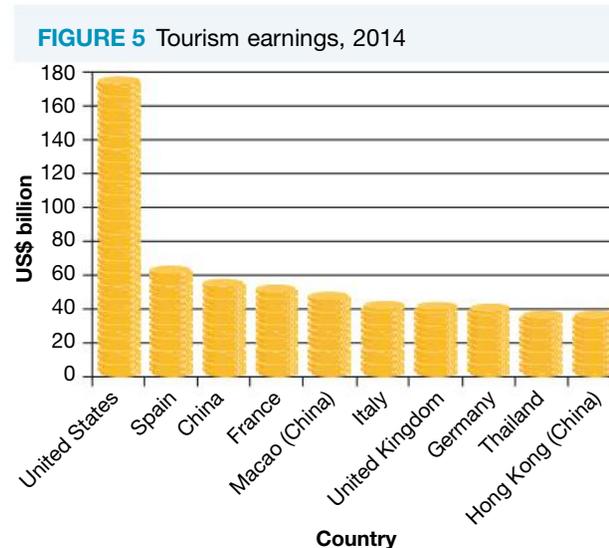
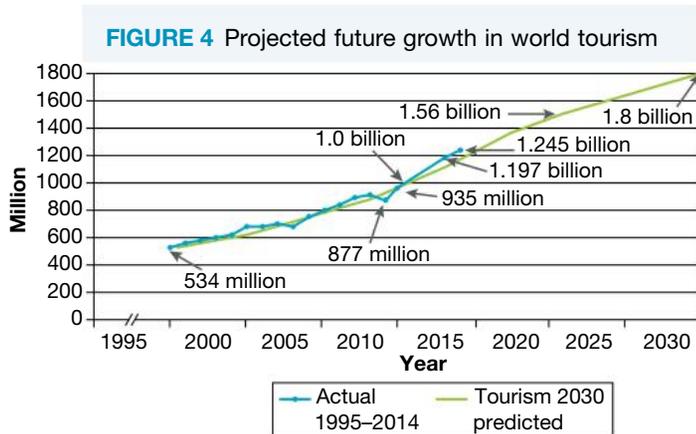
Tourism has increased dramatically over the past 50 years and continues to grow. Advances in transport technology have reduced not only travel times but also cost.

- Today, you can fly from Australia to Europe in about 20 hours, whereas 40 years ago the same journey took six weeks by boat.
- Today, airline and tour companies offer a range of cut-price deals, and the increased number of competitors for the tourist dollar means that travel is more affordable.
- Increased awareness and knowledge of the world has sparked people's desire to see new places and experience different cultures.
- In general, the travelling public has more leisure time and more disposable income, making both domestic and international travel viable.

9.2.3 What are the latest trends in tourism?

Tourism is an important component in world economies. One in 11 jobs worldwide is linked either directly or indirectly to the tourism industry. In the first 10 years of the twenty-first century, this industry grew by almost 40 per cent, from 674 million international arrivals in 2000 to 1.2 billion in 2014. It is predicted that this figure will rise to 1.8 billion in the year 2030 (see figure 4).

Tourists added US\$1.246 billion to the global economy in 2014. Figure 5 shows the top 10 tourism earners for 2014.



9.2.4 Factors shaping the future of tourism

Tourism is no longer just for the elite. Improvements in transport and technology have increased our awareness of the world around us. Improved living standards, increased leisure and greater disposable incomes have all created opportunities for people to travel and to experience new places and cultures. These factors are also shaping the tourist of the future (see figure 6). Particular growth areas are the 18–35 market — young people travelling while studying, taking a break from study, or seeing the world before they settle down. The other major area of growth is the over-60 age bracket.

Predictions also suggest that Africa and the Asia–Pacific region will be particular growth areas, attracting more and more of the tourist dollar.

Countries such as Kenya and Tanzania offer a different type of tourist experience. Kenya, for instance, offers:

- safety
- beaches and a tropical climate

- safari parks and encounters with lions and elephants
- a unique cultural experience with the **Masai** people.

The resulting influx of tourists to Kenya has led to the establishment of **national parks** to protect endangered wildlife and promote this aspect of the tourism experience. Money flowing into the region helps improve water quality and infrastructure such as water pipes, roads and airports.

The true challenge for the future, however, is to ensure that:

- money remains in the local economy rather than in the hands of developers, and is used to improve local services, not just tourist services
- the need of indigenous communities to farm the land is balanced with tourist development
- tourist numbers are controlled, to ensure that the environment is not damaged.

FIGURE 6 Factors shaping the future of tourism



9.2.5 Medical tourism

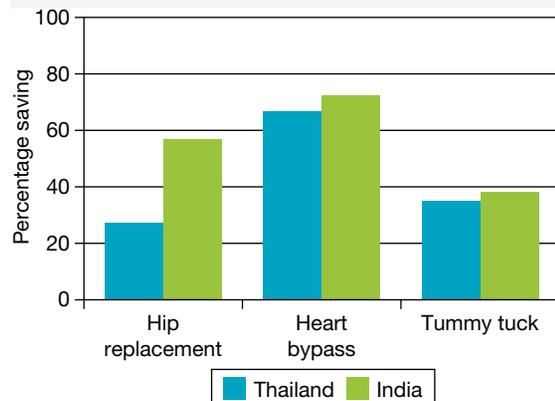
Medical tourism involves people travelling to overseas destinations for medical care and procedures. The low cost of travel, advances in technology and lengthy waiting lists caused by increased demand for elective surgery are turning medical tourism into a multi-billion dollar industry.

While people once travelled overseas only for cosmetic procedures such as facelifts and tummy tucks, the range of services offered has expanded dramatically over recent years to include orthopaedic procedures such as knee and hip replacements, fertility treatments and surrogacy services, and complex heart surgery.

Countries all over the world are attracting patients for a variety of reasons. In some instances, it is the high standard of medical care or the outstanding reputation of a particular facility that attracts people, while for others it is the savings to be made and the opportunity to include a holiday and luxury accommodation as part of the package.

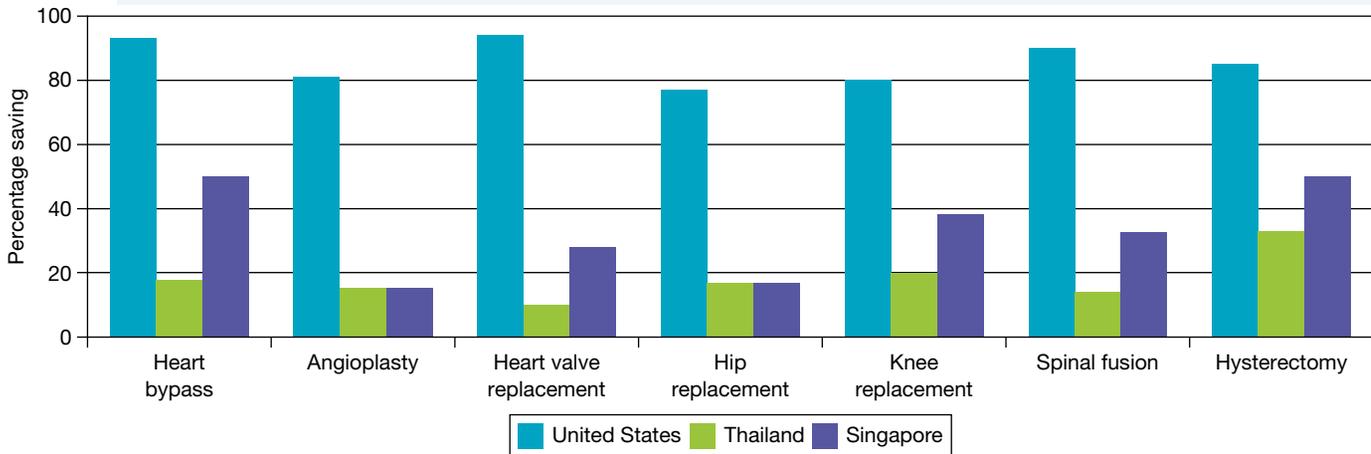
Asia is the market leader in the medical tourism industry, with Thailand and India vying for the number one spot. Thailand is slightly more expensive, but does offer a better tourist experience and has a wider number of services available. India, on the other hand, is cheap and boasts state-of-the-art facilities staffed by Western medical staff, predominantly from the United States. Figure 7 illustrates the savings to be made by having selected medical procedures carried out in Asia rather than Australia; figure 8 shows the savings when a variety of procedures are undertaken in Malaysia as compared to the United States, Thailand or Singapore. With medical tourism expected to add more than \$8.5 million to Asian economies per year, it is not surprising that there has been a dramatic increase in the number of facilities to deliver these services.

FIGURE 7 Cost savings that can be made by having medical treatment in Asia versus Australia



Adapted from: Cosmetic Surgeon India and Rowena Ryan/News.com.au

FIGURE 8 Cost savings that can be made by having medical procedures carried out in Malaysia versus the United States, Thailand or Singapore



Adapted from: Cosmetic Surgeon India and Rowena Ryan/News.com.au

9.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is a tourist?
2. Why do you think tourism is one of the fastest growing industries?

Explain

3. Using your atlas as a primary source of information, select three **places** from different categories shown in figure 2 that you might like to visit.
 - (a) Calculate the distance between them.
 - (b) Explain how you would travel to each **place**.
 - (c) Explain what you might expect to see and do in each **place**.
 - (d) Work out how long it might take to visit each **place**.
 - (e) Describe each location using geographical concepts such as latitude and longitude, direction and **scale**.
 - (f) Explain why you have chosen each **place**.

Discover

4. What type of tourist are you? Make a sketch of yourself, similar to the one shown here. Annotate your cartoon to describe yourself as a tourist, using information in this section to help you. Include information about your ideal holiday and explain why you appear as you do in your cartoon.

Predict

5. In 2014, 1.1 billion tourist movements were recorded globally. How many movements is this per day?
6. (a) Using information in this section, predict how many tourists there will be in 2020. What percentage increase does this represent?
 - (b) Which **places** do you think will be the most popular?
 - (c) What impact do you think these increases will have on the **environment**?
 - (d) Will this result in small-**scale** or large-**scale change**?
 - (e) Do you think these numbers are **sustainable**? Explain.



- Tourism expenditure increased by 93 per cent between the year 2000 and the year 2010, from \$475 billion to \$918 billion. Using these figures as a guide, predict how much income might be generated through tourism by 2030.
- Look back over your responses to the last three questions. What does this tell you about the importance of tourism? Explain.

Think

- (a) Explain what you understand by the term **sustainable tourism**.
(b) Describe an example of tourism that would be considered **sustainable**.
(c) Describe an example of tourism that would not be considered **sustainable**. Suggest what **changes** might be needed to make it **sustainable**.



Deepen your understanding of this topic with related case studies and questions.

World tourism



9.3 Who goes where?

9.3.1 Why is global tourism on the rise?

Tourism is one of the world's largest industries. Even when global economies are experiencing a downturn, people still travel. After natural disasters, countries rely on the return of the tourist dollar to help stimulate their economies. However, the spread of tourism is not uniform across the Earth.

Over time, travel has become faster, easier, cheaper and safer. Economic growth has meant that many people now have more money to spend and can afford to travel. Increases in annual leave have provided people with more time to travel. For example, Australians and New Zealanders can take long-service leave, which is often spent on an extended overseas trip. It has also become more fashionable for young people to spend time seeing the world during their 'gap year' and to travel before settling down and establishing a career and raising a family (see figure 1).

Many young travellers see backpacking as the optimum way to travel. Generally this group:

- is on a tight budget
- wants to mix with other young travellers and local communities
- has a flexible itinerary
- seeks adventure
- is prepared to work while on holiday to extend their stay.

At the other end of the scale, there has also been a dramatic growth in **mature-aged** tourist movements. The number of older people in **developed** countries is growing. In many instances, they have older children who are no longer dependent on their parents for support. Some of these travellers have savings, access to super-annuation funds, and the opportunity to retire early; thus, they have both the time and the money to travel.

FIGURE 1 Backpackers spend more, travel further and stay longer than other tourists.



9.3.2 Which countries are top-10 destinations?

As each tourist enters or leaves a country, they are counted by that country’s customs and immigration officials. This data is collected by the World Tourism Organization, and the results can be shown spatially (see figure 2).

FIGURE 2 World’s top 10 tourist destinations, 2014



Source: World Tourism Organization (UNWTO)

9.3.3 Who spends the most?

Figure 2 shows the countries that attract the most tourists, but which countries do these tourists come from, and how much do they spend? Figure 3 shows the top-10 countries in terms of the money they spend on international tourism.

9.3.4 Where do people stay?

When travelling overseas, most tourists give little thought to who owns the hotel or resort in which they are staying. Table 1 shows the locations of various hotel-chain headquarters, indicating that the corporate owners of many hotels are based in a country that is often not the one a tourist is visiting. Home Inns entered the market in 2008 when they took over another hotel chain. They are primarily located in China and offer budget accommodation.

FIGURE 3 World’s top 10 tourist spenders, 2013

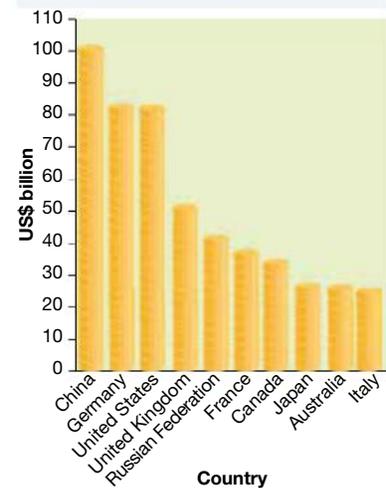


TABLE 1 World’s top 10 hotel owners, 2015 (based on rooms)

| Company | Headquarters (country) | Total hotels | Total rooms |
|--------------------------------|------------------------|--------------|-------------|
| Intercontinental Hotels Group | UK | 4840 | 710295 |
| Hilton Worldwide | USA | 4278 | 708268 |
| Marriott International | USA | 4117 | 701899 |
| Wyndham Hotel Group | USA | 7645 | 660826 |
| Choice Hotels International | USA | 6376 | 504808 |
| Accor | France | 3717 | 482296 |
| Starwood Hotels & Resorts | USA | 1207 | 346599 |
| Best Western | USA | 3900 | 302144 |
| Home Inns | China | 2609 | 296075 |
| Jin Jiang (inc. Louvre Hotels) | China | 2208 | 241910 |

9.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

- Carefully study figures 2 and 3 and answer the following.
 - On which continents are the top 10 destinations located?
 - Which continents are generating the most in tourism spending?
 - Describe the **interconnection** between destinations and tourism spending.
- What is the difference between a mature-age tourist and a backpacker? With the aid of a Venn diagram, show the differences in the needs of these two groups of tourists.

Discover

- The three main types of tourist attraction are natural, cultural and event attractions. Use a dictionary to help you write your own definition of each term. For each of the countries shown in figure 2, try to find an example of each type of attraction. Use the map in figure 2 in subtopic 9.2 to help you.

Predict

- On a blank outline map of the world, locate and label the capital cities of each of the top 10 tourist destinations.
 - Plot a trip from your nearest capital city to all 10 of these **places**, covering the shortest possible distance, and returning to your capital city. Use the **scale** on the map to estimate the distance travelled. Calculate the time it might take to complete this journey.
- Describe the pattern of hotel ownership shown in table 1.
 - Construct a bar graph showing both the total number of hotels and total number of rooms for the top 10 hotel companies.
 - Find out the average cost of a one-week stay in one of these hotel chains.
 - How much income would this room generate if it was occupied for each night of the year?
 - What percentage of your answer to question 5d would be needed to maintain this room, the complex and other associated costs, such as wages?
 - Estimate how much money is left and where you think it goes. What effect do you think this might have on local economies?

9.4 SkillBuilder: Constructing and describing a doughnut chart



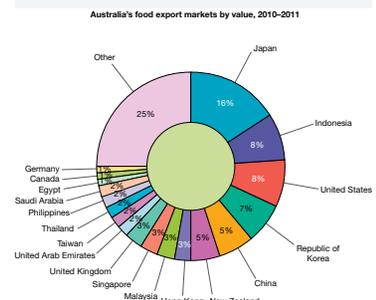
WHAT IS A DOUGHNUT CHART?

A doughnut chart is a circular chart with a hole in the middle. Each part of the doughnut is divided as if it were a pie chart with a cut-out. The circle represents the total, or 100 per cent, of whatever is being looked at. The size of the segments is easily seen. Doughnut charts are a useful visual interpretation of data.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Australia's food export markets by value, 2010–2011



Source: © DAFF 2012, National Food Plan green paper 2012, Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.



Watch this eLesson: Constructing and describing a doughnut chart (eles-1738)



Try out this interactivity: Constructing and describing a doughnut chart (int-3356)

9.5 Who comes and goes in Australia?

9.5.1 Where in the world are Australians going?

Over 13 million Australians go away on holiday each year. Of these, 10 per cent plan to travel overseas, and 55 per cent plan to holiday within Australia. While the numbers of domestic travellers may be high, international tourism is on the rise.

In 2014 Australians made 7.9 international trips and spent a total of 161 million nights abroad. It is estimated that they contributed \$47.3 billion to global economies. While the decline in the Australian dollar has seen an increase in the number of Australians choosing to travel domestically we are taking three times as many international holidays today than we were a decade ago.

Despite the decline in the Australian dollar against other currencies in 2014 our currency still has excellent buying power in a wide range of holiday destinations. Competition between airlines; choice of flights; and package deals that include combinations of tours, accommodation, flights and meals continue to fuel the growth of the international market.

The opportunity to live and work overseas has also seen an increase in the number of people under 30 travelling abroad. The under 30s working visa has ensured that foreign travel is both appealing and affordable for this age group. At any one time there are about one million Australians living and working overseas.

Nepal, Japan and the United Arab Emirates are the fastest expanding destinations for Australians travelling abroad.

9.5.2 Who comes here?

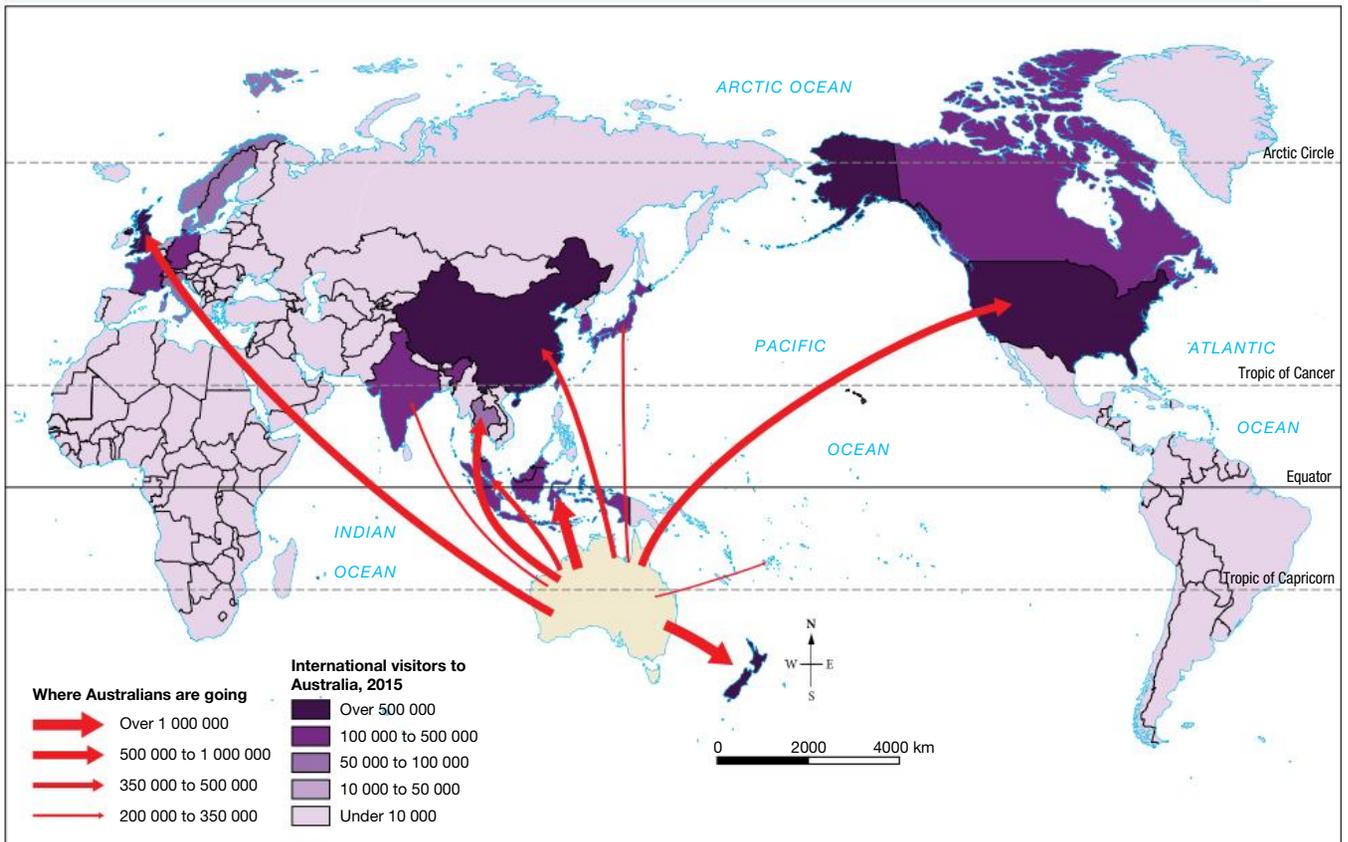
In the first eight months of 2015, 6.8 million tourists came to Australia and spent 242 million nights in the country. Approximately 64 per cent of these international visitors had previously been to Australia. They added about \$34 billion to the Australian economy. The most visited states were New South Wales with 52 per cent, Queensland with 37 per cent and Victoria with 31 per cent. The countries of origin of these visitors are shown in figure 1, while the reasons for their visits are shown in figure 2.

Nine-hundred and twenty-five thousand jobs can be attributed either directly or indirectly to the tourism industry. It is predicted that by 2020 an additional 123 000 jobs will be created.

9.5.3 What do visitors want to see?

Australia is a land of contrasts, having a wide variety of both human and natural environments. Thirty of the most popular tourist destinations are shown in figure 3.

FIGURE 1 Country of origin for tourists visiting Australia, and destinations for Australian tourists, 2015



Source: ABS, Austrade

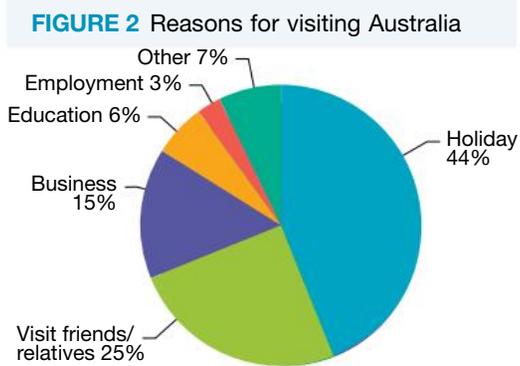
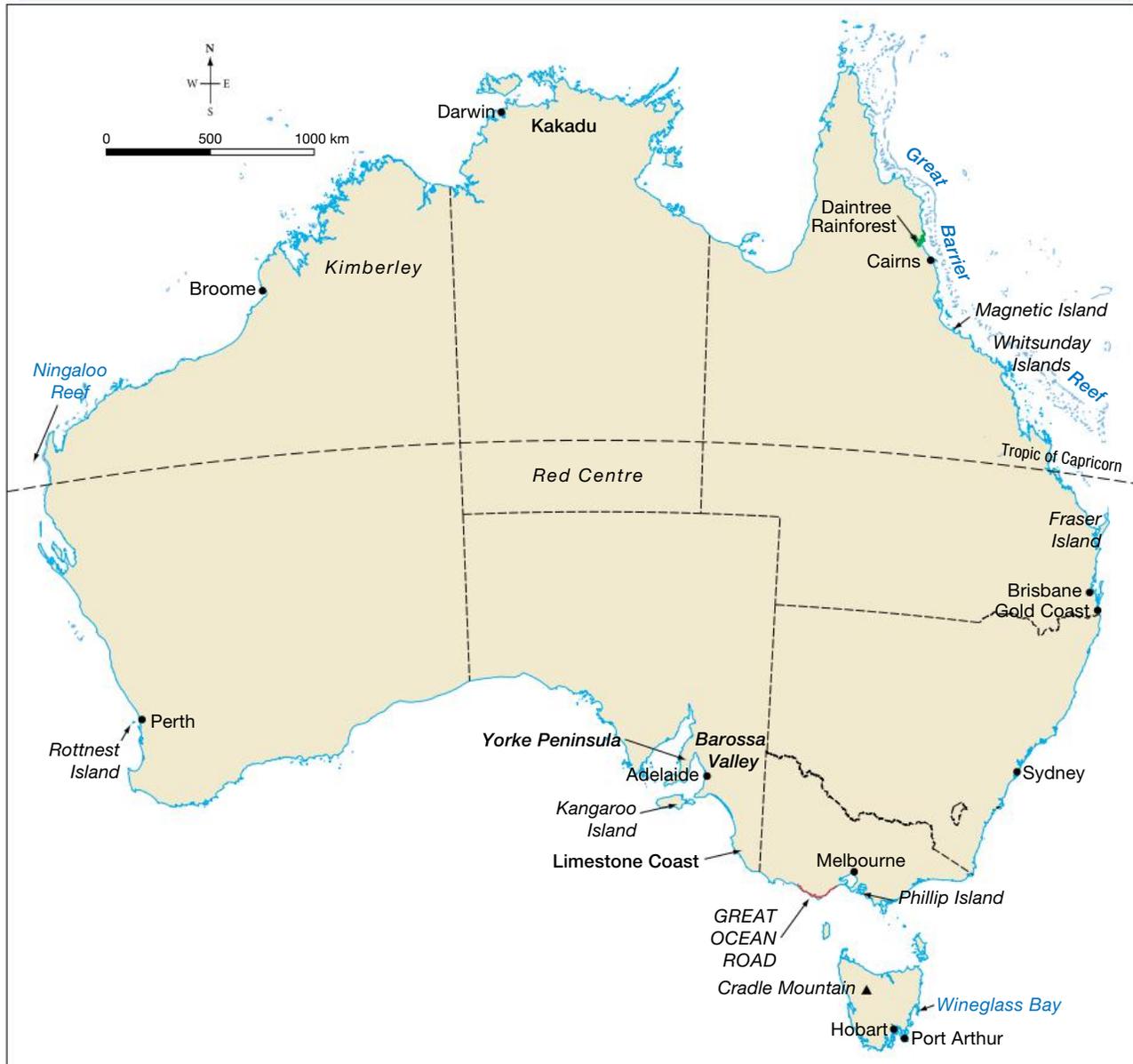


TABLE 1 How we see ourselves

| | |
|--------------------|-----------|
| New South Wales | Nightlife |
| Northern Territory | Outback |
| Queensland | Beaches |
| South Australia | Wine |
| Tasmania | Nature |
| Victoria | Sport |
| Western Australia | Wine |

FIGURE 3 Thirty of Australia's most popular tourist destinations



Source: Data © Commonwealth of Australia (Geoscience Australia) 2013 & © State of Queensland (Department of Agriculture, Fisheries and Forestry) 2013

How are we perceived?

Tourism statistics have revealed that Victoria has increased its share of the international tourist market. Tourism in this state grew by 28 per cent in the 12-month period ending September 2015, a figure that is significantly higher than the national average, which is just 15 per cent. New South Wales, however, remains the most visited state.

9.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Why might more Australians choose to holiday overseas rather than in Australia?

Explain

2. Explain the **interconnection** between the **places** most visited by Australians and our major source of tourists.

Discover

3. Study figure 3.
 - (a) Identify the top tourist destinations in Victoria.
 - (b) Suggest other **places** that you think should be at the top of every tourist's holiday itinerary.
 - (c) Identify which are human and which are natural **environments**.
 - (d) Prepare an annotated visual display that showcases places of interest within Victoria. Include information about the attractions, their location and why they are a viewing must.
 - (e) What strategies are in place to ensure the **sustainable** management of tourist facilities in Victoria?
4.
 - (a) Survey members of your class to find out which three overseas **places** they would most like to visit and why.
 - (b) Each member of the class should ask their parents which three overseas **places** they would most like to visit and why.
 - (c) Compile your class data and identify the most popular **places** selected by students and their parents. Make sure you also collate the data showing the reasons for the choices.
 - (d) On an outline map of the world, show the results of your survey. Make sure you can distinguish between **places** chosen by parents and **places** chosen by students.
 - (e) Annotate your map with the reasons given for the choices.
 - (f) Is there an **interconnection** between **places** chosen by parents and by students? Suggest reasons for your observations.



Deepen your understanding of this topic with related case studies and questions.

▶ **Tourism in Australia**

9.6 SkillBuilder: Creating a survey

WHAT IS A SURVEY?

Surveys collect primary data. A survey involves asking questions, recording and collecting responses, and collating and interpreting the number of responses. Surveys are useful because they provide statistics for a specific topic that might not be available by any other means. A wide range of data can be gathered in an efficient and simple way.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

online only

FIGURE 1 A survey of shoppers

A survey of shoppers

QUESTIONNAIRE FOR SHOPPERS

1. What suburb do you live in? _____
2. How did you get to the centre?
Taxi Bus Bicycle
Train Car or motorcycle Walk
3. Did you use the car park provided by the centre?
Yes No
4. How often do you shop at the centre?
This is the first time Once a fortnight
Several times a week Once a month
Once a week Only very occasionally
5. What types of goods and services will you buy today?
Clothes Groceries
Household/electrical goods Fresh fruit and vegetables
Financial/banking services Light meal/refreshments
6. Do you often shop at any other major shopping centre?
Yes No If yes, which one? _____
7. What attracts you to this centre? _____
8. Apart from shopping, are there any other reasons for you coming to the centre?
Work Post office Bank
Hairdresser Doctor Dentist
Solicitor Restaurants Entertainment
Other _____

-  Watch this eLesson: Creating a survey (eles-1764)
-  Try out this interactivity: Creating a survey (int-3382)

9.7 SkillBuilder: Describing divergence graphs

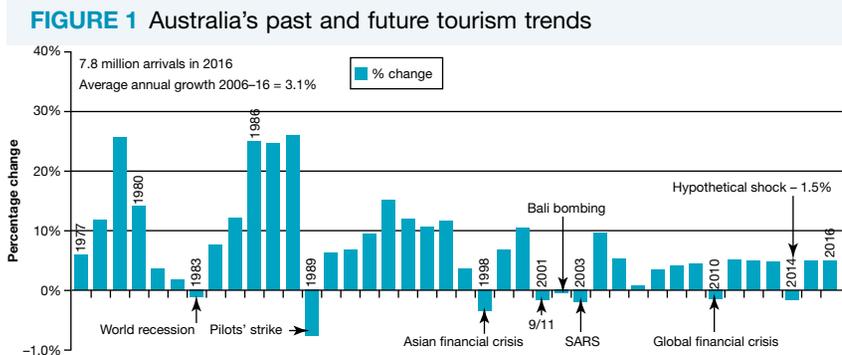
online only

WHAT IS A DIVERGENCE GRAPH?

A divergence graph is a graph that is drawn above and below a zero line. Those numbers above the line are positive, showing the amount above zero. Negative numbers that are shown indicate that the data has fallen below zero. A divergence graph allows you to identify changes away from the norm in a trend.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.



-  Watch this eLesson: Describing divergence graphs (eles-1739)
-  Try out this interactivity: Describing divergence graphs (int-3357)



Deepen your understanding of this topic with related case studies and questions.
Tourism in Australia

9.8 What are the impacts of tourism?

9.8.1 Do the benefits outweigh the costs?

Tourism seems like the perfect industry. It can encourage greater understanding between people and bring prosperity to communities (see figure 1). However, tourism development can also destroy people's culture and the places in which they live (see figure 2). There is sometimes a fine line between exploitation and sustainable tourism.

FIGURE 1 The negative impacts of tourism

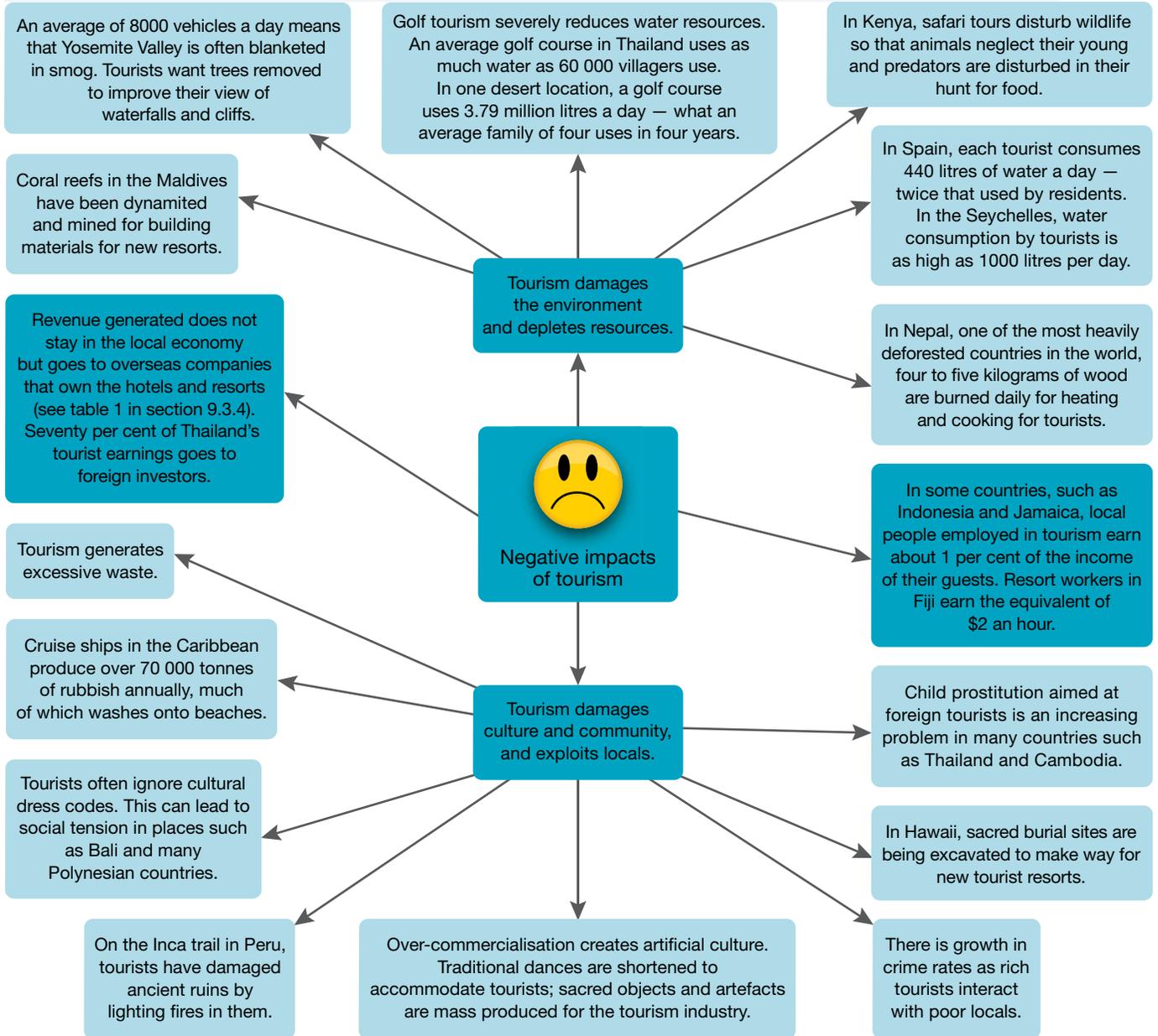
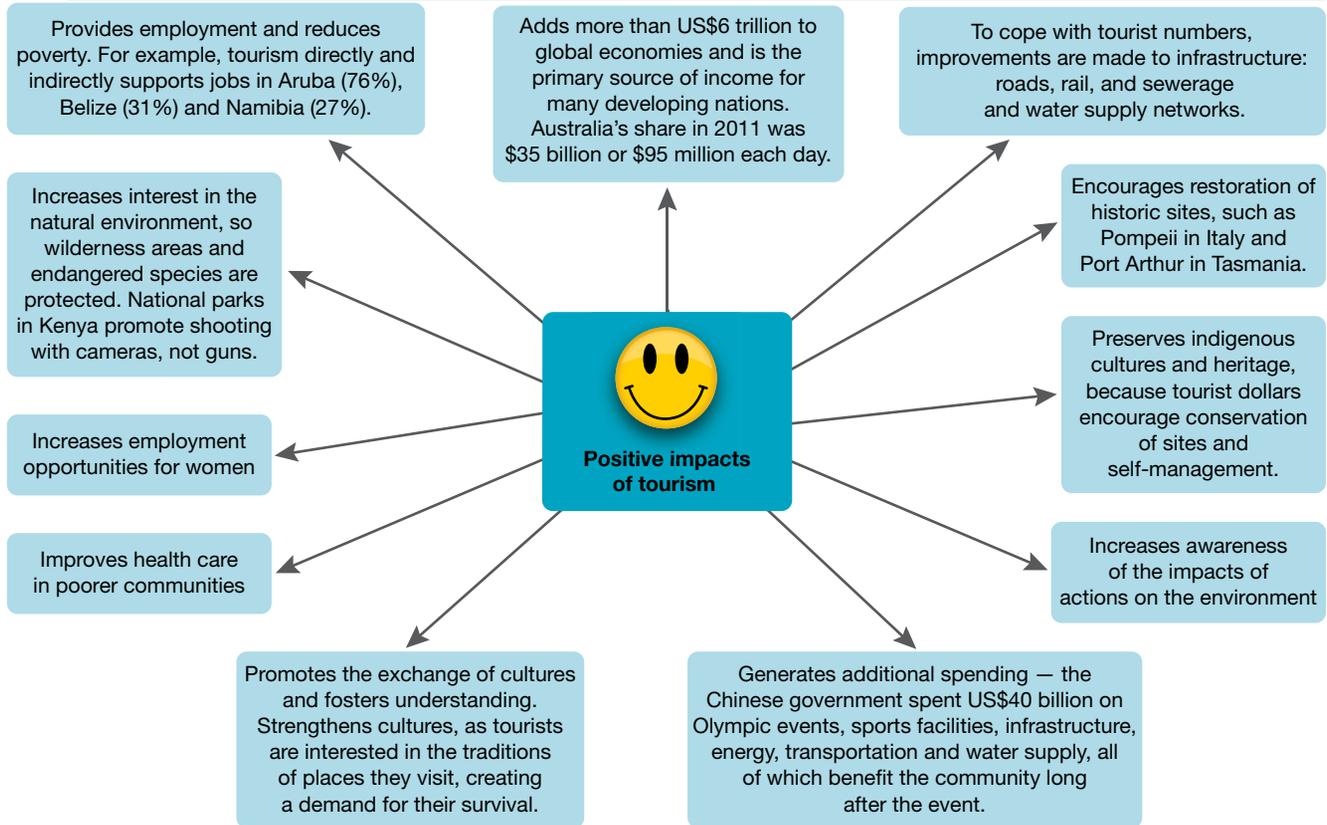


FIGURE 2 The positive impacts of tourism



9.8 Activities

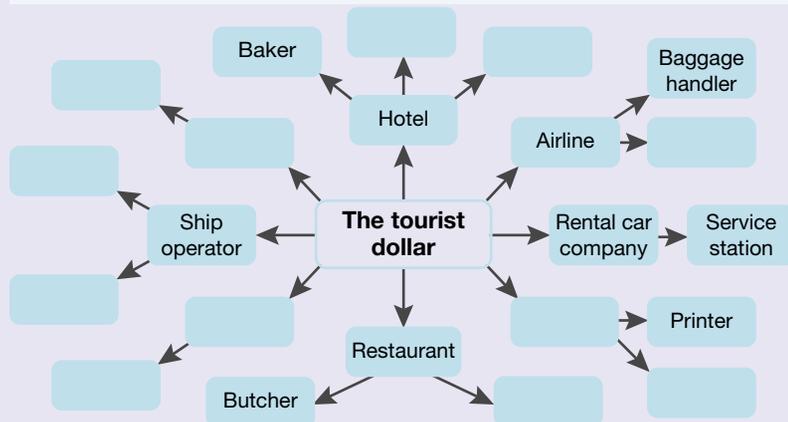
To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Think

1. Using figures 1 and 2, explain how tourism can have both positive and negative effects.

2. (a) Figure 3 shows how the tourist dollar can flow from one job to the next. Those jobs in the centre of the diagram interact directly with the tourist, while those on the outside do not. Copy the diagram into your workbook at an enlarged size. Complete it by adding other jobs. Add to it if you can. Study your completed diagram and write a paragraph explaining the **interconnection** between tourism and the economy.
- (b) Repeat this exercise looking at either the social or **environmental** impacts.

