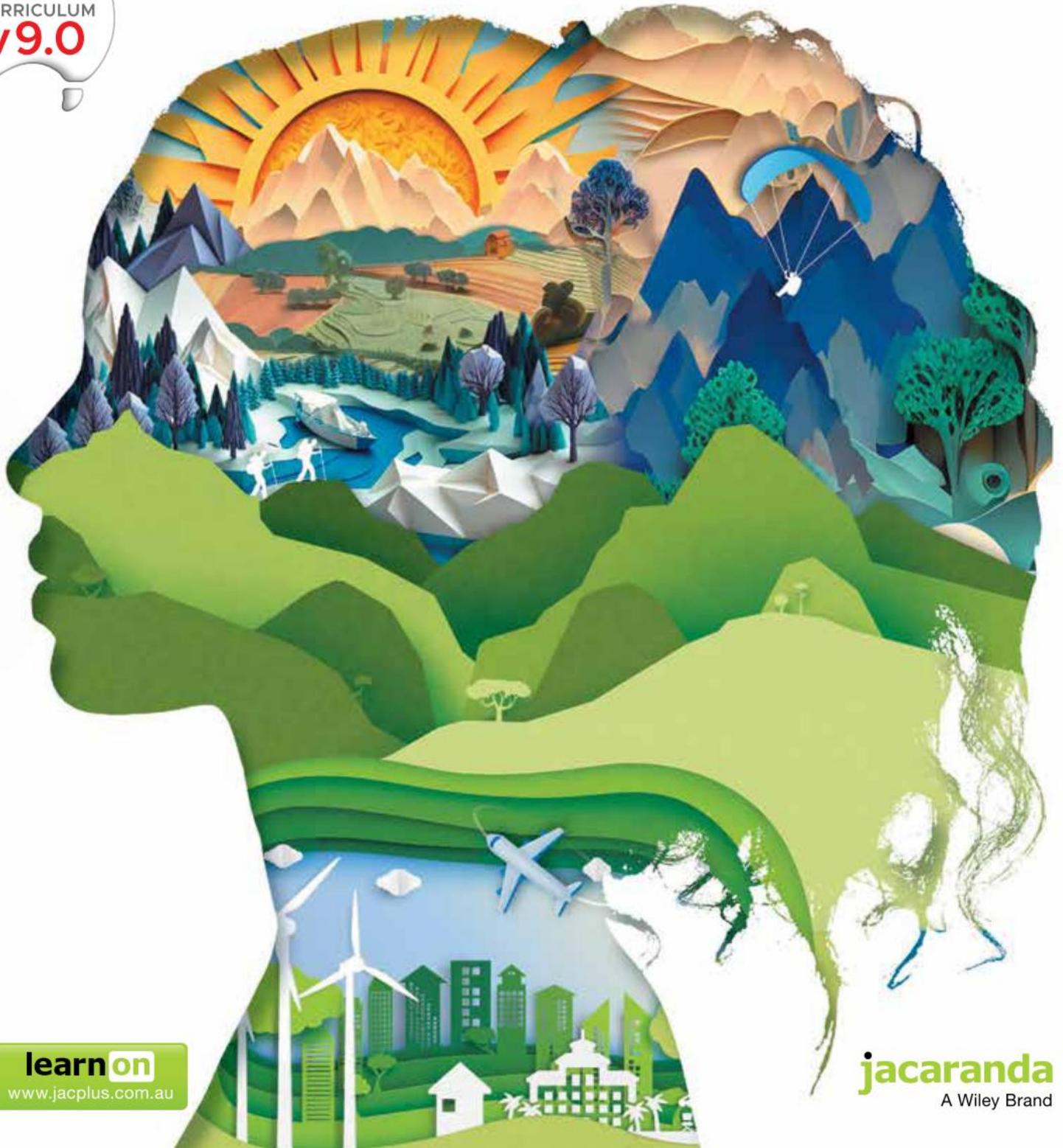


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JACARANDA GEOGRAPHY ALIVE 9

AUSTRALIAN CURRICULUM | THIRD EDITION

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Third edition published 2023 by
John Wiley & Sons Australia, Ltd
Level 4, 600 Bourke Street, Melbourne, Vic 3000

First edition published 2012
Second edition published 2018

Typeset in 10.5/13 pt TimesLT Std

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ISBN: 978-1-394-22421-0

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This suite of resources may include references to (including names, images, footage or voices of) people of Aboriginal and/or Torres Strait Islander heritage who are deceased. These images and references have been included to help Australian students from all cultural backgrounds develop a better understanding of Aboriginal and Torres Strait Islander Peoples' history, culture and lived experience.

It is strongly recommended that teachers examine resources on topics related to Aboriginal and/or Torres Strait Islander Cultures and Peoples to assess their suitability for their own specific class and school context. It is also recommended that teachers know and follow the guidelines laid down by the relevant educational authorities and local Elders or community advisors regarding content about all First Nations Peoples.

All activities in this resource have been written with the safety of both teacher and student in mind. Some, however, involve physical activity or the use of equipment or tools. **All due care should be taken when performing such activities.** To the maximum extent permitted by law, the author and publisher disclaim all responsibility and liability for any injury or loss that may be sustained when completing activities described in this resource.

The Publisher acknowledges ongoing discussions related to gender-based population data. At the time of publishing, there was insufficient data available to allow for the meaningful analysis of trends and patterns to broaden our discussion of demographics beyond male and female gender identification.

Contents

About this resource.....	vii
Acknowledgements	xiv
Understanding cognitive verbs	1
1 Geography concepts and skills	2
1.1 Overview.....	3
1.2 Concepts in Geography	4
1.3 Skills used in Geography.....	9
1.4 SkillBuilder: Describing spatial relationships in thematic maps.....	online only
1.5 SkillBuilder: Describing divergence graphs.....	online only
1.6 SkillBuilder: Describing patterns and correlations on a topographic map.....	online only
1.7 SkillBuilder: Interpreting satellite images to show change over time.....	online only
1.8 SkillBuilder: Constructing and describing a transect on a topographic map	online only
1.9 SkillBuilder: Constructing multiple line and cumulative line graphs	online only
1.10 SkillBuilder: Constructing a land use map.....	online only
1.11 SkillBuilder: Creating a survey	online only
1.12 SkillBuilder: Constructing ternary graphs.....	online only
1.13 SkillBuilder: Constructing and describing proportional circles on maps	online only
1.14 SkillBuilder: Constructing and describing isoline maps.....	online only
1.15 SkillBuilder: Constructing and describing a flow map	online only
1.16 SkillBuilder: Constructing a table of data for GIS	online only
1.17 SkillBuilder: GIS — deconstructing a map.....	online only
1.18 SkillBuilder: Interpreting a geographical cartoon	online only
1.19 SkillBuilder: Using advanced survey techniques — interviews	online only
1.20 SkillBuilder: Writing a fieldwork report as an annotated visual display (AVD).....	online only
1.21 Review	21
2 Biomes and food production	24
2.1 Overview.....	25
2.2 What are the major biomes around the world?	26
2.3 How do we characterise biomes?.....	30
2.4 What are Australia's major biomes?.....	35
2.5 What is the importance of biomes to humans?	39
2.6 How is global food production linked to climate?.....	46
2.7 How and why do we modify biomes for agriculture?.....	53
2.8 What types of agriculture are practiced in Australia and Asia?	58
2.9 How are the world's biomes and food production interconnected?.....	66
2.10 How has deforestation changed the forest biome?	70
2.11 How has overfishing changed the ocean biome?	75
2.12 INQUIRY: Overfishing	80
2.13 What are the causes and effects of land degradation?	81
2.14 Why is global biodiversity diminishing?	89
2.15 Investigating topographic maps — Coastal wetland biome in Binydjarrna (Dalywoi/Daliwuy Bay).....	94
2.16 Review	97
3 Food security	106
3.1 Overview.....	107
3.2 What is global food security?.....	108
3.3 What are the impacts of land loss on food security?.....	113
3.4 How does access to water supplies impact food security?	120

3.5	What challenges does climate change pose for food security?	125
3.6	How will we feed the future?	130
3.7	How do we improve food production and distribution?.....	134
3.8	How do First Nations Australians use and alter biomes for food production?	142
3.9	INQUIRY: Famine crisis report.....	145
3.10	Investigating topographic maps — Lake Victoria as a food source.....	148
3.11	Review	151

4 Connecting with our places 158

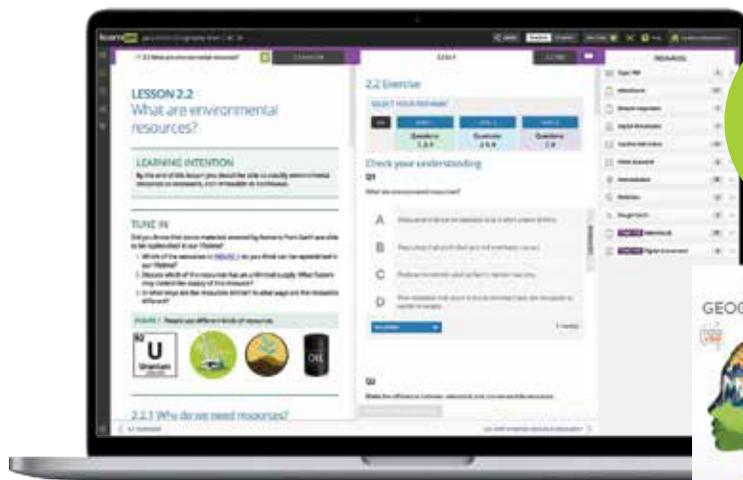
4.1	Overview.....	159
4.2	How do perceptions of land vary?	160
4.3	How do we access places?	165
4.4	INQUIRY: Designing a sustainable garden	170
4.5	How is Australia connected globally through export and import trade?.....	171
4.6	How does trade connect us?	175
4.7	What is Australia's contribution to the global trade industry?	184
4.8	Is international trade fair?.....	193
4.9	How do Australians use technology to communicate and interconnect?.....	199
4.10	What is a digital divide?	204
4.11	Why is e-waste presenting such significant challenges?.....	209
4.12	Investigating topographic maps — Norway — the best place on Earth.....	216
4.13	Review	219