FIGURE 3 One view of tourism



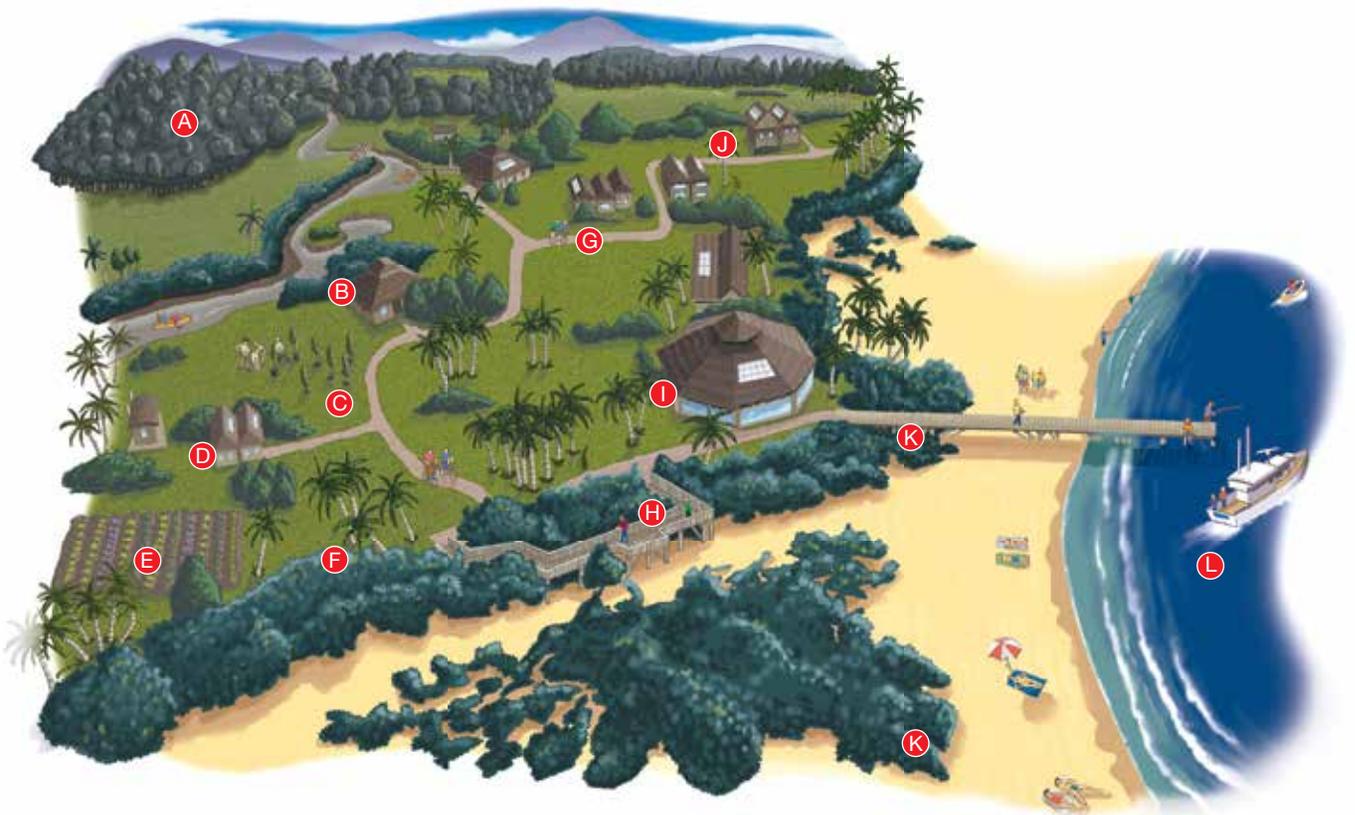
3. The type of **interconnection** shown between industries in figure 3 is sometimes called the multiplier effect. Explain what you think this means.
4. The impact of tourism can be classified as **environmental**, cultural and economic. Study figure 1, showing the negative impacts of tourism. Working in groups of three, select an impact from each group. Explain the **scale** of each impact and devise a strategy for **sustainable** tourism.
5. Which of the following would be the best to develop as a tourist resource in your region: art gallery, museum, cinema complex or sports stadium? Justify your answer.

9.9 What can we learn from our travels?

9.9.1 What is ecotourism?

Tourism has the capacity to benefit environments and cultures or destroy them. **Ecotourism** has developed in response to this issue. The aim is to manage tourism in a sustainable way. This might be through educational programs related to the environment or cultural heritage, or through controlling the types and locations of tourist activities or the number of tourists visiting an area.

FIGURE 1 Anatomy of an ideal ecotourism resort



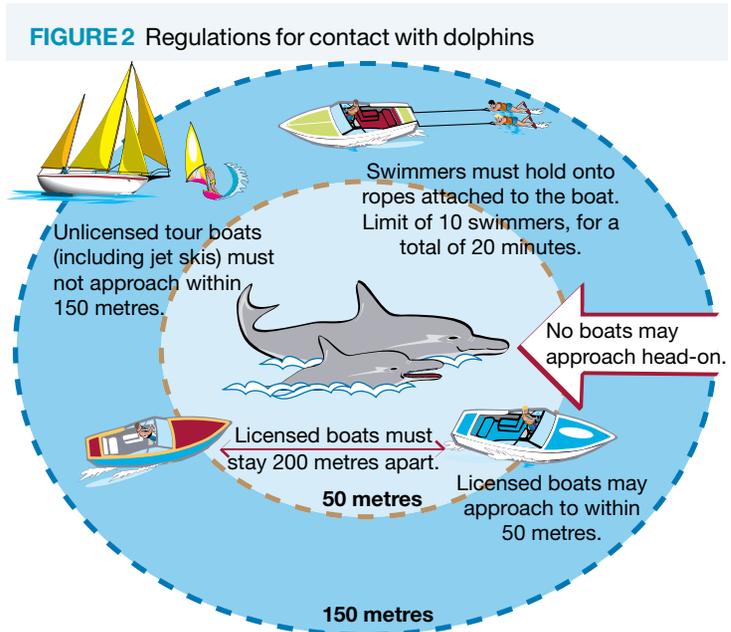
- A** The natural bush is retained and native plants are used to revegetate or landscape the area.
- B** Composting toilets treat human waste, and worm farms consume food waste. Water is treated with ultraviolet light rather than chlorine. Recycling is practised; for example, grey water is used in irrigation and toilet systems.
- C** Visitors are encouraged to improve and maintain the environment by using paths or planting trees.
- D** Buildings blend in with the natural landscape, and local materials are used. Buildings are often raised to prevent damage to plant roots. During construction, builders prevent contamination of the local environment by having workers change shoes and by washing down equipment to keep out foreign organisms.
- E** Local organically grown produce is used, and craft markets and stalls might also be established and run by indigenous communities, supporting the local economy, creating jobs and reducing poverty.
- F** There is no golf course, because of the high water use and need for pesticides it would require.
- G** Low-impact, non-polluting transport such as bicycles are provided for guests.
- H** Walking trails include educational information boards.

- I An information centre helps visitors understand the environment. Local indigenous people are employed to educate visitors about their culture.
- J Electricity is generated through solar panels on the roofs of eco-cabins.
- K Boardwalks are built over sensitive areas such as sand dunes to protect them from damage. Boardwalks might also be constructed in the tree canopies.
- L Trained guides educate tourists about coral reefs and native vegetation, and show visitors how to minimise their impact.

Ecotourism differs from traditional tourism in two main ways.

- It recognises that many tourists wish to learn about the natural environment (such as reefs, rainforests and deserts) and the cultural environment (such as indigenous communities).
- It aims to limit the impact of tourist facilities and visitors on the environment.

Ecotourism is the fastest growing sector in the tourism industry, increasing at about 10 to 15 per cent per year.



9.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. How does an ecotourism resort differ from a traditional tourist resort?

Explain

2. Use a mind map to explore further **changes** that could be made to the resort shown in figure 1 to make it even more **environmentally** friendly. Would you describe your **changes** as small-**scale** or large-**scale**? Justify how these **changes** might be more **environmentally sustainable**.

Discover

3. Visitors to ecotourism resorts are often attracted by brochures that emphasise the resort's **environmental** policies. These brochures also set out guidelines to follow in order to minimise visitor impact.
 - (a) Design and produce a brochure for the ecotourism resort illustrated in figure 1. Use ICT tools and techniques to maximise the brochure's impact.
 - (b) Add another eco-activity to the island and devise strategies to educate tourists and minimise their impact on the **environment**.

Think

4. One of the most famous examples of wildlife-based ecotourism in Australia is Monkey Mia in Western Australia. Here the wild dolphins come into shore and tourists are able to feed, swim with and touch them.
 - (a) What rules and other techniques are used to control the interaction between dolphins and tourists?
 - (b) Predict potential problems that might occur between dolphins and tourists.
 - (c) Do you think this is an example of **sustainable** ecotourism? Give reasons for your answer.

➡ Try out this interactivity: Sustainable sightseeing (int-3336)



Deepen your understanding of this topic with related case studies and questions.

- ◉ Kakadu National Park
- ◉ Wilsons Promontory
- ◉ Ningaloo Reef and ecotourism

9.10 Are zoos and aquariums eco-friendly?

online only

To access this subtopic, go to your learnON title at www.jacplus.com.au

9.11 What is cultural tourism?

9.11.1 Different cultures

Cultural tourism is concerned with the way of life of people in a geographical region. It is usually connected to elements that have shaped their values or culture, such as a shared history, traditions or religion. It may be linked to unique events, such as the celebration of Chinese New Year or Thanksgiving in the United States. Whatever the reason, the mass movement of people associated with these events has a significant impact on both people and places.

9.11.2 What is the impact of Thanksgiving?

Thanksgiving is held in the United States on the fourth Thursday in November. It dates back to the seventeenth-century celebration of the harvest. Today it is a time for families to get together and give thanks for what they have.

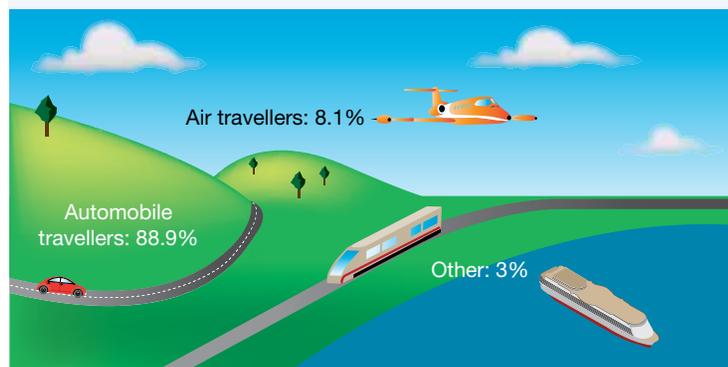
The holiday period runs from Wednesday to Sunday. In 2015, about 46.9 million people travelled an average distance of 884 kilometres to celebrate with family and friends (see figure 1). As millions of people travel across the United States, transport systems are stretched to the limits, creating delays and traffic congestion. Because the holiday season is so close to the start of winter, the weather can further complicate people's travel plans, especially those who live in the northern states. Early winter storms can bring ice and snow, resulting in airport closures and impassable roads.

Surprisingly, in 2015 the cost of travel decreased around the time of Thanksgiving. Travellers paid less for fuel, car hire, accommodation and air-fares.

9.11.3 What is the impact of Chinese New Year?

Chinese New Year is the longest and most important of the traditional Chinese holidays. Dating back centuries, it is steeped in ancient myths and traditions. The festivities begin on the first day of the first month in the traditional Chinese calendar, and last for 15 days. They conclude with

FIGURE 1 Thanksgiving and modes of transport



the lantern festival on Chinese New Year's Eve, a day when families gather for their annual reunion dinner. It is considered a major holiday, and it influences not only China's geographical neighbours but also the nations with whom China has economic ties.

Of special significance is the fact that the date on which Chinese New Year occurs varies from year to year. This date coincides with the second **new moon** after the Chinese **winter solstice**, which can occur any time between 21 January and 20 February.

Chinese New Year, or Lunar New Year, is celebrated as a public holiday in many countries with large Chinese populations or with calendars based on the Chinese lunar calendar (see figure 2). The changing nature of this holiday has meant that many governments have to shift working days to accommodate this event.

In China itself, many manufacturing centres close down for the 15-day period, allowing tens of millions of people to travel from the industrial cities where they work to their hometowns and rural communities. This means that retailers and manufacturers in overseas countries such as the United States and Australia have to adjust their production and shipping schedules to ensure they have enough stock on hand to deal with the closure of factories in China. For those shopping online, goods simply will not be available and will be placed on back order.

FIGURE 2 To ensure prosperity and good fortune in the year ahead, parades, dragons and lion dances feature in Chinese New Year celebrations.



9.11.4 The logistics of moving 80 million people each day

Chinese New Year has been described as the biggest annual movement of people in China. Over a five-day period, an average of 80 million journeys are recorded in the last-minute dash to make it home for the traditional family celebrations. If you include the 40 days surrounding 8 February (the date of Chinese New Year in 2016), more than 3.65 billion people travel in China alone.

Most people elect to travel by road as most middle-class citizens cannot afford to fly home, nor do they want to queue for hours or days to purchase bus or rail tickets. Nevertheless, in 2016, 24 million

chose to travel by air; in fact, one airline added an additional 210 flights to cope with the increased demand. However, weather conditions and the impact of additional flights competing for the same amount of air space meant that about 80 per cent of flights were delayed. Delays of more than five hours were not uncommon. It is also not uncommon for commuters to add thousands of kilometres to their journey. One airline traveller flew from Beijing to Kunming in southern China via Bangkok because he could not get a direct flight.

A growing trend in both 2015 and 2016 was motorcycle convoys as these vehicles are not only cheaper to run but have the added advantage of being able to avoid the congestion created by 80 million people and their vehicles clogging the motorways.

Rail travel was not without its own problems as a system with a capacity to move 3.4 million people had to cope with 145 million travellers. In 2012 a new online booking system was introduced; however, it crashed when 1.66 million people attempted to log on at the same time. The system is still plagued with issues and unable to keep pace with the increased demand and has done little to address the issue of scalpers. Even with extended selling hours people were faced with long queues that often saw tempers flare. Prices were also often double or triple the usual cost as scalpers cashed in on those desperate to get home. In 2015 the rail network was expanded through the addition of 9000 kilometres of track, making it the world's second largest rail network, second only to the United States.

In 2016 almost 100 000 people were left stranded at railway stations after ice and snow in other parts of the country caused long delays. Fifty-five trains in Shanghai and 24 in Guangzhou were unable to leave their respective stations when China was struck by a record-breaking cold snap. Almost 4000 police and security guards were called in to keep order (see figure 3).

FIGURE 3 Travel chaos as crowds swell outside Guangzhou station after bad weather causes long delays



9.11 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Explain

1. In your own words, explain what is meant by the term *cultural tourism*.
2. Why are Thanksgiving and Chinese New Year regarded as cultural events?

Discover

3. As a class, brainstorm a list of cultural or celebratory events that occur in Australia.
4. Use the internet to find out more about either Chinese New Year or Thanksgiving. Investigate the history, myths and traditions associated with your chosen event. Prepare an annotated visual display comparing your finding with a cultural or celebratory event in Australia. Make sure you include references to the **scale** of your chosen event and the **place** in which it occurs.

Think

5. Copy the table below into your workbook and fill it in. Use the **Thanksgiving** weblink in the Resources tab to find out more and help you complete your table.
 - (a) What is the preferred mode of transport for Thanksgiving and for Chinese New Year? Suggest reasons for differences in travel arrangements. In your response, include reference to the **scale** of movement.
 - (b) Make a list of problems associated with the mass movement of people.
 - (c) Select one of the problems you have identified and explain the impact it might have on people, **places** and the **environment**. Suggest a strategy for the **sustainable** management of this problem in order to reduce its impact.
6. Write a paragraph explaining how cultural events can **change** people, **places** and the **environment**.

| | Thanksgiving | Chinese New Year |
|-------------------------------|--------------|------------------|
| Number of trips | | |
| Most common form of transport | | |
| Length of holiday period | | |
| Purpose of trip/activities | | |

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 Explore more with this weblink: Thanksgiving

9.12 Is sport a new tourist destination?

9.12.1 How are tourism and sport connected?

Sport tourism involves people travelling to view or participate in a sporting event. It is an expanding sector of the tourism industry, currently adding \$600 million to global economies each year. It is estimated that, on average, 12 million international trips are made to view sporting events. But what impact does this have on people and places?

Governments spend millions of dollars to attract people to sporting events such as the Olympics, the cricket and soccer world cups, and motor racing events, to name just a few. These events also trigger:

- construction of new stadiums
- expansion and upgrades of transport networks
- improvements to airport facilities
- clean-ups of cities in readiness for the arrival of tourists.

Sports tourists fall into two broad categories: those who like to watch and those who want to participate. The latter view sport as a part of their leisure and recreational activities (see figure 1). A common trait in all sports tourists is their passion and willingness to spend money to indulge this passion.

9.12.2 Are the Olympics a tourist bonanza?

Major sporting events such as the Olympics translate into improved infrastructure, and provide the host city with considerable international exposure. Does this bring in more tourists and justify the capital outlay? (See figure 2.)

The general consensus is that the costs associated with hosting a one-off major event, such as the soccer World Cup or the Olympic Games, do not meet the anticipated outcomes. Statistics show that three million tourists visited the United Kingdom in August 2012 (their Olympic year) — 5 per cent *less* than in the previous year. Tourism spending, however, went up by 9 per cent, in part because of spending on Olympic tickets. In addition, many UK residents chose to holiday overseas rather than remain at home during the Olympic Games. Organisers were also frustrated by the number of empty seats in many of the venues. On the plus side, however, building the Olympic village provided a £6 billion boost to the building and construction industry.

But what happens to the people who originally lived on the site of the proposed new venues and athletes' village? Quite simply, they are moved on. While they may receive some compensation, land values go up in the shadow of renewed development. Residents simply cannot afford to live in the new developments, nor can they afford to renovate their existing dwelling. In the lead-up to the Beijing Olympics, 1.5 million Chinese people were forced out of their homes to make way for Olympics venues.

Once the event is over, many of the stadiums are under-used, and it can take years to recover from the cost of staging the event. The city of Montreal, for instance, took 30 years to pay back the equivalent of US\$6 billion (in today's money) in Olympic spending.

FIGURE 1 On the trail — recreational tourism



FIGURE 2 Olympics expenditure (both summer and winter), including infrastructure

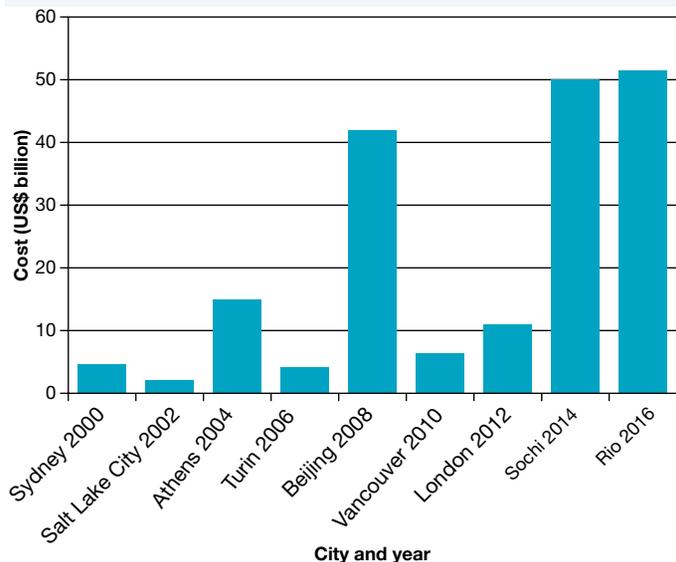


FIGURE 3 The opening ceremony of the London Olympic Games



9.12.3 What is the status of other sports events?

It has generally been accepted that regular sporting events can have financial benefits. Many international tourists visiting the United Kingdom include a sporting event on their itinerary. Most popular is soccer, because of the opportunity to see some of the world's most talented athletes playing in some of the UK's top teams. In 2014, 800 000 international fans added £684 million to the British economy. Official figures show that these fans spent an average of £850 — far more than the average £570 spent by the rest of the tourist population.

Overall, sports tourists stay longer and are not deterred by the weather. The popularity of football is also evident in Australia, where three separate codes attract huge crowds every week, and fans are prepared to travel interstate to watch their team play.

But it is not just football that attracts the crowds. The English cricket team is followed around the world by its unofficial cheer squad, nicknamed the Barmy Army. Other 'fanatics' based in Australia organise 58 tours to 57 destinations each year, taking in some of the biggest sporting events both at home and abroad.

FIGURE 4 The Barmy Army comprises thousands of fans who come to Australia to cheer on the English cricket team.



9.12 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. (a) Is someone who goes to a local football match a tourist? Explain.
(b) What if that person travels interstate? Explain.

Explain

2. Brainstorm a list of sports that might spend money to attract tourists. Categorise these as **hard** and **soft sport tourism** events.
3. Compile a table that highlights the positives and negatives of sport tourism. Choose two positives and two negatives. For each, explain the impact it has on people and **places**.

Think

4. The Phillip Island Grand Prix racing circuit is located 100 kilometres south of Melbourne, Victoria. The island is linked to the mainland by a bridge. The area is popular for its beaches and wildlife, but it is also home to a racing circuit that stages a variety of motor sports throughout the year. Collectively, more than \$110 million is generated annually from the circuit's car and bike activities. Three events — the Moto GP, V8 Supercars and Superbikes — bring in over \$79 million. Each of these events brings more than 65 000 people to the island.
 - (a) What facilities would be needed to cater for such a large influx of people?
 - (b) Figure 3 in subtopic 9.8 shows how the tourist dollar can flow from one job to the next. Complete a diagram like this for the Phillip Island Grand Prix circuit.
 - (c) With a partner, brainstorm a list of negative consequences that might result from having a Grand Prix circuit on Phillip Island. Make sure you consider the impact on people and the **environment**, as well as the **scale** of such effects.
 - (d) Write a paragraph explaining the **interconnection** between the location of sporting facilities and their impact on people and **places**.
 - (e) Do you think this is an example of **sustainable** tourism? Justify your point of view.

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 Try out this interactivity: Are the Olympic Games worth gold? (int-3337)



Deepen your understanding of this topic with related case studies and questions.

- Sport
- The FIFA World Cup

9.13 Review

online only

9.13.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

9.13.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

9.4 SkillBuilder: Constructing and describing a doughnut chart

9.4.1 Tell me

What is a doughnut chart?

A doughnut chart is a circular chart with a hole in the middle. Each part of the doughnut is divided as if it were a pie chart with a cut-out. The circle represents the total, or 100 per cent, of whatever is being looked at. The size of the segments is easily seen. Presenting the parts in order from largest to smallest makes it easy to interpret.

Why is a doughnut chart useful?

Doughnut charts are a useful visual interpretation of data. Just like a pie chart, they give us an overall impression of data. They are useful for comparing proportions of categories. You will find them easy to read, as they show a lot of data and make it easy for us to interpret and compare this data. You can use these in class to graph any data that adds up to 100 per cent.

They are also useful for:

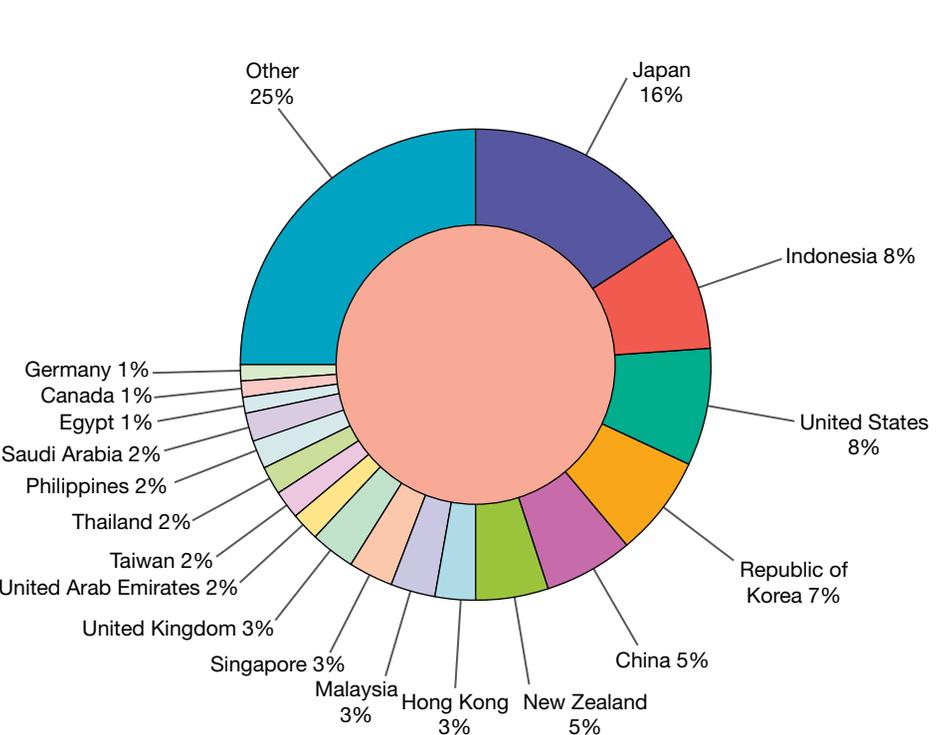
- economists showing segments of a country’s tourism industry
- agriculturalists showing the percentage of various crops on the land
- retailers comparing the importance of various goods in their stores during different years.

Model

TABLE 1 Australia’s food export markets by value, 2010–2011

| Country | Value (\$ million) |
|----------------------|--------------------|
| Japan | 4207 |
| Indonesia | 2288 |
| United States | 2138 |
| Korea, Rep. of | 1994 |
| China | 1511 |
| New Zealand | 1281 |
| Hong Kong, China | 886 |
| Malaysia | 849 |
| Singapore | 739 |
| United Kingdom | 692 |
| United Arab Emirates | 581 |
| Taiwan | 569 |
| Thailand | 539 |
| Philippines | 502 |
| Saudi Arabia | 499 |
| Egypt | 402 |
| Canada | 332 |
| Germany | 263 |
| Other | 6815 |

FIGURE 1 Australia’s food export markets by value, 2010–2011



Source: © DAFF 2012, National Food Plan green paper 2012, Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

Australia's food exports go to a large number of countries. These countries are predominantly in Asia, with the exception of the United States and New Zealand. Japan is Australia's greatest importer of food by monetary value, with \$4207 million of imports in 2010–2011, or about 16 per cent. Indonesia, the Republic of Korea and China are the other significant Asian buyers of Australian food. Asian countries account for 51 per cent of all our food exports, while the United States and New Zealand account for 13 per cent of Australia's food exports. Europe and the Middle East take less of our food.

A good doughnut chart:

- has a hole at its centre
- has segments that are labelled with names, or has a key
- includes percentages and/or raw figures
- is drawn with the largest segment starting at 12 o'clock, proceeding clockwise from largest to smallest, unless there is an 'other' category, which comes last
- gives the source of the data
- has a clear title.

A good description of a doughnut chart:

- identifies and communicates key features, such as highest and lowest data values
- refers to data and names.

9.4.2 Show me

How to construct and describe a doughnut chart

You will need:

- a set of data
- a computer
- a blank Excel spreadsheet.

Procedure:

STEP 1

Open a spreadsheet in Excel. Into the spreadsheet, add the data that you wish to graph. If the data is in the form of whole numbers, you will need to convert them to percentages. If the total of the whole numbers is not given, you will have to add the numbers together to get the total. Excel will do this for you with the Auto Sum function (Σ) in the toolbar. For example, using the data that went into figure 1, select all the data in column B plus row 20 (see figure 2a). Then click on the Auto Sum symbol and the total will appear in cell B20 (figure 2b).

STEP 2

To complete the percentage column, click on the first cell of a new column, cell C1, and type in the formula $=B1/\$B\20 . (The \$ sign is used to make sure that one specific cell is referred to. Make sure the final number, 20 in this example, is the cell number in which the total appears. This will change with each set of data you enter.) Press Enter and a decimal number will appear. Now click the percentage symbol (%) in the Number section of the toolbar, and the figure in cell C1 will appear as a percentage.

FIGURE 2 (a) Selecting the column (b) The total appears when you click the Σ button in the Editing section of the toolbar.

| (a) | A | B | (b) B |
|-----|----------------------|------|--------------|
| 1 | Japan | 4207 | 4207 |
| 2 | Indonesia | 2288 | 2288 |
| 3 | United States | 2138 | 2138 |
| 4 | Republic of Korea | 1994 | 1994 |
| 5 | China | 1511 | 1511 |
| 6 | New Zealand | 1281 | 1281 |
| 7 | Hong Kong | 886 | 886 |
| 8 | Malaysia | 849 | 849 |
| 9 | Singapore | 739 | 739 |
| 10 | United Kingdom | 692 | 692 |
| 11 | United Arab Emirates | 581 | 581 |
| 12 | Taiwan | 569 | 569 |
| 13 | Thailand | 539 | 539 |
| 14 | Philippines | 502 | 502 |
| 15 | Saudi Arabia | 499 | 499 |
| 16 | Egypt | 402 | 402 |
| 17 | Canada | 332 | 332 |
| 18 | Germany | 263 | 263 |
| 19 | Other | 6815 | 6815 |
| 20 | | | 27087 |

STEP 3

Click on cell C1, and you will see a small black square in the bottom right corner (see figure 3a). Using the cursor, drag this down over the remaining rows to be calculated. Do not include the row in which the total is shown (row 20 in this example). The percentages for all remaining cells will appear. Figure 3b shows a completed chart.

STEP 4

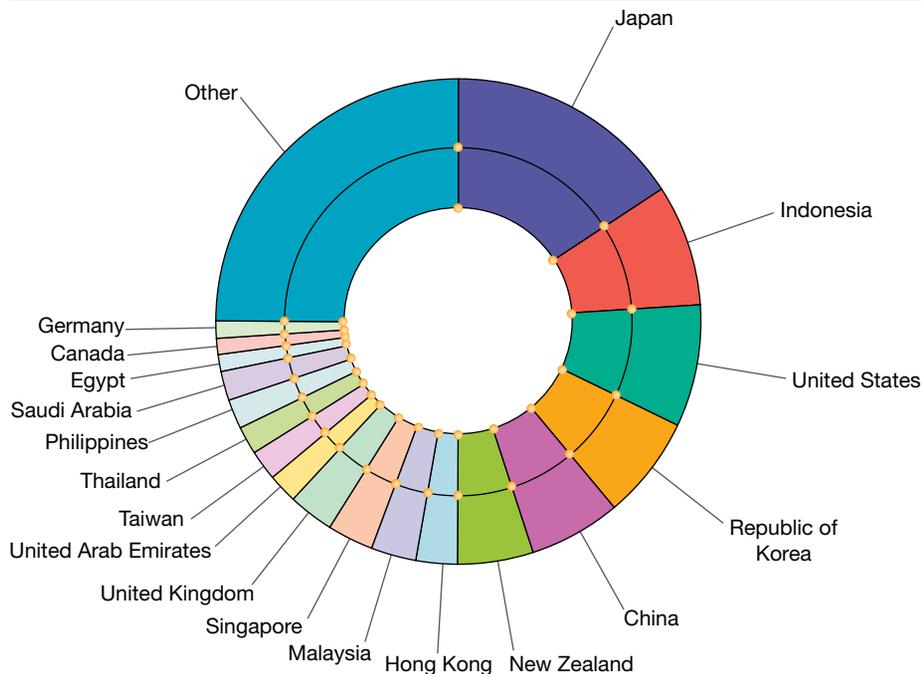
You can now generate the doughnut chart. To do this, select all columns and rows in which your data appears, excluding the total figure (columns A, B and C and rows 1 to 19 in this example), and then click the Insert tab on your toolbar. In the Charts section, select Other Charts and choose the simple doughnut chart. The Excel spreadsheet will create a doughnut chart (see figure 4).

If your doughnut chart appears with a second, inner doughnut, click on this and delete it (see figure 4).

FIGURE 3 (a) Use the cursor to drag the bottom right corner of a cell over the remaining rows to be calculated. (b) Percentage data is now complete.

| | A | B | C |
|----|----------------------|-------|-----|
| 1 | Japan | 4207 | 16% |
| 2 | Indonesia | 2288 | 8% |
| 3 | United States | 2138 | 8% |
| 4 | Republic of Korea | 1994 | 7% |
| 5 | China | 1511 | 6% |
| 6 | New Zealand | 1281 | 5% |
| 7 | Hong Kong | 886 | 3% |
| 8 | Malaysia | 849 | 3% |
| 9 | Singapore | 739 | 3% |
| 10 | United Kingdom | 692 | 3% |
| 11 | United Arab Emirates | 581 | 2% |
| 12 | Taiwan | 569 | 2% |
| 13 | Thailand | 539 | 2% |
| 14 | Philippines | 502 | 2% |
| 15 | Saudi Arabia | 499 | 2% |
| 16 | Egypt | 402 | 1% |
| 17 | Canada | 332 | 1% |
| 18 | Germany | 263 | 1% |
| 19 | Other | 6815 | 25% |
| 20 | | 27087 | |

FIGURE 4 A completed doughnut chart. This one has a secondary ring within it, which needs to be deleted in this instance.



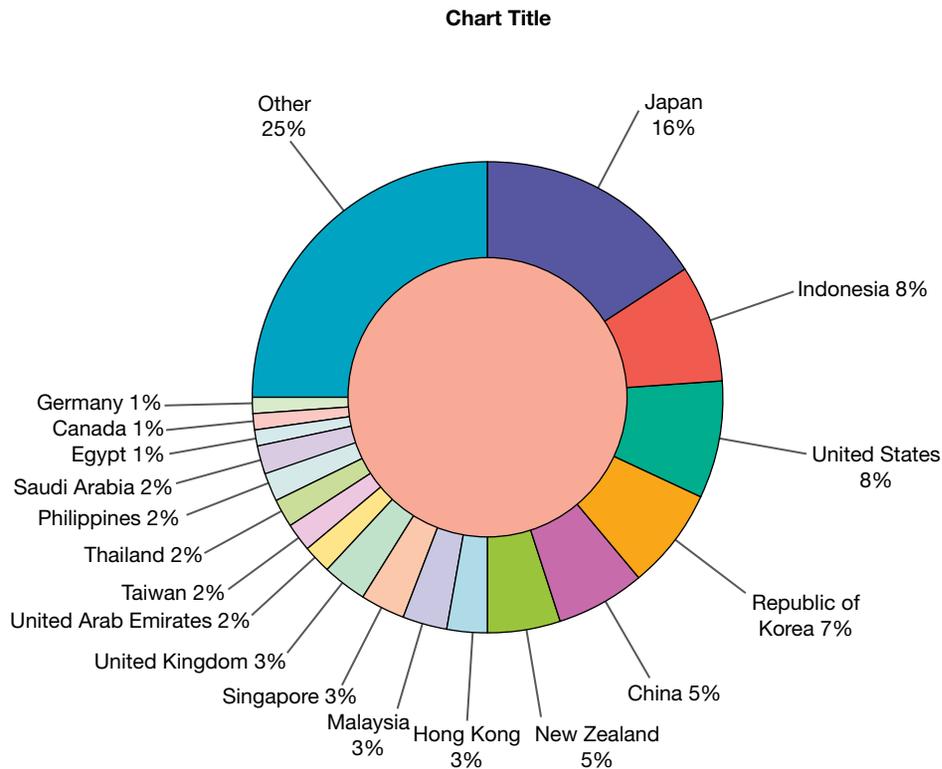
STEP 5

To make the percentage labels appear within your doughnut chart, click on the doughnut and select Chart Layouts in the Design tab on the toolbar, then choose a layout in which the percentage symbol (%) appears. Percentages will appear (see figure 5). Try different chart layouts to see which works best.

You might find that the chart appears small and cramped. If so, click on the outer rectangular border around your doughnut chart and drag it. As you do this, the chart will enlarge and the labels and legend will become easier to read.

You can also decrease the type size of the labels by clicking on one (which will highlight all of them), going to the Home tab and reducing the font size. You can do the same for the legend if necessary.

FIGURE 5 A doughnut chart with percentages added

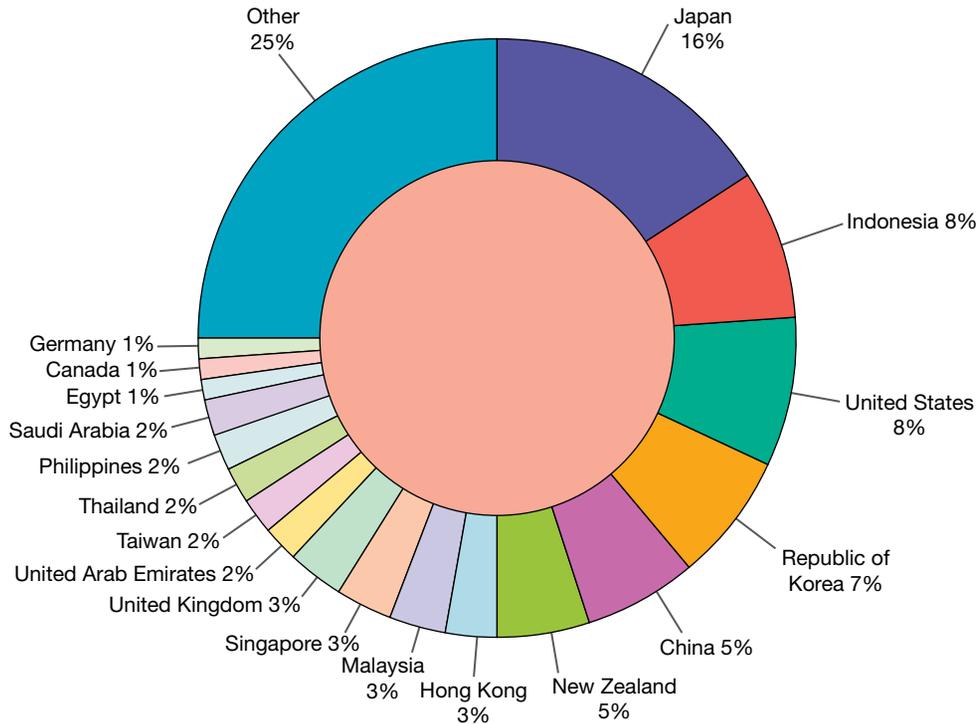


STEP 6

You now need to add the title. Simply click on the heading *Chart Title* (see figure 5), type your title and then press Enter. Your title should include the places and dates for which this data was relevant. You should also provide the source of the data (see figure 6).

FIGURE 6 A doughnut chart with its legend and title in place, along with a source line

Australia's food export markets by value, 2010–2011



Source: © DAFF 2012, National Food Plan green paper 2012, Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

9.4.3 Developing my skills

Using the data in table 2, construct a doughnut chart and then write a description of the information it conveys.

Questions

1. Where do most visitors to Sydney come from?
2. Suggest which states provide the fewest visitors to Sydney.
3. The ACT is within the boundaries of New South Wales but provides only 6.4 per cent of visitors. Can you explain why?
4. List two factors that might indicate why there is no separate category for visitors from South Australia.
5. What did your doughnut chart make clear, which the table did not?

TABLE 2 Origins of Australian tourists visiting Sydney, June 2012

| Origin | Percentage |
|------------------------------|------------|
| New South Wales | 51.4 |
| Victoria | 20.2 |
| Queensland | 12.7 |
| Australian Capital Territory | 6.4 |
| Other states | 9.3 |

Checklist

In drawing a doughnut chart I have:

- drawn a hole at the centre of the chart
- drawn segments that are labelled with names or have a key

- included percentages or raw figures
- drawn the largest segment starting at 12 o'clock, proceeding clockwise from largest to smallest, unless there is an 'other' category, which comes last
- provided the source of the data
- given my chart a clear title.

In writing a description of a doughnut chart I have:

- identified and communicated key features, such as the highest and lowest data values
- referred to data and names.

Skills questions

1. Doughnut charts are used to show:
 - (a) total populations
 - (b) *change* over time
 - (c) directions of flow
 - (d) proportions of a whole.
2. Doughnut charts include information about:
 - (a) negative values
 - (b) percentages
 - (c) *place* comparisons
 - (d) highest values.
3. Why can many divisions make a doughnut chart difficult to read? What can you do to avoid this?
4. How does using Excel make plotting a doughnut chart a fairly simple procedure?

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Watch this eLesson: Constructing and describing a doughnut chart (eles-1738)



Try out this interactivity: Constructing and describing a doughnut chart (int-3356)

9.6 SkillBuilder: Creating a survey

9.6.1 Tell me

What is a survey?

Surveys collect primary data. A survey involves asking questions, recording and collecting responses, and collating and interpreting the number of responses. Because your survey is taken from a relatively small number of people in a population, it is called a sample.

Why are surveys useful?

Surveys are useful because they provide statistics for a specific topic that might not be available by any other means. A wide range of data can be gathered in an efficient and simple way.

They are also useful for:

- counting features in a given area — tourist destinations, houses with air conditioners or traffic flows, for example
- summarising people’s activities
- providing a snapshot of people’s opinions, values and attitudes
- testing people’s perspectives and viewpoints — how they rate a feature, for example.

Model

A good survey:

- has no more than 10 questions
- ensures that each question focuses on one thing
- makes almost all questions closed questions, providing choices for participants to select from
- uses simple and direct language
- includes questions respondents will be able to answer without needing too much time to think
- ensures questions can be answered briefly
- puts questions in a logical order
- has questions that avoid bias
- does not include questions that are of a personal nature
- has data/results that can be summarised.

9.6.2 Show me

How to develop a survey

You will need:

- a computer to set out the questions — this makes organising the questions easier
- suitable computer software.