5 Connecting people and place 224

5.1	Overview.....	225
5.2	How is tourism important?	226
5.3	What is global tourism?.....	233
5.4	Is Australian tourism growing?	241
5.5	What are the impacts of tourism?	246
5.6	How can we manage the environmental impacts of tourism?	251
5.7	What is cultural tourism?.....	256
5.8	How are tourism and sport connected?.....	263
5.9	INQUIRY: Cruising sustainably	268
5.10	Investigating topographic maps: Nature-driven tourism at Victoria Falls	270
5.11	Review	273

Glossary	278
Index.....	281

About this resource



NEW FOR

AUSTRALIAN CURRICULUM V9.0



JACARANDA

GEOGRAPHY ALIVE 9

AUSTRALIAN CURRICULUM
THIRD EDITION

Developed by teachers for students

Tried, tested and trusted. Every lesson in the new *Jacaranda Geography Alive* series has been carefully designed to support teachers and help students evoke curiosity through inquiry-based learning while developing key skills.

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Practical teaching advice and ideas for each lesson provided in teachON

Brand new! Tune in activities to spark interest and kick off every lesson with discussion and source analysis

Reading content and rich media including embedded videos, interactivities and audio files.

The screenshot shows the learnON website interface for a lesson titled "LESSON 2.2 What are environmental resources?". The page is divided into several sections:

- Header:** "learnON Jacaranda Geography Alive 7 AC 3e" and "2.2 What are environmental resources? 2.2 teachON".
- Lesson Title:** "LESSON 2.2 What are environmental resources?".
- Learning Intention:** "By the end of this lesson you should be able to classify environmental resources as renewable, non-renewable or continuous."
- Tune In:** "Did you know that some materials sourced by humans from Earth are able to be replenished in our lifetime?" followed by three numbered questions.
- Figure 1:** "People use different kinds of resources." with images of Uranium (92 U, 238.029), wind turbines, a plant growing from soil, and an oil barrel.
- Navigation:** "2.2.1 Why do we need resources?" and "2.1 OVERVIEW".
- Right Sidebar:** "2.2 Exercise", "SELECT YOUR P...", "ALL", "Check your m", "Q1", "What are environme", "A Resource", "B Resource", "C Radioa", "D Raw ma useful to", "SOLUTION", "Q2", "State the difference", "STUDENT RESULTS & MA".

powerful learning tool, learnON

The screenshot shows the learnON interface with several callout boxes pointing to specific features:

- Differentiated question sets**: Points to the 'Teacher' and 'Student' tabs at the top.
- Teacher and student views**: Points to the 'Teacher' tab.
- Textbook questions**: Points to the '2.2 TBQ' tab.
- eWorkbook**: Points to the 'eWorkbook' resource in the list.
- Answers and sample responses**: Points to the 'Sample responses' resource.
- Digital documents**: Points to the 'Digital documents' resource.
- Video eLessons**: Points to the 'Video eLessons' resource.
- Interactivities**: Points to the 'Interactivities' resource.
- Extra teaching-support resources**: Points to 'TEACHER eWorkbook' and 'TEACHER Digital documents' in the list.
- Interactive questions with immediate feedback**: Points to a question card in the main content area.

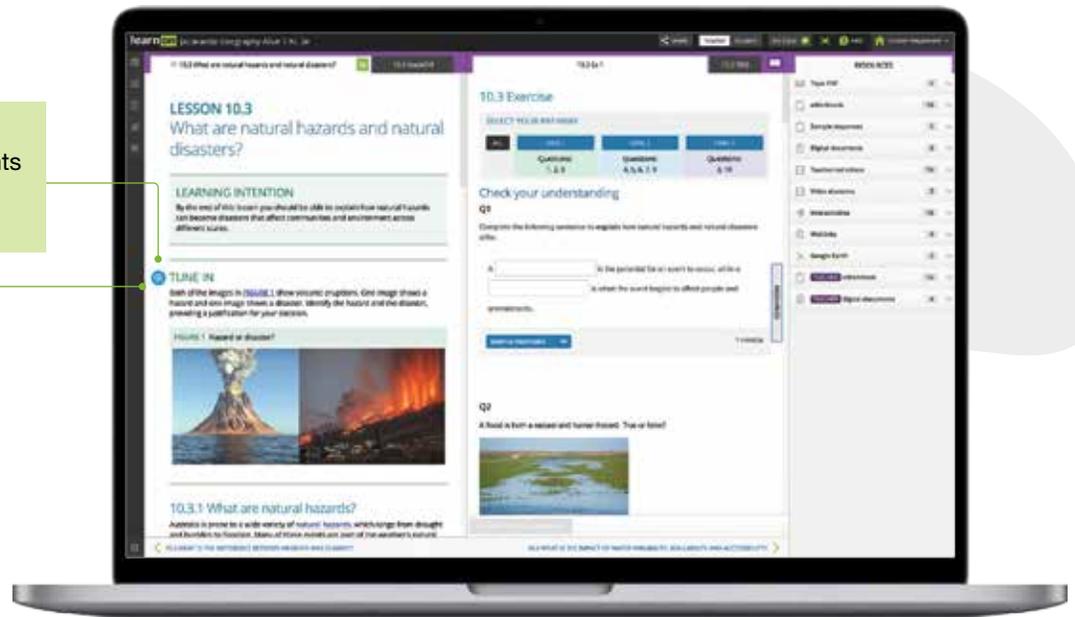
Resource Type	Count
Topic PDF	1
eWorkbook	17
Sample responses	1
Digital documents	7
Teacher-led videos	14
Video eLessons	2
Interactivities	18
Weblinks	4
Google Earth	2
TEACHER eWorkbook	15
TEACHER Digital documents	4

Get the most from your online resources

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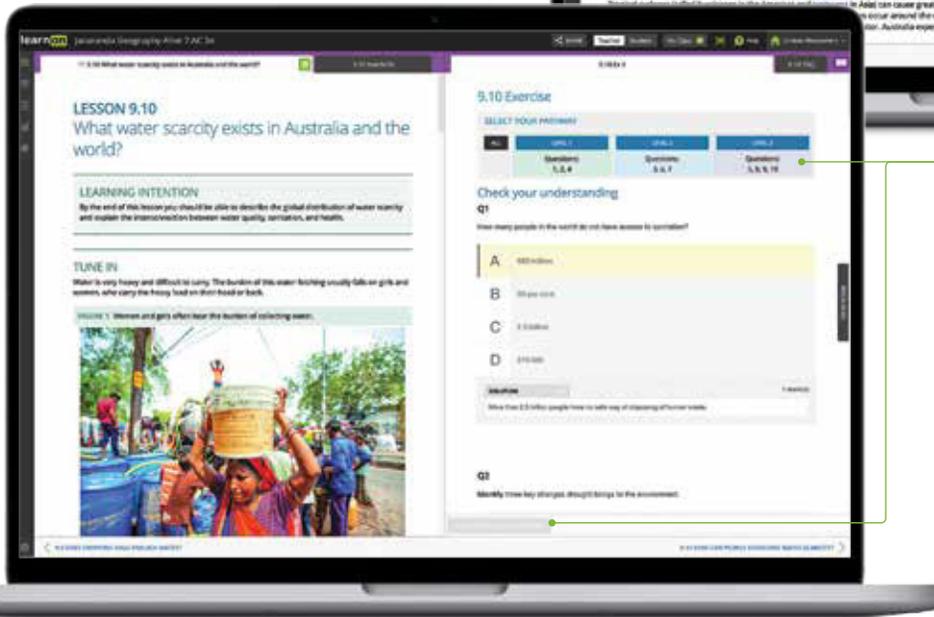
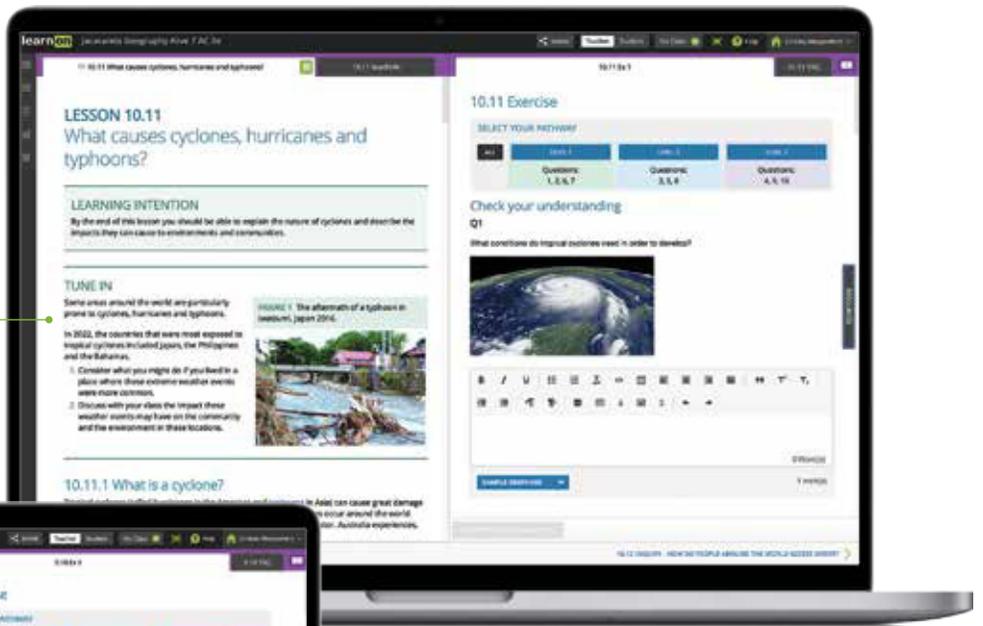
Trusted Jacaranda theory, plus tools to support teaching and make learning more engaging, personalised and visible.