Procedure:

To develop a survey, you must take the time to create a set of questions relevant to the topic being explored.

STEP 1

Determine the topic that you want to gather data about, and consider why you want this data. In figure 1, the above example, the questionnaire is about shopping habits.

FIGURE 1 A survey of shoppers

QUESTIONNAIRE FOR SHOPPERS

1. What suburb do you live in? _____
2. How did you get to the centre?
Taxi Bus Bicycle
Train Car or motorcycle Walk
3. Did you use the car park provided by the centre?
Yes No
4. How often do you shop at the centre?
This is the first time Once a fortnight
Several times a week Once a month
Once a week Only very occasionally
5. What types of goods and services will you buy today?
Clothes Groceries
Household/electrical goods Fresh fruit and vegetables
Financial/banking services Light meal/refreshments
6. Do you often shop at any other major shopping centre?
Yes No If yes, which one? _____
7. What attracts you to this centre? _____
8. Apart from shopping, are there any other reasons for you coming to the centre?
Work Post office Bank
Hairdresser Doctor Dentist
Solicitor Restaurants Entertainment
Other _____

STEP 2

Begin by listing a series of questions. Use a computer so that you can easily modify the wording. Remember these should be closed questions, so they should include a series of answers to choose from. Each question should have four to six responses for people to select from. Examples of these in figure 1 are questions 2 to 5.

STEP 3

Try your questions with a classmate, to see whether the questions are clear and whether they elicit quick, concise responses. If necessary, reword your questions.

STEP 4

Discuss the order of questions with a classmate, and review and reorganise the order of the questions if this seems necessary.

STEP 5

Provide one or two open-ended questions to allow the respondent to have their say. These are questions for which the respondent can answer in their own words and give more detail. Question 7 in figure 1 (*What attracts you to this centre?*) is considered open-ended, because a wide range of answers is possible. Word these carefully, because you need to be able to gather the data from all the respondents.

STEP 6

Make sure that you have not asked the respondents anything that is too personal, as you don't want to offend or embarrass people. Reword or delete any questions that you are not sure about.

STEP 7

Check your survey for bias. Bias is when you have unfairly influenced the respondent to your survey. You do not want to lead your respondent in a particular direction and thus skew your research. This is particularly important if the survey is about opinions, values, attitudes and perspectives on issues. For example, question 2 in figure 1 would be considered biased if it asked 'If you didn't come by bus, what transport did you use?'

STEP 8

Review your work before asking people to complete your survey.

STEP 9

When you go out into the field to ask people to respond to your survey, there are a number of guidelines to follow.

- Introduce the survey (what it is, who you are, what you are trying to find out).
- Assure people that you are a student and that their responses will be used only for research purposes and no one will be identified.
- Accept that not everyone will want to talk to you.
- Be sure that you are safe at all times; take no risks and always work with a partner.
- Thank the respondents for their time at the end.

9.6.3 Let me do it

Developing my skills

Design a questionnaire to discover places that students from your year level, or people in the wider community, have visited as tourists in the past five years. Check the five things you need to find out to help you work out which questions to ask in your survey.

Ask people in your class, year level or local area to complete your survey. When you come back to school, tally your results and see if you can draw some conclusions. Write a paragraph on what your survey has shown you.

Questions

1. Based on responses to your survey, what percentage of people have travelled somewhere as tourists within the past five years?
2. What trends emerged from your survey with regard to the frequency with which people travel within Australia compared to those who travel overseas?
3. Is there a relationship between how far people travel and how frequently they go? Is there a relationship between how far people travel and how long they stay?
4. What were the main recreational activities people were involved in when they travelled to other *places* as tourists?
5. Describe the key features of your respondents' travel patterns. For example, were there particular continents or countries, or even regions within countries, that were more popular than others?

Checklist

I have:

- asked no more than 10 questions
- ensured that each question focuses on one thing
- made almost all questions closed questions, providing choices for participants to select from
- used simple and direct language
- included questions respondents will be able to answer without needing too much time to think
- ensured questions can be answered briefly
- put questions in a logical order
- ensured that questions avoid bias
- not included questions that are of a personal nature
- ensured that data/results can be summarised.

Skills questions

1. Surveys are used to gather information that is:
 - (a) a personal opinion
 - (b) a summary of ideas
 - (c) a biased account
 - (d) a set of untruths.
2. One of the aims of a survey is to find the number of people who:
 - (a) dislike a topic
 - (b) have similar ideas on a topic
 - (c) have varied views on a topic
 - (d) like a topic.
3. Did your classmates come up with similar questions to yours? Why or why not?
4. How important is the wording of the questions? Give an example in which you and a friend wanted to find out the same information but worded the question differently. Which version was better? Why?

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Watch this eLesson: Creating a survey (eles-1764)



Try out this interactivity: Creating a survey (int-3382)

9.7 SkillBuilder: Describing divergence graphs

9.7.1 Tell me

What is a divergence graph?

A divergence graph is a graph that is drawn above and below a zero line. Those numbers above the line are positive, showing the amount above zero. Negative numbers that are shown indicate that the data has fallen below zero.

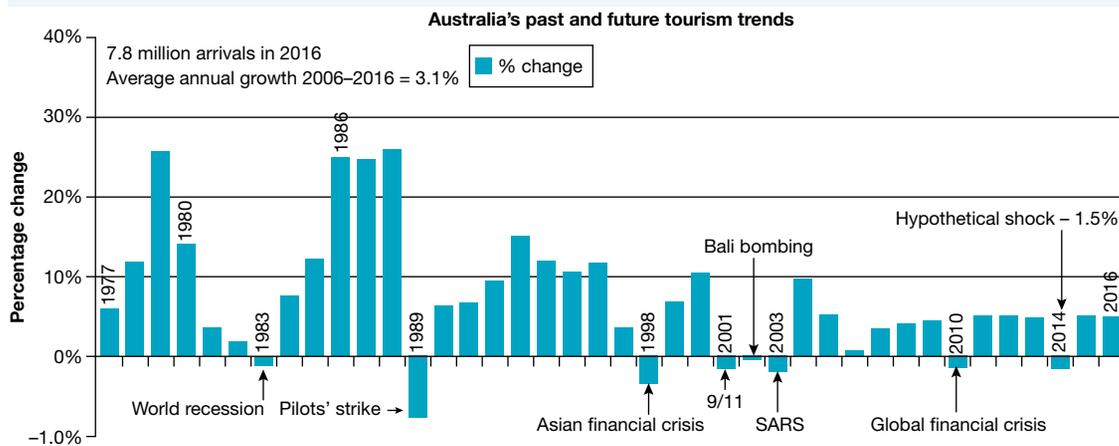
You may have seen graphs with negative numbers in climate graphs, where some months of the year in some places are below 0 °C on average.

Why is a graph with negative numbers useful?

A divergence graph allows you to identify changes away from the normal in a trend. A trend is a common pattern of gradual change. A divergence graph can indicate data that varies considerably over time.

Model

FIGURE 1 Australia's past and future tourism trends



Australia's tourism industry has experienced fluctuating highs and lows for the past 50 years. The 1980s was a period of high percentage change in tourism (20–30 per cent), hit by a world recession and pilots' strike (negative growth) but rebounding strongly afterwards (15 per cent) in the early 1990s. The percentage change in tourism has not been as strong (<10 per cent) since the 1990s. The 1990s saw more growth than the 2000s (5 per cent), when global events had a big impact. More recently, Australian tourism has been affected by the global financial crisis (2010, with negative growth).

A good interpretation of a graph with negative numbers:

- identifies and communicates key features such as patterns, peaks and troughs
- clearly represents and communicates the data, for example about a specific place.

9.7.2 Show me

How to describe a divergence graph

You will need:

- a graph showing trends, including negative trends.

Procedure:

STEP 1

Read the title of the graph carefully to see what data has been graphed, and to check the locations and dates to which the graph refers.

STEP 2

Study the labels on both axes and any key or legend provided to add to your knowledge. In figure 1, you can see that the time frame of the information is from 1977 to 2016, and that the number of visitors to Australia is represented on the vertical axis as percentage change.

STEP 3

Study the shape of the graph; in figure 1, you will note that some features are related to global events, such as recessions, pilots' strike, terrorism and disease outbreaks (SARS). At times the graph flattens out as there is little change, such as in the late 2000s.

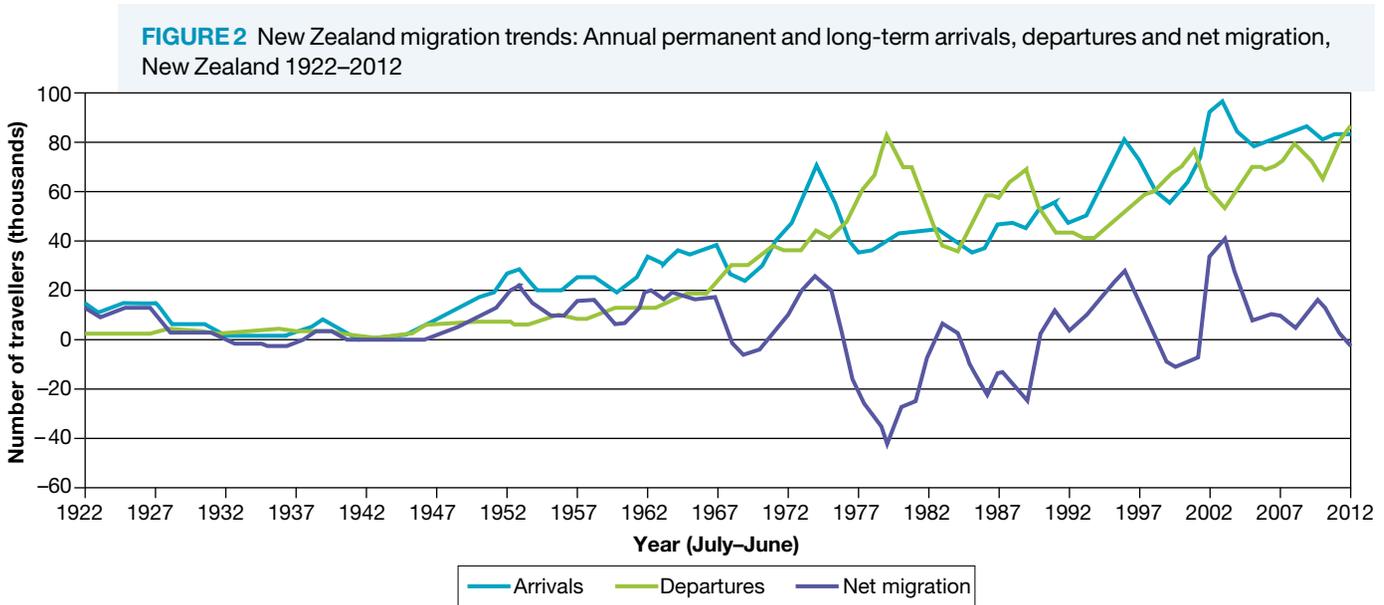
STEP 4

Write a few sentences to outline the shape of the graph; for example, 'figure 1 shows that Australian tourism has experienced fluctuating highs and lows for the past 50 years'. Include any events that affected the change into your description. For example, the text below figure 1 includes the explanation that the 1980s was 'a period of high percentage change in tourism (20–30 per cent), hit by a world recession and pilots' strike (negative growth)'. Also look for periods of time where the change was either slow (2010 in figure 1) or rapid (1989 in figure 1).

9.7.3 Let me do it

Developing my skills

Using the graph shown in figure 2, explain what is happening to the level of migration in New Zealand. Use the net migration line as the basis for your answer.



Questions

1. What is the trend for the line indicating the number of arrivals?
2. What is the trend for the line indicating the number of departures?
3. In which years did the population of New Zealand lose more people than it gained?
4. Identify a period of time when increases took time and a period when they happened quickly.
Identify a period of time when decreases took time and a period when they happened quickly.
5. If net migration is the difference between arrivals and departures, what is happening to people's migratory attitudes with regard to New Zealand?

Checklist

I have:

- identified and communicated key features such as patterns, peaks and troughs
- clearly represented and communicated the data about a specific place.

Skills questions

1. Divergence graphs are used to show that:
 - (a) a loss has occurred
 - (b) variation from the average is negative
 - (c) less of a product has been produced
 - (d) production is decreasing.
2. Divergence graphs include information about:
 - (a) total production
 - (b) production comparisons
 - (c) patterns over time
 - (d) increases in production.
3. What does the zero line indicate?
4. Why is it important to know some of the historical events behind the data for a *place*?

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 **Watch this eLesson:** Describing divergence graphs (eles-1739)

 **Try out this interactivity:** Describing divergence graphs (int-3357)

9.10 Are zoos and aquariums eco-friendly?

9.10.1 How have zoos developed?

A zoo is a place where animals are held in captivity and are put on display for people to view. The concept of zoos is not new; wall carvings provide evidence that ancient civilisations had zoos. Some of the earliest records date back to 2500 BCE when wealthy aristocrats and rulers in Egypt and Mesopotamia had their own private collections called menageries. They arranged expeditions to distant lands to bring back both terrestrial and marine creatures. They hired people to care for their collections and ensure that their animals not only thrived but also reproduced.

The first public zoo was built in 1793 in Paris, France. People not only wanted to be able to see exotic foreign animals but also study them for scientific purposes. However, these early zoos have been described as resembling a museum with living animals that were kept in small display areas rather than natural habitats (see figure 1).

In recent years zoos have undergone a major transformation in many parts of the world. People have become more aware of the plight of animals that are kept in captivity. The trend is towards giving animals more space and redeveloping enclosures to mimic their natural environment (see figure 2). Education programs are also integrated to provide information about the threats and challenges that exist in the wild. Conservation strategies are highlighted, including what individuals may do. Captive breeding programs are also part of a much wider conservation strategy.

Today the definition of a zoo can be extended to include wildlife reserves, petting zoos, aquariums and aviaries, where care is taken to reproduce natural environments including reproducing cold habitats for animals such as polar bears and heated enclosures with regulated humidity for species from tropical areas.

FIGURE 1 Melbourne Zoo, 1940



FIGURE 2 Melbourne Zoo, 2016



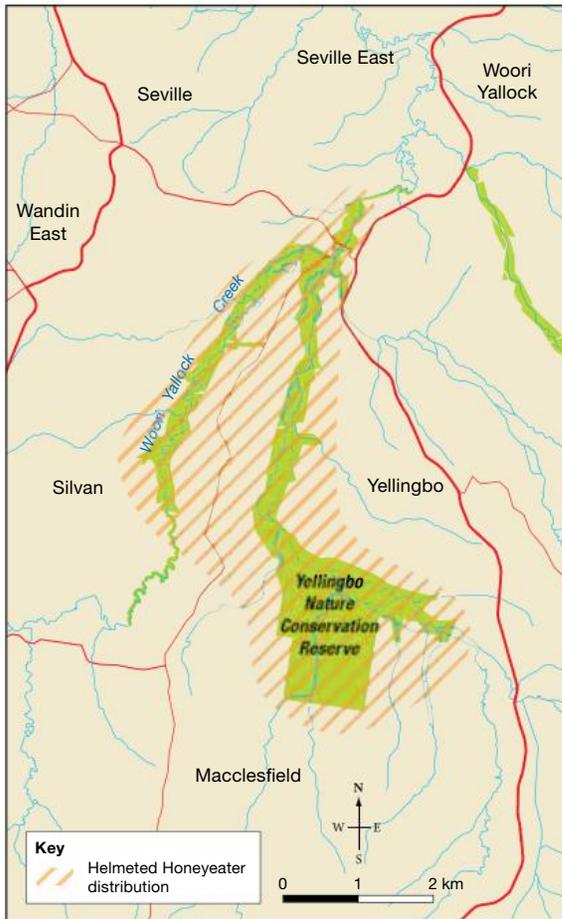
9.10.2 How are zoos eco-friendly?

The redevelopment of zoos and the focus on conservation rather than purely on human entertainment has meant that they are considered to have some environmental benefit. Although the IUCN (International Union for Conservation of Nature) Red List of endangered and threatened species continues to grow, zoos have been instrumental in ensuring that some species have been brought back from the brink of extinction.

Przewalski's horse

The rare and endangered wild horse called Przewalski's horse is a native of the Gobi Desert in Mongolia. In 1969 it was declared extinct in the wild, with the only remaining populations being held in the Munich and Prague zoos. At one stage the number of remaining animals was 15. A captive breeding program was devised to not only increase numbers but also ensure the genetic viability of the offspring produced. The program, which continues today, had astounding success.

FIGURE 3 Helmeted Honeyeater distribution map



Source: <http://www.zoo.org.au/healesville/animals/helmeted-honeyeater>
The State of Victoria, Department of Environment, Land, Water & Planning
2016

Today, there are about 1500 Przewalski's horses in captivity and 400 in the wild after they were successfully reintroduced into a protected reserve in Mongolia. Despite the harsh conditions of their natural environment and setbacks such as the brutally cold winter of 2009, which saw the wild population fall by half, they have continued to thrive.

Helmeted Honeyeater

Victoria's bird emblem the Helmeted Honeyeater is listed as critically endangered with numbers falling to as low as 50 in the wild. There are currently only three remnant populations in the Yellingbo Conservation Reserve, which consists largely of swamp forest to the east of Melbourne (see figure 3 for the location of the Helmeted Honeyeater). Healesville Wildlife Sanctuary has an extensive captive breeding program that has the intention of increasing the number of birds in the wild to ten interconnected and stable breeding colonies.

Due to the risk of fire, the sanctuary also has a complicated management plan that includes relocating its inhabitants to Melbourne in the event of fire sweeping through the area. The Helmeted Honeyeaters held at Healesville are the only viable populations that could be used to repopulate the Yellingbo Conservation Reserve if it were devastated by fire.

9.10.3 Are all zoos eco-friendly?

While zoos primarily promote themselves as acting in the best interests of the wildlife they keep, sometimes this is not necessarily the case (see figure 4).

FIGURE 4

The case of Marius the giraffe

Last weekend, a healthy juvenile male reticulated giraffe at the Copenhagen Zoo was killed. His name was Marius. The reason given was that his genes were already sufficiently represented in the giraffe population across the zoos of the European Association of Zoos and Aquariums (EZA) — his brother lives in a zoo in England, for example — making him a so-called 'surplus animal.' Despite the international outcry against it, the giraffe was euthanized, a necropsy was performed by scientists while educators explained the dissection to the gathered crowd, and hunks of meat were fed to the zoo's lions, polar bears, and other carnivores.

Source: Jason G Goldman

Thailand's Tiger Temple

Founded in 1994 and promoted as a wildlife sanctuary for tigers and other wildlife, Thailand's Tiger Temple has been under investigation for years, with conservationists questioning not only the treatment of the tigers but also the sanctuary's involvement in black-market trading.

It is estimated that Tiger Temple generates up to \$3 million each year. However, little of this is spent on improving conditions for the tigers. Allegations of abuse include that the tigers are beaten and poorly

fed, lack proper veterinary care, are housed in small cages, and are provided with limited opportunities for exercise or to exhibit natural behaviors — all in the name of tourism.

There are also reports that tigers are being taken illegally from the wild, and are not microchipped or have had microchips removed to cover up the illegal trade in live tigers or their skins, bones and other body parts.

In 2016, after lengthy undercover investigations, authorities finally removed tigers from the temple. Five were removed in January, and plans were underway to remove all the tigers. The main challenge was to find new homes for up to 140 tigers.

Marine parks

Marine Parks are similar to zoos except that they are home to marine creatures. They were a boom industry in the mid- to late-twentieth century, many offering not just the opportunity to view marine animals but also to watch them perform.

While most promoted the fact that they only housed animals born in captivity or rescued from the wild, this has not always been the case, with adult orcas, for example, sometimes killed so that their young could be taken into captivity. The *Free Willy* movies, which first screened in the 1990s, focused attention on the plight of whales in captivity. Orcas were often housed in pools that were inadequate in size and had collapsed dorsal fins indicating inadequate standards and perhaps even boredom. In addition, their lifespan is halved compared to their species in the wild.

Marine parks such as Sea World in San Diego, California, have been revamping their shows to improve the conditions of the animals and emphasise the natural environment as a result of falling visitor numbers. Tourists were boycotting the facility in a show of protest against the treatment of killer whales within the facility. Some marine parks are also promoting themselves as theme parks — for example, Sea World on the Gold Coast.

Chimelong Ocean Kingdom, China

Meanwhile, China's ocean theme parks are experiencing a tourist boom despite the fact that their living conditions are less than adequate. It is thought that across China 491 cetaceans are held, including about 279 bottlenose dolphins, 114 beluga whales and seven orcas, all taken directly from the wild at prices ranging from US\$125 000 to US\$40 000 each.

Chimelong is home to 18 beluga whales, 41 bottlenose dolphins and three polar bears in tanks and enclosures described as inadequate in terms of meeting their social and behavioural needs.

In the wild, beluga whales are social animals that live in pods that vary in size from a few individuals to a couple of hundred and they inhabit Arctic and sub-Arctic waters. They may travel up to 160 kilometres in a day and dive to depths of 300 metres. In captivity, they are confined to shallow tanks that only allow them to aimlessly circle their enclosure and are expected to perform tricks that are not a part of their natural behaviour.

FIGURE 5 Reports include drugging tigers to make them more docile for tourist photos.



FIGURE 6 Sea World in California is home to orcas



9.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is a zoo?
2. Prepare a mind map that explores the different types of zoos and the positive and negative impacts they have on wildlife.

Discover

3. Visit <http://www.zoo.org.au/>
 - (a) Investigate what is being done to manage waste or fight extinction.
 - (b) Investigate one of the species held at one of the zoos.
 - (c) Prepare an annotated visual display of your findings.

Think

4. (a) Select one of the species mentioned in this spread. Write a report that compares their natural habitat with being held in captivity.
(b) Do you think this is an example of **sustainable** ecotourism?
5. To what extent do you think zoos are an ethical form of tourism? Justify your point of view. In your response consider:
 - how culture, personal beliefs and world views can influence the decision-making of people in different **places**
 - how individual perceptions of fairness, equality, respect and tolerance influence their decision-making.

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Explore more with this weblink: Zoos Victoria

9.13 Review

9.13.1 Review

1. Use the information in table 1 to complete the activities that follow.

(a) On a blank outline map of the world (go to doc-11392 in the Resources tab), shade the regions listed in the table according to the number of tourists they attracted in 2011, using a different shade of one colour for each of the following categories:

- 0–30 million
- 30.1–60 million
- > 60 million.

(b) What percentage of the world's tourists came to Australia in 2011? What advantages and disadvantages might Australia have in attracting foreign visitors to its shores?

2. Think of a *place* in your state that you have visited and

that attracts tourists. Describe how this *place* has *changed* over the past 60 years to cater for tourists. Have these *changes* had a positive or a negative impact? Explain. Describe the *interconnection* between people and *places* and *change* over time.

3. If tourism does not significantly harm or *change* natural or cultural *environments*, does this mean it is *environmentally sustainable*? Explain.

4. Working in groups, use what you have learned in this topic to complete the following. You and three of your friends have won the ultimate holiday adventure. Your prize allows you to plan your own itinerary with the following conditions attached.

- You cannot travel more than 60 000 kilometres.
- You can travel in only one direction around the world and can only make ten stops on your journey.
- Stop 10 will be the airport from which you departed.
- If you include a cruise as part of your itinerary, each time you get off the ship in a new country, this is counted as a new destination.
- Your journey must be plotted on a map and presented as a slide show.
- You must include the following in your itinerary:
 - a country that attracts a lot of tourists
 - a country that attracts few tourists
 - one of the world's natural wonders
 - an ecotourism resort
 - a cultural event
 - a sporting event
 - a cold environment
 - a hot environment
 - a medical tourism destination.

TABLE 1 Tourist arrivals by region, 2011

| Region | Tourist arrivals (millions) |
|-----------------|-----------------------------|
| Africa | 50.2 |
| North America | 101.7 |
| Caribbean | 20.8 |
| Central America | 8.3 |
| South America | 25.8 |
| Asia | 205.4 |
| Pacific Islands | 6.1 |
| Australia | 5.9 |
| Europe | 504.0 |
| Middle East | 47.6 |

Source: © UNWTO

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 Complete this digital doc: Blackline master: world map (doc-11392)

FIGURE 1 Priority projects in the Great Ocean Road region



Source: Spatial Vision

Lake Condah/Budj Bim National Heritage Landscape

- Restoration of Lake Condah church site as a place of reconciliation and healing
- Development of an international learning centre at Lake Condah
- Development of employment and enterprise activities focused on tourism accommodation, aquaculture, bush tucker and supporting industries

Great Ocean Road integrated resort

- Large bistro/restaurant
- Self-contained accommodation
- Hotel accommodation
- Cabins
- Tourist park facility for vans

Port Campbell precinct and Loch Ard interpretive centre

- Loch Ard interpretive centre
- Improved interpretation, trails and other infrastructure at other locations (Bay of Islands)
- Apostle trail
- Food merchandising with views
- Merchandising

Great Ocean Walk

- New trails investment
- Improvements to existing trail network

Great Ocean Road signature accommodation

- 25 luxury suites
- Day spa
- Restaurant
- Guest lounge and bar

Great Ocean Road upgrade

- Increased safety improvements
- Improvements to areas where landslips occur
- General maintenance, pruning of trees and grooming of vegetation
- Shoulder sealing for cyclists
- Improvements to road reserves

Geelong Convention and Exhibition Centre

- Plenary capacity of 1000 delegates
- Exhibition hall of 3000 square metres
- Break-out rooms
- Multi-purpose format to accommodate small- to medium-size events
- Provision of a 4-star hotel of 150–200 rooms as part of the complex

Avalon Airport upgrade

- 7500 square metres of new international terminal proposed

9.13.2 Reflect

Is development necessary?

A proposal has been put forward to rezone about 1155 hectares of land across 20 sites, including some along the Great Ocean Road, in order to expand tourism accommodation and facilities. The plans include the development of 4- and 5-star resort-style accommodation in an environmentally sensitive region renowned for its breathtaking views. Those in favour of the development say that the region is the third most visited tourist site in the country but the lack of high-end accommodation and facilities means that the region does not benefit significantly in financial terms from its attractions.

5. Use the map to describe the *scale* of the proposed *changes* to the Great Ocean Road region.
6. Explain what is meant by the term resort-style accommodation.
7. Do you think these *changes* will have a positive or negative impact on the *environment* in these *places*?
8. Do you think this proposal is an example of *sustainable* tourism? Explain.
9. Write a letter to the editor expressing your views on these proposed *changes* and the consequences they might have for people and *places*.

Are tourism development and conservation compatible?

Development and conservation are complex issues and often have competing needs. Once, endangered species were threatened by poachers, but now it is the tourists and animals themselves that require careful monitoring. In Africa, for example, wildlife reserves often have luxury accommodation attached. They give tourists the opportunity to experience natural environments and go on safari, where they are encouraged to 'shoot' animals using cameras rather than guns. However, the presence of too many tourists places a strain on the natural resources of a region. Roads, vehicles and the people they bring damage grasslands and can interfere with the nomadic way of life and culture of local communities. While elephants are an important component of the grassland ecosystem, too many can turn the grasslands into a desert wasteland.

FIGURE 2 When elephant numbers exceed the carrying capacity of the land, they can cause considerable damage to the environment.



10. Why do you think balancing the needs of tourists and natural *environments* requires careful planning?
11. In groups, investigate Madikwe Game Reserve, Kruger National Park or another similar area in Africa that you are aware of.
 - (a) What is the *interconnection* between *sustainable* management, the *environment* and tourism development in the *place* you have investigated?
 - (b) Prepare a map of the area your group has investigated. Annotate your map with suggestions for *sustainable* strategies to cater for the needs of people and the *environment* in this *place*.

Is space tourism the final frontier?

Richard Branson, the founder of Virgin Airlines, is planning the lift-off of Virgin Galactic spacecraft in the near future. More than 500 people have paid large sums of money to book a seat on a suborbital space flight. The three-hour flight will take passengers into space, but its descent trajectory means that the spacecraft will re-enter the Earth's atmosphere before completing one full orbital revolution. Dennis Tito demonstrated the viability of this potential new market in 2001 (see figure 3).

12. What places might be included on a space tourist's itinerary?
13. What jobs might space tourism create? Complete a diagram like the one in figure 3 in section 9.8.1 to show the multiplier effect of space tourism.
14. If space tourism becomes popular, what impact do you think it might have on people and *places*, both in space and on Earth?
15. What controls should be put in place to ensure that this form of tourism is *sustainable* and does not have an adverse effect on *environments* in different *places*?
16. If you were to design an ecotourist resort on a tropical island:
 - (a) Which *environmental* responsibilities would you need to take into consideration?
 - (b) How could you minimise the *environmental* consequences of your planning decisions?
17. Chinese New Year is one of the most important events in Chinese culture.
 - (a) Suggest some examples of the impact of the large-*scale* movement of people within China.
 - (b) In the future, how might the Chinese Government manage this event to cope with such a large-*scale* movement?

FIGURE 3 Dennis Tito paid US\$20 million to board a Russian spacecraft bound for the International Space Station. In April 2001, he became the world's first official space tourist.



TOPIC 10

Buy, swap, sell and give

10.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

10.1.1 Introduction

Trade, in the form of buying, swapping, selling and giving goods and services, is a driving force that interconnects people and places all over the world. Trade has gone on ever since human societies existed. In contrast, international aid is a modern phenomenon, although countries have always had internal programs to help those in need. Trade and aid can bring people together to share the Earth's resources, but there can be problems when those resources are limited and, potentially, negative consequences for the environment. The big question is how to organise trade and aid so that it fosters social justice and is fair and sustainable.

Container terminals, Hong Kong, China



Starter questions

1. What goods and services do you need to support your lifestyle? Think about your everyday life at home, at school, and in sport, recreation and hobbies.
2. Where do you access your goods and services? To what extent do you obtain goods and services online?
3. From what you know, do you think all trade that occurs in the world today is fair? How can fair trade and aid make the world a better *place* for all?

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10.2 How does trade connect us?

10.2.1 Trade in goods and services

The Earth's resources are not distributed evenly over space. For instance, some places may have an abundance of iron ore and others may have none. To solve this problem, nations have developed trade, allowing producers and consumers to exchange goods and services.

The system of trade has been around for a long time. Its earliest form was bartering at local markets or fairs. Merchants also used land and sea routes to access markets in foreign lands, where they exchanged goods for payment. More recently, air transport has become a means of trade, and the internet has made it possible to instantly exchange information. Today, we have a highly sophisticated, large-scale, global system of trade.

A modern example of the interconnection of trade is the production of the Airbus A380. To construct this plane, component parts must be purchased from different countries and transported over land and sea to reach their final assembly place in Toulouse, France (see figure 1).

Goods and services, of which there are many, are generated by either processing Earth's resources or people doing things for each other.

FIGURE 1 The component parts routes of the Airbus A380



Source: Data from Wikimedia Commons.

A good can be an item as simple as a loaf of bread or it can be as complex as a motor car.

A service is not something you can hold in your hand; examples of services are education in a school or the advice a doctor gives a patient. What types of goods and services do you use to support your lifestyle?

As seen in figure 2, the processing of a resource into more complex goods can be a series of transitions, in which there is **value adding** at each level of industry (that is, its value increases). An important consideration in the production of goods and services is the impact on the environment.

10.2.2 How are goods and services consumed?

Household final consumption per person

Household final consumption per person is the value or money spent on all goods and services such as food, cars, washing machines, electricity, water and gas, education, medical service expenses and entertainment. The total figure of all goods and services when calculated for a country for a year is then divided by the total population of the country to give a figure in dollars and this is then referred to as the household final consumption per person.

The highest consumers of goods and services on a per-person basis are wealthy, industrialised countries such as the United Arab Emirates, the United States and Hong Kong (see figure 3). However, countries such as China and India consume high levels of goods and services because they have very large populations. As would be expected, countries that are high-level consumers can have significant impacts on the environment, particularly in terms of energy use and waste production.

What about the poorest countries in the world?

At the lower end of the scale of household final consumption per person, people in countries such as Malawi and Burundi spend \$507 and \$468 respectively per year, or less than \$1.40 per day per person. This expenditure is mainly for food (see figure 4).

FIGURE 2 Four levels of industry

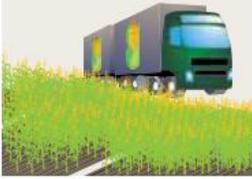
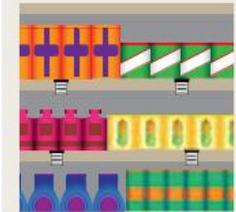
| | |
|--|---|
| <p>Primary industry Takes natural resources from the Earth or grows them Example: a farmer grows corn that is then transported to a canning factory.</p>  | <p>Secondary industry Makes products from natural resources Example: a factory makes tins of corn and sells them to supermarkets.</p>  |
| <p>Tertiary industry Sells products or services Example: a supermarket sells tins of corn and other products to consumers.</p>  | <p>Quaternary industry Sells knowledge and information Example: a marketing analyst works out how best to position products, and sells this information to supermarkets.</p>  |

FIGURE 3 Top 13 countries for household final consumption, per person. Australia is ranked twelfth in this list for the years 2013–2014

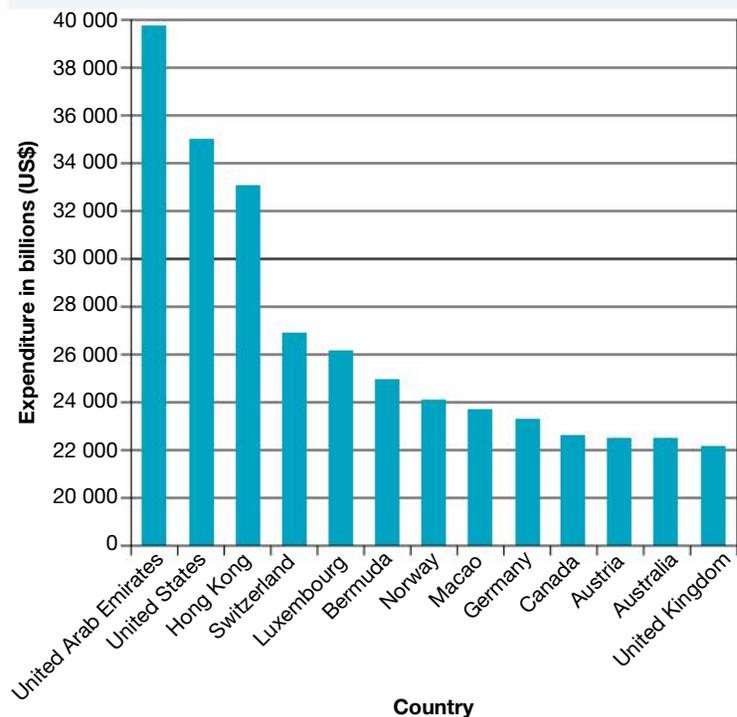
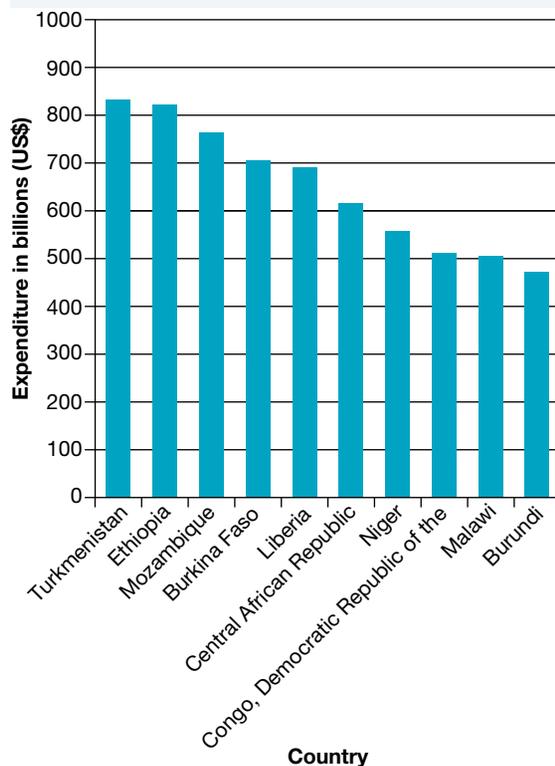


FIGURE 4 Household final consumption expenditure per person for the 10 lowest ranked countries in the world for 2013–2014



10.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What reasons can you suggest as to why goods and services are traded?
2. Name the four levels of industry, and give an example of a good as it moves through the production process.

Explain

3. What reasons can you suggest for component parts of the Airbus A380 having to come from different **places** (countries)?
4. Explain what is meant by the term *value adding*, as a product moves through the four levels of industry. Choose a product such as wheat or timber.

Discover

5. Suggest why the United States is one of the largest consumers of goods and services in the world.
6. Use the **CIA** weblink in the Resources tab to select a country to compare with Australia. Look up figures for population and trade and see if you can explain why the figures for the country you have chosen differ from the figures for Australia, based on the wider range of data presented for each country.

Predict

7. It has been claimed that countries such as China and India, with growing middle classes that are now eager for goods and services, will put a strain on world resources. How might a growing demand for energy sources in these countries affect the **environment**?
8. How might a **change**, such as growth in Australia's population from 23 million to 40 million, affect Australia's trade?

Think

9. Why is Hong Kong, which is a Self Administered Region (SAR) of China, ranked third in household final consumption per person, while the wider country of China is ranked one-hundred-and-twelfth?
10. What reasons can you give for people being able to survive on \$468 per person in countries such as Burundi?

Try out this interactivity: Up, up and away! (int-3339)

Explore more with this weblink: CIA

10.3 How does trade connect Australia with the world?

10.3.1 Australia's trade organisation

Australia is one of the 162 members of the World Trade Organization (WTO), which covers 95 per cent of global trade. The organisation promotes free and fair trade between countries and, since 2001, its Doha Development Agenda has aimed to help the world's poor by slashing **trade barriers** such as tariffs, quotas and farm subsidies.

FIGURE 1 People involved with trade



The Australian Department of Foreign Affairs and Trade (DFAT) coordinates trade agreements on behalf of the Australian Government, and the Australian Trade Commission (Austrade) promotes the export of goods and services. About 73 per cent of Australia’s trade is with the member countries of the Asia–Pacific Economic Cooperation (APEC) forum.

10.3.2 Australia’s trading partners

China, Japan, the Republic of Korea and the United States were Australia’s top four **trading partners** in 2014. Figure 2 and table 1 show details of Australia’s import and export trade for the years 2013 and 2014.

FIGURE 2 Australia's top five import and export partners, 2013 (A\$ million)

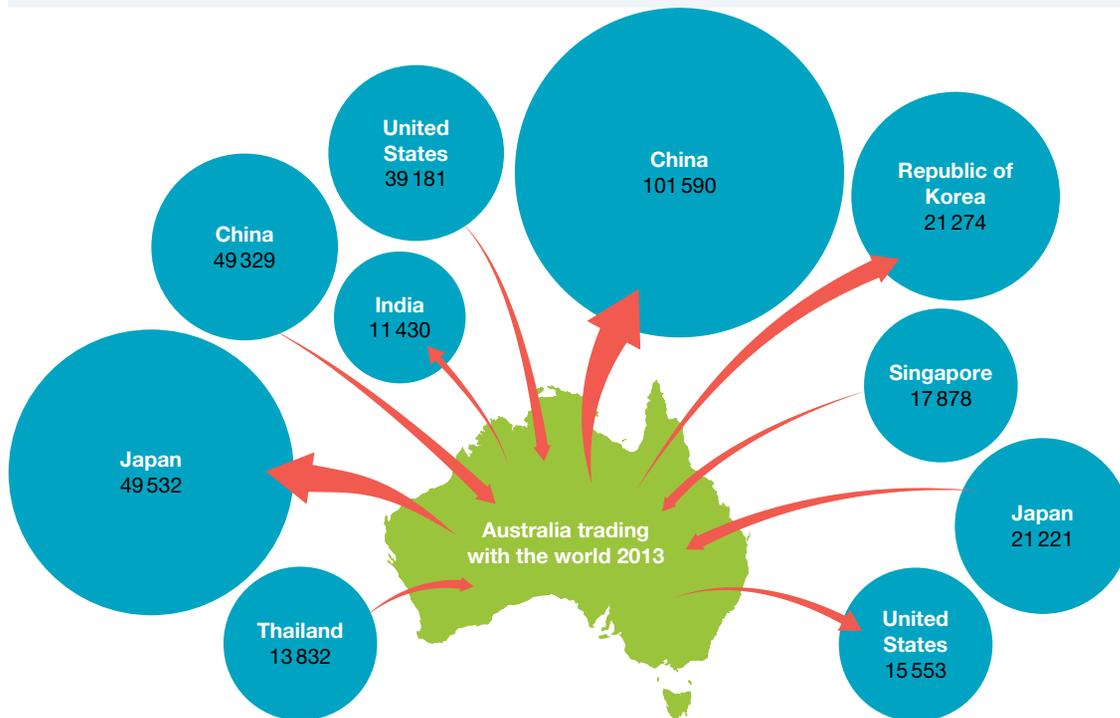


TABLE 1 Australia's top 10 two-way trading partners, 2014 (A\$ million)

| Rank | | Goods | Services | Total | % share |
|------|----------------------------|----------------|----------------|----------------|---------|
| | Total two-way trade | 533 264 | 130 555 | 663 819 | |
| 1 | China | 142 078 | 10 390 | 152 468 | 23.0 |
| 2 | Japan | 65 431 | 4 787 | 70 218 | 10.6 |
| 3 | United States | 40 635 | 19 807 | 60 442 | 9.1 |
| 4 | Republic of Korea | 32 424 | 2 202 | 34 626 | 5.2 |
| 5 | Singapore | 21 128 | 9 059 | 30 187 | 4.5 |
| 6 | New Zealand | 16 083 | 7 384 | 23 467 | 3.5 |
| 7 | United Kingdom | 9 920 | 10 868 | 20 788 | 3.1 |
| 8 | Malaysia | 17 394 | 3 188 | 20 582 | 3.1 |
| 9 | Thailand | 16 106 | 2 872 | 18 978 | 2.9 |
| 10 | Germany | 13 725 | 3 000 | 16 725 | 2.5 |

10.3.3 Australia's types of trade

Exports

Australia's export trade in 2014 was valued at \$327 billion, and was dominated by the mineral products of iron ore, coal and natural gas. Recreational and educational travel were Australia's leading services exports. See figure 3 for details of leading exports.

International students

A more recent high-level earner for Australia (now ranked as our number four export after iron ore, coal and natural gas), is the category of 'education-related travel services', which for 2015 was valued at \$18.2 billion.

With more than 450 000 international students from 191 countries studying in Australia (see figure 4), education is now very important for our economy. In effect, it is a service export in that students are paying for knowledge that they will take back to their home country.

FIGURE 3 Australia's exports of goods and services for 2014 — share of exports by sector

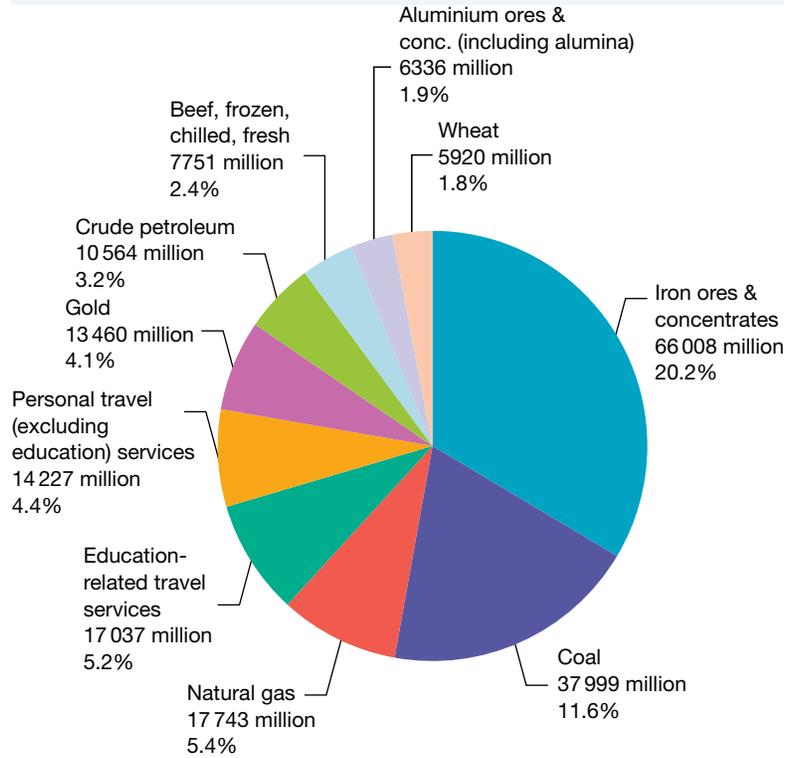


FIGURE 4 International students studying in Australia, 2014

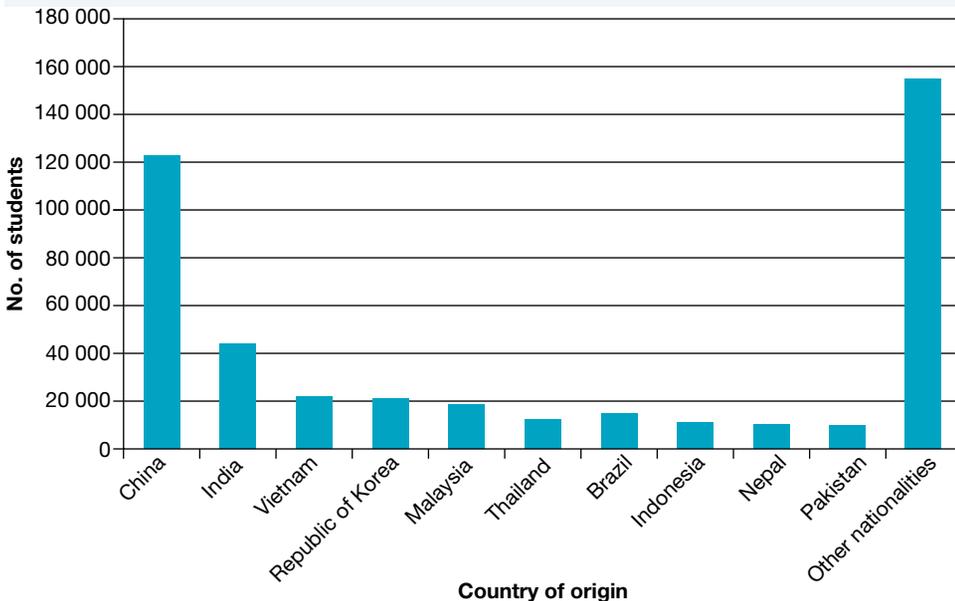


FIGURE 5 Education is now a major export for Australia, with the number of international students studying here increasing in recent years.



Imports

Like many countries, Australia is not self-sufficient in all goods and services. In 2014 Australia imported goods and services to a value of close to \$337 billion. Figure 6 shows the main aspects of this trade.

FIGURE 6 Australia's leading imports for goods and services, 2014 (A\$ million)

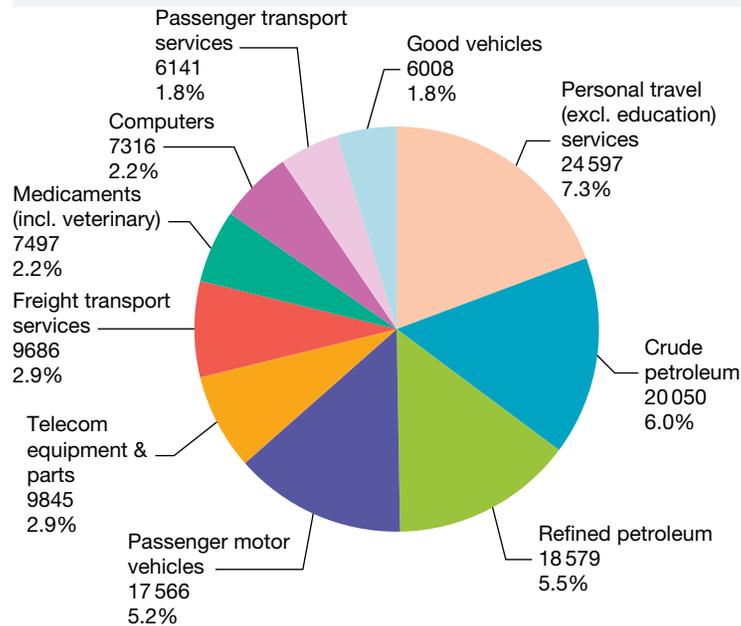


FIGURE 7 Oil and petroleum products make up a significant part of Australia's import trade.



10.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is the **interconnection** between the World Trade Organization and Australia's trade?
2. What are Australia's three most important exports and imports?

Explain

3. Refer to figure 2 and table 1. Compare Australia's imports and exports with those of Asian countries. What changes have occurred in the imports and exports between countries from 2013 to 2014. Use data to support your answer.

4. Despite having a relatively small population, Australia has many goods and services to trade. Explain why this might be so.

Predict

5. How might a **change** in the growth of Australia's population affect the country's agricultural exports?
6. Look at the list of goods that Australia imports (see figure 6). What factors could lead to a **change** in the types of goods imported by the year 2050?

Think

7. (a) What evidence is there in this section to confirm the fact that Australia is regarded as mostly a **primary industry** exporter?
(b) Are there any figures of export trade that contradict this statement?
(c) Why has Australia become such an important exporter of education services?

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 Try out this interactivity: Trading partners (int-3338)



Deepen your understanding of this topic with related case studies and questions.
▶ Aid, migration and trade



10.4 How is food traded around the world?

10.4.1 Trade in food

The world's population is unevenly distributed across space, as is the quantity of food produced. Some places, such as Australia, produce an abundance of food, while others struggle to produce enough to maintain food security.

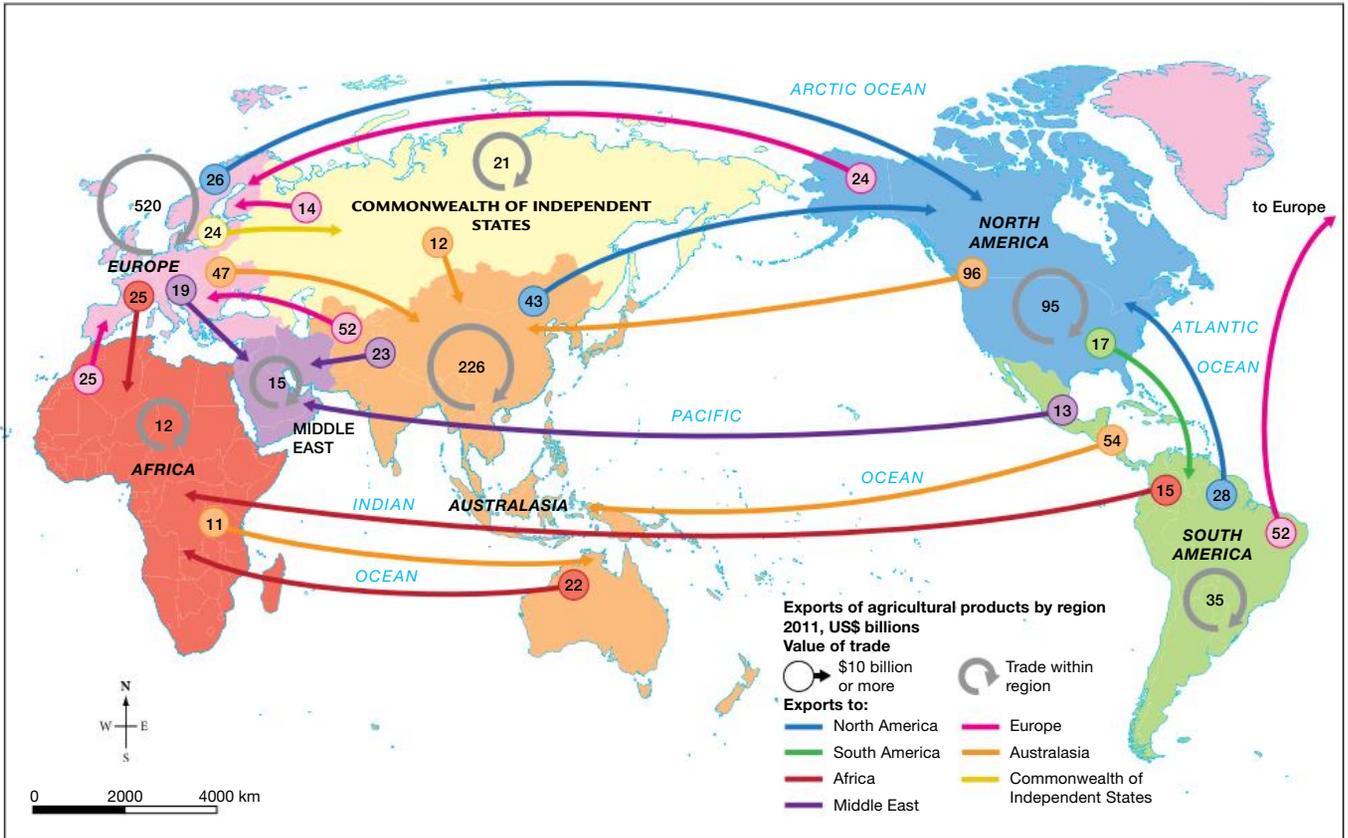
Traditionally, food production consisted of hunting and gathering or cropping and herding. Excess food was consumed locally or sent to nearby markets for **barter** or cash. While up to 41 per cent of the world's population is still directly tied to subsistence agriculture, many of the world's highly developed economies produce large surpluses of food specifically for international trade. For instance, Australia's food production is estimated to be worth \$100 billion annually, and of that, \$44.3 billion-worth is exported.

The flow of food trade

Much of the flow of food trade is controlled by powerful nations, such as the United States, the European Union and China, and by international food trade agreements. The World Trade Organization (WTO) and G20 (a group of 20 developed and powerful nations) have a significant say in the flow of food products around the world, particularly with respect to tariffs and fair trade rules.

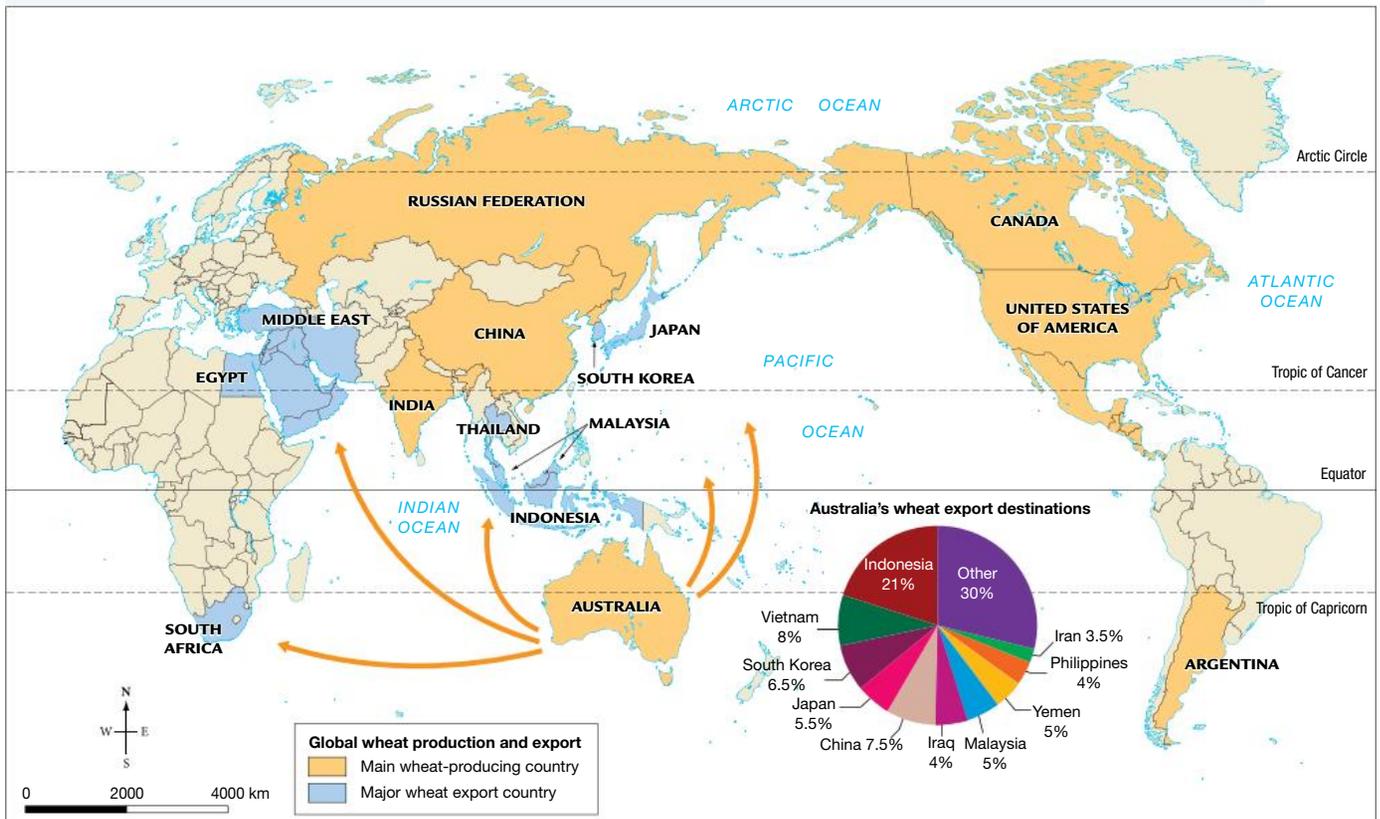
Food trade is a complicated business, as can be seen in figure 1. It is estimated that for **developing countries**, three-quarters of exports are agricultural produce. While developed countries may need to import tropical foods, many actually export as much as they import in agricultural produce. For instance, the United States, Canada and Australia use large farms to produce wheat, and they control 75 per cent of the global export trade in cereals. In 2015, Australia produced 23 million tonnes of wheat, the majority of which was for sale in overseas markets (see figure 2). Australia's top 10 agricultural markets can be seen in figure 3.

FIGURE 1 World trade flows — exports of agricultural products by region, US\$ billion



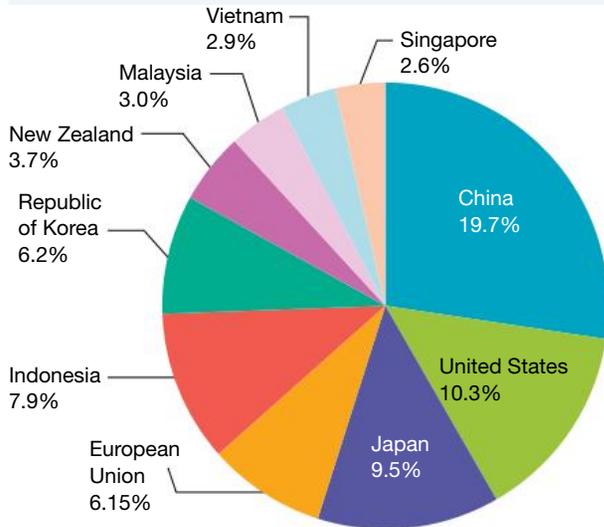
Source: Data from World Trade Organization

FIGURE 2 Top export countries for Australian wheat



Source: Vicstock Grain

FIGURE 3 Australia's agricultural exports to various countries, 2014



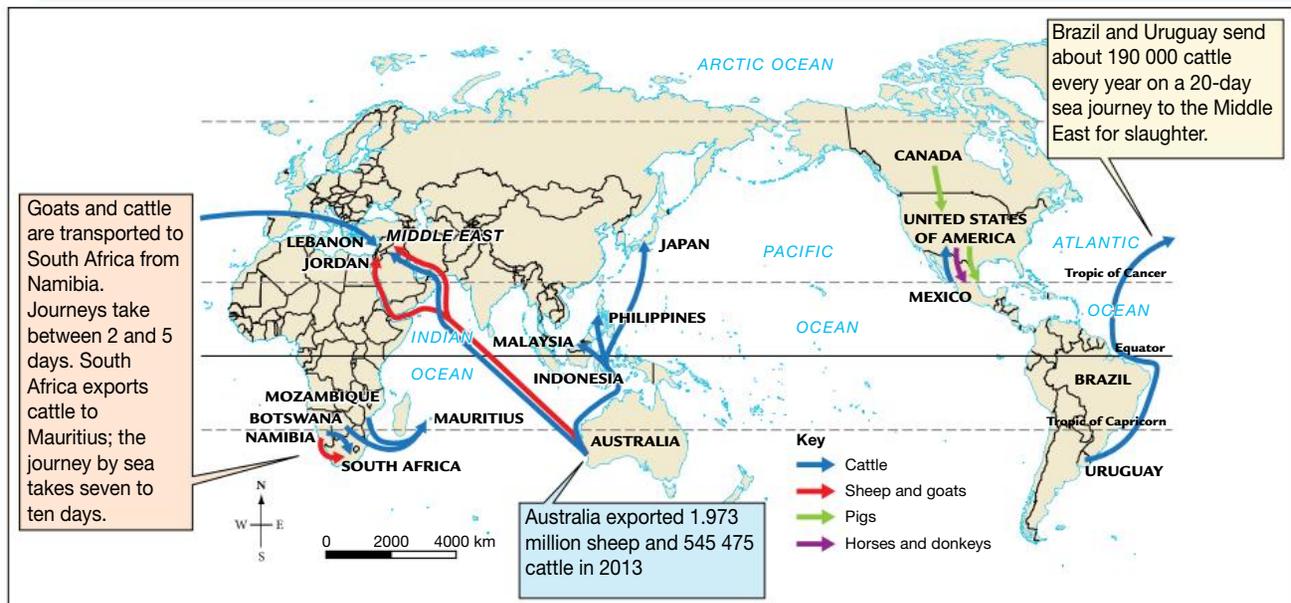
10.4.2 Trade in animals

World trade in animals as food is estimated at close to 50 million animals per year — pigs, cattle, goats and sheep. Using modern shipping methods, many animals are transported over long distances, and questions have been asked about potential cruelty in the operation of this trade (see figure 4).

Australia's exports of live sheep and cattle to Asia and the Middle East in 2014 amounted to 3.7 per cent of Australia's total exports. The value of the live animal export trade to Australia is estimated at \$1.6 billion or 3.7 per cent of all agricultural produce per year. The industry employs up to 10 000 rural workers at abattoirs, ports and in the transport industry. While there may be concerns about this industry, it should be remembered that countries request live animal exports so that they can be slaughtered according to **halal** religious customs.

Due to the extensive nature of farming cattle and sheep in Australia, these animals must often travel very large distances to reach ports. They then travel by ship to distant markets. The Australian Government has set high standards in the handling of live animals and is monitoring carefully how they are treated at destination ports.

FIGURE 4 Live animal transport around the world



Source: Spatial Vision

10.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What is the value of Australia's agricultural exports?
2. What is the percentage of world trade in animals that Australia controls?
3. Refer to figure 1.
 - (a) What is the value of food trade from Australasia to Europe?
 - (b) What is the value of food trade from Europe to Australasia?
 - (c) Is there a balance in this food trade based on your calculations in (a) and (b)?
 - (d) Place the regions of the world in decreasing order by volume of food trade.

Explain

4. Refer to figure 2.
 - (a) Explain why Australia can export such a large quantity of wheat to the world.
 - (b) What reasons can you suggest as to why a country such as Russia might not export wheat to Indonesia and Malaysia?

Discover

5. Why do countries in **places** such as the Middle East and Asia have a preference for live animal imports?
6. Use the **Trade** weblink in the Resources tab to help you prepare a 200-word statement about the types of agricultural produce Australia exports and the nations to which we export. Also state which agricultural produce Australia imports.
7.
 - (a) Investigate the issue of live animal exports from Australia.
 - (b) How might a ban on live animal exports from Australia affect farmers?

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Explore more with this weblink: Trade

10.5 SkillBuilder: Constructing multiple line and cumulative line graphs

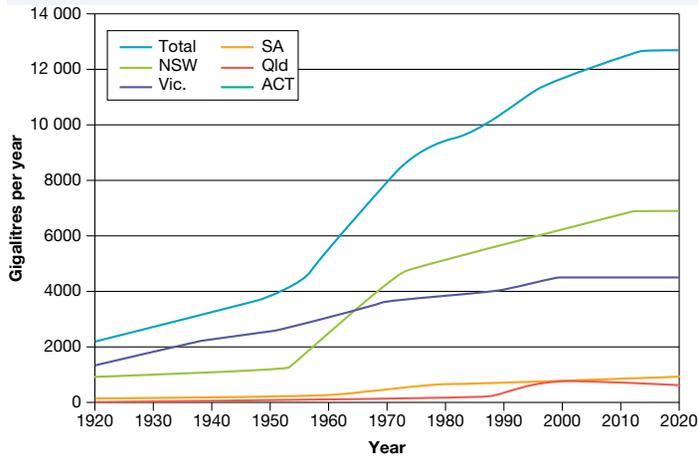
WHAT ARE MULTIPLE LINE GRAPHS AND CUMULATIVE LINE GRAPHS?

Multiple line graphs consist of a number of separate lines drawn on a single graph. Cumulative line graphs are more complex to read, because each set of data is added to the previous line graph.

Go online to access:

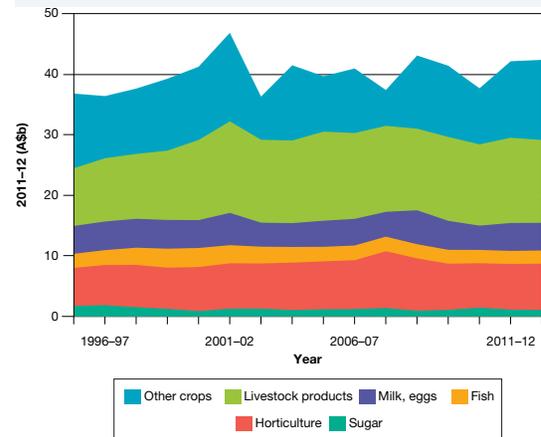
- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Water use by five states: a multiple line graph



Source: Food and Agriculture Organization of the United Nations, 2012 FAOSTAT, <http://faostat3.fao.org/home/index.html>

FIGURE 2 Value of farms and fisheries food production: a cumulative line graph



Source: © DAFF 2013, *Australian Food Statistics 2011-12*. Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

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 **Watch this eLesson:** Constructing multiple line and cumulative line graphs (eles-1740)

 **Try out this interactivity:** Constructing multiple line and cumulative line graphs (int-3358)

10.6 How has the international automotive trade changed?

10.6.1 The car trade

Trade is one of the strongest interconnections between people and places on the planet, as goods are transported all over the world. Worldwide earnings from car exports make up 5.3 per cent of earnings from all international exports. Two countries with the largest share of the car export market are Japan in north-east Asia and Germany in Europe. Together, they have 61 per cent of the world's net profits on international car exports. Other countries with significant car exports include China and South Korea in Asia.

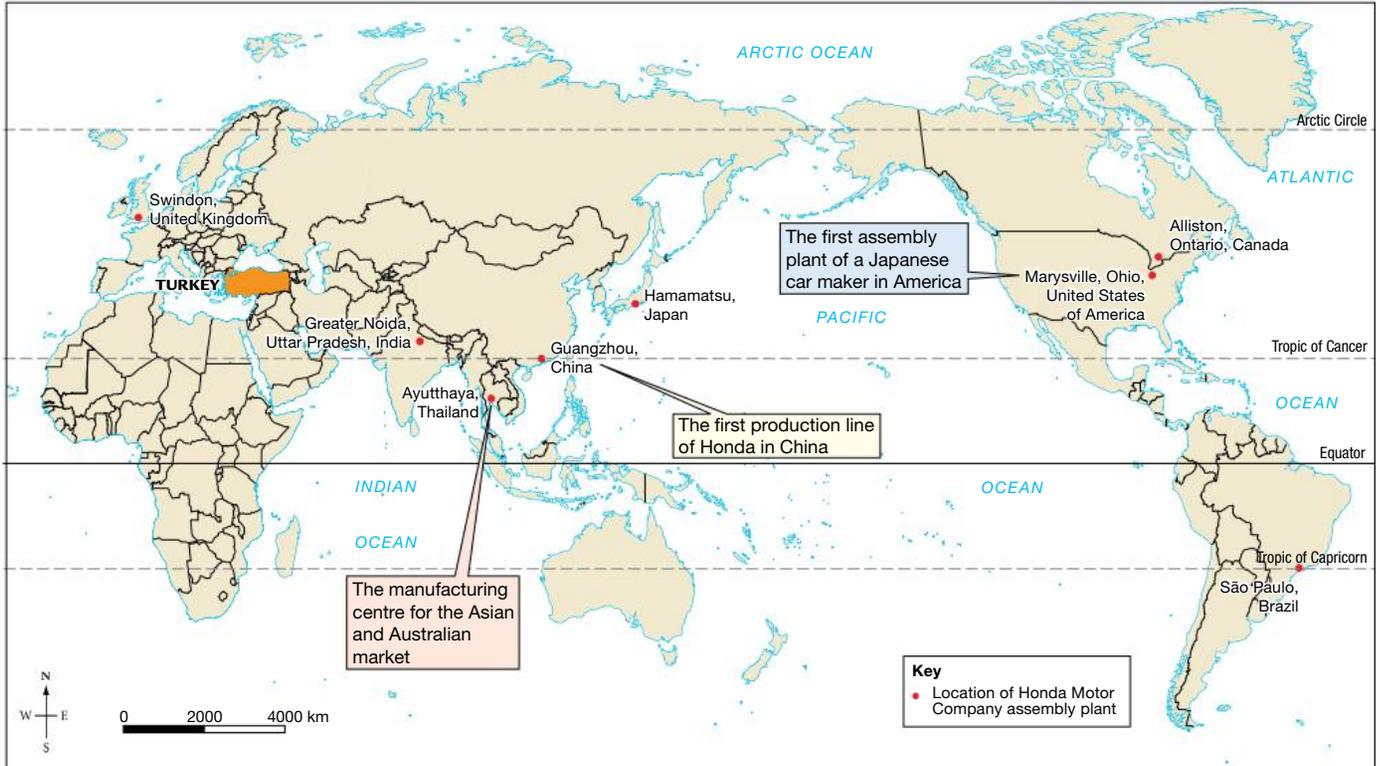
10.6.2 The rise of the Asian car industry

The Honda Motor Company is a Japanese multinational corporation. It is:

- the world's largest motorcycle manufacturer
- the world's largest manufacturer of internal combustion engines (by volume)
- the second-largest Japanese car manufacturer
- the fourth largest car manufacturer in the United States
- the seventh largest car manufacturer in the world behind Toyota, General Motors, Volkswagen, Hyundai, Ford and Nissan.

The company has assembly plants around the globe (see figure 1). Honda develops vehicles to cater to different needs and markets, so its vehicles vary by country and may feature vehicles exclusive to a region.

FIGURE 1 The Honda Motor Company operates plants worldwide for the manufacture of its products.



Source: Spatial Vision

10.6.3 The decline of the American car industry

Detroit is the largest city in the state of Michigan, in the United States, and was long known as the world's automotive centre. Detroit and the surrounding region constitute a major centre of commerce and global trade, most notably as home to America's 'Big Three' automotive companies: General Motors, Ford and Chrysler.

These three car manufacturers were, for a while, the largest in the world, and two of them are still in the top five. Ford had held the position of second-ranked car maker for 56 years, but was relegated to third in North American sales after being overtaken by Toyota in 2007. That year, Toyota also produced more vehicles than General Motors. In the North American market, the Detroit car makers retain the top three spots, though their market share is dwindling, and Honda passed Chrysler for the fourth spot in the United States in 2008.

The United States car industry is suffering from increased overseas competition and from the 2008–2012 global recession. Car dealerships across the United States are struggling, and many are closing. The Big Three manufacturers have suffered from perceived inferior quality compared to their Japanese counterparts. They have also been slow to bring new vehicles to the market, whereas the Japanese are considered leaders in producing smaller, more fuel-efficient cars.

Falling sales and market share have resulted in the Big Three's plants operating below capacity. General Motors' plants were at 85 per cent capacity in November 2005 — well below the plants of its Asian competitors. This led to production cuts, plant closures and layoffs. Between 2000 and 2010, Detroit's population fell by 25 per cent. It had been the nation's tenth largest city but is now its eighteenth largest, with a population of 713 777. In April 2012, General Motors and Ford continued to lose market share, with yearly sales down 8.2 per cent and 5.3 per cent respectively.

FIGURE 2 A Honda S2000



As a consequence, a rise in automated manufacturing using **robotic technology** has created related industries in Detroit. Inexpensive labour in other parts of the world and increased competition have led to a steady change in certain types of manufacturing jobs in the region. For example, the Detroit area has gained new **lithium ion battery** plants. As well, the Detroit car makers and local manufacturers have restructured in response to competition. General Motors has invested heavily in fuel-cell-equipped vehicles, while Chrysler has researched and developed **biodiesel**.

FIGURE 3 Car industry redistribution in the United States



Source: Spatial Vision

10.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. Honda cars are manufactured in many **places** around the world. Where is Honda's manufacturing centre for the Australian market?

Explain

2. Explain the advantages of the Big Three US car manufacturers being located in the same **place**.
3. Why has the Japanese automotive industry become a world leader in international exports?
4. What **changes** have Detroit's industries made in response to the decline of the car industry?
5. Look at figure 3. Describe the location of foreign and domestic automotive plants.

Discover

6. Research the effects of the decline of the US car industry on Detroit and surrounding towns and businesses.
7. New Zealand used to have a Honda assembly plant. Find out when it opened, when it closed and the reason for its closure.

10.7 Are global players altering the industrial landscape?

10.7.1 Changing trends

Until recently, designer clothing came from Italy, and jeans came from the United States. Today, that Italian suit might be designed in Milan, but it is woven from New Zealand wool and stitched together in China. **Globalisation** has brought global marketing, encouraging consumers everywhere to buy goods without a thought to where they come from.

The clothing industry has faced several tough years. Until late 2008, Australians flocked to shopping centres around the country and spent freely on clothing. However, since the global recession, or global financial crisis, consumer spending behaviour has changed, and clothing retailers have suffered. Retailers have also been affected by the increase in online shopping, which has grown in popularity over the years, mainly because people find it convenient and easy to bargain shop from the comfort of their home or office. Online shopping has revolutionised the business world by making everything anyone could want available by the simple click of a mouse button.

The Australian clothing manufacturing industry has produced some very recognisable brand names and distinctive products. One challenge facing this industry is international competition, especially from developing countries that can afford to mass-produce clothing more cheaply than Australian companies can. Australian clothing manufacturers tend to focus on high-end, high-quality products rather than attempting to compete with lower cost producers.

Many multinational firms have **'offshored'** their production to China, owing to its low labour costs, stable political system, aggressive export promotion policies and exchange rate. There are no labour unions, and incentives offered by the government include tax breaks, low import duties, low-cost land and low construction costs for new factories.

Horror unfolding as Holden production goes off-shore

After months of speculation and days of denials, General Motors Holden has finally announced the decision its Australian workforce has feared. The company will stop production of its iconic Australian car brand from 2017.

It means the loss of nearly 3000 jobs in Victoria and South Australia and may spell the beginning of the end for the automotive industry in this country.

The company blames a high dollar, the rising costs of production and a small domestic market.

Holden follows Ford and Mitsubishi in exiting Australia and it signals the demise of a cultural icon.

Holden started making cars in Australia in 1917. Mass production started in 1948. The last car will roll off the production line in 2017, making it a century of car making.

Source: ABC Online 11 December 2013

FIGURE 1 This symbol signifies that a product has been manufactured in Australia by an Australian-owned company.



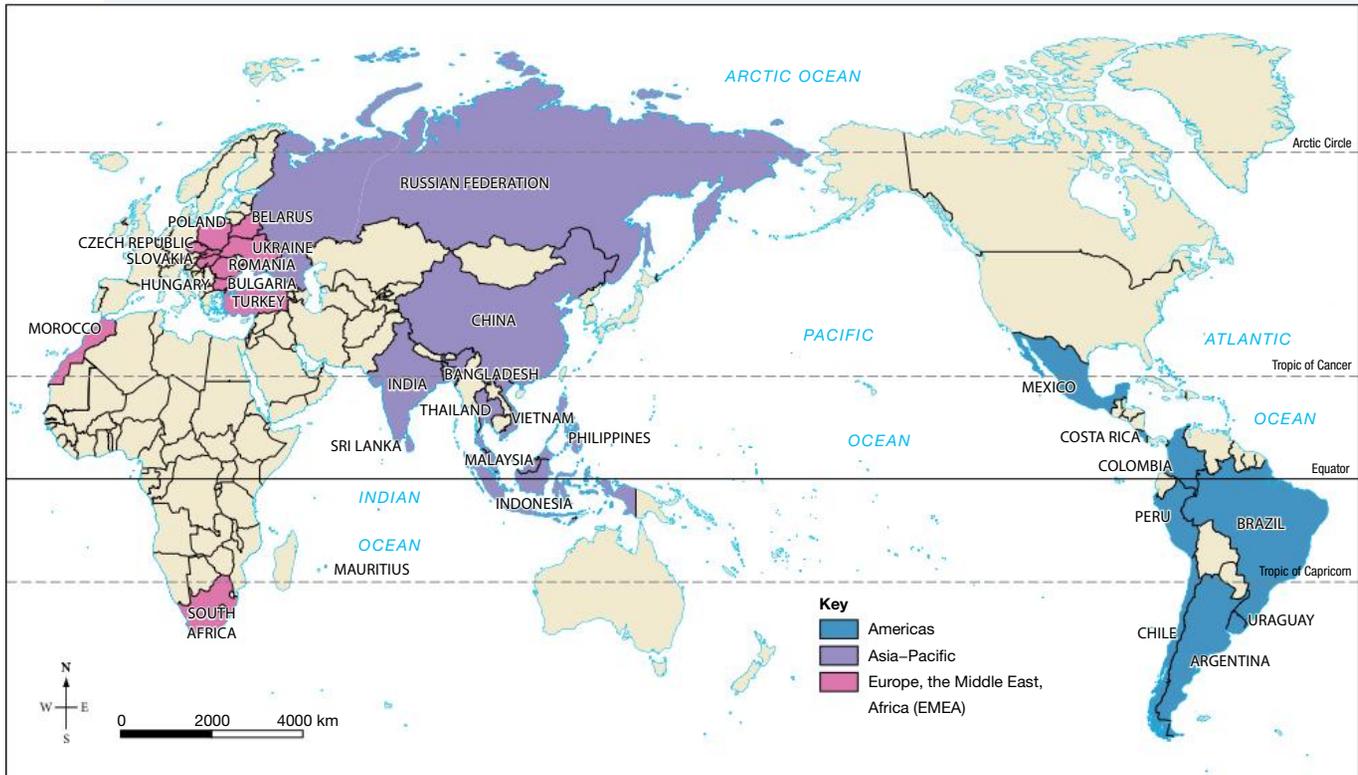
FIGURE 2 Ikea's store in Beijing had more than six million visitors in 2011.



10.7.2 Foreign companies in China

In 1979, there were 100 foreign-owned enterprises in China. In 1998, there were 280 000, and by 2012 there were 436 800. Since 2007, foreign companies have employed 25 million people in China. Foreign companies that operate in China include Coca-Cola, Pepsi, Nike, Citibank, General Motors, Philips, Ikea, Microsoft and Samsung.

FIGURE 3 Top 30 locations for offshore companies in 2010, by region



Source: Spatial Vision

10.7.3 Are your clothes made in sweatshops?

If you buy the brands Puma, Nike, Adidas, Mizuno, New Balance, Bonds or Just Jeans, then you may be wearing clothing or footwear that was made in a sweatshop.

A sweatshop is any working environment in which the workers experience long hours, low wages and poor working conditions. Typically, they are workshops that manufacture goods such as clothing. Sweatshops are common in developing countries, where labour laws are less strict or are not enforced at all. Workers have to use dangerous machinery in cramped conditions and can even be exposed to toxic substances. Child labour may be used.

Despite the fact that sweatshop workers receive wages, many of them continue to live in poverty. Most are young women aged 17 to 24.

FIGURE 4 A Bangladesh sweatshop



10.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Why have many countries moved their production to offshore **places**?
2. What are sweatshops?

Predict

3. What **change** do you think online shopping will make to the Australian retail industry?
4. What do you think would happen to the price of clothing if sweatshops were to close down?

Think

5. Look at figure 3. Give reasons why most offshore manufacturing companies are located in the Asia-Pacific region.
6. What impact does moving production offshore have on the Australian economy and its people?
7. If clothing carries the Ethical Clothing Australia (ECA) label, it means the garment was manufactured in Australia and the manufacturer has ensured that all people involved in its production received the legally stated wage rates and conditions — known in Australia as award wages and conditions. Find out which Australian-made garments you can purchase to support fair working conditions.
8. How might internet shopping affect **places** such as shopping centres?
9. Are sweatshops ethical or **sustainable**? Explain your answer.

10.8 Why is fair trade important?

10.8.1 Social justice and problems of trade

The benefits of international trade are not evenly distributed around the world, and trade often favours large, developed countries rather than small developing countries. It is the role of governments, organisations and agencies to regulate this trade so that economic benefits are more evenly distributed.

Australians benefit economically, culturally and politically from international trade, but **social justice** problems can arise from this trade. For example, when we import blood diamonds from Africa or carpets made by child labour from Nepal, we are supporting unethical industries.

In addition, some countries can make it difficult for other countries to compete fairly, on a 'level playing field'. They do this by:

- imposing tariffs — taxes on imports
- imposing quotas — limits on the quantity of a good that can be imported
- providing subsidies — cash or tax benefits for local farmers or manufacturers.

10.8.2 Fair trade

The fair trade movement aims to improve the lives of small producers in developing nations by paying a fair price to artisans (craftspeople) and farmers who export goods such as handicrafts, coffee, cocoa, sugar, tea, bananas, cotton, wine and fruit. The movement operates through various national and international organisations such as the World Fair Trade Organization and Fairtrade International (see figure 2).

FIGURE 1 Fair trade organisations promote fair labour practices such as preventing and eliminating child labour.