Embedded interactivities and videos enable students to explore concepts and learn deeply by 'doing'.



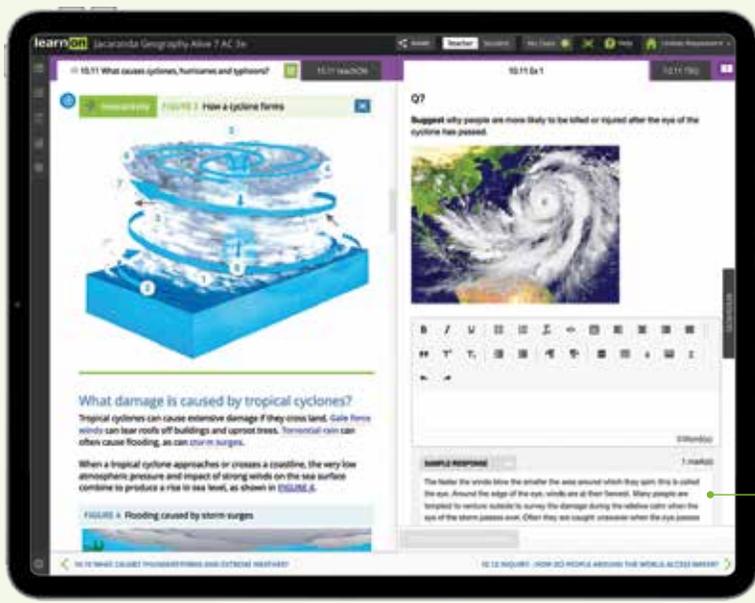
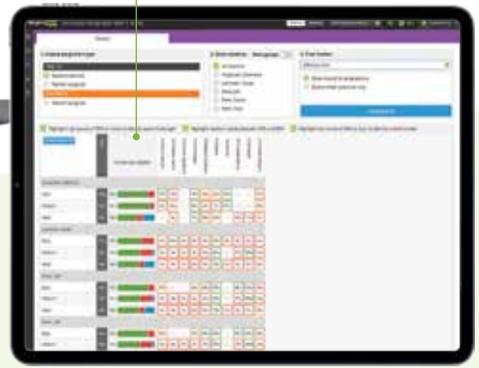
New teaching videos are designed to help students learn concepts by having a 'teacher at home', and are flexible enough to be used for pre- and post-learning, flipped classrooms, class discussions, remediation and more.

Brand new! Tune in activities to spark interest and kick off every lesson with discussion and source analysis



Three differentiated question sets, with immediate feedback in every lesson, enable students to challenge themselves at their own level.

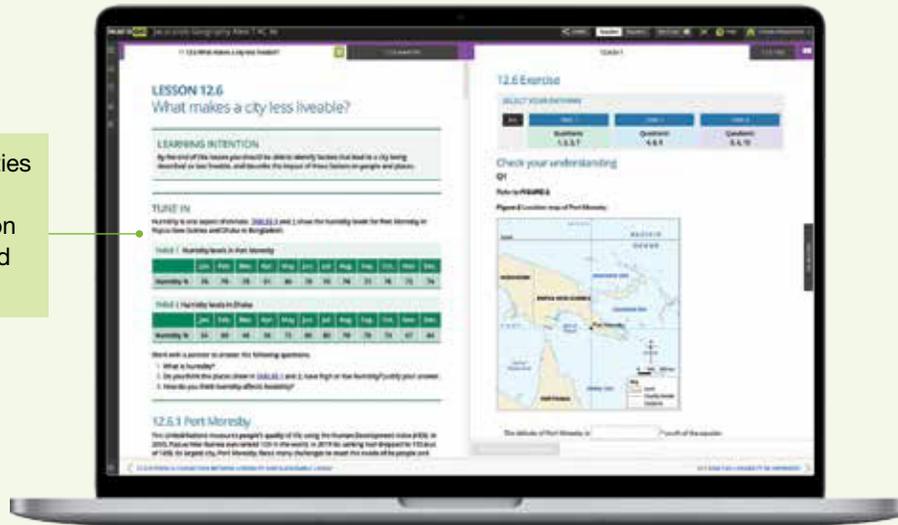
Instant reports give students visibility into progress and performance.



Every question has immediate, feedback to help students overcome misconceptions as they occur and get unstuck as they study independently – in class and at home.

TUNE IN lesson starters

New Tune In activities spark interest and kick off every lesson with discussion and source analysis.



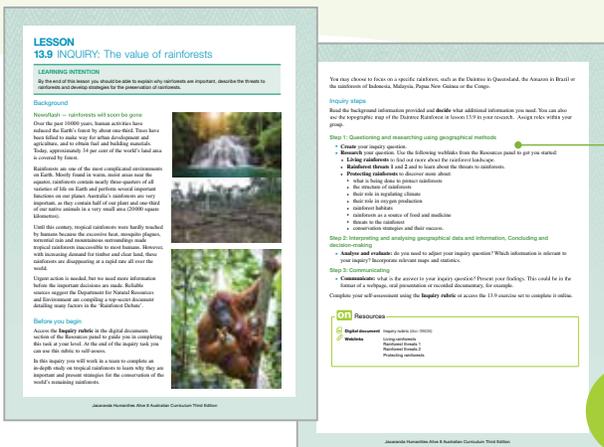
Skill development

New skill activities provide opportunities to develop and build crucial Geography skills using research, collaboration and analysis.



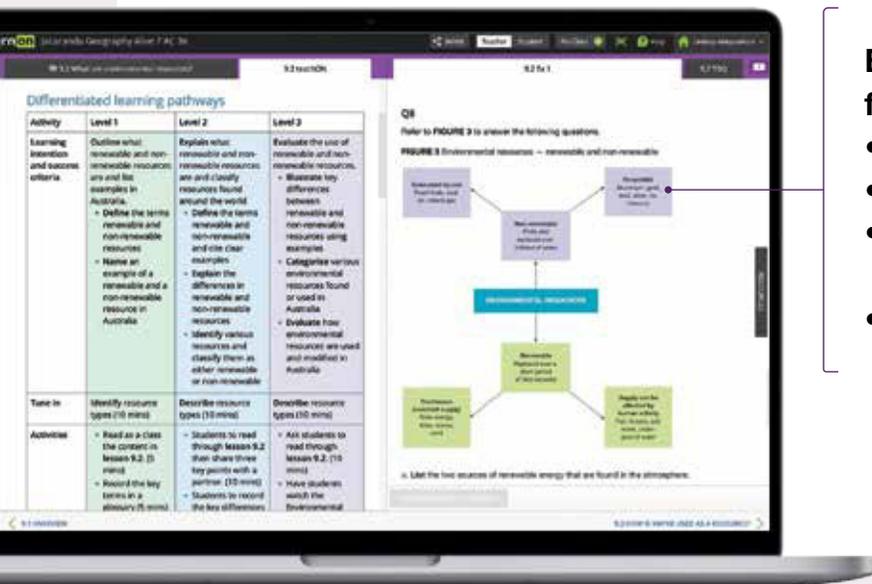
SkillBuilders support and strengthen skill development using our Tell me, Show me, Let me do it approach.

Inquiry projects



New Inquiry lessons use project-based learning and a clear skill structure for a deep dive into every topic while practising the curriculum-specific skills.

A wealth of teacher resources

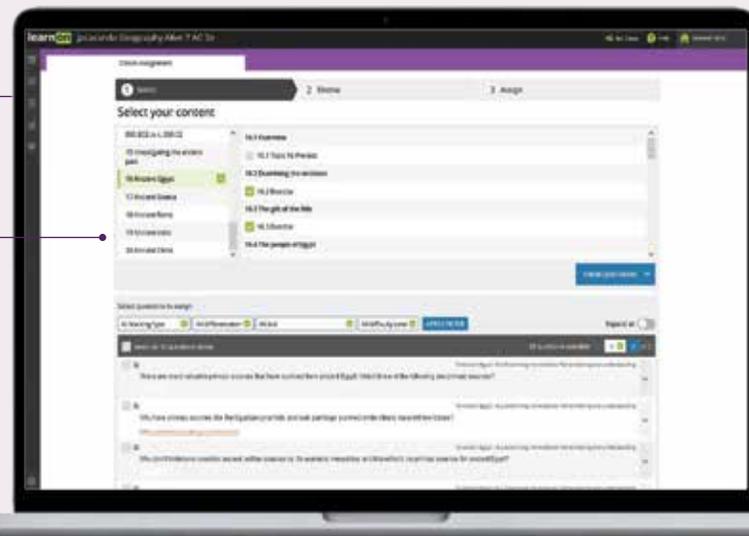


Enhanced teaching-support resources for every lesson, including:

- work programs and curriculum grids
- practical teaching advice
- three levels of differentiated teaching programs
- quarantined topic tests (with solutions)

Customise and assign

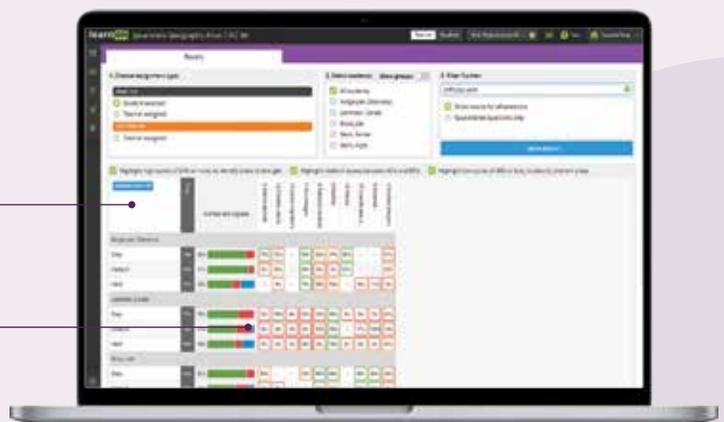
An inbuilt testmaker enables you to create custom assignments and tests from the complete bank of thousands of questions for immediate, spaced and mixed practice.



Reports and results

Data analytics and instant reports provide data-driven insights into progress and performance within each lesson and across the entire course.

Show students (and their parents or carers) their own assessment data in fine detail. You can filter their results to identify areas of strength and weakness.



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Understanding cognitive verbs

Cognitive verbs in the Australian Curriculum

The Australian Curriculum aims to develop students' disciplinary knowledge, skills, understanding and general capabilities across the curriculum. Students are also expected to progressively develop their thinking skills.

In the Australian Curriculum, cognitive verbs are used as signposts for this depth of thinking. Cognitive verbs signify different types of thinking and are already used in the classroom by many teachers and students.

Questions within Jacaranda resources use these cognitive verbs to support students in cognitive verb 'thinking'. The following list describes the cognitive verbs that are frequently used in Years 9 and 10.

Cognitive verb	Description
analyse	considering something in detail, finding meaning or relationships and identifying patterns. In an analysis you may reorganise ideas and find similarities and differences.
apply	using knowledge and understanding in order to solve a problem or complete an activity; activities and problems may be familiar or unfamiliar; applying knowledge and understanding can require recalling previous experiences.
compare	recognising how things are similar and dissimilar. Concepts or items are generally grouped before a comparison is made.
decide	selecting from available options. This may involve considering criteria on which to base your selection.
describe	giving an account of a situation, event, pattern or process. A description may require a sequence or order.
develop	bringing something to a more advanced state. Processing and understanding are required to develop an idea or opinion. Developing an idea or opinion may also involve considering feedback or the collective thoughts of a group.
evaluate	making a judgement using a set of criteria. This may include considering strengths and limitations of something in order to make a judgement on a preferred option.
examine	considering the information given and recognising key features. This might require making a decision, which involves gathering more information.
explain	making an idea, concept or relationship between two things clear by giving in-depth information. Explanations may include details of who, what, when, where, why and how in a step-by-step format.
identify	recognising and showing particular features of something. This might also include showing what or who something or someone is.
interpret	gaining meaning from text, graphs, data or other visuals. An interpretation includes stating what something might mean and drawing a conclusion.
select	choosing the most suitable option from a number of alternatives. This might require some consideration of context.
investigate	planning, collecting and interpreting data and information, and drawing conclusions.
synthesise	combining elements (information, ideas and components) into a connected or coherent whole.

Source: Adapted from the QCAA Cognitive Verbs.

1 Geography concepts and skills

LESSON SEQUENCE

1.1 Overview	3
1.2 Concepts in Geography	4
1.3 Skills used in Geography	9
1.4 SkillBuilder: Describing spatial relationships in thematic maps	online only
1.5 SkillBuilder: Describing divergence graphs	online only
1.6 SkillBuilder: Describing patterns and correlations on a topographic map	online only
1.7 SkillBuilder: Interpreting satellite images to show change over time	online only
1.8 SkillBuilder: Constructing and describing a transect on a topographic map	online only
1.9 SkillBuilder: Constructing multiple line and cumulative line graphs	online only
1.10 SkillBuilder: Constructing a land use map	online only
1.11 SkillBuilder: Creating a survey	online only
1.12 SkillBuilder: Constructing ternary graphs	online only
1.13 SkillBuilder: Constructing and describing proportional circles on maps	online only
1.14 SkillBuilder: Constructing and describing isoline maps	online only
1.15 SkillBuilder: Constructing and describing a flow map	online only
1.16 SkillBuilder: Constructing a table of data for GIS	online only
1.17 SkillBuilder: GIS — deconstructing a map	online only
1.18 SkillBuilder: Interpreting a geographical cartoon	online only
1.19 SkillBuilder: Using advanced survey techniques — interviews	online only
1.20 SkillBuilder: Writing a fieldwork report as an annotated visual display (AVD)	online only
1.21 Review	21

LESSON

1.1 Overview

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1.1.1 Introduction

When you study Geography, you are building knowledge and skills that you and your community will need now and into the future. The concepts and skills that you use in Geography can also be applied to everyday situations, such as finding your way from one place to another. Studying Geography may help you in a future career here in Australia or somewhere overseas.

Throughout your study of Geography, you will cover topics that will give you a better understanding of the social and physical aspects of the world around you, at both the local and global scale. You will investigate important issues that need to be addressed now and in the future.

FIGURE 1 Studying Geography will give you a better understanding of the social and physical aspects of the world around you.



Resources



eWorkbook

Customisable worksheets for this topic (ewbk-11471)



Video eLesson

Geography concepts and skills (eles-6115)

LESSON

1.2 Concepts in Geography

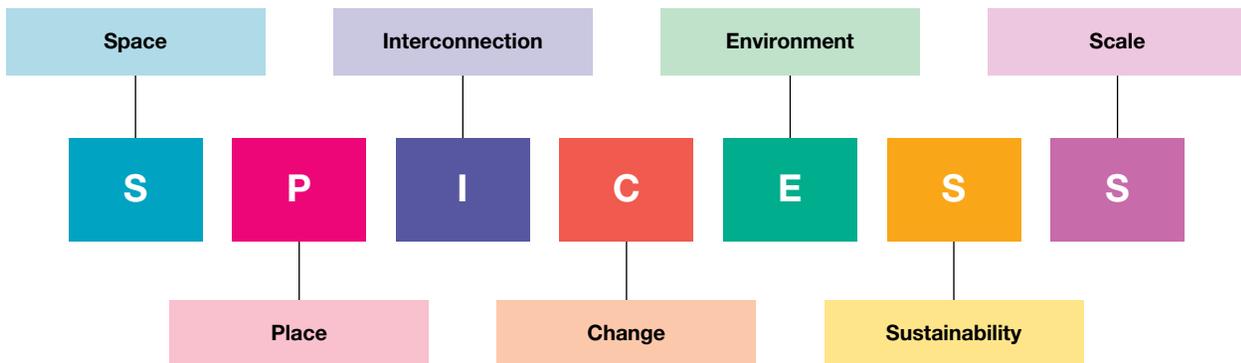
LEARNING INTENTION

By the end of this lesson you should be able to identify, explain and apply the seven Geography concepts using the acronym SPICESS.

1.2.1 Geographical concepts: SPICESS

Geographical concepts help you make sense of your world. By using these concepts you can investigate and understand the world you live in, and you can use them to try to imagine a different world. The concepts help you to think geographically. The seven major concepts (*space, place, interconnection, change, environment, sustainability* and *scale*) will be explored in detail in the following sections and through the activities and exercises in this lesson.

FIGURE 1 A way to remember the seven geographical concepts is to think of the term SPICESS.



1.2.2 What is space?

The concept of **space** is about where things are located and distributed on the surface of the Earth.

When referring to space in Geography we can have absolute or relative location. Absolute location is the unique location of a site or geographical feature. For example, the absolute location of Broken Hill is at 31°57' South latitude and 141°28' East longitude. Relative location is the location of a place or feature in relation to other places. It can be described by direction and distance from other places and features.

A site 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 its relative location — where it is in relation to another place in terms of distance and direction.

space where things are located and distributed on the surface of the Earth

Explore more with my  World Atlas

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

- Developing Australian Curriculum concepts > **Space**

1.2.3 What is place?

Place is an area on the Earth's surface which is identified and has meaning for people. 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 is 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 other 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 2 Located in a desert biome, this array of greenhouses in Almeria, Spain, allows for the control of soil, moisture, nutrients and weather conditions, enabling the large-scale farming of fruit and vegetables.