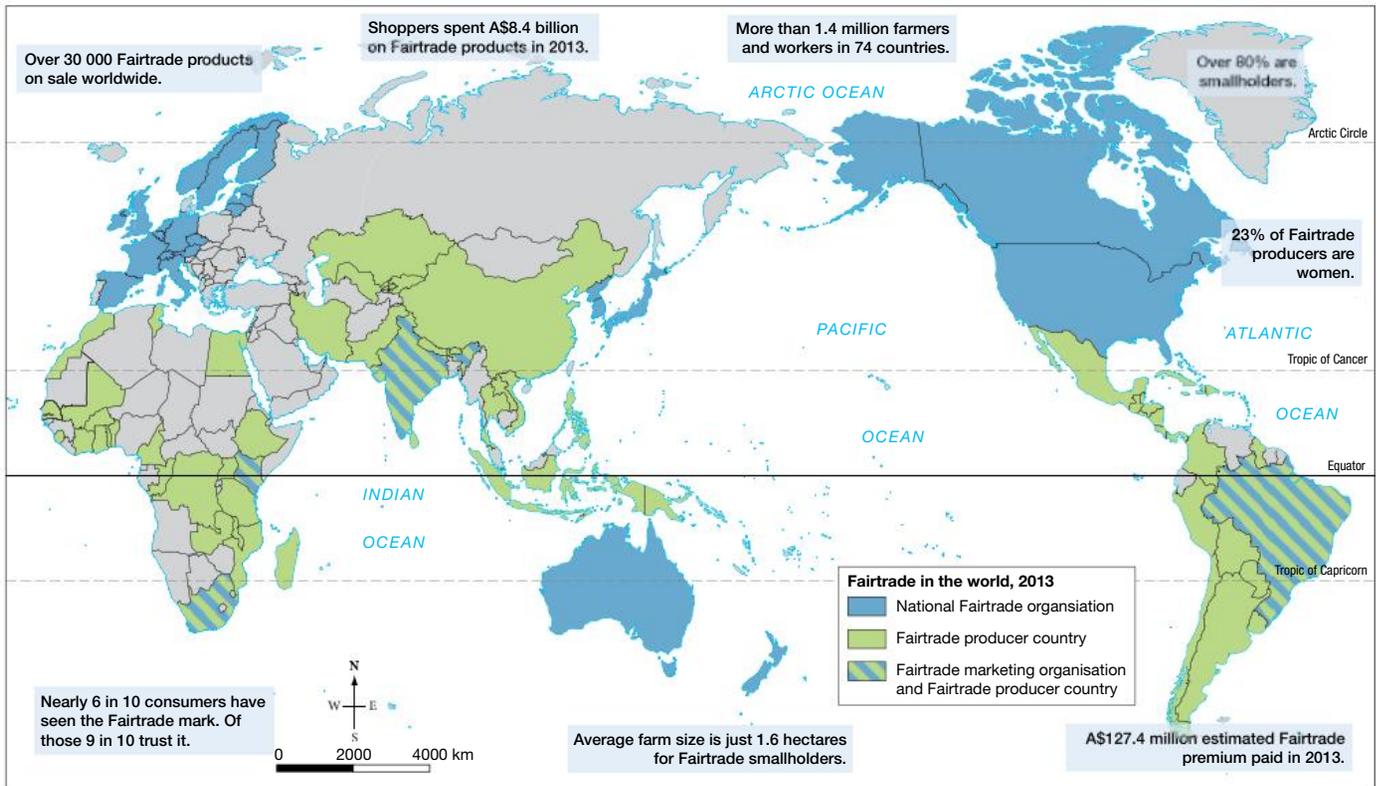


FIGURE 2 Goods produced by workers for the World Fair Trade Organization mission



The fair trade labelling system is operated by Fairtrade International, of which Australia is a participating member. This system works to ensure that income from the sale of products goes back directly to farmers, artisans and their communities. Fairtrade International is present in over 120 countries worldwide and has a total of 1226 producer groups (see figure 3). The number of farmers and workers participating in Fairtrade is estimated to be 1.4 million, with 23 per cent of this number being women.

FIGURE 3 Fairtrade in the world, 2013



Source: Fairtrade Foundation

Fairtrade food items currently include sugar, chocolate, coffee, tea, wine and rice. Other products include soaps, candles, clothing, jewellery, bags, rugs, carpets, ceramics, wooden handicrafts, toys and beauty products.

In 2013, Australia and New Zealand had a combined retail sales total of A\$290.3 million in Fairtrade Certified products. The highest volume of trade in tonnes for 2013 were bananas: 373 000; sugar: (cane sugar) 194 000; and coffee/cocoa beans: 138 500. On a global scale, 11.4 million producers and their families have benefited from Fairtrade-funded infrastructure and community development projects with a value of \$8.4 billion.

10.8.3 Non-government organisations and fair trade

Non-government organisations (NGOs) such as Oxfam and World Vision also support fair trade, and oppose socially unjust trade agreements. They oppose attempts by developed countries to:

- block agricultural imports from developing countries
- subsidise their own farmers while demanding that poor countries keep their agricultural markets open.

10.8 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. Note: Question numbers may vary slightly.

Remember

1. What are the main principles of fair trade?

Explain

2. Explain the role of NGOs such as Oxfam in relation to trade.
3. Why can trade be unfavourable to poorer countries?

Discover

4. Find out more about Fairtrade labelling of products sold in **places** such as Australia.
5. What types of goods do Oxfam and World Vision sell in Australia?
6. Find out what Oxfam does to promote fair trade by using the internet to search for its programs.

Predict

7. Online ordering of goods has become a feature of the internet age. Make a list of the advantages and disadvantages of online ordering for workers in the Australian retail industry (such as those who work in department stores).

Think

8. In theory, every country, rich or poor, should have the opportunity to benefit from international trade. However, the reality is very different. Discuss.
9. Australia has made stronger regional trade **interconnections** with its neighbours by lowering its tariffs on imported textiles, clothing and footwear. How has Australian trade benefited from this?

10.9 Why does Australia give foreign aid?

10.9.1 Introduction

Countries give aid to other countries in order to help with their development and, for example, help people overcome poverty and resolve humanitarian issues. Aid often helps the donor country by promoting stability and prosperity in the region. Australia's Official Development Assistance (ODA) program is known as Australian Aid.

10.9.2 Australian Aid aims

Over one billion people in the world live in poverty and do not have easy access to education and health care. When disasters strike, they lack the resources to get back on their feet. Poverty needs to be addressed by the international community because it can:

- breed instability and **extremism**
- cause people to flee violence and hardship, thus swelling the number of refugees.

Australia takes the stance that helping people who are less fortunate is a vital way of supporting **humanitarian principles** and social justice. Apart from showing we care, it is in the interests of our **national security**. It also increases our status throughout the world and creates political and economic interconnections with our Asia–Pacific neighbours.

10.9.3 The Australian Aid program

The Department of Foreign Affairs and Trade (DFAT) manages the Australian Government's multi-billion-dollar overseas aid program. To ensure that funds reach the needy, Australian Aid works with Australian businesses, non-government organisations such as CARE Australia, and international agencies such as the United Nations (UN) and the World Bank.

10.9.4 The Australian Aid plan

Overseas aid is the transfer of money, food and services from developed countries such as Australia to developing countries such as Papua New Guinea. There are many programs that are part of the Australian Aid budget, which is classified as Official Development Assistance (ODA) (see figure 1). These include:

- aid to governments for post-war reconstruction, as in Afghanistan and Iraq

- distribution of food through the United Nations World Food Programme
- contributions to United Nations projects on refugees and climate change
- disaster and conflict relief in the form of food, medicine and shelter, such as that given after the 2004 Indian Ocean tsunami
- programs by non-government organisations to reduce child labour in developing countries
- funding for education programs
- support for Australian volunteers working overseas.

A newly developed Australian Aid program for 2015–16 includes \$50 million for gender equity and women’s economic empowerment.

10.9.5 The Australian Aid budget

The Australian Aid program supports the United Nations Sustainable Development Goals (SDGs). In addition, countries with a low Human Development Index (HDI) are the target for development assistance. The Human Development Index ranks a country according to life expectancy at birth, adult literacy, school enrolments and income. The highest possible score for a country is 1.0 (see figure 2).

The total Australian Aid budget for 2015–16 was over 4 billion dollars with 92 per cent of the Regional Budget of 2.5 billion allocated to our nearest neighbours in the Asia–Pacific region (see figure 3).

FIGURE 1 Distribution of the Australian Aid budget

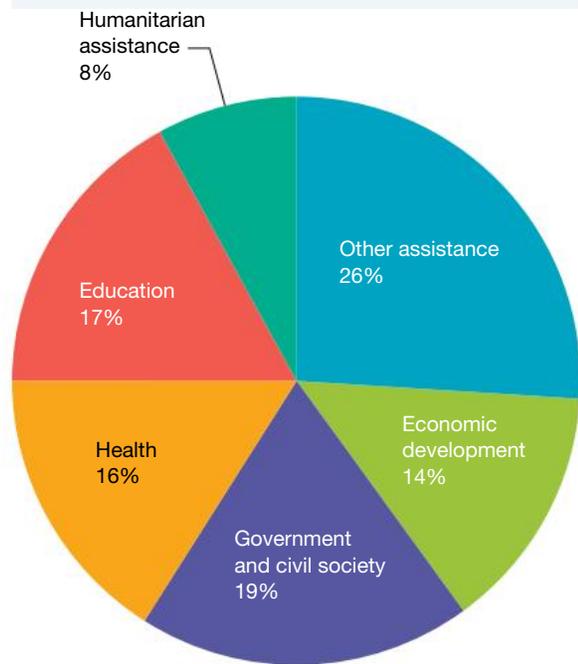
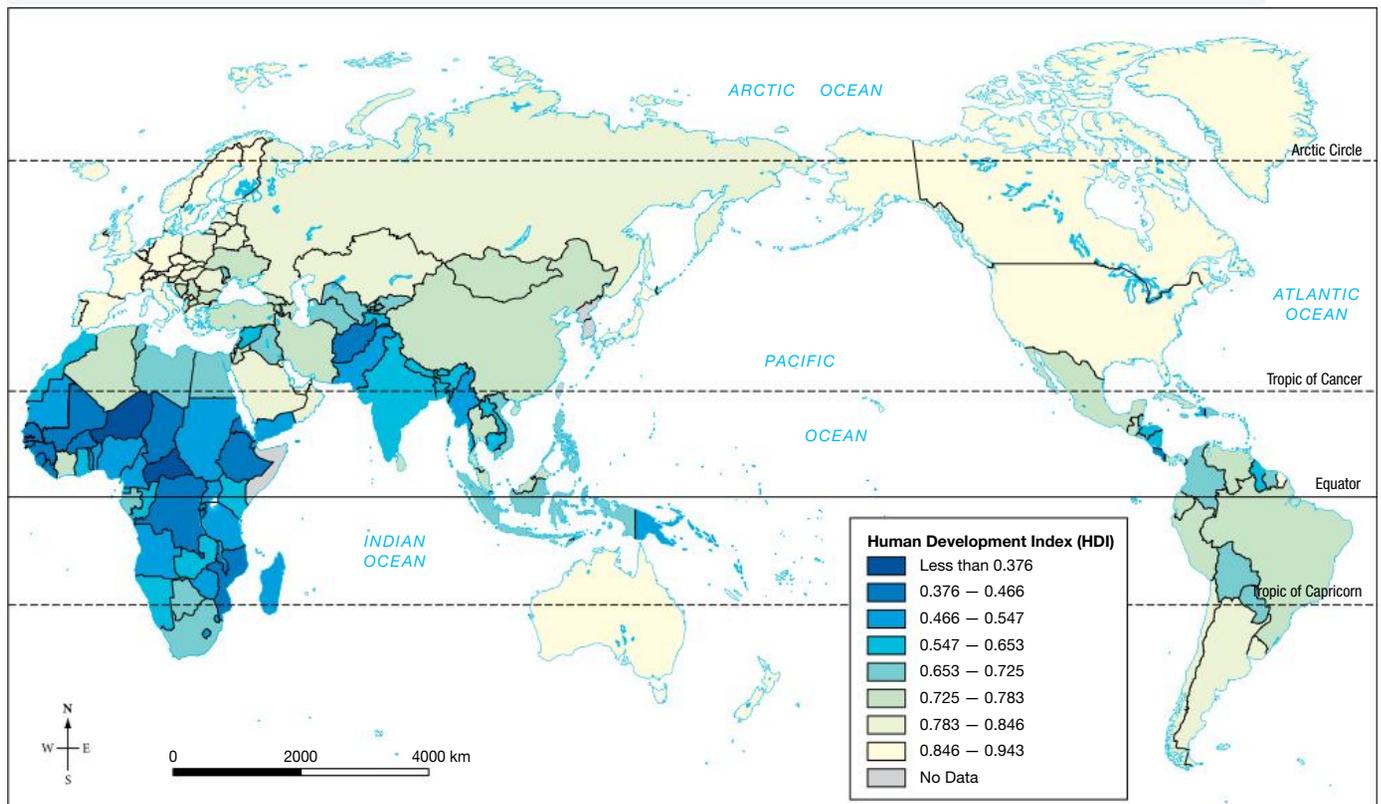
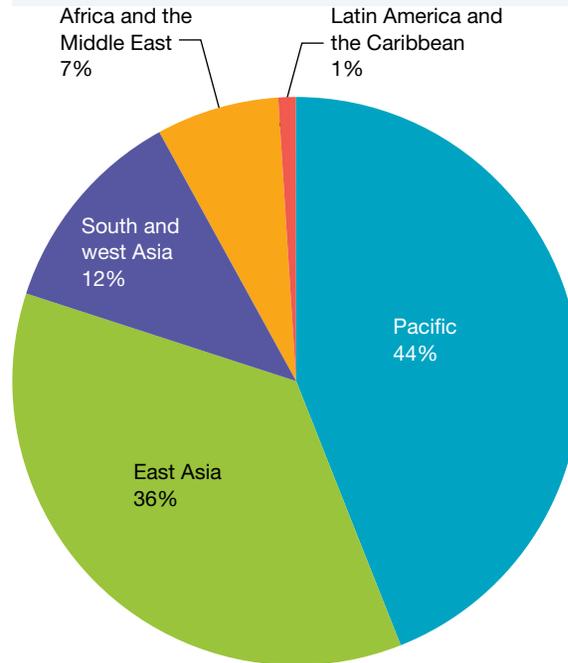


FIGURE 2 The Human Development Index, 2015



Source: Spatial Vision

FIGURE 3 Australian Aid 2015–16



10.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Which government department manages Australia's Official Development Assistance program?
2. Which regions of the world receive most of Australia's aid funding and why do you think this is so?

Explain

3. What reasons can you put forward to explain why Australian Aid programs are worthwhile in terms of Australia's **interconnections** with its neighbours?
4. Is there a case that could be argued for cutting aid budgets? Explain your reasons.

Discover

5. Undertake some internet research to find out how the Sustainable Development Goals guide the Australian Aid program.
6. (a) Why is East Asia such an important **place** for the distribution of Australian Aid?
(b) Why does north-east Asia receive little foreign aid from Australia?

Predict

7. If Australian Aid were to stop, what **changes** do you think this would have on Australia's reputation in the international community?
8. Which elements of the Australian Aid program do you think will have the greatest impact on the lives of people in the Pacific region? Give reasons for your selection.

Think

9. Can you suggest a better way of distributing the budget dollars of the Australian Aid program in order to improve the lives of people in the Asia–Pacific region?
10. If Australia's economic prosperity were to decline in the next 50 years, which elements of the Australian Aid program do you believe would not be **sustainable**?

Try out this interactivity: The gift of giving (int-3340)

10.10 Why is the illegal wildlife trade a cause for concern?

online only

Access this subtopic at www.jacplus.com.au

10.11 SkillBuilder: Constructing and describing a flow map

online only

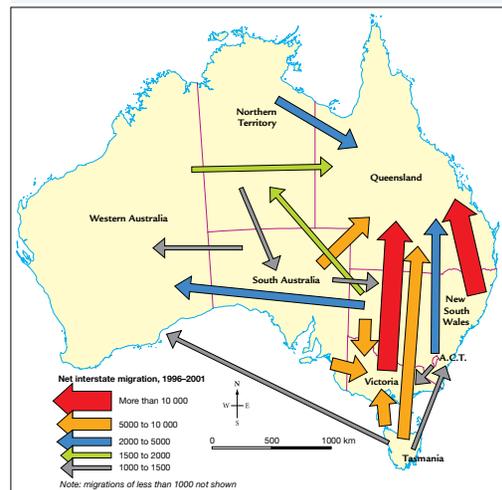
WHAT IS A FLOW MAP?

A flow map is a map that shows the movement of people or objects from one place to another. Arrows are drawn from the point of origin to the destination. Sometimes these lines are scaled to indicate how much of the feature is moving. Thicker lines show a larger amount; thinner lines show a smaller amount.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 Interstate migration flows, 1996 to 2001



Watch this eLesson: Constructing and describing a flow map (eles-1741)

Try out this interactivity: Constructing and describing a flow map (int-3359)

10.12 Review



10.12.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

10.12.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

10.5 SkillBuilder: Constructing multiple line and cumulative line graphs

10.5.1 Tell me

What are multiple line graphs and cumulative line graphs?

Multiple line graphs consist of a number of separate lines drawn on a single graph. Cumulative line graphs are more complex to read, because each set of data is added to the previous line graph. Both formats show change over time and show trends effectively.

Why are multiple line graphs and cumulative line graphs useful?

Multiple line graphs and cumulative line graphs are useful when comparing the change in one set of data with changes in other sets of data, and are easier to read than a table of statistics. Sometimes in multiple line graphs the lines may cross one another, so a coloured key is used. Cumulative line graphs are good at showing the breakdown of a total quantity.

They are also useful for:

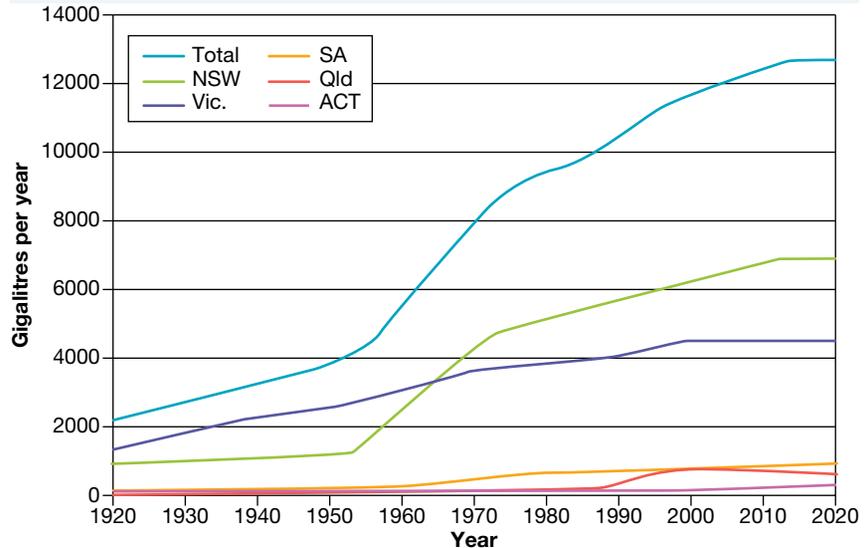
- showing a pattern of change
- comparing changes in components of the total
- showing trends in data.

Model

Good multiple line graphs and cumulative line graphs:

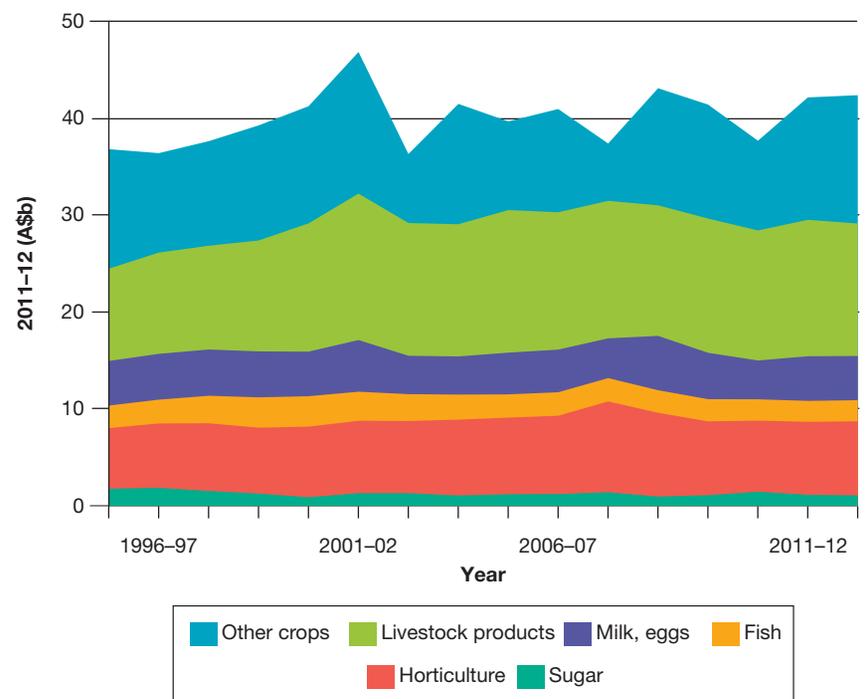
- have labelled axes
- include a clear title or caption that identifies places and dates for the data.

FIGURE 1 Water use by five states in the Murray–Darling Basin, 1920–2020, as a multiple line graph



Source: Food and Agriculture Organization of the United Nations, 2012 FAOSTAT, <http://faostat3.fao.org/home/index.html>

FIGURE 2 Value of Australian farms and fisheries food production, 1996–2012, as a cumulative line graph



Source: © DAFF 2013, *Australian Food Statistics 2011–12*. Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

10.5.2 Show me

How to draw multiple line graphs and cumulative line graphs

You will need:

- data for multiple places or uses shown over time
- access to a computer
- a blank Excel spreadsheet.

Procedure:

To complete multiple line graphs and cumulative line graphs you must have an appropriate set of data to graph. Both types of graphs can be completed from the same data set.

STEP 1

TABLE 1 Agricultural food production, selected grains (1000 tonnes), Australia, 2006–12

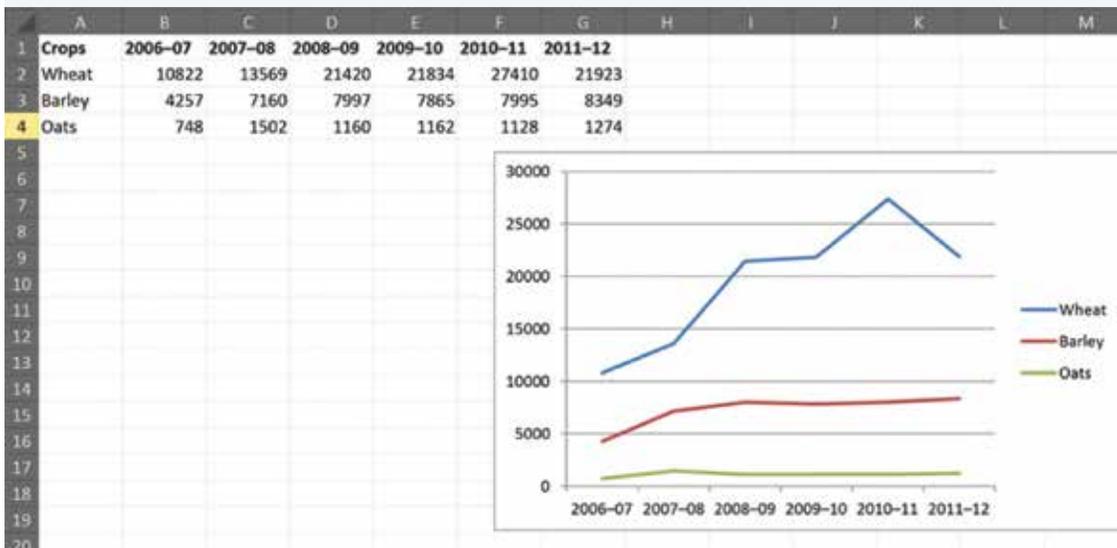
| Crops | 2006–07 | 2007–08 | 2008–09 | 2009–10 | 2010–11 | 2011–12 |
|--------|---------|---------|---------|---------|---------|---------|
| Wheat | 10822 | 13569 | 21420 | 21834 | 27410 | 21923 |
| Barley | 4257 | 7160 | 7997 | 7865 | 7995 | 8349 |
| Oats | 748 | 1502 | 1160 | 1162 | 1128 | 1274 |

Source: © DAFF 2013, *Australian food statistics 2011–12*. Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

Place all the data into an Excel spreadsheet. At this stage, if you have spaces in your numbers, close them up or replace them with commas, as spaces can create problems in Excel.

Next, click on the Insert tab and select a multiple line chart. You will then have to add the axis labels. Do this by clicking on your graph's outer border, selecting the Layout tab in the Chart Tools section, clicking on Axis Titles in the Labels section, and following the steps from there.

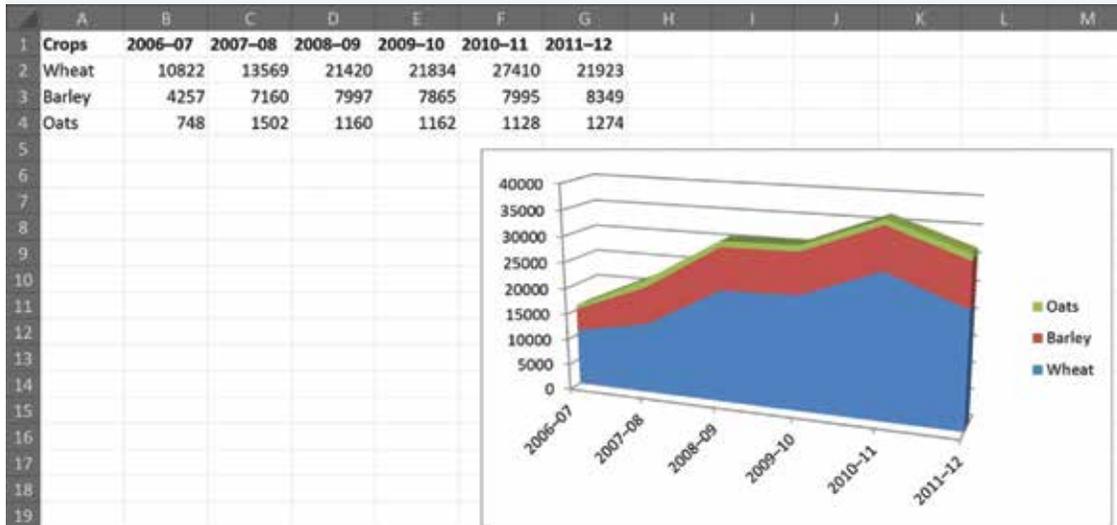
FIGURE 3 An Excel-generated multiple line graph



STEP 2

A cumulative line graph can be generated by selecting the table data and selecting an Area chart from the Charts section under the Insert tab. Don't forget to add axis labels.

FIGURE 4 An Excel-generated cumulative line graph



STEP 3

Check that you have supplied labels on all axes, units of measurement, and a title or caption.

10.5.3 Let me do it

Developing my skills

Use the data in table 2 to construct a multiple line graph and a cumulative line graph for four Asian countries to which Australia exports food.

Questions

1. Which country received the greatest value of food exports from Australia?
2. Which country showed the greatest change in its level of importation of food from Australia?
3. From 2006 to 2012, which country was most consistent in its level of importation of food from Australia?
4. Suggest why these Asian countries need to import food from Australia.
5. Which graph showed you a clearer picture of the data: the multiple line graph or the cumulative line graph?

TABLE 2 Australian total food exports by selected destination, \$ million, 2006–12

| Country | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 |
|-------------------|---------|---------|---------|---------|---------|---------|
| China | 664 | 917 | 1178 | 1426 | 1540 | 2174 |
| Indonesia | 1566 | 1702 | 2652 | 2129 | 2288 | 2272 |
| Japan | 4752 | 4553 | 5517 | 4278 | 4207 | 4448 |
| Republic of Korea | 1850 | 1655 | 1873 | 1925 | 1994 | 2338 |

Source: © DAFF 2013, *Australian food statistics 2011–12*. Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

Checklist

I have:

- labelled the axes
- included a clear title or caption that identifies places and dates for the data.

Skills questions

1. Multiple line graphs and cumulative line graphs are used to show:
 - (a) total values of data
 - (b) single values of data
 - (c) comparisons between data
 - (d) mixed data.
2. Multiple line graphs and cumulative line graphs include information about:
 - (a) money
 - (b) slope
 - (c) rainfall
 - (d) *change* over time.
3. Why might the lines on a multiple line graph cross over?
4. Why might it be important to carefully calculate totals when constructing a multiple line graph?

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Watch this eLesson: Constructing multiple line and cumulative line graphs (eles-1740)



Try out this interactivity: Constructing multiple line and cumulative line graphs (int-3358)

10.10 Why is the illegal wildlife trade a cause for concern?

10.10.1 Threatened wildlife

Not all trade is legal. The international trade in wildlife has been one of the factors responsible for the massive decline in many species of animals and plants. Millions of live animals and plants are illegally shipped around the world each year to supply the pet trade and to meet the demand for decorative plants. Wild animal and plant products, such as skins, meat, ornaments, animal parts and timber, are traded in large quantities.

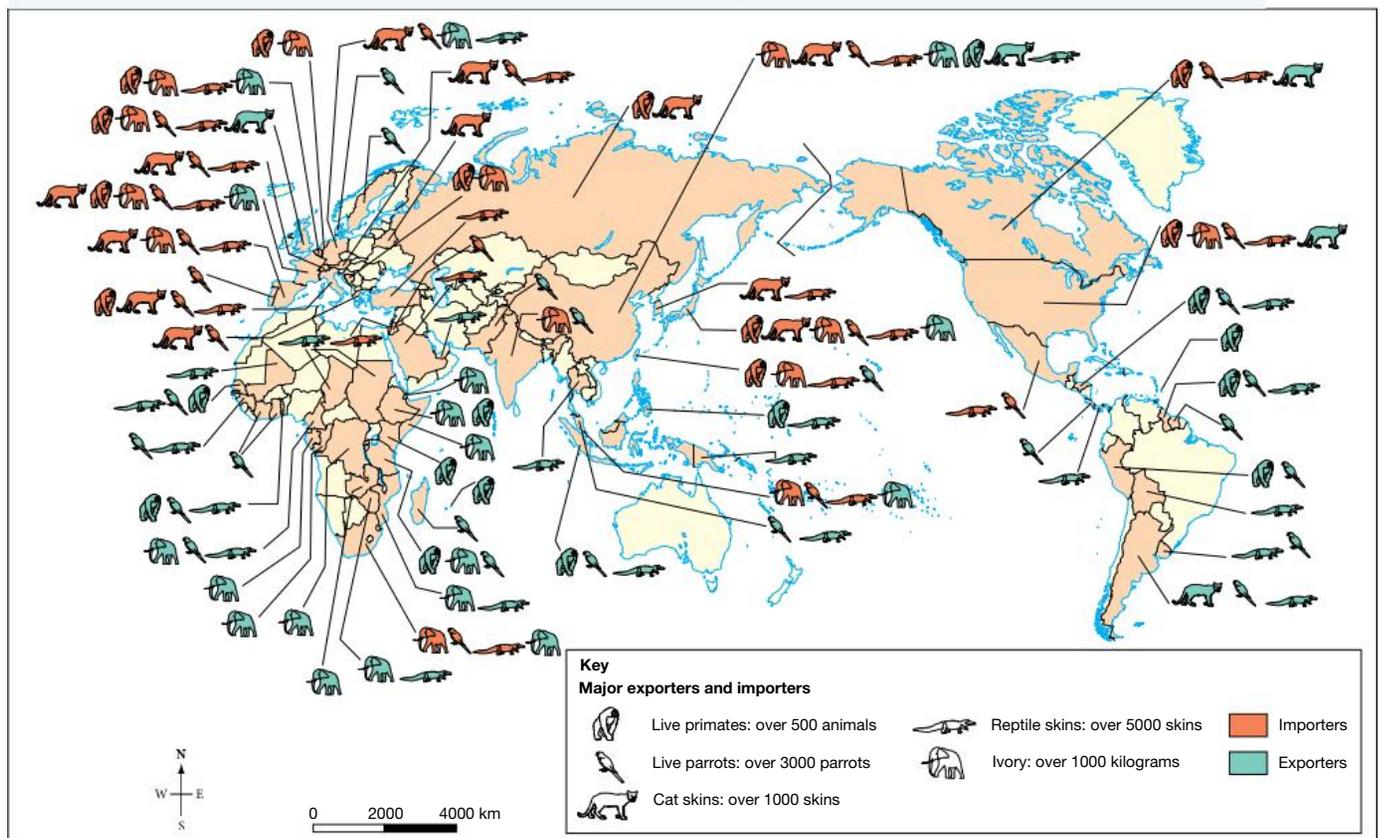
In 1973, an international **treaty** known as the Convention on International Trade in Endangered Species (CITES) was drawn up in Washington to prevent international trade that threatened species with extinction. Any trade in products from threatened wildlife now requires a special permit. Unless there are exceptional circumstances, no such permits are issued for species threatened with extinction. These include species of tigers, elephants, rhinoceroses, apes, parrots and all sea turtles.

The live pet trade

Trade in threatened wildlife still takes place through **smuggling**. Birds are drugged and stuffed into plastic tubes; snakes are coiled into stockings and posted; lizards are stitched into suitcases. Many of the animals die.

Prices on the **black market** can be very high. Bird traffickers can earn more than \$150 000 for taking 30 eggs out of a country in specially designed vests that keep the eggs warm. Overseas collectors will pay up to \$50 000 for a breeding pair of endangered red-tailed black cockatoos

FIGURE 1 Who trades what — exporters and importers of endangered species



Source: MAPgraphics Pty Ltd, Brisbane

FIGURE 2 Some of the skins seized from poachers in India.



Traditional Chinese medicine

Traditional Chinese medicine (TCM), the most widely practised traditional medicine system in the world, uses more than 1000 plant and animal species. While TCM has been practised for perhaps 5000 years, some of the wild plants and animals used are now threatened or in danger of extinction. Among them are certain orchids, musk deer, rhinoceroses, tigers and some bear species.

All five species of rhinoceros are threatened with extinction because people have been hunting them for many years, poaching them just to sell their horns. The horn of the black rhino is sometimes called ‘black gold’ because it is so expensive. Asian rhinoceros horns are mostly used for medicines said to reduce fever. Horns are cut into oblong pieces and smuggled into other countries in jars of honey, cartons of matches or raw meat.

Rhinoceroses are also endangered because of other factors. Rhinos prefer shade and, owing to the cutting down of trees in grasslands, their source of shelter is being wiped out. Pollution is also endangering these animals; toxic waste and pesticides are left on the grass that the rhinos eat.

Although international trade in rhino horn has been banned under CITES since 1977, demand remains high, and this encourages rhino poaching in both Africa and Asia. Criminal syndicates link the poachers, in places like South Africa, to transit points, smuggling channels and final destinations in Asia. The main market is now Vietnam, where there is a newly emerged belief that rhino horn cures cancer. Rhino horn is used in other traditional Asian medicine to treat a variety of ailments, including fever and blood disorders.

It is also used by wealthy Asians as a cure for hangovers.

FIGURE 3 Conservationists dehorning a sedated rhinoceros



In October 2011, the World Wide Fund for Nature (WWF) helped to successfully establish a new black rhino population in a safer, more spacious place in South Africa. Nineteen critically endangered black rhinos were transported to a new home. Such relocations reduce pressure on existing wildlife reserves and provide new territory, where rhinos have a better chance of increasing in number. Creating more dispersed and better protected populations also helps keep rhinos safe from poachers.

10.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Why are wild species traded?

Explain

2. Look carefully at figure 1.
 - (a) Which categories of wildlife are traded for their skins?
 - (b) Using an atlas, list the **places** that are the major exporters of the following.
 - Live primates
 - Cat skins
 - Ivory
 - Live parrots
 - Reptile skins
 - (c) Based on your list in part (b), list the continents that are the main sources of wildlife species and wildlife goods.
3. Study figures 4 and 5.
 - (a) Which two countries in the Asia–Pacific region have high numbers of threatened mammals and threatened birds?
 - (b) What reasons can you think of for Indonesia having the greatest number of threatened mammal and bird species?

Discover

4. Look at figure 2.
 - (a) List the smuggled items seized from poachers.
 - (b) Suggest what could be done to persuade people not to buy these products.
5. Refer to figure 3.
 - (a) How does the action shown support the **sustainability** of rhinoceros populations?
 - (b) Why are conservationists taking this action?

Predict

6. Other than the loss of endangered species, what other negative consequences may occur through the illegal export and import of wildlife?
7. What would be the impact on the Australian **environment** if animals such as koalas were to become a target for smugglers?

FIGURE 4 Number of threatened mammal species

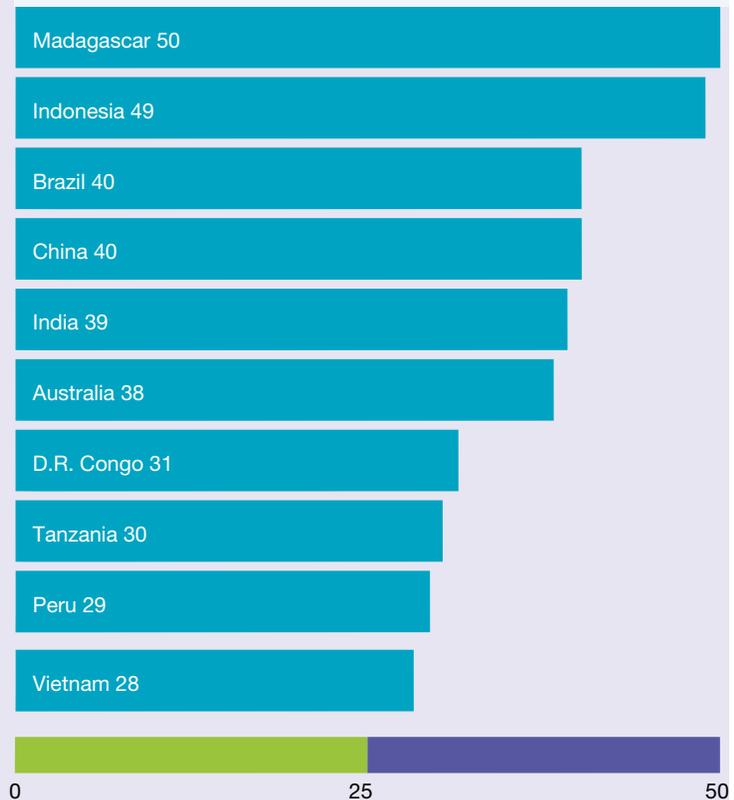
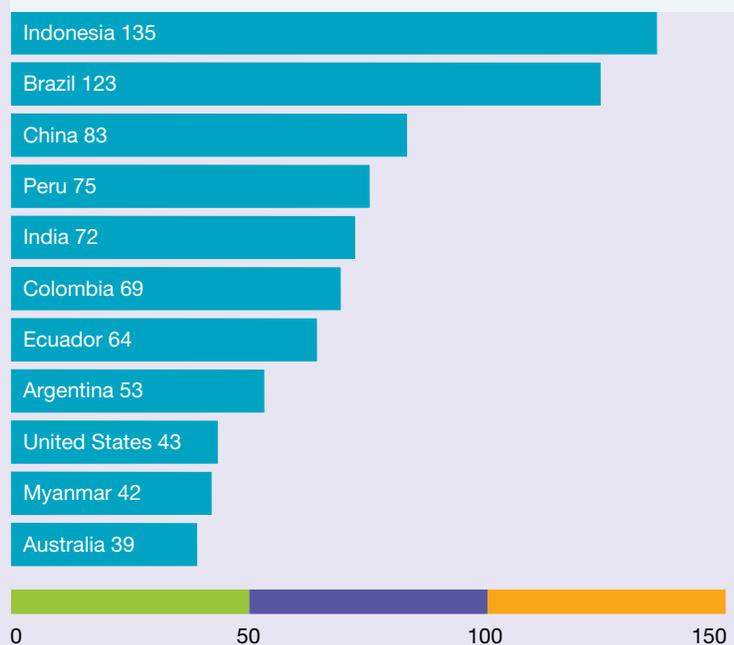


FIGURE 5 Number of threatened bird species



10.11 SkillBuilder: Constructing and describing a flow map

10.11.1 Tell me

What is a flow map?

A flow map is a map that shows the movement of people or objects from one place to another. Arrows are drawn from the point of origin to the destination. Sometimes these lines are scaled to indicate how much of the feature is moving. Thicker lines show a larger amount; thinner lines show a smaller amount.

Why is a flow map useful?

A flow map is used to give us a visual image of the movement of something that might otherwise be provided through a set of statistics or a lengthy paragraph of text. Interconnections between destinations and places of origin are made very clear, and regional patterns can be readily identified.