Explore more with my  World Atlas

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

- Developing Australian Curriculum concepts > Place

1.2.4 What is interconnection?

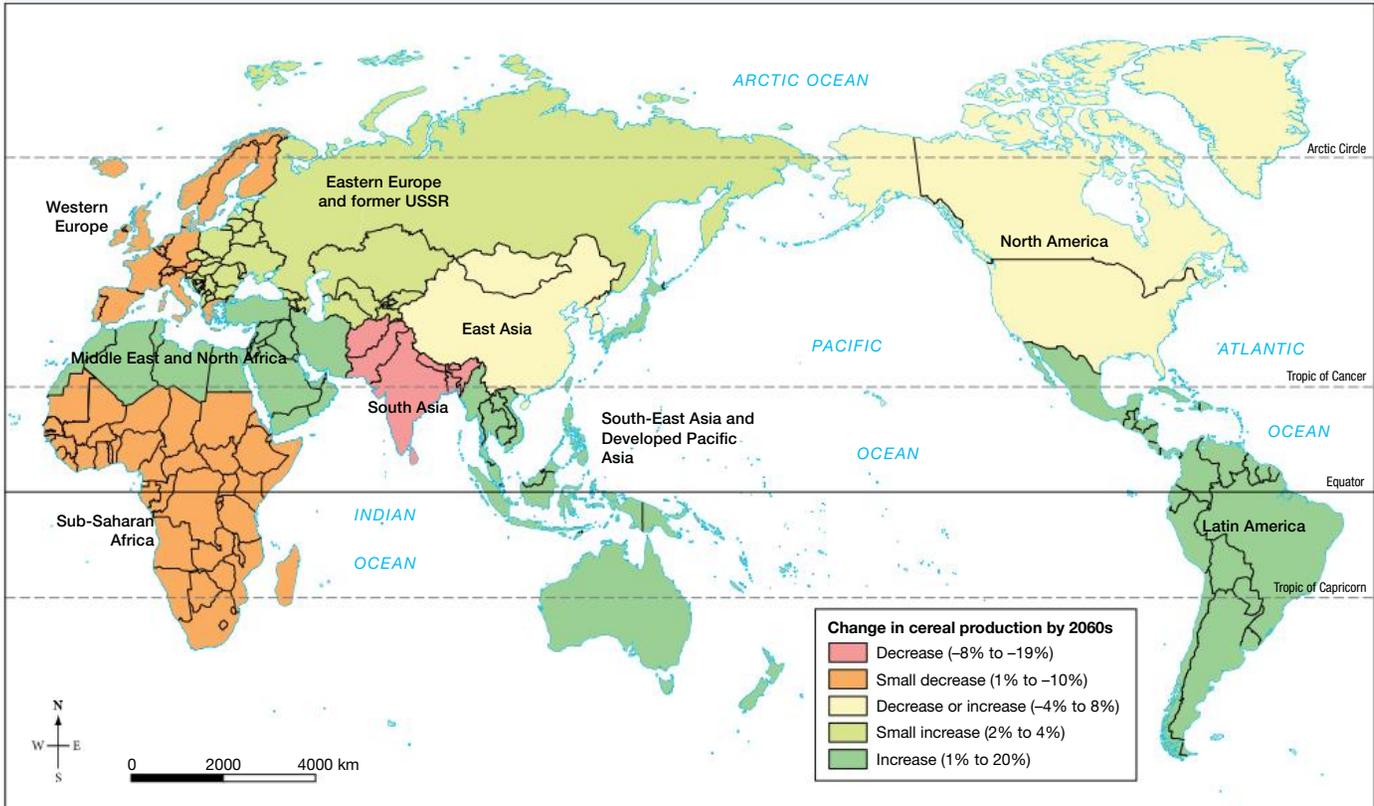
People and things are connected to other people and things in their own and other places, and understanding these connections helps us to understand how and why places are changing.

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 cultural ties. The manufacture of a product may create **interconnections** between suppliers, manufacturers, retailers and consumers. Trade in goods and services creates interconnections across the globe.

place an area on the Earth's surface which is identified and has meaning for people

interconnection the fact that people and things are connected to other people and things in their own and other places around the world

FIGURE 5 Mapping potential change: predictions of the effects of climate change on cereal crops



Source: Based on data from Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000•2080 by Tubiello F N, Fisher G in Technological Forecasting and Social Change 2007, 747: 1030-56. Map drawn by Spatial Vision.

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > 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, three different people could look at a well-vegetated hillside; 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.



environment the physical and biological world around us, which supports and enriches human and other life by providing raw materials and food, absorbing and recycling wastes, and being a source of enjoyment and inspiration to people

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > 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 now and into the future.

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.

sustainability refers to maintaining the capacity of the environment to support our lives and those of other living creatures now and into the future

FIGURE 7 The unsustainable nature of fishing



Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > Sustainability

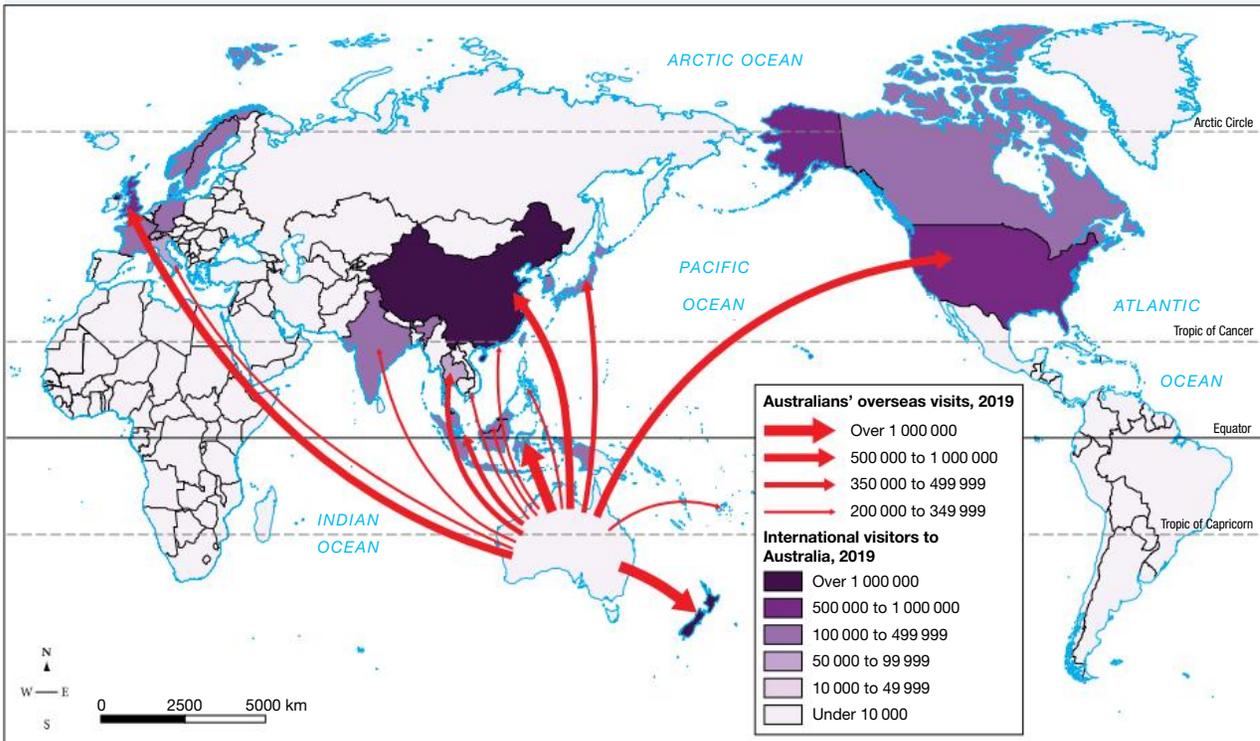
1.2.8 What is scale?

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

A little like a camera zoom, 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; for example, 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.

scale the way that geographical phenomena and processes can be examined at different spatial levels. Scale can be applied from personal and local levels to regional, national or global levels.

FIGURE 8 Country of origin for tourists visiting Australia, and destinations for Australian tourists



Source: Based on data from ABS and Austrade. Map redrawn by Spatial Vision.

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > Scale

LESSON

1.3 Skills used in Geography

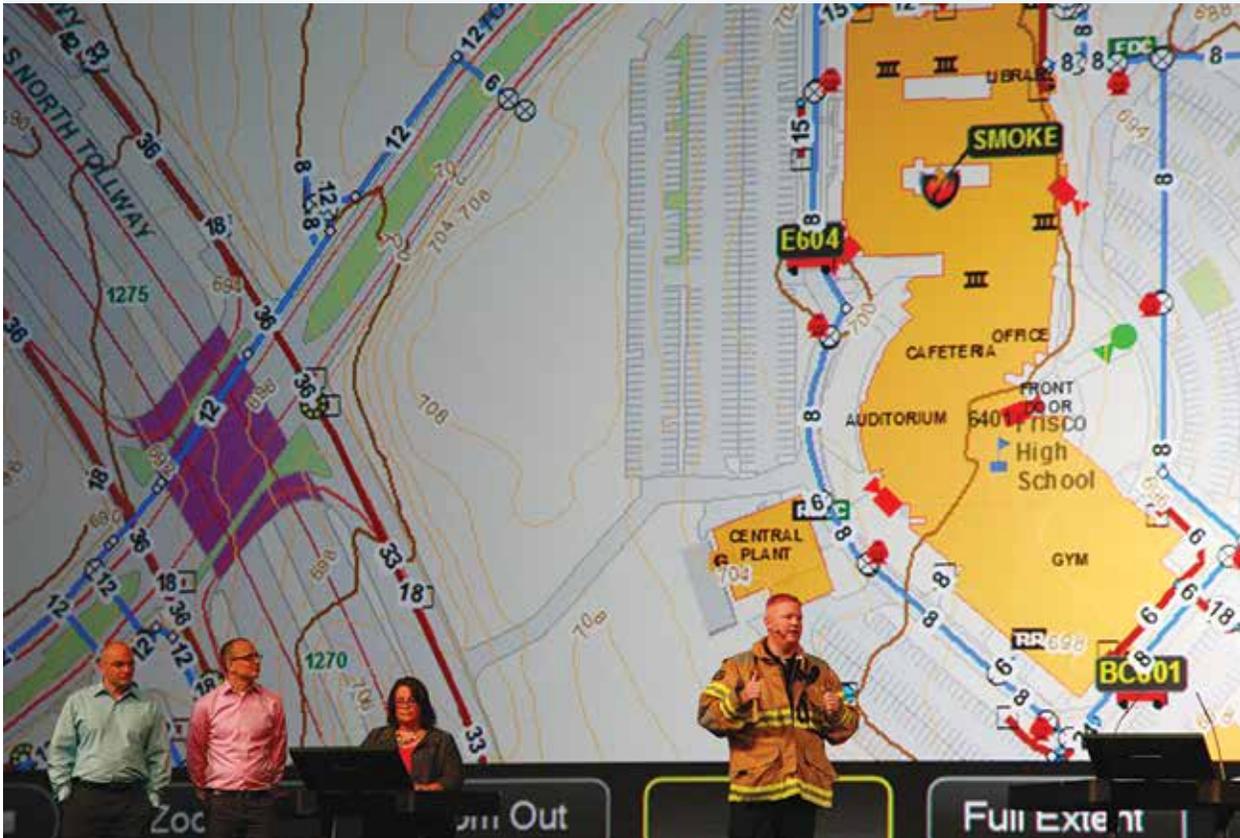
1.3.1 Skills for work

Studying Geography is about developing an understanding of the world. The concepts and skills you will learn are transferable to the workplace and can be used as a basis for evaluating strategies for the sustainable use and management of the world's resources. An understanding of Geography and its application for managing sustainable futures is important knowledge that will be desirable to many future employers. Perhaps more importantly, however, the study of Geography helps you to understand the world you live in: its landscape, natural systems, people and human interconnectivity.

Geographical skills and knowledge are a foundation for many occupations. The study of Geography includes developing important geospatial and spatial technology skills, which underpin the knowledge base of a range of courses and careers.

- *Geospatial skills:* the ability to collect and collate information gathered from fieldwork and observations. Geospatial skills are used in careers such as mining, 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 is used to manage spaces and plan escape routes during a fire.



1.3.2 Skills used in studying Geography

In addition to the concepts you study in Geography, there is a range of essential practical skills that you will learn, practise and build.

The specific Geographical skills you'll use in Year 9 are listed below. These can be categorised into the four core Geography skills.

Questioning and researching using geographical methods

Questioning and researching using geographical methods involves applying geographical concepts to develop questions and using primary research or fieldwork to gain a greater understanding of a concept or issue. This year your research and fieldwork should involve gathering information from both primary sources and a range of secondary sources, while evaluating them for relevance, reliability and bias. In Geography we look at information from a range of perspectives, and use ethical protocols to assess reliability and worth. In Year 9 you will be investigating the causes and consequences of change in places and environments and how this change can be managed. You will also look at the way in which our increasingly interconnected and interdependent world will shape the planet's future.

The SkillBuilders related to this skill that you'll use at Year 9 level are:

- Constructing a land use map
- Creating a survey
- Using advanced survey techniques — interviews.

Interpreting and analysing geographical data and information

In Geography this year you will interpret data by using both quantitative methods (measurable information) and qualitative methods (observations and descriptions) to find similarities, patterns and differences in sources studied. You will also be expected to predict trends and discuss relationships by identifying the key aspects of data presented to you in a variety of forms (e.g. different types of maps, tables, graphs and charts).

In Year 9 Geography this may include analysing the links between different biomes and food production. It may also involve an analysis of the interconnectedness of our world through trade and information technologies.

The SkillBuilders related to this skill that you'll use at Year 9 level are:

- Describing patterns and correlations on a topographic map
- Interpreting satellite images to show change over time
- Constructing and describing a transect on a topographic map
- Constructing a land use map
- Describing spatial relationships in thematic maps
- Describing divergence graphs
- Constructing ternary graphs
- Constructing and describing proportional circles on maps
- Constructing and describing isoline maps
- Constructing and describing a flow map
- Constructing a table of data for GIS
- Constructing multiple line and cumulative line graphs
- GIS — deconstructing a map.

Concluding and decision-making

In Geography you will learn to justify conclusions and propose strategies by analysing data, information and perspectives from a variety of sources. By considering environmental, economic and social factors you will make assessments about the interconnectedness of issues relating to biomes and food security as well as the geography of interconnection.

You will be expected to draw conclusions about how to best manage the balance between feeding the world's growing population and the maintenance of viable and sustainable biomes. You will also be theorising about the ways in which information and communication technologies will influence the future of our relationships with each other and the natural world.

The SkillBuilders related to this skill that you'll use at Year 9 level are:

- GIS — deconstructing a map
- Interpreting a geographical cartoon.

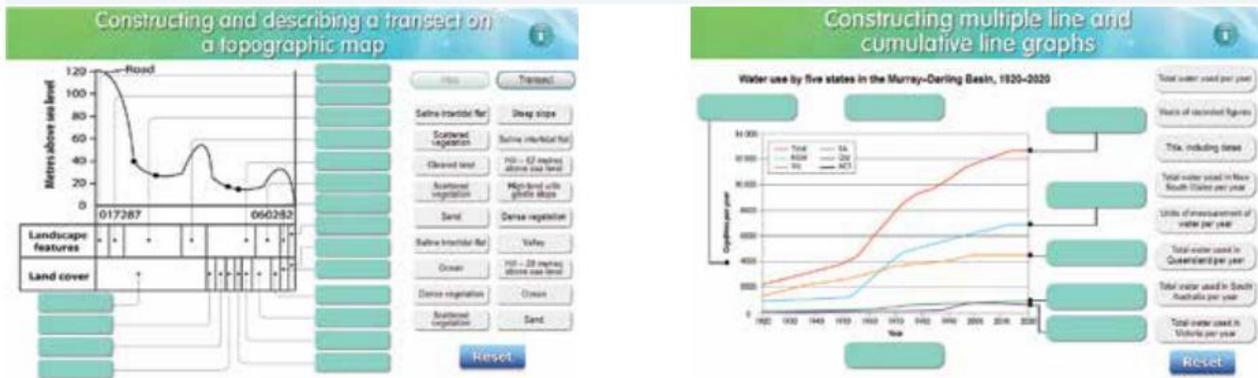
Communicating

Communicating your ideas and justifying your conclusions are key skills you will develop in Geography. Using geographical concepts and knowledge, and a range of digital and non-digital formats, you will learn to express your ideas on a wide range of concepts and issues. When communicating in Geography you need to ensure that you consider your audience, you acknowledge your sources and you choose appropriate methods of communication to ensure your message is clear and well presented. In Year 9 you will be expected to explore new ways of presenting information and further develop the skills you acquired in earlier years.

The SkillBuilders related to this skill that you'll use at Year 9 level are:

- Writing a fieldwork report as an annotated visual display (AVD).

FIGURE 2 Your online resources include interactivities that will help you to build your Geography skills.



LESSON

1.4 SkillBuilder: Describing spatial relationships in thematic maps

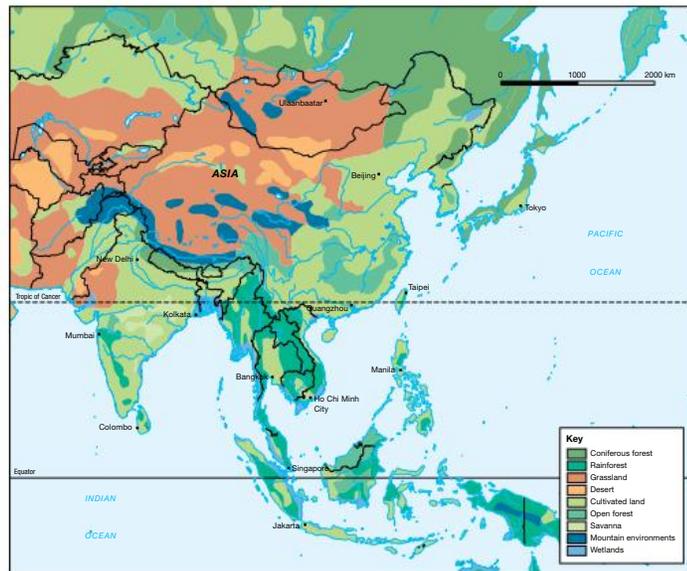
online only

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.

Select your learnON format to access:

- an explanation of the skill (Tell me)
- a step-by-step process to develop the skill, with an example (Show me)
- an activity to allow you to practise the skill (Let me do it).



Source: Map drawn by Spatial Vision.

on Resources

- Video eLesson** Describing spatial relationships in thematic maps (eles-1726)
- Interactivity** Describing spatial relationships in thematic maps (int-3344)

LESSON

1.5 SkillBuilder: Describing divergence graphs

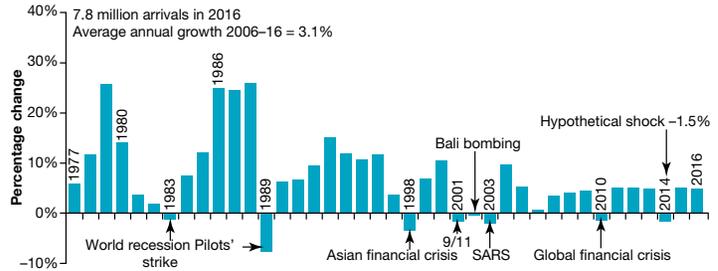
online only

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.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Video eLesson** Describing divergence graphs (eles-1739)
- Interactivity** Describing divergence graphs (int-3357)

LESSON

1.6 SkillBuilder: Describing patterns and correlations on a topographic map

online only

What is a pattern?

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.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Digital document** Topographic map of Clare Valley (doc-27426)
- Video eLesson** Describing patterns and correlations on a topographic map (eles-1729)
- Interactivity** Describing patterns and correlations on a topographic map (int-3347)
- Google Earth** Clare Valley

LESSON

1.7 SkillBuilder: Interpreting satellite images to show change over time

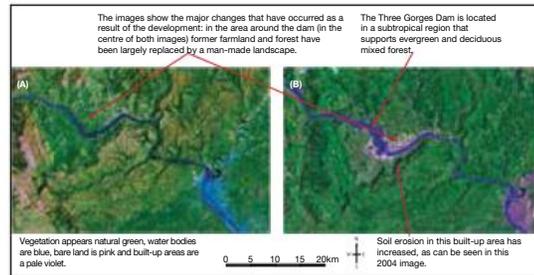
online only

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. 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.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



Source: Geoscience Australia.

on Resources

- Video eLesson** Interpreting satellite images to show change over time (eles-1733)
- Interactivity** Interpreting satellite images to show change over time (int-3351)

LESSON

1.8 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. In addition to the shape of the land, a transect shows what is on the ground, including landforms, vegetation, soil types, settlements and infrastructure.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Digital doc** Topographic map of Dalywoi Bay, Northern Territory (doc-11565)
- Video eLesson** Constructing and describing a transect on a topographic map (eles-1727)
- Interactivity** Constructing and describing a transect on a topographic map (int-3345)

LESSON

1.9 SkillBuilder: Constructing multiple line and cumulative line graphs

online only

What are multiple line 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 in a new layer or level. Both formats show change over time, and both show trends effectively.



Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).

on Resources

-  **Video eLesson** Constructing multiple line and cumulative line graphs (eles-1740)
-  **Interactivity** Constructing multiple line and cumulative line graphs (int-3358)

LESSON

1.10 SkillBuilder: Constructing a land use map

online only

What is a land use map?

A land use map may be drawn from a topographic map, an aerial photograph or a plan, or during fieldwork.

A land use map shows simplified information about the uses made of an area of land. In a built environment, a land use map may show a shopping centre, a local shopping strip, or the types of houses in a street. In a rural environment, a land use map may show vegetation types or agricultural activities.



Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).

on Resources

-  **Video eLesson** Constructing a land use map (eles-1755)
-  **Interactivity** Constructing a land use map (int-3373)

LESSON

1.11 SkillBuilder: Creating a survey

online only

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.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).

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

on Resources

- Video eLesson** Creating a survey (eles-1764)
- Interactivity** Creating a survey (int-3382)

LESSON

1.12 SkillBuilder: Constructing ternary graphs

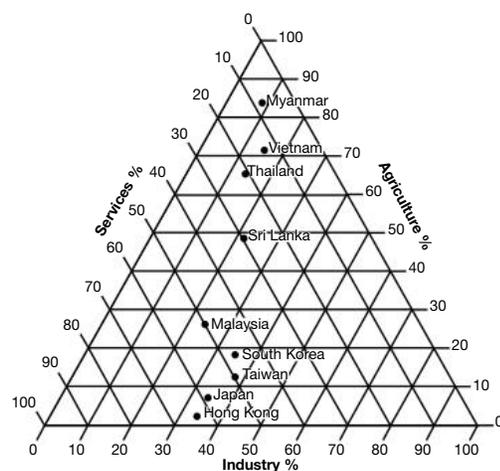
online only

What are ternary graphs?

Ternary graphs are triangular graphs that show the relationship or interconnection between features. They are particularly useful when a feature has three components and the three components add up to 100 per cent.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Video eLesson** Constructing ternary graphs (eles-1728)
- Interactivity** Constructing ternary graphs (int-3346)

LESSON

1.13 SkillBuilder: Constructing and describing proportional circles on maps

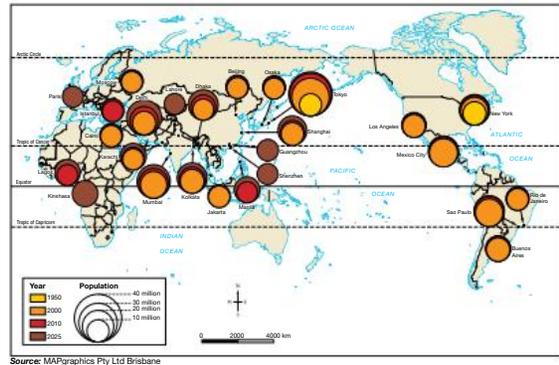
online only

What are proportional circle maps?

Proportional circle maps are maps that incorporate circles, drawn to scale, to represent data for particular places. Different-sized circles on a map reflect different values or amounts of the particular factor being studied.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Video eLesson** Constructing and describing proportional circles on maps (eles-1735)
- Interactivity** Constructing and describing proportional circles on maps (int-3353)

LESSON

1.14 SkillBuilder: Constructing and describing isoline maps

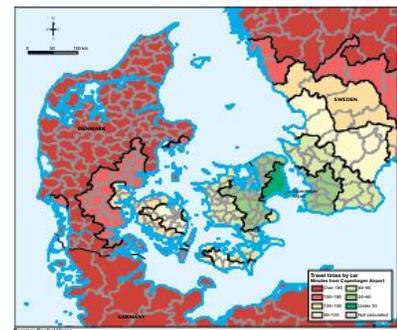
online only

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 do not cross or touch each other. The same difference is always shown between each isoline and the next over the entire map.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



on Resources

- Video eLesson** Constructing and describing isoline maps (eles-1737)
- Interactivity** Constructing and describing isoline maps (int-3355)

LESSON

1.15 SkillBuilder: Constructing and describing a flow map

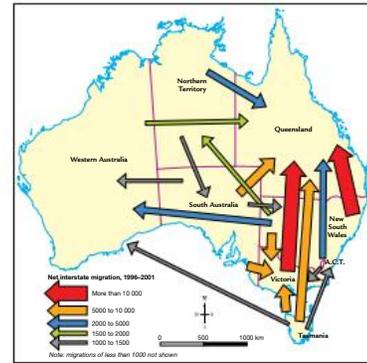
online only

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.

Select your learnON format to access:

- an overview of the skill and its application in Geography (Tell me)
- a video and a step-by-step process to explain the skill (Show me)
- an activity and interactivity for you to practise the skill (Let me do it).



Resources

- Digital document** Topographic map of Griffith, New South Wales (doc-11566)
- Video eLesson** Constructing and describing a flow map (eles-1741)
- Interactivity** Constructing and describing a flow map (int-3359)

LESSON

1.16 SkillBuilder: Constructing a table of data for GIS

online only

Why are there tables within GIS?

Geographical information systems, or GIS, use 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.

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

Resources

- Video eLesson** Constructing a table of data for a GIS (eles-1743)
- Interactivity** Constructing a table of data for a GIS (int-3361)

LESSON

1.17 SkillBuilder: GIS — deconstructing a map

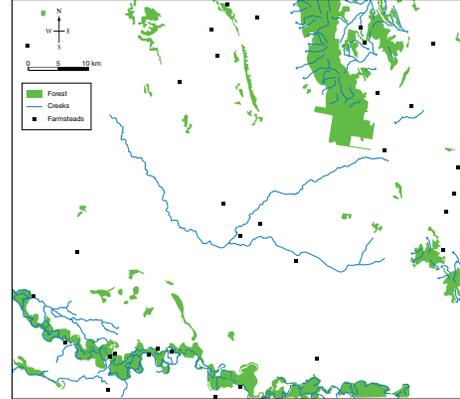
online only

What is GIS?

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

Select your learnON format to access:

- an explanation of the skill (Tell me)
- a step-by-step process to develop the skill, with an example (Show me)
- an activity to allow you to practise the skill (Let me do it).



on Resources

-  **Digital document** Topographic map of Griffith, New South Wales (doc-11566)
-  **Video eLesson** GIS — deconstructing a map (eles-1730)
-  **Interactivity** GIS — deconstructing a map (int-3348)

LESSON

1.18 SkillBuilder: Interpreting a geographical cartoon

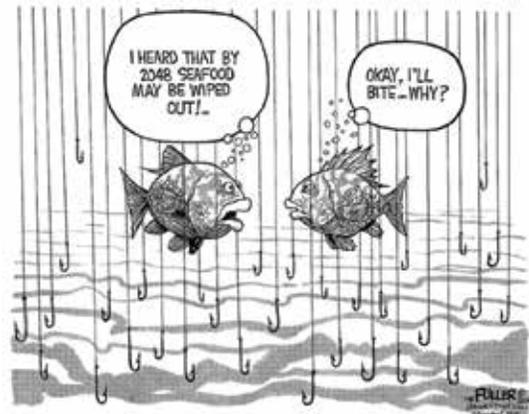
online only

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.

Select your learnON format to access:

- an explanation of the skill (Tell me)
- the step-by-step process involved in developing the skill with an example (Show me)
- an activity to allow you to practise the skill (Let me do it).



on Resources

-  **Video eLesson** Interpreting a geographical cartoon (eles-1731)
-  **Interactivity** Interpreting a geographical cartoon (int-3349)

LESSON

1.21 Review

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1.21.1 Key knowledge summary

Use this dot point summary to review the content covered in this topic.

1.2 Concepts in Geography

- The acronym SPICESS helps you remember the seven geographical concepts:
 - space
 - place
 - interconnection
 - change
 - environment
 - sustainability
 - scale.

1.3 Skills used in Geography

- Many occupations are linked to the study of Geography.
- New jobs are developing in the spatial sciences that use geographical tools such as GPS, GIS, satellite imaging and surveying.
- You will learn, practise and master a range of essential practical skills, including:
 - questioning and researching using geographical methods
 - interpreting and analysing geographical data and information
 - concluding and decision-making
 - communicating.

on Resources



eWorkbook Customisable worksheets for this topic (ewbk-11471)
Reflection (ewbk-11473)



Interactivity Geography concepts and skills crossword (int-9057)

1.21.2 Key terms

change is about using time to better understand a place, an environment, a spatial pattern or a geographical problem. The concept of change involves both time and space — change can take place over a period of time, or over an area.

environment the physical and biological world around us, which supports and enriches human and other life by providing raw materials and food, absorbing and recycling wastes, and being a source of enjoyment and inspiration to people

interconnection the fact that people and things are connected to other people and things in their own and other places around the world

place an area on the Earth's surface which is identified and has meaning for people

scale the way that geographical phenomena and processes can be examined at different spatial levels. Scale can be applied from personal and local levels to regional, national or global levels.

space where things are located and distributed on the surface of the Earth

sustainability refers to maintaining the capacity of the environment to support our lives and those of other living creatures now and into the future

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LESSON

1.4 SkillBuilder: Describing spatial relationships in thematic maps

LEARNING INTENTION

By the end of this lesson you should be able to describe spatial relationships in thematic maps.