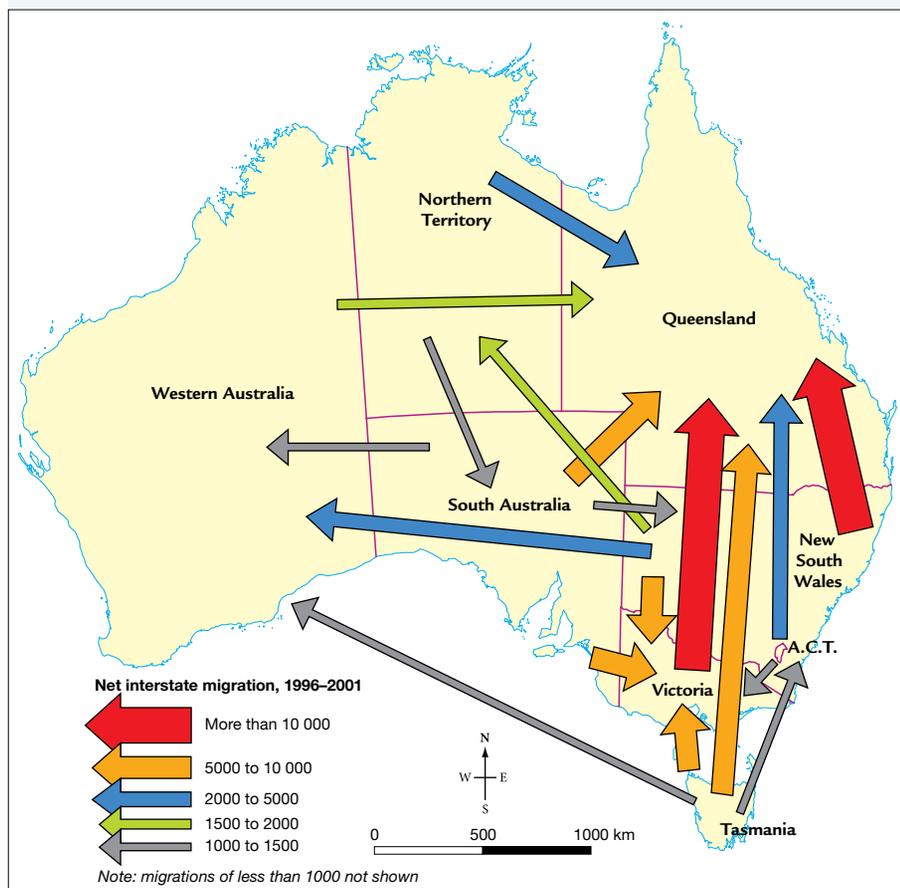
Flow maps are useful when trying to understand:

- individual movements, such as use of transport systems and aisles in supermarkets
- local movements, such as traffic flows at intersections or the use of pathways in parks
- national movements, such as the importation of cars to Australian states
- regional movements, such as flows between states of Australia or between countries within the Pacific
- global movements, such as imports and exports, human movement and communication.

Model

Between 1996 and 2001, people moved from the southern states to Queensland, and from the eastern states to Western Australia. All states experienced migration of residents to Queensland, with more than 10000 from each of Victoria and New South Wales, and 5000–10000 from Tasmania and South Australia. New South Wales lost more people than it gained, with inflows of 1000 to 1500 from South Australia and Tasmania only. Victoria, however, had inflows from all the surrounding states, including Tasmania (totalling between 16000 and 31500), which indicates that Victoria's net loss — more than 10000 to Queensland — was far less than that of New South Wales, which had a loss of 13500 to 17000 or more.

FIGURE 1 Interstate migration flows, 1996 to 2001



Source: Spatial Vision

A good flow map:

- is drawn in pencil initially and then coloured appropriately
- uses arrows to indicate flow directions
- may use scaled arrow widths, which are also explained in a key/legend
- includes labelled features as necessary
- has a clear title, which identifies places and dates.

A description of a flow map:

- identifies and communicates key features of the movement, patterns and places shown
- clearly represents and communicates the data with the use of statistics, places and dates.

10.11.2 Show me

How to construct and describe a flow map

You will need:

- a set of data that shows the movement of some object
- a base map that corresponds to the places included in your data set
- a light grey pencil
- a set of coloured pencils
- a ruler
- an eraser.

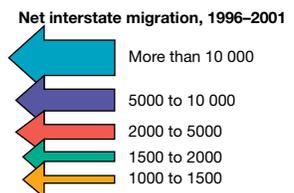
Procedure:

To complete a flow map, you will need to convert a table of data to a coloured map.

STEP 1

If you are planning to simply show the flow between places, then you need only identify each place and draw an arrow from the origin to the destination, as shown in figure 1 in subtopic 10.2. Writing numbers on the flow lines is another method for creating a basic flow map. (If you use this method, go now to step 5.) On the other hand, if you want to create a map that provides an instant snapshot of the quantities of a feature being moved, then a scaled flow map is a better option. Your first step is to determine the scale you will use. Look over the data set that you have, and establish no more than five categories that will allow you to represent the data. Figure 2 shows how these appear in the key of figure 1.

FIGURE 2 Scaled arrows for the flow map in figure 1



STEP 2

Draw up the key, or legend, for the base map. Note that you will have to work in millimetres; otherwise, your arrows will dominate the map. In a key such as figure 2, one millimetre could be used to represent 1000 people. This will avoid having very wide arrows for the larger values, and allow the arrows to fit within the map. Label your key appropriately.

STEP 3

Now you need to rule an arrow, of an appropriate width, from a place of origin to a place of destination. Before you begin, think where you will place each arrow, as it is best to avoid overlapping them. This is most important if you are mapping global data; look at figure 1 in subtopic 10.4 to see how complex this can become.

STEP 4

As you draw arrows between the places of origin and destination, use your ruler to keep the arrow widths consistent. Neatness is important. Colour the arrows as you go to avoid confusion at the end.

STEP 5

Ensure that the completed map includes geographical conventions (BOLTSS).

STEP 6

Look at the completed map and identify any patterns that are evident. Is there an interconnection between the widest arrows? Is there an interconnection between the narrowest arrows? Write a few sentences to explain any patterns you can identify. In figure 1, people moved from the southern states to Queensland — more than 10 000 from Victoria, 5000–10 000 from Tasmania, 2000–5000 from the ACT and more than 10 000 from New South Wales. They also moved from the eastern states to Western Australia — 2000–5000 from New South Wales, 1000–1500 from Tasmania, and 1000–1500 from South Australia.

STEP 7

Look for any anomalies in the pattern — arrows that stand out as being different. Write a sentence to identify any anomalies. For example, in figure 1, although Victoria had an inflow from all its surrounding states, including Tasmania, fewer than 1000 Victorians moved to each of the states of Western Australia, South Australia, New South Wales, ACT or Tasmania.

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Watch this eLesson: Constructing and describing a flow map (int-1741)



Try out this interactivity: Constructing and describing a flow map (int-3359)

10.12 Review

10.12.1 Review

1. Australia's major trade market has switched from Europe and the United Kingdom to Asia. Suggest reasons for this *change*.
2. Name the top ten nations that Australia exports to and imports from. Based on percentage data, draw graphs to represent these trade figures. What do your completed graphs reveal?
3. Why is trade in live animals such a controversial topic?
4. Which two countries have the largest share of the international car export market?
5. The Honda Motor Company has assembly plants in many *places* around the world. Why are so many located in developing countries?
6. Why is Fairtrade such an important idea for countries in the developing world?
7. Explain how Australian Aid promotes social justice through its foreign aid program.
8. Why do you think some species become endangered?

10.12.2 Reflect

9. Does the increase and expansion of the human population have to result in the loss of other species?
10. Use the **Australian Aid** weblink in the Resources tab and refer to the map of countries that receive Australian aid to answer the following questions.
 - (a) Make a list of the Pacific Island nations that Australia assists with aid.
 - (b) Write a summary of the Australian Aid program for the Middle East, North Africa and sub-Saharan Africa based on the information provided when you click on the *Program overview* links for those regions.
 - (c) Use the menu on the left of the web page to explore features of the Australian Aid program in Indonesia. Write a brief report about the program.
 - (d) Select an Australian Aid country from the map. Using this and other online sites, prepare a three-minute oral report on your country of choice. Include images that you can show your class in a PowerPoint presentation.
11. Imagine a world without trade. How would this affect your day-to-day life?
12. Would Australia be failing to respect and tolerate other countries' cultural practices if we were to ban the live export of animals?
13. What ethical principles are taken into consideration when deciding if a business can be given a Fairtrade label?

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Explore more with this weblink: Australian Aid

TOPIC 11

For better or worse?

11.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

11.1.1 Introduction

The development of technology and communication around the world has had both positive and negative effects. One positive outcome is that advances in technology have made people's lives more interconnected. On the other hand, drawbacks include a widening gap between the 'haves' and the 'have-nots', and some negative effects on the environment. Therefore, it is essential to ask whether we are better off or worse off with ever-improving technology and communication.

E-waste at Agbogbloshie dump, in Accra, Ghana — a dumping ground for electronic waste from all over the developed world



Starter questions

1. What percentage of students in your class have a mobile phone? How many times a day do you use your mobile phone?
2. If you wanted to discard your outdated mobile phone, do you know how to do so responsibly? Do you think about where your e-waste goes?
3. Have you ever considered how many people in developing countries have access to the internet?
4. When did you last 'Google' the answer to a question?

INQUIRY SEQUENCE

| | |
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11.2 How do you communicate?

11.2.1 Communication technology

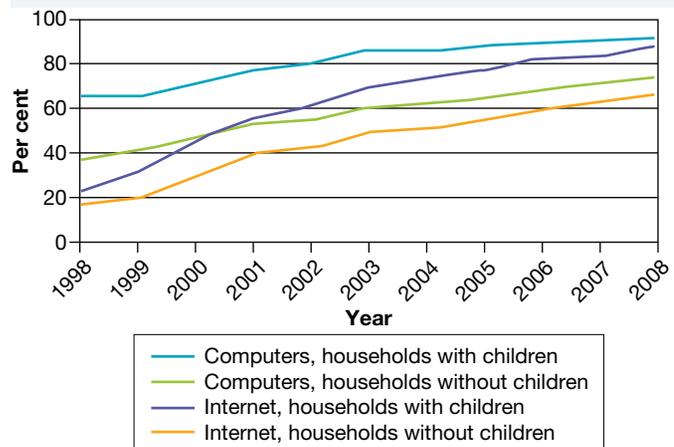
Youth culture is strongly linked to the use of communication technology. More than 800 million adults in the world lack basic literacy skills, yet the boom in information and communication technology is skyrocketing. A survey conducted in 23 countries explored the media access and media use of 12-year-olds. The study showed that in 97 per cent of the countries surveyed, the inhabitants received at least one television channel. However, less accessible were personal computers (23 per cent) and the internet (9 per cent). Internet use among youths in developed countries is increasing at a rapid rate.

11.2.2 Who uses the internet?

Internet access in Australia is continually growing. Households with children have greater access to a computer and the internet at home than do households without children. This reflects the growing digital culture among youth (see figure 1).

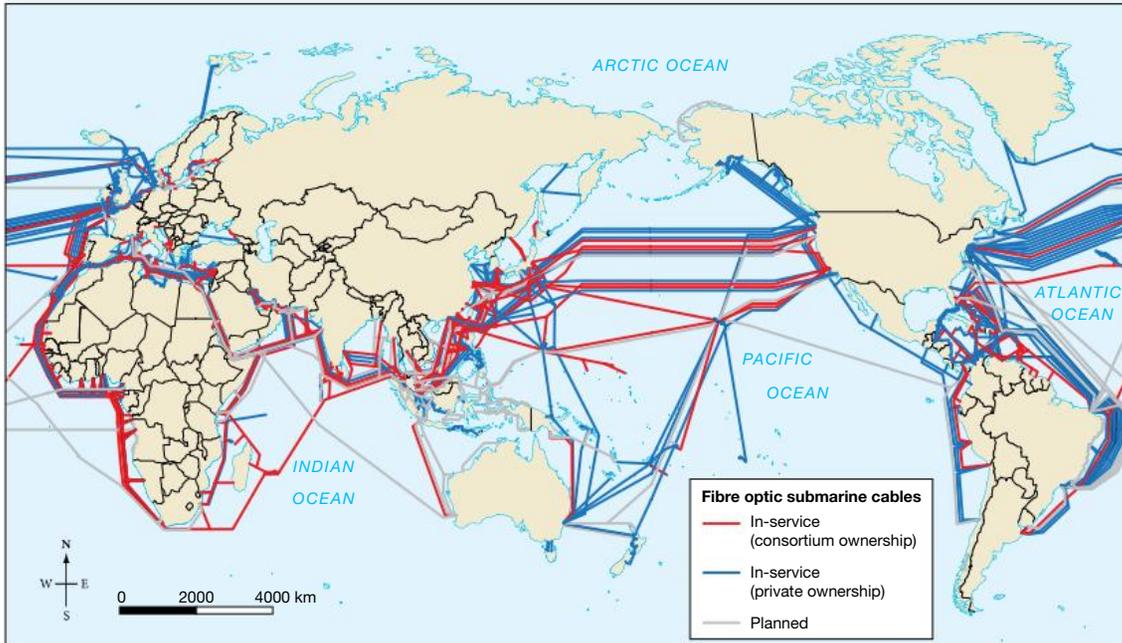
It is often thought that internet communication is all done via satellite. However, that is not the case. There are also fibre optic cables under the sea that help link the network of networks that is the internet, as shown in figure 2. These cables improve the speed of the internet in Australia. New cable, which connects Australia to the United States via New Zealand, will assist in creating the national broadband network.

FIGURE 1 Households with access to the internet in Australia, 1998–2008



Source: ABS 2008

FIGURE 2 The global submarine cable network, which helps connect the world's internet network

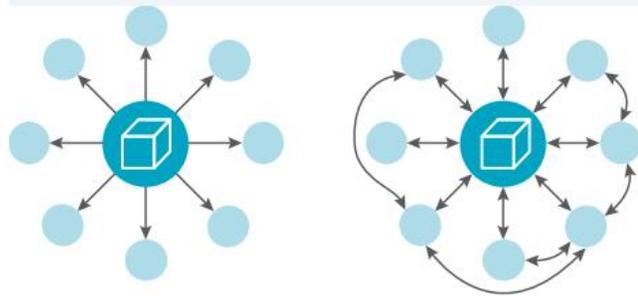


Source: Telegeography

11.2.3 What is Web 2.0?

The World Wide Web is a way of accessing and spreading information on the internet. **Web 2.0** technology enables the sharing of online information and ideas that anyone has created. It is the second generation of the World Wide Web, and enables collaboration and exchanging of information online. This is different from the original **Web 1.0**, which is considered to be read only (see figure 3). Web 1.0 allowed users only to search and read information. The nature of Web 2.0 makes it popular, because it is an easy form of communication technology to use. There is a variety of different types of Web 2.0 applications, including Facebook, YouTube, Wikipedia, Flickr and Instagram.

FIGURE 3 Web 1.0 versus Web 2.0



11.2.4 Mobile phones

Mobile phones are a form of wireless communication that is transmitted via radio wave or satellite transmission. They are no longer used solely for conversation. With new technology, mobile phones and smartphones are now a source of almost endless information. They can help people find their way from place to place, can be used as a diary, take photos and videos, print documents wirelessly, do banking, record music and much more. Mobile phones bridge the domains of communication and information technology. The Australian Bureau of Statistics (ABS) estimates that 29 per cent of all children owned a mobile phone in 2012. It was also noted that ownership increased with age. Two per cent of 5- to 8-year-olds owned mobile phones, while 73 per cent of 12- to 14-year-olds owned them.

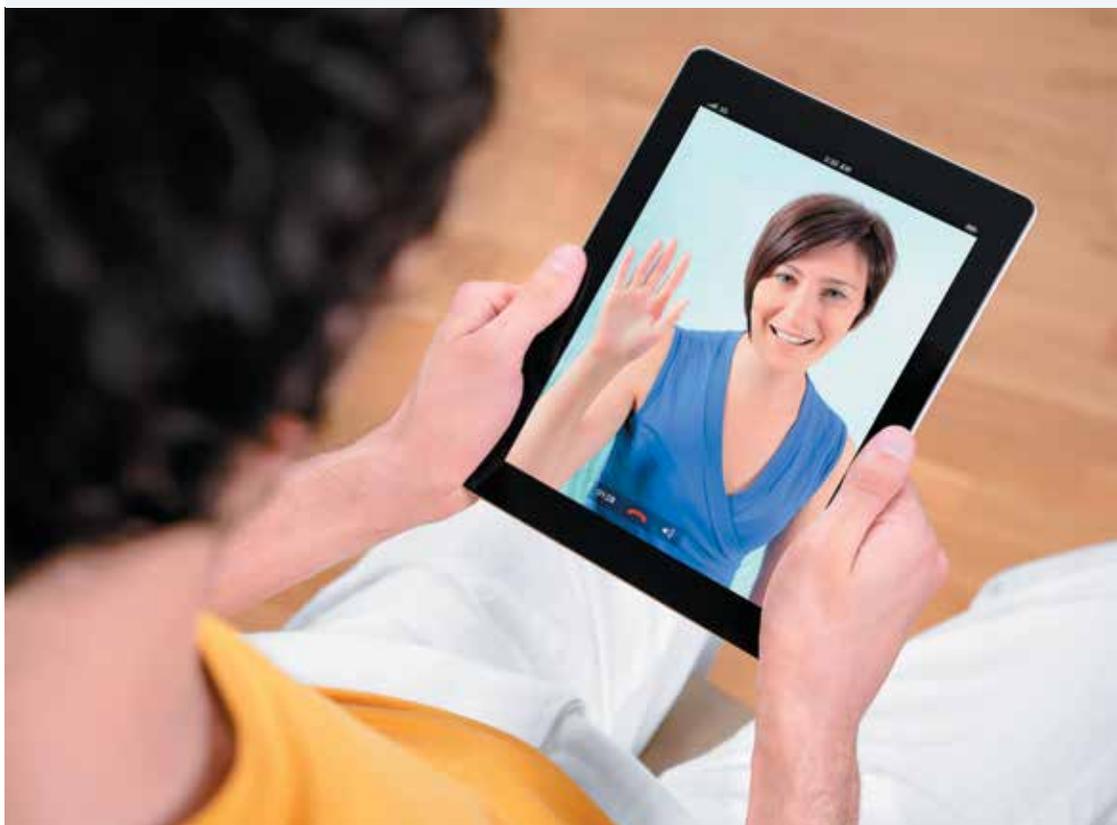
11.2.5 Information and communication technology

Information and communication technology is now used for a variety of purposes to make connections. We often do not realise how convenient our lives have been made by various forms of communication.

Some of these include online and telephone banking, storing and sharing of medical records, online shopping and online games.

Skype is another example of an online communication medium — this service makes it possible for anyone with an internet connection to converse in the form of a video call with someone else anywhere in the world. Skype is also available as a mobile phone application, allowing any user to have a more interactive telecommunication experience. This simple form of communication technology improves the interconnectedness of places around the globe.

FIGURE 4 Skype allows you to make video calls using the internet.



11.2 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. How many more households with children have an internet connection compared with households without children?
2. Refer to figure 2. How does the number of submarine cables in Australia compare with the number in Japan?

Explain

3. Refer to figure 2. Explain the geographical pattern of submarine cables worldwide. Where are the greatest concentrations of cables? Which parts of the seas or oceans seem to lack cables? Why do you think this is?

Discover

4. Refer to figure 3. Find out more about how web 1.0 differs from web 2.0, and create a PowerPoint presentation to compare and contrast them.

Predict

5. Predict how the **interconnectedness** between Asia and Australia will **change** in the future. What effects do you think it will have on the environment?
6. Predict what you think will happen to **low-income countries'** access, quality and usage of information and communication technology.

Think

7. Create a futures wheel to consider how the consumption of information and communication technology may **change** and affect the environment in low-income countries in the future.

learn on RESOURCES – ONLINE ONLY

Try out this interactivity: [www \(int-3341\)](http://www.int-3341)

11.3 Who has access to technology?

11.3.1 Who owns mobile phones?

When we think of using the internet and mobile phones, we often forget about those who do not have access. Access is not equal across the world, let alone Australia. This is also related to government **expenditure** on the infrastructure needed to access information and communication technology.

Today it seems that mobile phones have become the most important form of communication. However, it is interesting to note that not everyone in Australia owns one, and Tasmania actually has the highest proportion of mobile phone ownership (see figure 1). As at June 2015, there were 21 million mobile phone users in Australia.

Mobile phone use across the globe is also

uneven. This could be due to a variety of factors, such as access, financial situation and way of life. Some countries, such as Saudi Arabia, have 180 mobile phones per 100 individuals, indicating that some people own two devices. In Bangladesh 76 mobile phones are owned per 100 individuals.

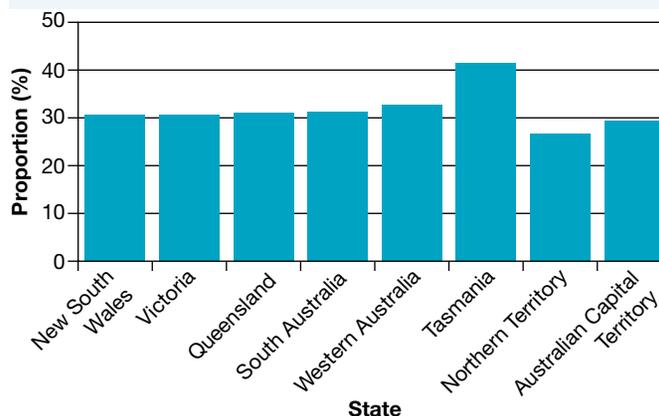
11.3.2 Internet access

Some of us take for granted the fact that we can access the internet almost everywhere we go, whether we are at home, at school, at the shops, or even walking down the street. While this might not be the case for everyone in Australia, it is definitely not the case for everyone in the world (see figure 2).

11.3.3 ICT expenditure

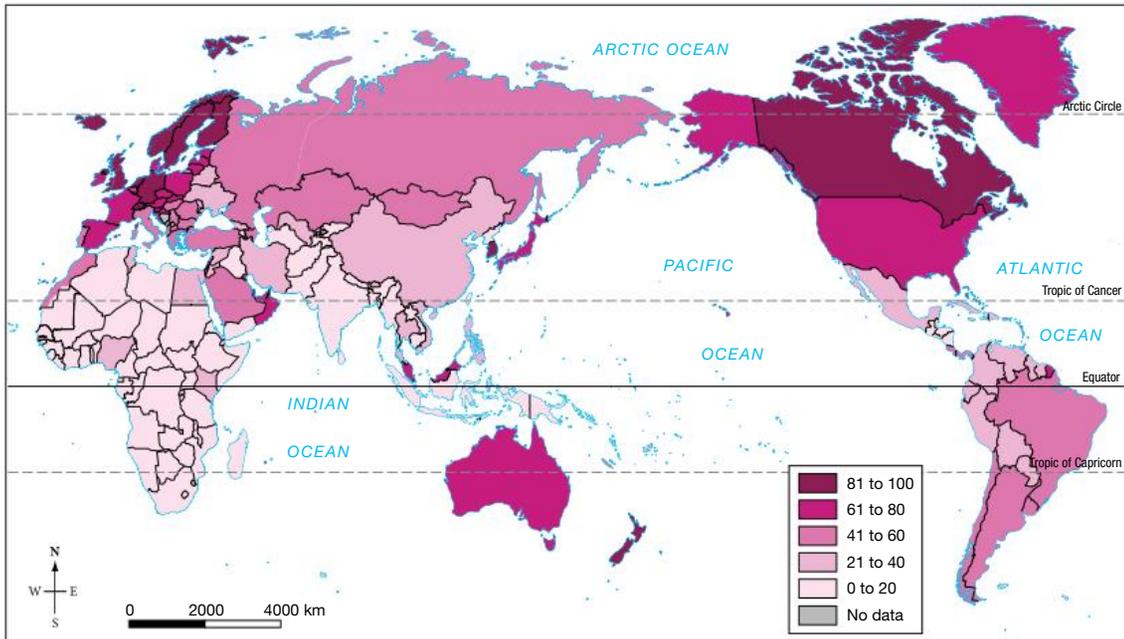
It is important to note that the amount of money spent by individual countries on information and communication infrastructure can play a vital role in consumer access and uptake. Figure 3 indicates expenditure on information and communication technology (ICT) as a percentage of GDP. This map shows that expenditure across the globe is uneven and there is no set pattern. It is difficult to correlate access to ICT with country expenditure; for example, Australia spends between 3 and 6 per cent of its GDP, but access is relatively high. In contrast, a developing nation such as Bangladesh spends 9 to 12 per cent of its GDP, yet access is limited.

FIGURE 1 Mobile phone ownership by Australian states and territories



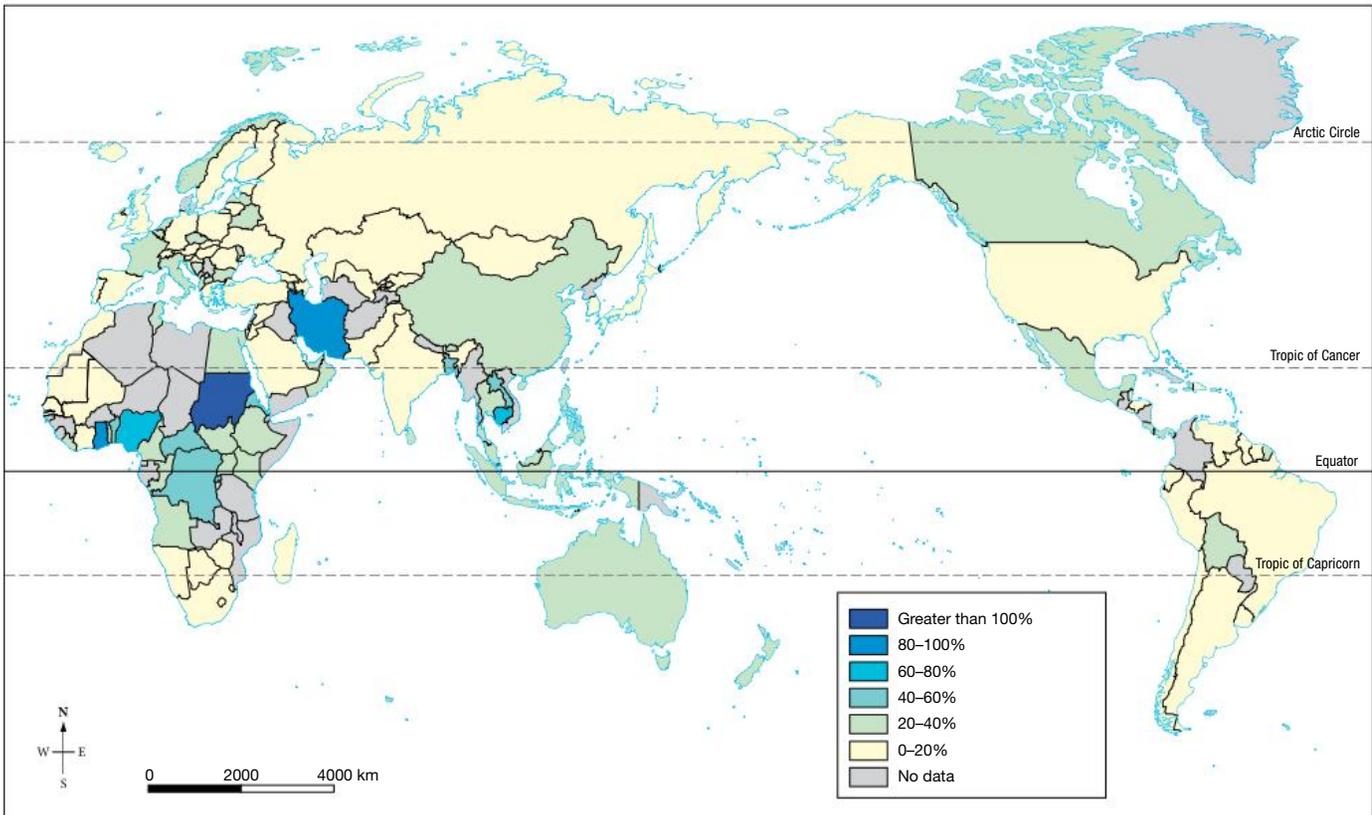
Source: ABS 2009

FIGURE 2 Internet users (per 100 people) in 2008–12



Source: World Bank

FIGURE 3 Expenditure on information and communication technologies by country, 2015



Source: World Bank. 2016 The Little Data Book on Information and Communication Technology 2015. Washington, DC: World Bank

It is interesting to note that Estonia, a small country in Europe, sets a worldwide benchmark by providing free wireless internet access almost everywhere. A group of volunteers successfully lobbied Estonian cafés, hotels, hospitals, local governments and small business owners to provide this free access,

which has been made available in a country with a GDP per capita of about US\$ 20 000; considerably lower than that of Australia, which has a GDP per capita of about US\$ 61 000. As a result, Estonian society has become reliant almost entirely on information in electronic form — doctors issue only electronic prescriptions, voting is conducted online, and government cabinet meetings are now paperless. Not only has free wifi helped the environment, it has also led to a better educated society.

11.3 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Refer to figure 1. Which two states have the same percentage of mobile phone ownership?

Discover

2. Research the reasons for Senegal and Morocco having a high expenditure on ICT.
3. Using figure 2 and the **Mobile phone subscriptions** weblink in the Resources tab, explain how global internet users and mobile phone subscribers are spatially *interconnected*. What are the similarities and differences?

Think

4. Refer to figure 2. What factors do you think affect the pattern of internet use throughout the world?

Predict

5. Refer to figure 3. Where in the world do you predict there will be an increase in infrastructure expenditure in the next 10 years? Explain.

learnon RESOURCES — ONLINE ONLY

 Explore more with this weblink: Mobile phone subscriptions

11.4 What are the consequences of unequal access?

11.4.1 What is the digital divide?

Unequal access to information technology creates a division between people with access and people without. Such divisions can have implications for economic growth and social equity. How often do you consider access to the internet as a necessity, not a luxury item?

There is a growth in internet access worldwide. However, the gap between low-income and **middle-income countries** is widening. This is known as the **digital divide**. The divide is primarily based on internet access, but it includes all forms of information and communication technology, as can be seen in tables 1 and 2.

It is also evident within countries that some people have access to high-speed internet, while others only have access to dial-up internet. This may be because of:

- income levels
- availability in local areas
- capabilities of computers and laptops
- the speed of internet access
- the level of technology assistance
- the price of connections
- capabilities of mobile phones.

TABLE 1 Middle-income countries, 2005 and 2014

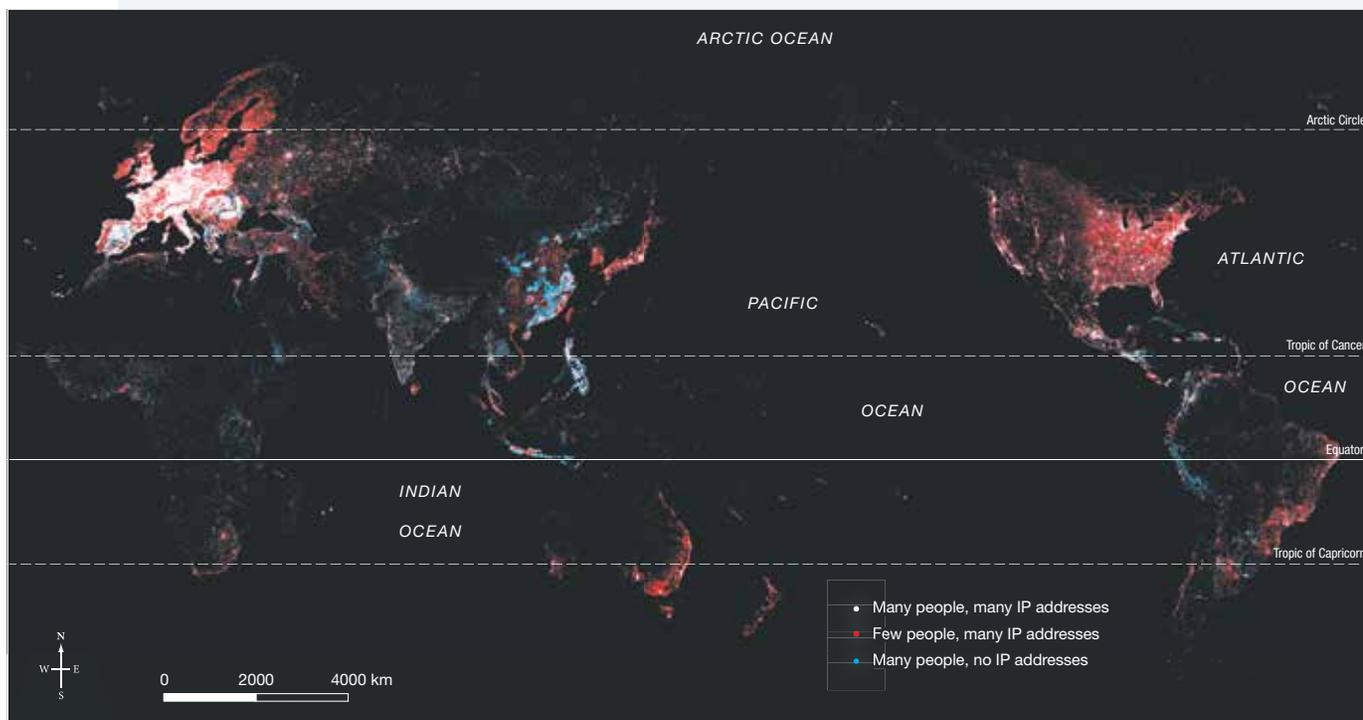
| | 2005 | 2014 |
|---|------|------|
| Sector performance | | |
| <i>Access</i> | | |
| Fixed-telephone subscriptions (per 100 people) | 13.5 | 10.2 |
| Mobile/cellular telephone subscriptions (per 100 people) | 23.4 | 93.6 |
| Fixed (wired) broadband subscriptions (per 100 people) | 1.1 | 4.3 |
| Households with a computer (%) | 14.1 | 32.2 |
| Households with internet access at home (%) | 6.7 | 32.5 |
| <i>Usage</i> | | |
| International voice traffic, total (minutes/subscription/month) | 3.8 | 4.6 |
| Individuals using the internet (%) | 7.1 | 34.1 |
| <i>Quality</i> | | |
| Population covered by a mobile/cellular network (%) | 86 | 97 |

TABLE 2 Low-income countries, 2005 and 2014

| | 2005 | 2014 |
|---|------|------|
| Sector performance | | |
| <i>Access</i> | | |
| Fixed-telephone subscriptions (per 100 people) | 0.8 | 0.9 |
| Mobile/cellular telephone subscriptions (per 100 people) | 3.9 | 57.2 |
| Fixed (wired) broadband subscriptions (per 100 people) | 0.00 | 0.2 |
| Households with a computer (%) | 1.3 | 4.5 |
| Households with internet access at home (%) | 0.3 | 4.2 |
| <i>Usage</i> | | |
| International voice traffic, total (minutes/subscription/month) | — | — |
| Individuals using the internet (%) | 1.0 | 6.3 |
| <i>Quality</i> | | |
| Population covered by a mobile/cellular network (%) | 38 | — |

This gap does not necessarily divide society in two. It is also important to note that large populations do not always correlate with increased internet access (see figure 1).

FIGURE 1 Internet users (per 100 people)



Source: The World Bank: Internet users (per 100 people)

The digital divide is not fixed or static; it changes as the structure and characteristics of the population shift. Digital disadvantage is a dimension of poverty, which leaves people with a sense of powerlessness. If your ability to connect to information and communication technology is limited, this can affect what you are able to do with your life.

11.4.2 Why bridging the gap is important

- *Economic equality.* Some social welfare services are administered electronically, so access to a telephone and the internet is important. The telephone also provides security, and can be used in emergency situations. In addition, access to the internet can be important for career development and accessing civic information.
- *Social mobility.* Computers play an important role in learning and education. The digital divide is unfair for children in lower socio-economic groups. The higher the qualification held by an individual, the more likely they are to have internet access at home.
- *Democracy.* Some people think that access to the internet creates a healthier democracy. It is thought that it increases public participation in elections and decision-making processes.
- *Economic growth.* Information and communication infrastructure and active use could stimulate economic growth, particularly for less developed nations. Economic changes and improvements tend to be associated with information technology. Certain industries can give a country's economy a competitive advantage.

11.4 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Define the term *digital divide* in your own words.

Explain

2. Refer to tables 1 and 2.
 - (a) Comparing low-income and middle-income countries, what **changes** have occurred between 2005 and 2014 to the percentage of individuals using the internet? Why?
 - (b) Comparing low-income and middle-income countries, what **changes** have occurred between 2005 and 2014 to the percentage of fixed telephone subscriptions? Why?

Predict

3. Based on table 2, predict how many people in low-income countries will have access to mobile networks in 2100. Give reasons for your answer.

Think

4. Why do you think the uptake of mobile/cellular telephone subscriptions in middle-income countries has been significantly higher than in low-income countries? Explain.

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 Try out this interactivity: The digital divide (int-3342)

11.5 How has technology improved lives in developing countries?

11.5.1 The situation in Kenya

While there is a difference between the developed and developing world, it is important to note that access to the internet and mobile phone networks is improving. This is largely thanks to non-government agencies and to service providers. The people of Kenya, for example, no longer need to take long journeys into town or to wait in long queues just to transfer money. Instead, they can type in a couple of numbers, hit a button, and pay for anything they want within seconds via mobile phone.

Most people in Kenya live in rural and remote places in the countryside. Landline access is very limited, and it is also considered costly to install, owing to the vast distances. This can leave families disconnected from one another, as the primary earner in the family often has to work in a distant township in order to provide money for the family. Those left in the rural villages are often self-employed farmers or tradespeople. Without communication, families are often disconnected.

Improving access

Mobile phone coverage and access has been significantly improved in Kenya, which has dramatically improved people's lives. The UK-based non-government organisation (NGO) called Financial Deepening Challenge Fund (FDCF) has worked with Vodafone to set up M-Pesa, meaning 'mobile money'. A customer can go to an M-Pesa agent, such as a supermarket, and:

- deposit and withdraw money
- transfer money to other users and non-users
- pay bills
- purchase phone credit
- transfer money between the service and a bank account (see figure 1).

People do not need a bank account or even a permanent address to use M-Pesa. They receive a text message to confirm a transaction, and the money can then be stored on the phone or it can be forwarded to someone else. At any time, the money can be transferred back to cash through an M-Pesa agent or an ATM. Figures 2 and 3 show population and mobile phone coverage, indicating the coverage is significant in highly populated areas.

FIGURE 1 A customer at an M-Pesa agent

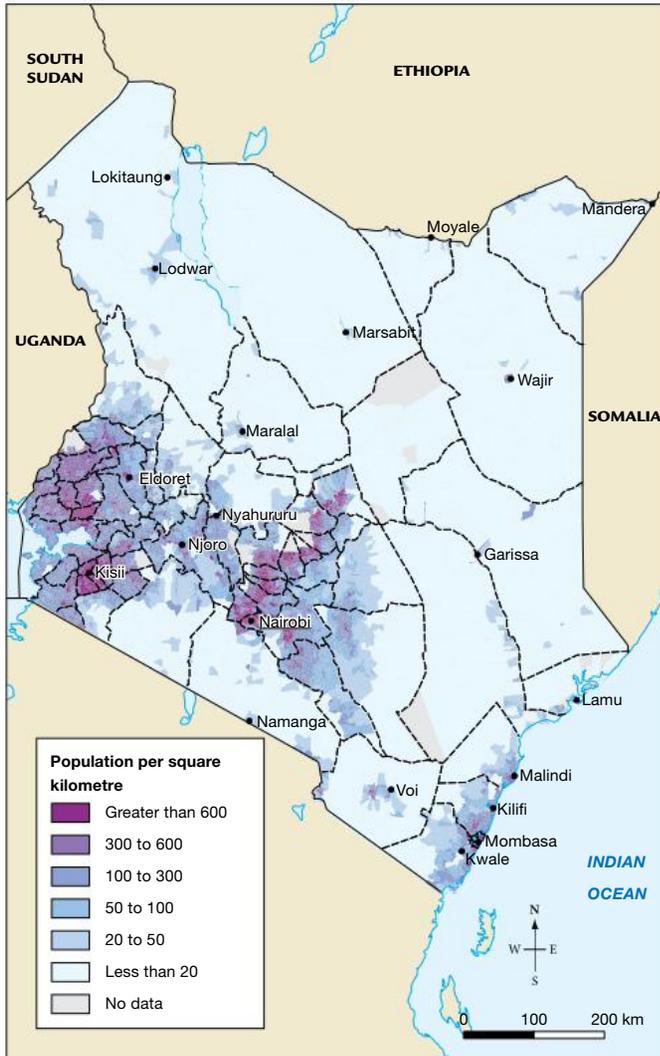


11.5.2 How successful has it been?

Today there are about 19 million subscribers and over 2200 M-Pesa agents in Kenya. These agents include petrol stations, supermarkets and other retail outlets. By 2010, over 50 per cent of Kenya's population was using M-Pesa. In 2012, when M-Pesa celebrated its fifth birthday, it had recorded over 15 million transactions. By March 2014 there were 260 transactions taking place every second. Figure 4 reflects this change in mobile phone usage and mobile money customers.

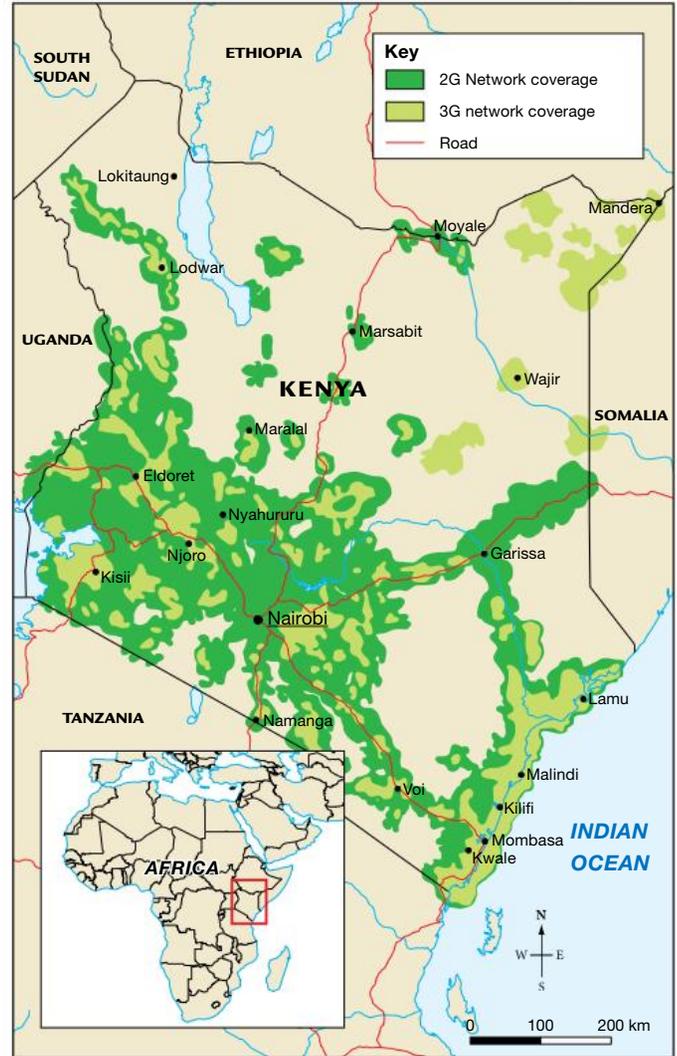
Taxi drivers have benefited, too. They no longer need to drive around with a lot of cash in their cars, because their passengers are able to pay using M-Pesa.

FIGURE 2 Kenya, population density



Source: Spatial Vision

FIGURE 3 Kenya, mobile phone coverage



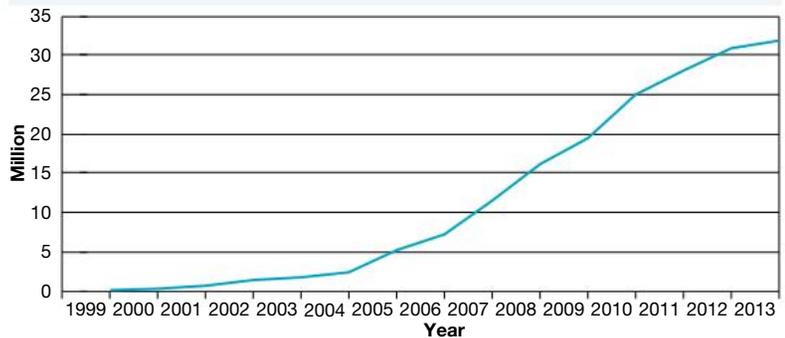
Source: A map of mobile coverage, Omae Malack Oteri, Langat Philip Kibet and Ndung'u Edward N., "Mobile Subscription, Penetration and Coverage Trends in Kenya's Telecommunication Sector" International Journal of Advanced Research in Artificial Intelligence(IJARAI), 4(1), 2015. <http://dx.doi.org/10.14569/IJARAI.2015.040101>

It has also been seen as an improvement in personal safety, because it is a secure and easy way to transfer money.

Access to mobile phones for small business operators has meant they are now able to advertise to a larger audience, and are no longer dependent on word-of-mouth advertising. Clients can now contact business operators with ease. For those working away from home, it is a safe and easy way to send money back to families in the countryside. This has enabled Masai herdsmen to go to the markets and make purchases by using their mobile phones. M-Pesa has eliminated the need to carry large sums of cash to markets, and has reduced the number of thefts.

M-Pesa demonstrates how dreaming big but thinking locally can have a significant effect on the economic and social structure of a place, just through the use of a mobile phone.

FIGURE 4 Changes to mobile phone subscriptions in Kenya



11.5 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. How successful has M-Pesa been in Kenya? Ensure you use specific examples in your answer.
2. What **interconnections** can now occur between people because of M-Pesa?

Explain

3. Why would safety be a concern to people in Kenya? How does safety relate to information and communication technology in Kenya?
4. Which **places** in Kenya are well serviced by the mobile phone network?
5. Which **places** are not well serviced by the mobile phone network? Suggest reasons for this.

Discover

6. Using the internet, research how another developing country has improved its information and communication technology. Create a multi-modal presentation on your findings.

Think

7. Which services in Australia serve a similar purpose to M-Pesa? Explain what they are and how they operate.

11.6 What are the impacts of e-waste production and consumption in China?

11.6.1 Introduction

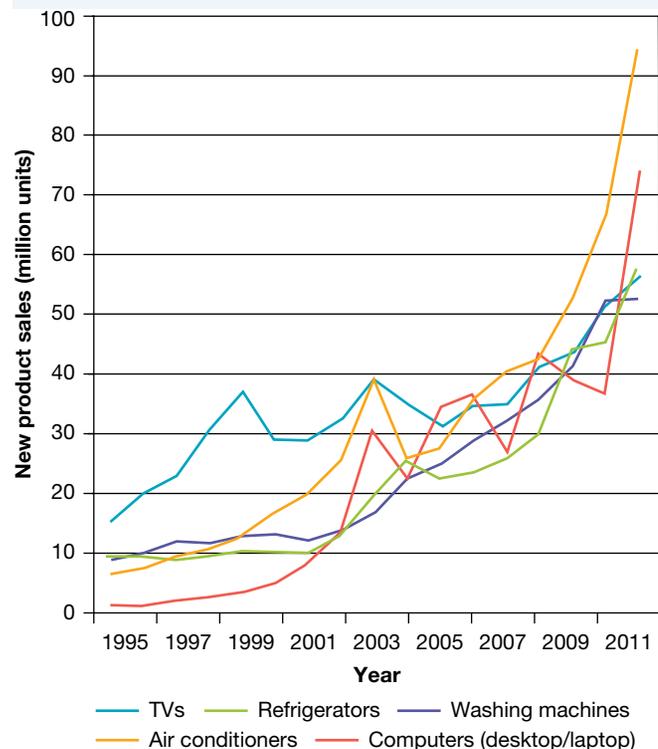
China is one of the largest producers and consumers of electronics. Almost 50 per cent of the major home appliances manufactured in China are exported. However, due to China's growing economy and the increase in its development, the other 50 per cent is attributed to local consumption. Figure 1 shows the changing nature of the sale of home appliances in China, which reflects growth in the national economy.

As a result, China has a growing **e-waste** problem from both domestic and international markets. The informal processing of e-waste has resulted in damage to local environments and people's health. Until formal policies are established, informal recycling will co-exist with formal recycling companies.

11.6.2 Production and consumption

Manufacturing accounts for about one-third of China's economic output; of this, about half is the production of electronic goods. This growing industry has resulted in an increase in

FIGURE 1 Sales of five major home appliances in China



the GDP per capita of the country. The GDP (per capita) has risen from US\$ 5572 in 2011 to US\$ 7590 in 2014. In 2011, 0.25 billion mobile phones were sold in China — more than any other electronic product.

11.6.3 E-waste

The importation of e-waste was banned by the Chinese Government in 2000; however, flows are still making their way into the country. The high levels of consumption of electronics globally poses a challenge for the Chinese Government as items reach the end of their life cycle or become obsolete. There are four main ways e-waste is making its way into China, even though the government has placed a ban:

- direct shipment to Chinese ports
- mixed shipments with bulk steel and copper scraps
- transit through Hong Kong
- transit through Vietnam.

11.6.4 Informal and formal collection

Formal collectors of e-waste are tax-paying businesses that recycle using environmentally sound methods. In contrast, informal collectors are self-employed, and often migrants, who travel door-to-door collecting household items for cash.

The formal collectors form a part of the national Home Appliances Old for New Rebate Program. This program was set up by the government to stimulate the purchasing of new products, and hence the economy, and to ensure the proper recycling of old appliances. Only authorised collectors such as retailers, chain stores and supermarkets are allowed to participate in this program (see figure 2).

FIGURE 2 Spatial distribution of registered formal e-waste recyclers in China



Source: E-Waste in China: A Country Report, StEP Initiative / United Nations 2012

In 2011 formal collectors collected 61.29 million home appliances, with e-waste making up about 64 per cent of this. Informal collectors work as brokers between consumers and medium-level scrap dealers. This method is convenient for households as it saves them time and also generates a small amount of money. About 20 million migrants are involved in the informal collection of household goods, many of which are e-waste. Figure 3 shows the distribution of informal sites and ports throughout China.

The formal sector is also less efficient than the informal sector as it does not have access to individual households. A similar trend is also seen in countries such as India, Nigeria and Pakistan, where the informal sector is growing and employs a lot more people.

FIGURE 3 Spatial distribution of informal e-waste recycling sites and ports through which e-waste shipments enter China

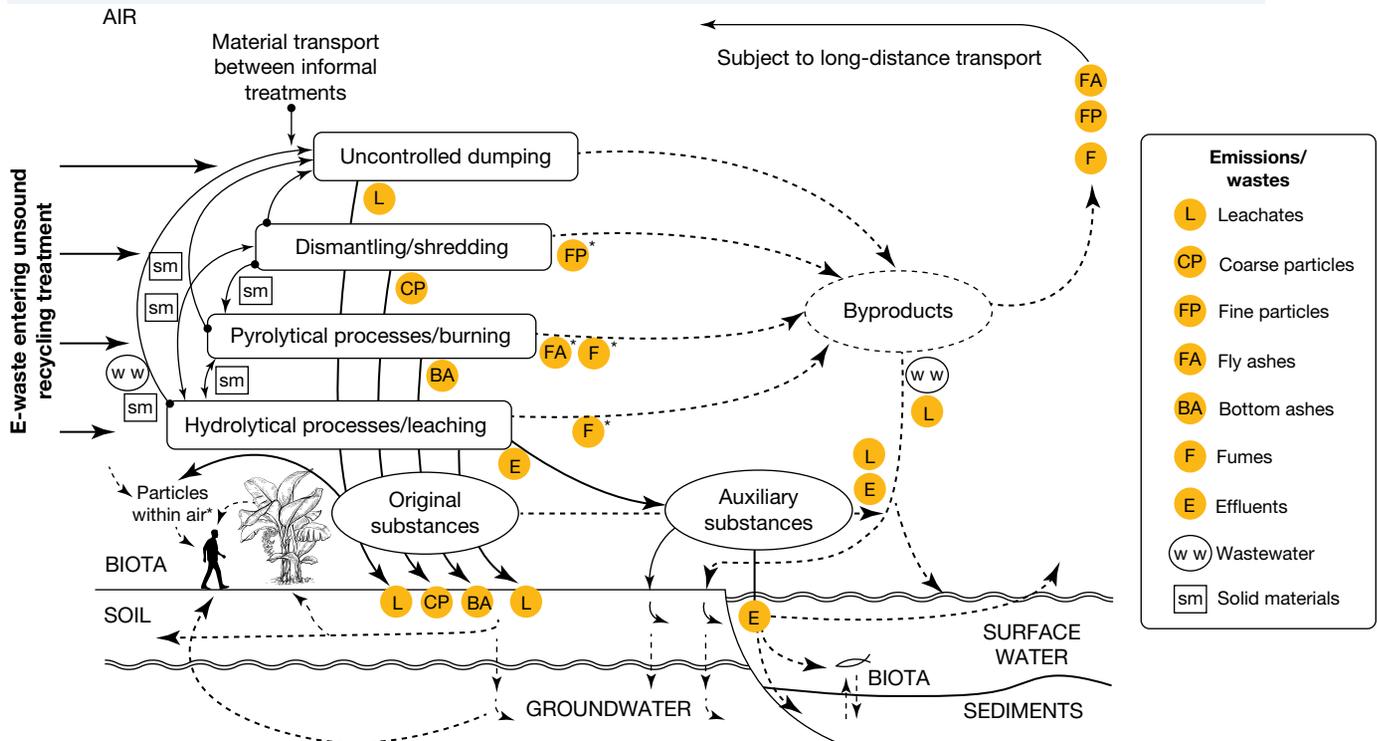


Source: E-Waste in China: A Country Report, StEP Initiative / United Nations 2012

11.6.5 Impacts of informal collection

The two largest centres for informal collection are located in the Guangdong Province and the Zhejiang Province (see figure 3). This method of collection is often labour intensive and involves contact with toxic and dangerous hazards. When workers dismantle equipment they do not use adequate protection, which leads to exposure (see figure 4).

FIGURE 4 Emissions and environmental pathways from informal e-waste recycling in China



11.6.6 Law and regulations

There are five main pieces of legislation regarding the management of e-waste in China:

- The Basal Convention, passed in February 2000
- The Technical Policy on Pollution Prevention and Control, enacted in 2006
- The Ordinance on Management of Prevention and Control of Pollution from Electronic and Information Products, implemented in 2007
- Administrative Measures on Pollution Prevention of Waste and Electrical Equipment, enacted in 2008
- The Regulation on Management of the Recycling and Disposal of Waste Electrical and Electronic Equipment, implemented in January 2011.

11.6 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What percentage of electronic goods is exported from China?

Explain

2. What factors have contributed to the increase in wealth in China?

Discover

3. Research one of the two main provinces that continue to participate in informal processing of e-wastes. What are the impacts on the people and the environment?

Think

4. Create a poster that gives suggestions for ways China can curb its informal collection and processing of e-wastes.

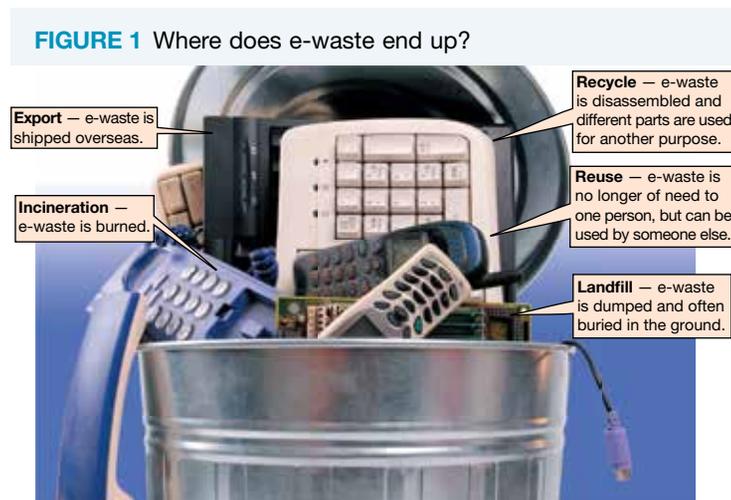
Despite this, illegal activity still occurs. Some local governments see these laws as a way of restricting progress and contrary to local interests and as a result they are not enforced. In addition, given the large number of ways e-waste is still entering China, reforms of customs controls are required.

11.7 How are e-wastes managed?

11.7.1 What is e-waste?

Litter in the schoolyard is only minor waste compared with that produced by technology and communication: e-waste. A controversial issue is how to dispose of it. The disposal and trade of e-waste is seen by developed nations as a solution and by many developing countries as a money maker. How e-waste is dealt with has serious economic, environmental and social consequences.

E-waste is any old electrical equipment, such as computers, toasters, mobile phones, iPods and televisions, that is broken, obsolete or no longer wanted. Given our technology-based lifestyle, our e-waste pile is growing at an alarming rate — faster than we know what to do with. There are five main places where e-waste usually ends up (see figure 1).



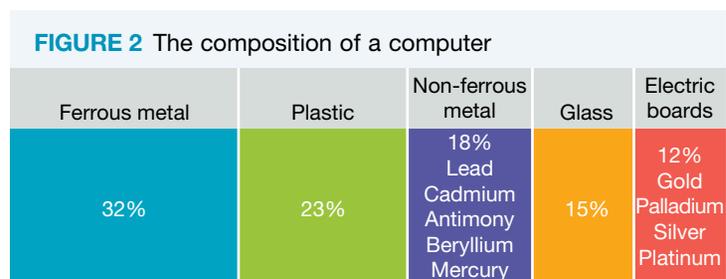
11.7.2 What are the impacts of e-waste?

Many of us do not think about where our rubbish goes. We just put it in a bin, and then it is out of sight, out of mind. However, e-waste is now a part of the global economy, and is sold, shipped and dumped worldwide.

We must think about the ramifications of such actions. Computers are made up of many toxic chemicals and metals; when dumped, these can cause significant environmental and health problems (see figure 2).

Health impacts

In the slums of Delhi, computers, keyboards and monitors are pulled to pieces and then placed in acid baths or melted, to extract metals. This practice should only ever occur in proper recycling facilities, where safety precautions can take place. Consequently, there has been a rise in Delhi of **mercury poisoning** and other side effects of dealing with cadmium, plastic, PVC, barium, beryllium, and carcinogens such as carbon black and heavy metals (see figure 3).



A report by India's Department of Scientific and Industrial Research showed that e-waste being sent to India is increasing by 10 per cent each year. Slum dwellers are unsafely disassembling the e-waste, and toxins are damaging the health of an enormous number of people.

Exposure to mercury, even in tiny amounts, can lead to health problems and threaten child development. It damages the nervous, digestive and immune systems, and harms the lungs and kidneys. It is corrosive to the eyes and skin and to the gastrointestinal tract if swallowed. Neurological and behavioural disorders have also been observed, which can lead to insomnia, memory loss and motor dysfunction. A large number of women and children in India now expose themselves daily to mercury while working in makeshift e-waste recycling facilities in slums.

Environmental impacts

As we have seen, thousands of tonnes of e-waste are being dumped in developing countries. There, the e-waste is burned in informal recycling stations in slums. In the slums, there is nowhere to dispose of byproducts such as acid and cyanide, and they are simply dumped in the local waterways or onto the soil. This contaminates aquifers and destroys vital freshwater resources, making the land too toxic to farm.

The issue is that the e-waste can be of great value to the citizens of developing nations, such as China and India, because it is a fairly easy way to make money. For example, the circuit boards of most phones contain precious metals such as copper, gold, lead and zinc which can be extracted and sold. However, there are many poisonous substances as well, which are dangerous to people and the environment (see figure 3). For example, burning the plastic coating around copper wires gives off deadly fumes, while heavy metals dumped into local rivers creates hazardous pollution.

The burning of plastic leads to an increase in air pollution, resulting in above-standard emissions. The air is often left with the stench of acid, paint and plastic, which impairs people's quality of life. Contamination of agricultural soils may occur, affecting local farms, which are often the main form of income in developing countries.

FIGURE 3 Health impacts of e-waste on waste workers and people who live near landfills or incinerators

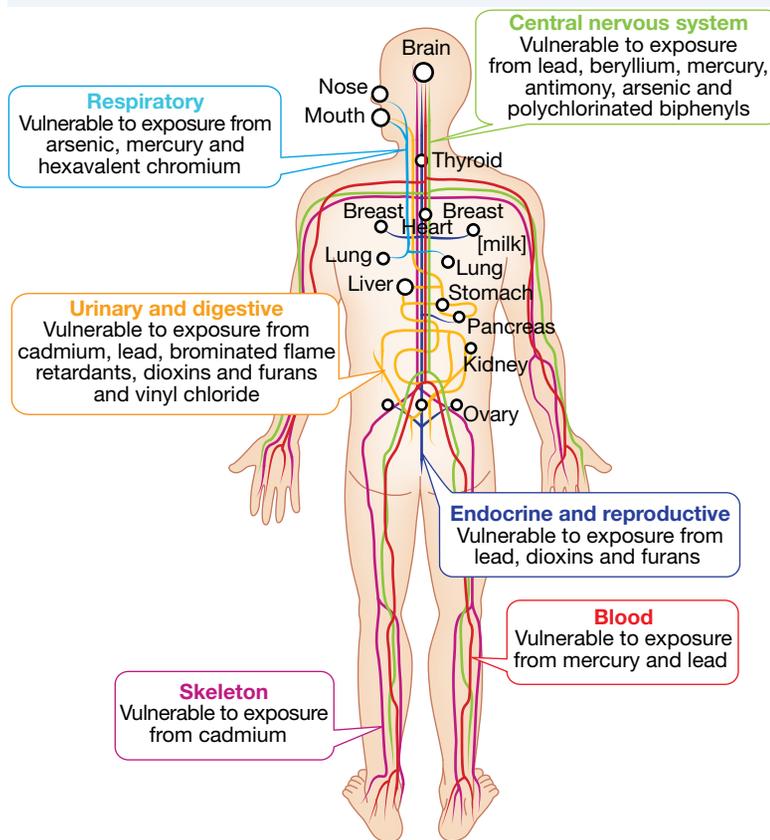


FIGURE 4 Two goats in a heavily polluted part of a slum in Ghana, Accra. When e-waste ends up in landfill, the toxins, carcinogens and heavy metals in it can leach into the environment. These substances then contaminate the groundwater and soil and enter the food chain.



Waste acids recovered from the burning process, which are of no value or use, are often dumped in rivers and streams, damaging the ecosystem. Often this leaves waterways black and pungent, and leads to contamination of drinking water. In Guiyu, China, the water is so toxic it can disintegrate a coin within a few hours.

11.7.3 International management of e-waste

By the start of this century, many countries could not deal with either the quantity or toxicity of the e-waste they were generating. One solution was to export it to developing nations that did not have laws in place to protect workers or the environment. It is also significantly cheaper to recycle waste in developing nations.

FIGURE 5 Who gets the trash?



Source: Data from Greenpeace

Concerns in Europe regarding the export of e-waste led to an agreement, known as the Basel Convention, being developed to manage the movement and disposal of hazardous wastes. The convention was adopted by the European Union (EU) in 1994 and has now been accepted by more than 151 countries, including Australia. The countries that sign the convention must:

- keep the production of hazardous waste as low as possible
- make suitable disposal facilities available
- reduce and manage the international movement of hazardous waste
- ensure management of waste is controlled in an environmentally friendly way
- block and punish illegal movement of hazardous waste.

However, the EU has reluctantly admitted that its rules are only somewhat effective, as the bans on exporting e-waste are being ignored or avoided.

Rotterdam is Europe's busiest port, with more than 11 million shipping containers passing through it each year. Despite every effort, only about three per cent of all containers in Rotterdam are checked; consequently only about one illegal shipment of e-waste is caught each week. Inevitably, containers of e-waste slip through. One of the difficulties that customs officers face is the fact that it is not illegal to export goods to be re-used and sold as secondhand goods. The fines for companies illegally exporting e-waste are between A\$300 and A\$9000.

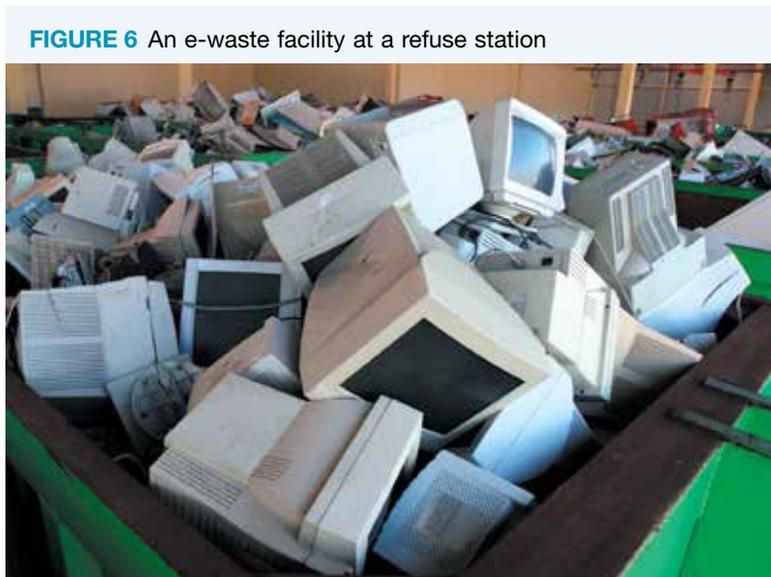


FIGURE 6 An e-waste facility at a refuse station

The United Kingdom's Environment Agency, which is in charge of regulating hazardous waste in England and Wales, has set up international cooperation and intelligence with over 40 countries. This is being done in order to combat the illegal smuggling of e-waste, and companies are fined if they are caught. The United States has not ratified the Basel Convention, and they are seen as lagging behind Europe. Almost 80 per cent of its e-waste goes to China via Hong Kong.

Until we find a cheap alternative to dumping waste overseas, it is going to be difficult to compete with this process in developed countries. More research needs to be done on how to make recycling safer in developing countries, and how to enable it to take place in proper factories instead of unsafe makeshift plants.

11.7.4 Local e-waste management

According to the ABS, almost all Australian households were involved in some form of recycling in the past 12 months. One report shows that by 2017, e-waste production in Australia will reach 65.4 million tonnes, which is the equivalent of about 1200 Sydney Harbour bridges.

Locally, most waste transfer stations in metropolitan areas now have e-waste facilities. A visit to the tip is no longer a matter of putting everything into **landfill**; it involves a more complex system of organisation. On arrival at your local waste transfer station, you are directed to various stations to dispose of your waste. Such stations include green waste, white goods, oils, gas bottles, petrol cans, copper and e-waste. This sorting of waste not only reduces the need for landfill, but also encourages and enables more recycling to take place.

11.7 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. Define the term *e-waste*. Compile a list of potential e-waste either in the classroom or in your home.
2. Why is it difficult to prevent the illegal trade in e-waste?

Explain

3. Using figure 5, explain the geographical pattern to illegal dumping of e-waste. Ensure you make specific reference to *places* in Asia on the map.

Discover

4. Discover the difference between ferrous and non-ferrous metals. Which is more harmful to humans and the *environment*?
5. Research the metals listed in figure 3, and explain what makes them harmful to humans and what *environmental* effects they can have.

Think

6. Create a presentation on how e-waste is managed at your school. Suggest strategies for making the current management techniques more *sustainable*.
7. Why are international agreements on e-waste difficult to manage?

learnON RESOURCES – ONLINE ONLY

 Try out this interactivity: e-wasted (int-3343)

11.8 SkillBuilder: Constructing a table of data for a GIS

online only

WHY ARE THERE TABLES WITHIN GIS?

AGIS, or geographical information systems, uses tables to organise and store information about points, lines and polygons (vector data). These tables have rows and columns, called fields. The GIS software links the rows in the table to the points, lines or polygons on a map.

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

FIGURE 1 In a GIS, each row in a table like this may be linked to a polygon on the map.

| Sample | Address | No. home | No. mobiles |
|--------|-----------------|----------|-------------|
| 1 | 42 Jacob Street | 2 | 4 |
| 2 | 27 Jacob Street | 3 | 3 |
| 3 | 36 Adele Avenue | 4 | 3 |
| 4 | 34 Flint Street | 4 | 1 |
| 5 | 35 Flint Street | 5 | 3 |
| 6 | 25 Flint Street | 4 | 2 |
| 7 | 12 Jess Court | 4 | 2 |
| 8 | 2 Jess Court | 4 | 4 |
| 9 | 12 Flint Street | 5 | 3 |
| 10 | 52 Jacob Street | 6 | 2 |

learnON RESOURCES – ONLINE ONLY

 Watch this eLesson: Constructing a table of data for a GIS (eles-1743)

 Try out this interactivity: Constructing a table of data for a GIS (int-3361)

11.9 How does e-cycling work?



Access this subtopic at www.jacplus.com.au

11.10 How can you reduce your consumption?

11.10.1 Act local, think global

On a global scale, entrepreneurs are tackling the waste problem society is creating. We live in a part of the world where consumption of information and communication technology is high. However, some global solutions have now been set up to ensure that individuals can easily find out online about what is recyclable, and can then undertake recycling from their own home. Society is now being encouraged to act locally, while thinking globally. This is an important concept when it comes to reducing and managing our own consumption.

11.10.2 Recycling your e-waste

In 2009, only nine per cent of the 16.8 million electronic devices discarded were recycled. About 88 per cent went to landfill, and the rest was exported as waste. Globally, 57.4 million tonnes of e-waste was recycled in 2010, and more than 75 million tonnes in 2015.

According to the ABS, when people were surveyed about their e-waste disposal, most stated that they did not recycle because they did not generate enough materials to warrant the use of e-waste services or facilities. Perhaps if everyone knew more about the hazardous nature and environmental impacts of e-waste, the idea of recycling would be embraced.

Below are some innovative ways of dealing with waste.

Ziilch

Most of us have an old computer we no longer use, or an old charger for a device we no longer have. We may even have books, furniture or clothing that could be recycled. The website Ziilch has come up with an easy solution to de-clutter, find new items and save on disposal costs. It is as easy as a click of a button (see figure 1).

This online company connects people in different places, and the platform enables you to exchange goods for free. This promotes the idea of recycling, which reduces consumption and will hopefully lead to a more sustainable future.

MobileMuster

MobileMuster is a simple, easy way to dispose of old mobile phones, batteries and accessories.

MobileMuster is voluntarily funded and managed by distributors, network carriers, service providers and manufacturers. It is a free service where you can send your mobile phone or find your nearest drop-off point, of which there are over 4500 in Australia. This ensures that mobiles are recycled correctly rather than dumped in landfill. Over 90 per cent of materials in mobile phones can be recycled (see figure 2).

FIGURE 1 How Ziilch works

How does it work?

- 1 List your item for FREE on the Ziilch website
- 2 People looking for free stuff request your item.
- 3 You choose someone to give the item to.
- 4 Arrange for the item to be collected or posted.

By using a certified recycling program, you can ensure that your e-waste is not being illegally exported, and the environment is not being contaminated by the metals and minerals in the products.

Reduce energy consumption

It is not only important to be involved in recycling, but also to reduce your **carbon emissions**, which is another by-product of information and communication technology. Some strategies include:

- turning off your PC overnight, on weekends and during holiday periods
- ensuring printers and other equipment are switched off when not in use
- refraining from printing emails whenever possible
- removing active screensavers
- only charging your mobile phone when it is flat.

National Television and Computer Recycling Scheme

The National Television and Computer Recycling Scheme, which commenced in November 2011, provides households and small businesses with free recycling services for televisions and computers. While it is governed by the *Australian Government Product Stewardship Act* of 2011, state and territory governments retain responsibility for regulating waste.

The first drop-off points were rolled out in 2012 in metropolitan areas, and expanded into rural and remote areas in 2013 with 98 per cent of the population having reasonable access to the service. The scheme will accept all televisions, computers, and computer accessories such as keyboards and hard drives. To date, more than 130 000 tonnes of televisions and computers has been collected from more than 1800 collection points.

It is hoped that by 2021–22, 80 per cent of computers and televisions will be recycled, compared to the 17 per cent that are recycled today.

FIGURE 2 The mobile phone recycling process

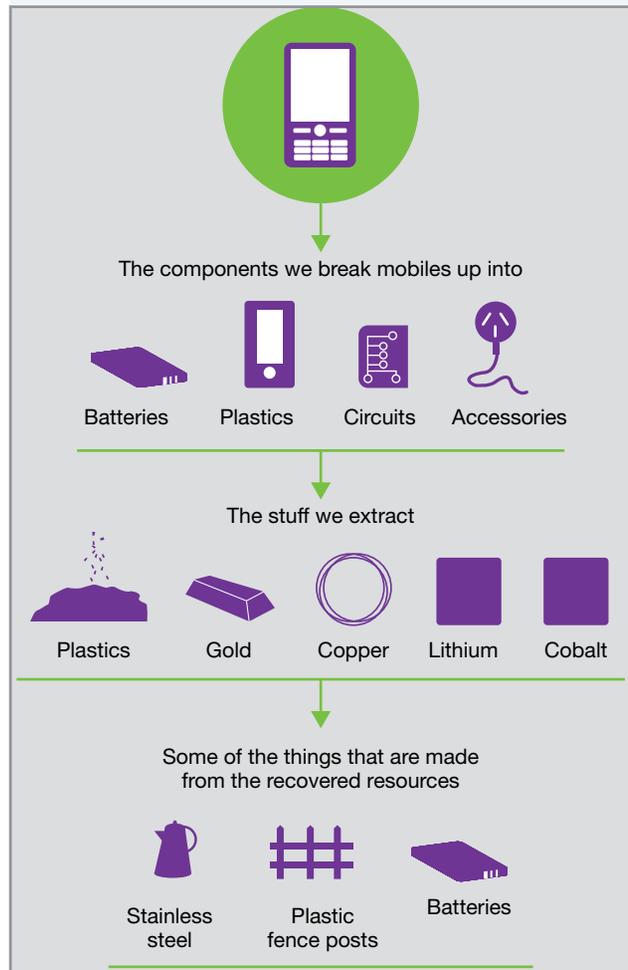
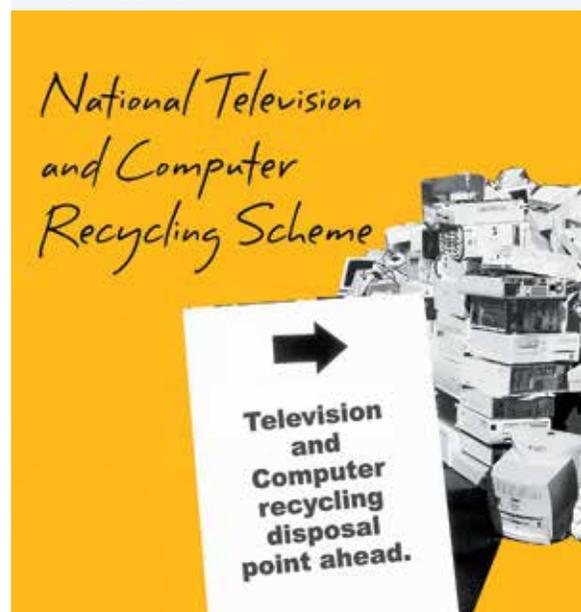


FIGURE 3 Australia's television and computer recycling program



11.10 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

- (a) In 2009, what percentage of discarded electronic devices was recycled?
(b) What was the main excuse that people gave for not recycling?
- Refer to figure 2. Name three byproducts extracted from mobile phones and two products that can be made from recovered resources in mobile phones.

Think

- Have you ever participated in a national or global recycling scheme? If so, explain what it was and what you recycled. If not, suggest what you could recycle and how to do so.
- Create a list of things you can do in your house to reduce your energy consumption.

Discover

- Find out where your nearest National Television and Computer Recycling Scheme drop-off point is. Describe this **place** in relation to where you live. Is it realistic for you to take your recyclables there?
- In a group, conduct a class survey in which you interview students and teachers about their recycling habits.
 - Decide on the types of questions you wish to ask and how you will record responses. If you wish to do this online, use the **Survey Monkey** weblink in the Resources tab.
 - After you have conducted your surveys, collate and present your findings in graphic form.
 - Analyse your graphs and write a summary of your findings, ensuring you cover the following questions.
 - Are students more **environmentally** conscious than teachers?
 - Does age make a difference?
 - Prepare a recycling plan for your school.

learnon RESOURCES – ONLINE ONLY

 Explore more with this weblink: Survey Monkey

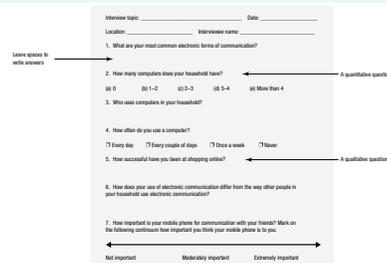
11.11 SkillBuilder: Using advanced survey techniques – interviews

online only

WHAT ARE INTERVIEWS THAT SURVEY PEOPLE'S OPINIONS?

Conducting a survey means asking questions, recording and collecting responses, and collating the number of responses.

FIGURE 1 Sample interview questions



Interview topic: _____ Date: _____
Location: _____ Interviewee name: _____

Learn about in this answer →

1. What are your most common electronic forms of communication? ← A qualitative question

2. How many computers does your household have? ← A quantitative question
(a) 0 (b) 1–2 (c) 3–5 (d) More than 4

3. Who uses computers in your household?

4. How often do you use a computer?
 Every day Every couple of days Once a week Never

5. How successful have you been at shopping online? ← A qualitative question

6. How does your use of electronic communication differ from the way other people in your household use electronic communication?

7. How important is your mobile phone for communication with your friends? Mark on the following continuum how important you think your mobile phone is to you.
← Not important Moderately important Extremely important →

Go online to access:

- a clear step-by-step explanation to help you master the skill
- a model of what you are aiming for
- a checklist of key aspects of the skill
- a series of questions to help you apply the skill and to check your understanding.

learnon RESOURCES – ONLINE ONLY

 Watch this eLesson: Using advanced survey techniques (eles-1742)

 Try out this interactivity: Using advanced surveying techniques (int-3360)

11.12 Review



11.12.1 Review

The Review section contains a range of different questions and activities to help you revise and recall what you have learned, especially prior to a topic test.

11.12.2 Reflect

The Reflect section provides you with an opportunity to apply and extend your learning.

Access this subtopic at www.jacplus.com.au

11.8 SkillBuilder: Constructing a table of data for a GIS

11.8.1 Tell me

Why are there tables within GIS?

A GIS, or geographical information system, uses tables to organise and store information about points, lines and polygons (vector data). These tables have rows and columns, called fields. The GIS software links the rows in the table to the points, lines or polygons on a map. GIS software also stores data as pixels in an image, called raster data.

The tables can be drawn with a spreadsheet program and linked to a GIS if there is relevant information about location in the table. However, specialist software is required.

Why are tables useful in GIS?

Tables are very useful ways of storing large amounts of information, because they help to organise it. Creating tables makes it easy for GIS software to read data and to import or export the data to other programs, such as Excel.

A table allows us to access the original data. Maps, on the other hand, often use symbols and colours to represent information, and therefore they may not be as precise. Setting up the structure for a table helps us to understand how information may be stored digitally.

Model

A good table of data:

- places point, line and polygon features into separate tables
- has rows in the table that relate to the points, lines or polygons on the map
- has columns called fields, which store the data as numbers (integers) or text
- has column (field) names that are no more than ten characters long and contain no spaces
- identifies the date, source and collector of the data, and stores this in the GIS program — this is called *metadata* in a GIS.

11.8.2 Show me

How to construct a table of data

You will need:

- a piece of paper or a spreadsheet
- a data set — in this case, the results of a class survey about mobile phones.

Procedure:

Imagine that your class has conducted a survey to find out how many mobile phones there are in each home, asking the following questions:

- Where do you live?
- How many people are in your home?
- How many mobile phones are in your home?

You can use the responses to construct a table of data and use GIS to plot the results on a map.

STEP 1

Draw a table with rows and columns. For this data there should be 11 rows (for ten students plus the heading row) and four columns.

FIGURE 1 Create a table with 11 rows and four columns.

STEP 2

Give each of the columns a heading to represent the data collected. Each heading must be short (no more than ten characters) and use underscores instead of spaces.

Create four columns: sample number, address, the number of people in the home and the number of mobile phones.

FIGURE 2 Give each column a short heading of no more than ten characters.

| Sample | Address | No_home | No_mobiles |
|--------|---------|---------|------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

STEP 3

Identify which columns (fields) contain text and which contain numbers (integers). You have to set this first when using GIS software.

FIGURE 3 Work out which are text fields and which are number (integer) fields.

In a GIS, this is a text field because it contains words.

In a GIS, these are integer fields because they contain numbers.

| Sample | Address | No_home | No_mobiles |
|--------|---------|---------|------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |

STEP 4

Enter the collected data into the table. A thematic map of the data can then be created using GIS software.

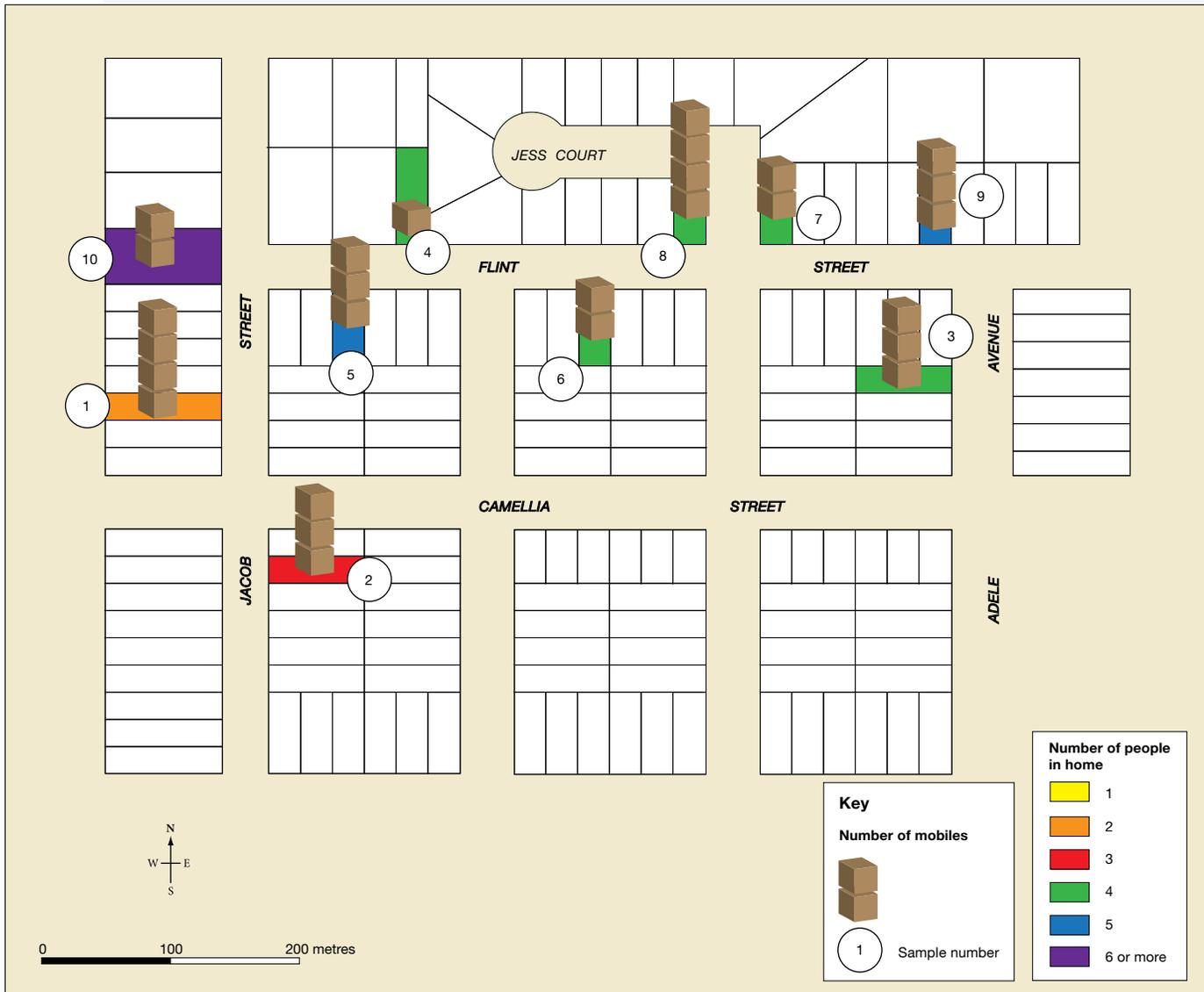
FIGURE 4 Enter the data into the table.

In a GIS, each row in the table is linked to a polygon on the map

| Sample | Address | No_home | No_mobiles |
|--------|-----------------|---------|------------|
| 1 | 42 Jacob Street | 2 | 4 |
| 2 | 27 Jacob Street | 3 | 3 |
| 3 | 36 Adele Avenue | 4 | 3 |
| 4 | 34 Flint Street | 4 | 1 |
| 5 | 35 Flint Street | 5 | 3 |
| 6 | 25 Flint Street | 4 | 2 |
| 7 | 12 Jess Court | 4 | 2 |
| 8 | 2 Jess Court | 4 | 4 |
| 9 | 12 Flint Street | 5 | 3 |
| 10 | 52 Jacob Street | 6 | 2 |

There are two layers on the map. Each land parcel is coloured according to the number of people in the home, and the columns represent the number of mobile phones. The map is shown in figure 5.

FIGURE 5 Map showing the number of mobile phones in each home



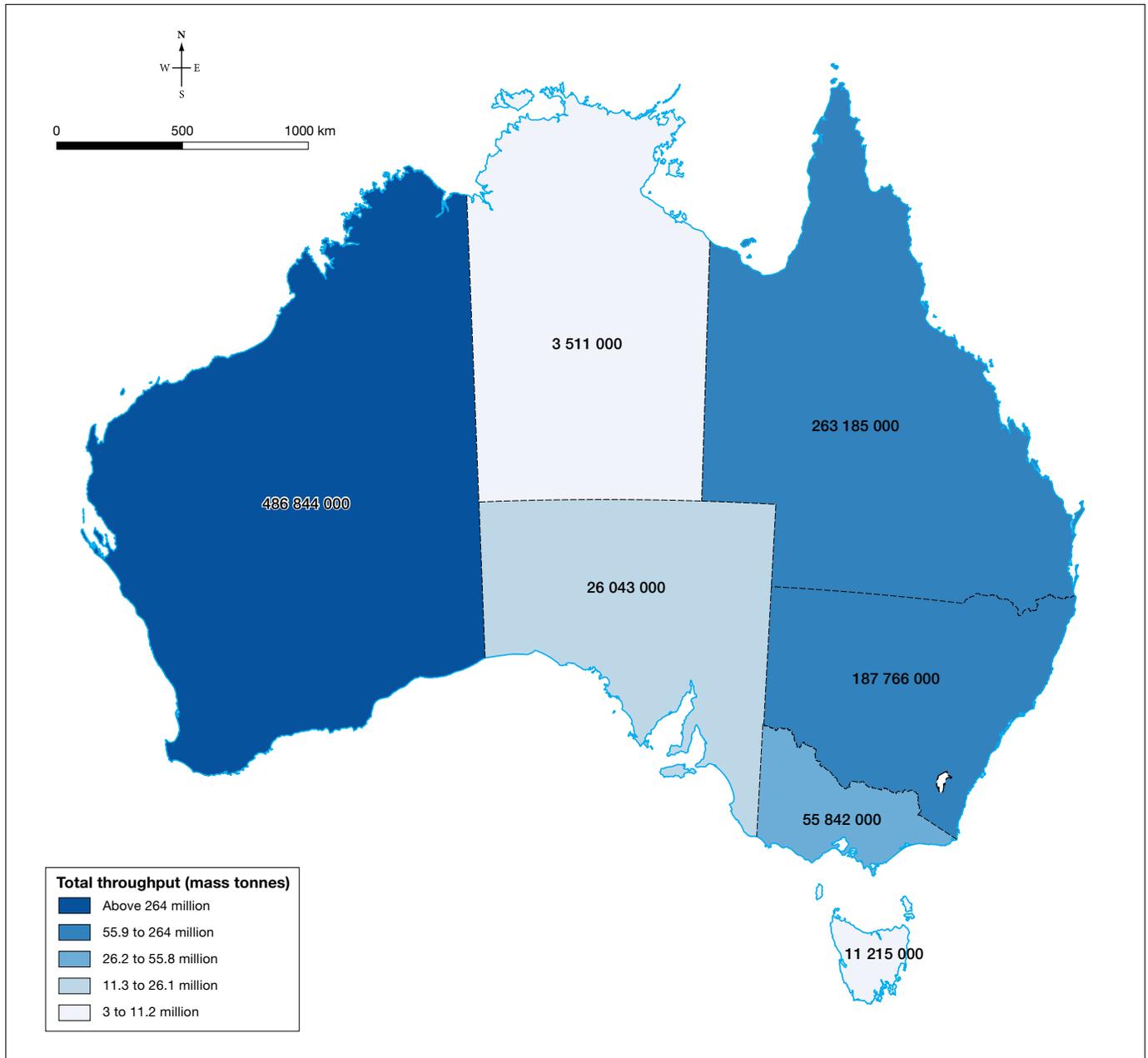
Source: Spatial Vision

11.8.3 Let me do it

Developing my skills

Create tables of data for the two maps shown in figures 6 and 7. Table 1 should be for the polygons (states) and table 2 for the points (ports). Table 1 should have two columns, or fields, and table 2 should have four columns. Identify the text and integer fields in each table.

FIGURE 6 Cargo handled by ports in Australian states and territories, in mass tonnes, 2011–12

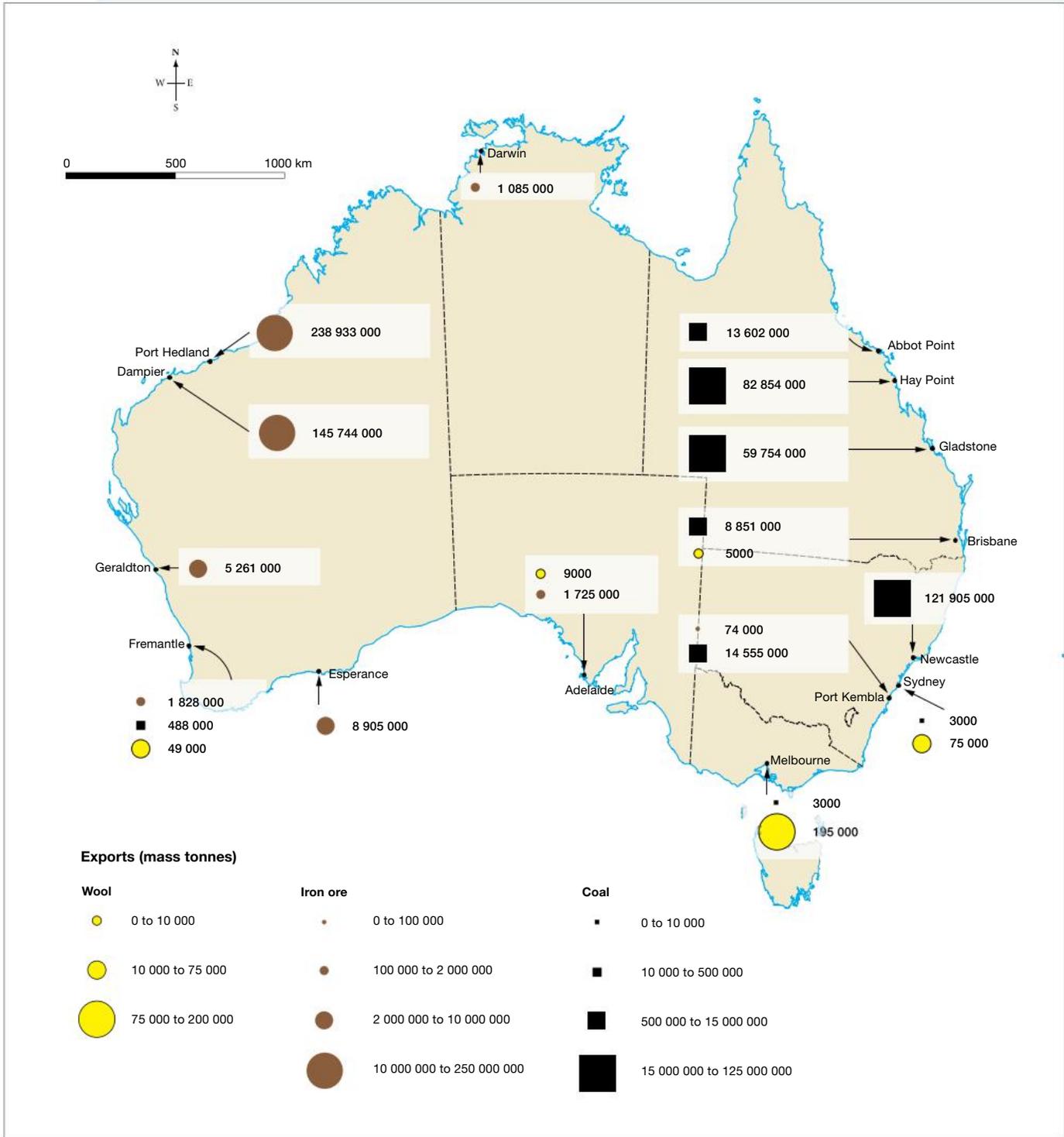


Source: Data © Commonwealth of Australia Geoscience Australia 2013. Map drawn by Spatial Vision.

Questions

1. Which state handled the most cargo by tonnage in 2011–12, and which two states handled the least cargo?
2. Name the two main ports exporting:
 - (a) iron ore
 - (b) coal.
3. Compare the distribution of coal-exporting ports with that of iron ore-exporting ports. What does this tell us about the location of these resources in Australia?
4. Why are the values for wool exports much smaller than those for iron ore and coal?
5. Why do wool exports take place from ports in the southern part of Australia?

FIGURE 7 Ports exporting iron ore, coal and wool, in mass tonnes, 2011–12



Source: Spatial Vision

Checklist

I have:

- created separate tables for polygon and point data (and line data, where relevant)
- created rows in the table that relate to the points, lines or polygons on the map
- identified the text and numeric fields
- ensured that the field headings have been shortened if necessary and contain no spaces
- entered the data as correctly as possible
- added explanatory notes (metadata) about the source of the data and the values in each field
- included a title for the tables.

Skills questions

1. Why are two tables used to represent the information contained in the figure 6 and figure 7 maps?
2. There is always one more row to the table than the number of points, lines or polygons on the map because:
 - (a) the metadata is stored here
 - (b) the extra row is for a column of data
 - (c) the table of data needs a heading row
 - (d) rows are linked to *places* on the map, and it depends on the number of *places*.
3. Which statement about tables in a GIS is false?
 - (a) Text fields in a GIS table store numerical data such as quantities.
 - (b) Tables help to organise information for use by the GIS.
 - (c) A table may be drawn up in Excel and imported into the GIS.
 - (d) Text fields in a GIS store text information such as names and addresses.
4. Why is it necessary to shorten the field headings in a GIS?

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Watch this eLesson: Constructing a table of data for a GIS (else-1743)



Try out this interactivity: Constructing a table of data for a GIS (int-3361)

11.9 How does e-cycling work?

11.9.1 Why recycle?

Recycling of e-waste is controversial, and is known to cause major health and environmental problems in developing countries. It should be noted, though, that e-waste is successfully being recycled in the United States, and that de-manufactured components are being shipped worldwide and reused.

Every year, as consumers, we purchase more and more electronic material that will eventually become e-waste. It was estimated that in the United States, more than 438 million new consumer electronics were sold and 2.37 million tonnes of consumer electronics was discarded in one year alone. Only 25 per cent of this waste was actually collected for recycling. In comparison, Australian consumption of ICT is set to increase by 60 per cent in 2018. Today, only 35 per cent of e-waste is recycled.

Electronic equipment contains poisons that can be hazardous to human health and to the environment if, for example, materials such as lead and cadmium are released from older model televisions and computer screens (see figure 1). Use the **High-tech trash** weblink in the Resources tab to take an interactive tour of the image shown in figure 1.

FIGURE 1 Toxic components in the central processing unit and cathode-ray tube monitor of a desktop computer



There are some challenges to the e-waste recycling process. It is not a universal process; for example, only 27 per cent of consumer e-waste was recycled in the United States in 2014. E-waste contains toxins, and if it is not recycled properly, it has the potential to contaminate groundwater and soils.

The benefits of recycling

The benefits of recycling include:

- reduced need for landfill, dumps and incineration
- reduced build-up of hazardous waste
- more jobs
- conservation of natural resources
- greater sustainability.

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[Explore more with this weblink: High-tech trash](#)

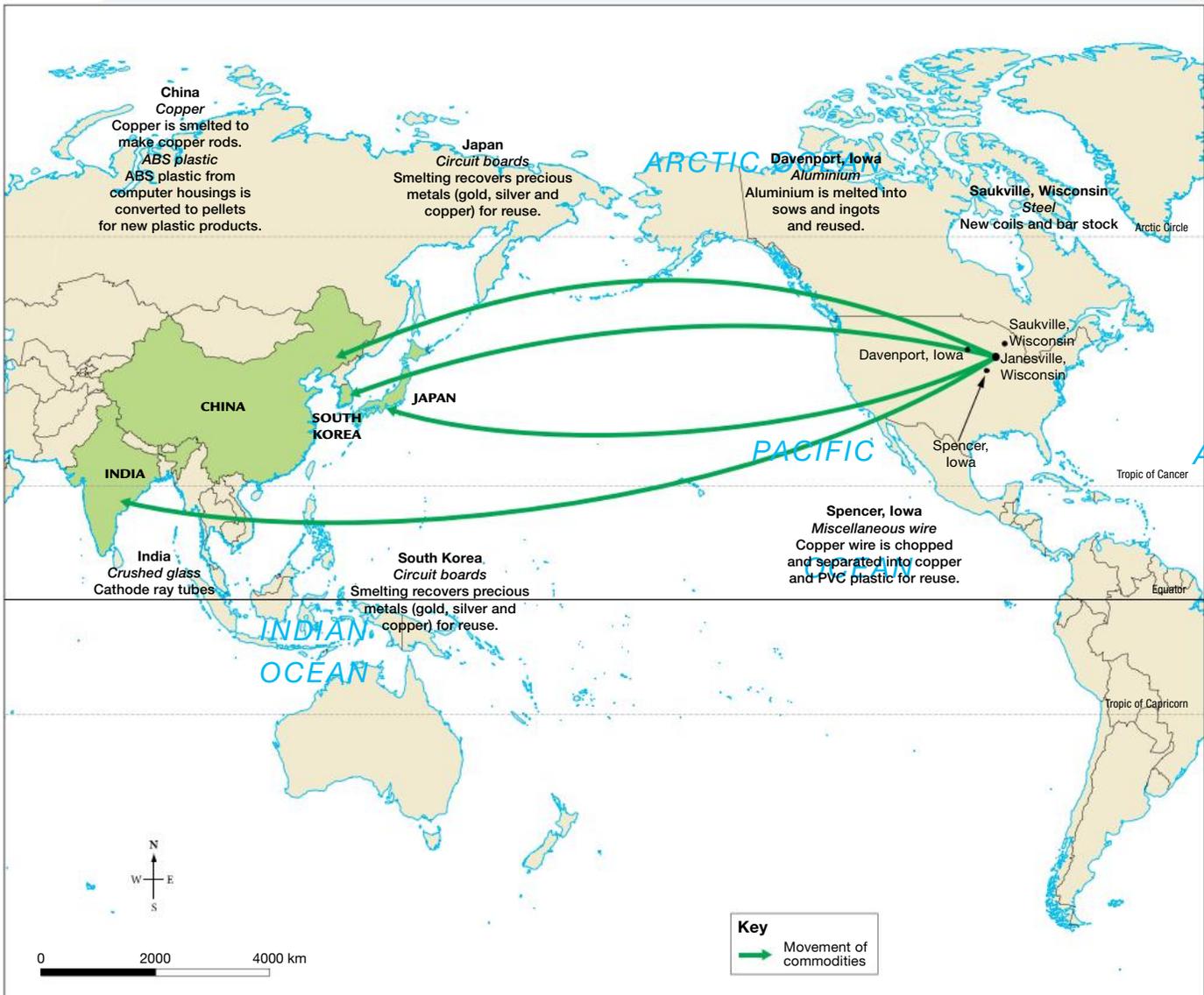
11.9.2 What is URT?

Universal Recycling Technologies (URT) is an end-of-life processing company that deals with all types of electronics, including consumer electronics, security equipment, computers, communication equipment, network equipment, circuit boards and more. URT saves millions of tonnes of e-waste from entering landfill each year, thus protecting the environment.

URT is a recycling company in the United States that has **e-Stewards certification**, the rules of which include the following:

- recyclers must follow strict environmental and socially responsible practices
- all exports of hazardous waste are banned
- the use of prison labour to work on recycling is banned
- the dumping of waste in landfill is banned.

FIGURE 2 Location of commodity exports from Universal Recycling Technologies



Source: © Universal Recycling Technology. Map drawn by Spatial Vision.

The company collects and purchases a wide variety of recyclable waste from municipal and retail locations across the country, and the waste is sorted and **de-manufactured**, or broken down to its original parts — a process similar to manufacturing but in reverse. Components such as glass, metals and plastic

can then be retrieved. The harvested materials are then sold to other companies all over the world to be reused in other formats. For example, plastics are turned into carpet and glass goes into road asphalt, thus closing the recycling loop.

11.9.3 What are the recycling standards?

Ethical recycling ensures hazardous material is separated on site and all equipment is reduced to its original components. The e-Stewards program, of which URT is a member, is an e-waste standard that bans exporting of hazardous electronic wastes to developing countries, and also outlaws the use of prisoners searching local dumps and landfills. However, URT sends a lot of what it recovers overseas, and the commodities are often reused and repurposed, as shown in figure 2.

11.9 Activities

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au. *Note:* Question numbers may vary slightly.

Remember

1. What does it mean for a recycling company to be a certified e-Stewards recycler?

Discover

2. Make a list of all the electrical and electronic products owned by your family and, if possible, list the age of each. Classify them into white goods, communication and entertainment products. Using this information, create a bar graph. What is the oldest product in your household? What is the most common product for the class as a whole?
3. What does your family do with its electrical and electronic waste?

Predict

4. As a throw-away society, are we getting worse?

Think

5. The advantages of recycling are listed above. What would the disadvantages be?

11.11 SkillBuilder: Using advanced survey techniques – interviews

11.11.1 Tell me

What are interviews that survey people's opinions?

Surveys collect primary data, such as data that has been gathered in the field. Conducting a survey means asking questions, recording and collecting responses, and collating the number of responses. You can use basic questionnaires or more advanced sampling techniques, such as interviews. You can also use a variety of tally methods. A survey is taken from a few people in a population and is therefore a sample.

Interviews are particularly useful for gathering information on attitudes and values. The information that is gathered can be either quantitative (involving numbers) or qualitative (involving ideas) or both.

Why are interviews that survey people's opinions useful?

Surveys are useful because they provide data gathered for a specific topic that might not be available by other means. They allow a wide range of data to be gathered in an efficient and simple way.

An interview, which is an advanced survey technique, allows you to explore attitudes and values without being restricted by survey categories. It may be difficult to then quantify the responses, but an interview does offer great flexibility, with a wide range of question types and varied responses. You also have the chance to add questions during the interview to pursue an idea that is raised.

Interviews are useful for:

- obtaining data or information that may not be available from another source
- summarising people's activities, such as recreational activities
- providing a snapshot of people's opinions, values and attitudes
- testing people's perspectives on the world, such as how a person rates a feature
- improving your understanding of a topic by speaking with people, or by obtaining first-hand information before collating it.

Model

A good interviewer:

- thinks about the information that needs to be gathered
- works out which groups of people to interview — by age, gender, locality, business and so on
- decides on the best time to conduct the interview
- decides on the best place to conduct the interview — for example, in a park, in the middle of a shopping complex, in a cafe, or in an office
- writes a set of longer and more detailed predetermined questions
- writes open-ended questions that allow interviewees to express their opinions
- includes no more than about 15 questions to ensure people retain interest in the interview
- develops supplementary questions in response to anticipated answers
- sets a time limit of 15 to 20 minutes.

11.11.2 Show me

How to construct an interview

You will need:

- a computer on which to design your questions
- a list of people to interview
- a questionnaire
- pens for people to use to write their answers

- If you are going to record the interview, then seek permission from the person to do so.
- Explain to the person the purpose of the interview; that is, give some details about the topic to be discussed.
- Use a separate interview sheet for each person.
- Speak clearly so that you do not have to repeat yourself.
- Use a non-threatening tone of voice.
- Listen carefully to the answers given.
- Don't ask an interviewee to repeat their responses if they cover information for one question in the answer to another question. Write the information in the appropriate place on the sheet.
- Be prepared to slot in an additional question if the person has some great information to give you.
- Take notes, using your note-taking skills. Don't use full sentences — use key words and facts only — and don't make the person wait while you write.
- Try to keep your own opinion out of the answers; be neutral about the responses, even when you do not agree.
- Never interrupt an answer and always allow plenty of time for the interview — it should not go for longer than 20 minutes.
- Always thank the person for their time and support when you have finished.

STEP 5

Collating your information will take time, because you need to seek common themes through each interview. Quantitative data can be placed in tables. Qualitative data needs to be classified according to the percentage of people with the same or similar viewpoints.

11.11.3 Let me do it

Developing my skills

Create a set of interview questions that seek the opinion of your local community on e-waste. See subtopics 11.7 and 11.9 for some ideas. Gather your data and summarise your findings.

Questions

1. What did people understand by the term *e-waste*?
2. Does the community dispose of its e-waste effectively?
3. Are there enough e-waste recycling depots for the community?
4. Is there enough advertising about how to deal with e-waste?
5. Which local community groups ought to be responsible for e-waste management?

Checklist

I have:

- thought about the information that needs to be gathered
- worked out which groups of people to interview
- decided when is the best time to conduct the interview
- decided where is the best place to conduct the interview
- written a set of longer and more detailed predetermined questions
- written open-ended questions that allow the interviewees to express their opinions
- included no more than about 15 questions to ensure people retain interest in the interview
- developed supplementary questions in response to anticipated answers
- set a time limit of 15 to 20 minutes.

Skills questions

1. Interviews are used to show:
 - (a) more information than you have read
 - (b) your opinion on an issue
 - (c) the public's opinion on an issue
 - (d) special knowledge about an issue.
2. Interviews include information about:
 - (a) quantitative data only
 - (b) qualitative data only
 - (c) secondary data
 - (d) both qualitative and quantitative data.
3. Why is it important to be able to think on your feet while conducting an interview?
4. Why is it important to keep your own opinion out of the answers?

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Watch this eLesson: Using advanced survey techniques (int-1742)



Try out this interactivity: Using advanced survey techniques — interviews (int-3360)

11.12 Review

11.12.1 Review

Uses of technology

1. Define *Web 2.0*.
2. Describe the trend of internet and mobile phone use in Australia.
3. Explain the geographical pattern of internet use around the world.
4. Think about the reliability of the internet in middle-income and low-income areas. Create two PMI charts to compare.
5. Suggest reasons for different levels of home access to high-speed internet services across Australia.

Changes to technology

6. What is the *digital divide*?
7. Can the challenges posed by the digital divide be overcome?
8. How has mobile phone technology *changed* lives in Kenya?
9. Using the **Kindle coverage** weblink in the Resources tab, describe the access to the Kindle 3G network around the world. Explain why different areas of Australia have limited or no access.



e-waste

10. What is e-waste?
11. What are the challenges of e-waste in Europe?
12. List five different things you personally can do to reduce your e-waste.
13. Why is the collection of e-waste important for the Chinese economy?
14. Why is e-waste still arriving in China illegally?
15. With reference to figure 1, why do you think India, Pakistan and China are the main countries receiving e-waste?
16. Using figure 1, explain the geographical pattern of illegal dumping of e-waste. How are we in Australia *interconnected* to the information shown in this map?
17. With reference to figure 2, explain why e-waste is considered an ethical issue.
18. Refer to figure 2. Suggest what toxins this child may be exposed to and how they could affect the child's health.
19. What are the economic, social, political and *environmental* impacts of e-waste?

FIGURE 2 A child in China sits among a pile of wires and e-waste.



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 Explore more with this weblink: [Kindle coverage](#)

11.12.2 Reflect

20. How can you change your behaviour to reduce your consumption and e-waste pattern?
21. How do you think information and communication technology will evolve in future?
22. Do you think e-wastes are critical for China? Explain.
23. Do you think that carbon emissions will curb improvements in information and communication technology?
24. Why are the connections you make through Web 2.0 so important in your day-to-day life?
25. What are the ethical and legal issues involved in the trade of e-waste?
26. (a) Suggest a list of possible criteria that you could use to judge how effective technology has been in improving people's lives in Kenya.
(b) Share your criteria in a small group and select the three criteria that your group considers will be the most effective for judging.
(c) Did you have to make many changes to create the group list? Why or why not?

TOPIC 12

Fieldwork inquiry: What are the effects of travel in the local community?

12.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

12.1.1 Scenario and your task

People travel for many reasons at the local scale — for example, they may travel to work, to shops, to visit friends and to local sporting venues. Often there are times when traffic congestion occurs, creating danger areas for motorists and pedestrians. Examples of places where such congestion occurs are schools and shopping centres. Undertaking fieldwork allows you to observe and collect original data first-hand.



Your task

Your team has been commissioned by the local council to compile a report evaluating the impacts of travel movements around a local school or traffic hotspot. You will need to collect, process and analyse suitable data and then devise a plan to better manage future traffic and pedestrian movement in the area.

12.2 Process

12.2.1 Process

- As part of a class discussion, determine a suitable location for your fieldwork study. This might be your own or a local school, or a nearby shopping centre. Talk about some of the issues related to your fieldwork site and then devise a key inquiry question — for example: What are the effects of ... ? or How can we reduce the impact of ... ? This will be the focus of your fieldwork. You then need to establish the following:
 - **What** sort of data and information will you need to study the travel issue at your site?
 - **How** will you collect this information?
 - **Where** would be the best locations to obtain data?
 - **When** would be the best times of the day or day(s) of the week to obtain data?
 - **How** will you record the information you are collecting?

If you wish to collect people's views on the issue, or suggestions for improvements, you will need to plan and write suitable survey questions.

12.2.2 Collecting and recording your information and data

- As a class, plan the field trip by identifying and allocating tasks and possible sites to groups or pairs. It is often easier to share data collection. Once everything has been planned, you will need to perform your allocated tasks on the day.
- In class, invite your school principal or a member of your local council to be a guest speaker discussing your fieldwork site. They may be able to assist with background information that you may not be able to gain elsewhere. They can also provide a different perception of the effects of travel at your site. Plan a series of questions you would like to ask and be prepared to take notes that you can use in your report.
- After the field trip, it may be necessary to collate everyone's data and summarise surveys so that everyone has access to the shared information.

12.2.3 Analysing your information and data

- Look at your completed graphs and maps. What trends, patterns and relationships can you see emerging? Within your fieldwork area, are there some places that have a bigger issue with cars and pedestrians than other areas?

Is there an interconnection between traffic congestion and time of the day, or day of the week? What have your surveys revealed? What are the major effects of travel at your fieldwork site? How do people perceive the travel issues in this place? Go back to your key inquiry question. To what extent have you been able to answer it? Write your observations up as a fieldwork report using subheadings such as:

 - Background and key inquiry question
 - Conducting the fieldwork [planning and collecting data]
 - Findings [results of data analysis].
- Download the report template from the Resources tab to help you complete this project. Use the report template to create your report.



12.2.4 Communicating your findings

- Now that you have identified a traffic problem and collected and analysed data, it is time to try to solve it. Your completed map and supporting data will form part of your management plan for the future. What have been the main issues that have emerged from your fieldwork research? How can you best manage these issues? Using your base map, create an overlay or annotated map to show possible options for reducing the traffic problem. You will need to support each proposal with data that you have gained from your fieldwork. Possible ideas could include:
 - changing parking restrictions
 - staggering times of drop-off and pick-up
 - introducing traffic wardens to guide traffic
 - creating a one-way system.

Your teacher may arrange for your completed report to be presented to your school or local council. Considering your audience, what is the best way to present your findings? You might like to produce a PowerPoint presentation or an annotated visual display.

12.3 Review

12.3.1 Reflecting on your work

- Think back over how well organised and prepared you were for the fieldwork, the data you collected and how you processed the data for your report. Download and complete the reflection template from the Resources tab.

GLOSSARY

- active consumerism:** a movement that is opposed to the endless purchase of material possessions and the pursuit of economic goals at the expense of society or the environment
- agribusiness:** business set up to support, process and distribute agricultural products
- agroforestry:** the use of trees and shrubs on farms for profit or conservation; the management of trees for forest products
- aquaculture:** the farming of aquatic plants and aquatic animals such as fish, crustaceans and molluscs
- aquaponics:** a sustainable food production system in which waste produced by fish or other aquatic animals supplies the nutrients for plants, which in turn purify the water
- aquifer:** a body of permeable rock below the Earth's surface, which contains water, known as groundwater
- arable:** describes land that can be used for growing crops
- barter:** to trade goods in return for other goods or services rather than money
- biodiesel:** a vegetable oil or animal fat-based diesel fuel
- biodiversity:** the variety of plant and animal life within an area
- biofuel:** fuel that comes from renewable sources
- biophysical environment:** the natural environment, made up of the Earth's four spheres — the atmosphere, biosphere, lithosphere and hydrosphere
- black market:** any illegal trade in officially controlled or scarce goods
- canal housing estate:** a housing estate built upon a system of waterways, often as the result of draining wetland areas. All properties have water access.
- carbon emissions:** carbon dioxide that is released into the atmosphere by natural processes or by burning gas, coal or oil contributing to climate change
- cash crop:** a crop grown to be sold so that a profit can be made, as opposed to a subsistence crop, which is for the farmer's own consumption
- clearfelling:** the removal of all trees in an area
- coral polyps:** a tube-shaped marine animal that lives in a colony and produces a stony skeleton. Polyps are the living part of a coral reef.
- crop rotation:** a procedure that involves the rotation of crops, so that no bed or plot sees the same crop in successive seasons
- deforestation:** clearing forests to make way for housing or agricultural development
- degradation:** deterioration in the quality of land and water resources caused by excessive exploitation
- de-manufacture:** to disassemble devices into their original components for recycling
- desertification:** the transformation of arable land into desert, which can result from climate change or from human practices such as deforestation and overgrazing
- developed:** describes countries with a highly developed industrial sector, a high standard of living, and a large proportion of people living in urban areas
- developing countries:** nations with a low living standard, undeveloped industrial base and low human development index relative to other countries
- digital divide:** a type of inequality between groups in their access to and knowledge of information and communication technology
- disability:** a functional limitation in an individual, caused by physical, mental or sensory impairment
- discretionary item:** an item that is bought out of choice, according to one's judgement
- ecotourism:** tourism that interprets the natural and cultural environment for visitors, and manages the environment in a way that is ecologically sustainable
- edible:** fit to be eaten as food; eatable
- endemic:** describes species that occur naturally in only one region

environmental refugees: people who are forced to flee their home region due to environmental changes (such as drought, desertification, sea-level rise or monsoons) that affect their wellbeing or livelihood

erosion: the wearing down of rocks and soils on the Earth's surface by the action of water, ice, wind, waves, glaciers and other processes

e-Stewards certification: an e-waste standard that bans exporting of hazardous electronic wastes to developing countries and outlaws the use of prisoners searching local dumps and landfills for e-waste

ethnicity: cultural factors such as nationality, culture, ancestry, language and beliefs

e-waste: any old electrical equipment such as computers, toasters, mobile phones and iPods that no longer works or is no longer required

expenditure: the amount of money spent

extensive farm: farm that extends over a large area and requires only small inputs of labour, capital, fertiliser and pesticides

extremism: extreme political or religious views or extreme actions taken on the basis of those views

factory farming: the raising of livestock in confinement, in large numbers, for profit

famine: a drastic, widespread food shortage

genetically modified: describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques

globalisation: the process that enables markets and companies to operate internationally, and world views, products and ideas to be freely exchanged

graffiti: the marking of another person's property without permission; it can include tags, stencils and murals

Green Revolution: a significant increase in agricultural productivity resulting from the introduction of high-yield varieties of grains, the use of pesticides and improved management

greenhouse gases: any of the gases that absorb solar radiation and are responsible for the greenhouse effect. The three main gases are water vapour, carbon dioxide and methane.

gross domestic product (GDP): the value of all the goods and services produced within a country in a given period of time. It is often used as an indicator of a country's wealth.

groundwater: water that exists in pores and spaces in the Earth's rock layers, usually from rainfall slowly filtering through over a long period of time

halal: describes food that is prepared under Islamic dietary guidelines

hard sport tourism: tourism in which someone travels to either actively participate in or watch a competitive sport as the main reason for their travel

horticulture: the practice of growing fruit and vegetables

household final consumption per person: the value of each person's goods and services expenditure in a country

humanitarian aid: assistance provided in response to human crises caused by natural or man-made disasters, in order to save lives, relieve suffering and maintain human dignity

humanitarian principles: the principles governing our response to natural disasters, such as tsunamis and earthquakes, or human-induced disasters, such as armed conflicts — the main aim being to save lives and alleviate suffering

humus: an organic substance in the soil that is formed by the decomposition of leaves and other plant and animal material

hybrid: plant or animal bred from two or more different species, sub-species, breeds or varieties, usually to attain the best features of the different stocks

hydroponic: describes a method of growing plants using mineral nutrients, in water, without soil

income diversity: income that comes from many sources

indicator: something that provides a pointer, especially to a trend

infrastructure: the facilities, services and installations needed for a society to function, such as transportation and communications systems, water pipes and power lines

innovation: new and original improvement to something, such as a piece of technology or a variety of plant or seed

intensive farm: farm that requires a lot of inputs, such as labour, capital, fertiliser and pesticides

irrigation: the supply of water by artificial means to agricultural areas where there is a shortage

jatropha: any plant of the genus *Jatropha*, but especially *Jatropha curcas*, which is used as a biofuel

kenaf: a plant in the hibiscus family that has long fibres; useful for making paper, rope and coarse cloth

landfill: a method of solid-waste disposal in which refuse is buried between layers of soil

latitude: the angular distance north or south from the equator of a point on the Earth's surface

leaching: the process by which water runs through soil, dissolving minerals and carrying them into the subsoil

leeward: describes the area behind a mountain range, away from the moist prevailing winds

lithium ion battery: type of rechargeable battery that is 'energy dense' and does not lose much charge when not in use

logging: large-scale cutting down, processing and removal of trees from an area

low-income country: a country that has a gross national income (GNI) per capita of \$1025 or less, has not reached its final stage of development and is eligible for international development assistance (IDA)

mallee: vegetation areas characterised by small, multi-trunked eucalypts found in the semi-arid areas of southern Australia

malnourished: describes someone who is not getting the right amount of the vitamins, minerals and other nutrients to maintain healthy tissues and organ function

marginal land: describes agricultural land that is on the margin of cultivated zones and is at the lower limits of being arable

Masai: an ethnic group of semi-nomadic people living in Kenya and Tanzania

mature-aged: describes individuals aged over 55

median age: the age that is in the middle of a population's age range, dividing a population into two numerically equal groups

mercury poisoning: a toxic condition caused by the ingestion or inhalation of mercury or a mercury compound. It has various symptoms, including vomiting, nausea, insomnia and fevers.

middle-income country: a country that has a gross national income (GNI) per capita of \$1026 to \$12479 and has not reached its final stage of development

mobility: the ability to move or be moved freely and easily

monoculture: the cultivation of a single crop on a farm or in a region or country

national park: a park or reserve set aside for conservation purposes

national security: the protection of a nation's citizens, natural resources, economy, money, energy, environment, military, government and energy

new moon: the phase of the moon when it is closest to the sun and is not normally visible

nomadic: describes a group of people who have no fixed home and move from place to place according to the seasons, in search of food, water and grazing land

non-government organisations: non-profit group run by people (often volunteers) who have a common interest and perform a variety of humanitarian tasks at a local, national or international level

offshored: to relocate part of a company's processes or services overseas in order to decrease costs

old-growth forests: natural forests that have developed over a long period of time, generally at least 120 years, and have had minimal unnatural disturbance such as logging or clearing

organic matter: decomposing remains of plant or animal matter

per capita: per person (literally 'by head')

perception: the process by which people translate sensory impressions into a view of the world around them

plantations: an area in which trees or other large crops have been planted for commercial purposes

pneumatophores: exposed root system of mangroves, which enable them to take in air when the tide is in

potable: drinkable; safe to drink

prairie: native grasslands of North America

precipitation: the forms in which moisture is returned to the Earth from the sky, most commonly in the form of rain, hail, sleet and snow

primary industry: industry involved in the gathering of natural resources, such as iron ore and timber, or activities such as farming and fishing

pulp: the fibrous material extracted from wood or other plant material to be used for making paper

rain shadow: the dry area on the leeward side of a mountain range

Ramsar site: a wetland of international importance, as defined by the Ramsar Convention — an intergovernmental treaty on the protection and sustainable use of wetlands

robotic technology: the branch of technology that deals with the design, construction, operation and application of robots and computer systems

salinity: the presence of salt on the surface of the land, in soil or rocks, or dissolved in rivers and groundwater

seasonal crops: crops that are harvested in a certain season of the year, rather than all year round

smuggling: importing or exporting goods secretly or illegally

social justice: the aim to create a society that is based on equality, that values human rights and that recognises the dignity of every human being

soft sport tourism: tourism in which someone participates in recreational and leisure activities, such as skiing, fishing and hiking, as an incidental part of their travel

stereotypes: widely held but oversimplified idea of a type of person or thing

street art: artistic work done with permission from both the person who owns the property on which the work is being done and the local council

subsistence: describes farming that provides food only for the needs of the farmer's family, leaving little or none to sell

sustainable: describes the use by people of the Earth's environmental resources at a rate such that the capacity for renewal is ensured

totem: an animal, plant, landscape feature or weather pattern that identifies an individual's connection to the land

trade barriers: government-imposed restriction (in the form of tariffs, quotas and subsidies) on the free international exchange of goods or services

trading partners: a participant, organisation or government body in a continuing trade relationship

treaty: a formal agreement between two or more independent states or nations, and usually involving a signed document

treeline: the edge of the areas in which trees are able to grow

tundra: the area lying beyond the treeline in polar or alpine regions

undernourished: describes someone who is not getting enough calories in their diet; that is, not enough to eat

undulating: describes an area with gentle hills

urbanisation: the growth and spread of cities

value adding: processing a material or product and thereby increasing its market value

water stress: situation that occurs when water demand exceeds the amount available or when poor quality restricts its use

waterlogging: saturation of the soil with groundwater so that it hinders plant growth

watertable: the surface of the groundwater, below which all pores in the soils and rock layers are saturated with water

Web 1.0: a read-only version of the web. It enabled users only to search and read information.

Web 2.0: version of the web that allows the sharing of online information and ideas that anyone has created. It is the second generation of the World Wide Web that enables collaboration and exchanging of information online.

Western-style diet: eating pattern common in developed countries, with high amounts of red meat, sugar, high-fat foods, refined grains, dairy products, high-sugar drinks and processed foods

windward: describes the side of the mountain that faces the prevailing winds

winter solstice: the shortest day of the year, when the sun reaches its lowest point in relation to the equator

yield gap: the gap between a certain crop's average yield and its maximum potential yield

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