1.4.1 Tell me

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.

This could mean the similarities that maps have to where things are located or areas of high frequency. Spatial relationships also highlight potential issues such as areas that are experiencing high traffic or high rates of animal deaths.

How 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 patterns of behaviour and links between environments. They are useful in helping you understand how one thing affects another.

They are used by:

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

A description of a spatial relationship in thematic maps:

- clearly identifies which features on thematic maps are linked or interconnected
- points out obvious anomalies (these are examples of where the general pattern or interconnection does not apply or exist)
- describes the extent of interconnections (e.g. as strong or weak).

1.4.2 Show me

You will need:

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

Model

The maps in **FIGURES 1(a)** and **1(b)** 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, but in Asia overall there is a strong spatial relationship between biomes and climate.

Procedure

Step 1

Use an atlas to familiarise yourself with the mapped area. Place names are important to use in your writing. In **FIGURES 1(a)** and **1(b)**, 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 **FIGURES 1(a)** and **1(b)**, 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 grassland biomes dominate the environment.'

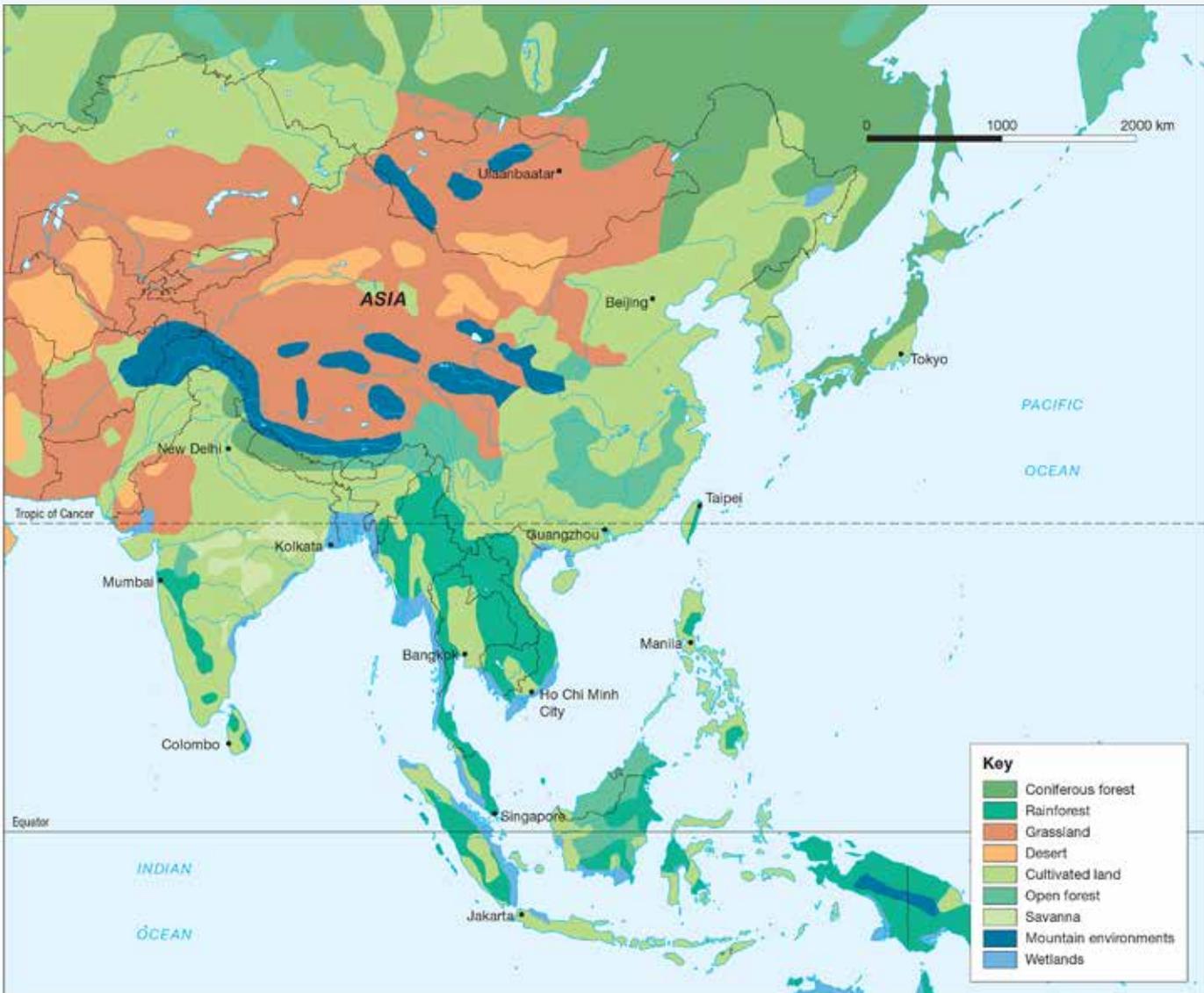
Step 3

Search the maps carefully and look for any areas where there seem to be no connections between biomes and climate. These are the anomalies because they do not fit the general pattern of a link between climate and biome. 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

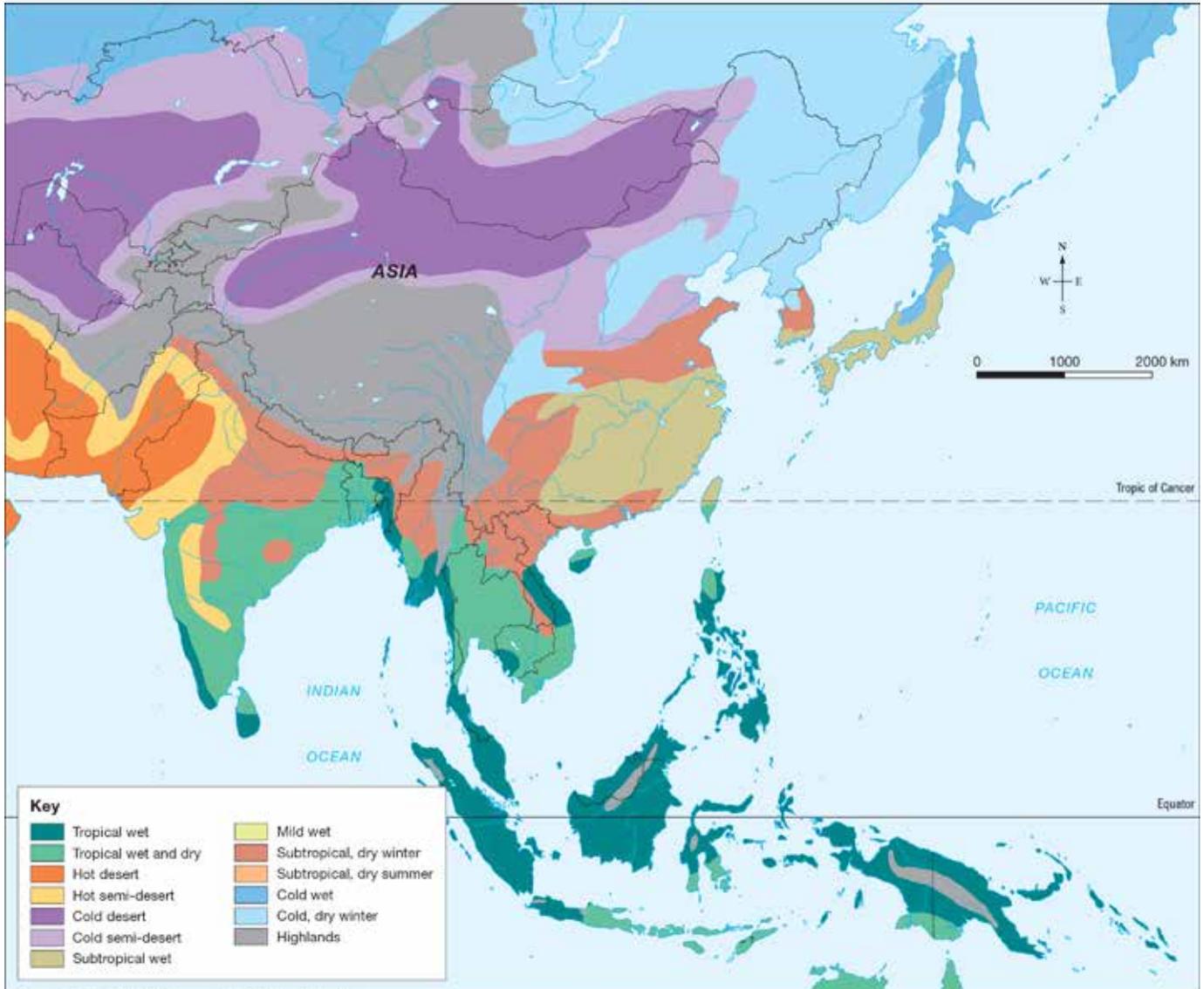
Conclude your paragraph with a final statement about spatial relationships. For example: 'In Asia there is a strong spatial relationship between biomes and climate.'

FIGURE 1(a) Thematic map of Asia showing biomes



Source: Spatial Vision.

FIGURE 1(b) Thematic map of Asia showing climatic zones



Source: Spatial Vision using Natural Earth.

on Resources

-  **Video eLesson** Describing spatial relationships in thematic maps (eles-1726)
-  **Interactivity** Describing spatial relationships in thematic maps (int-3344)

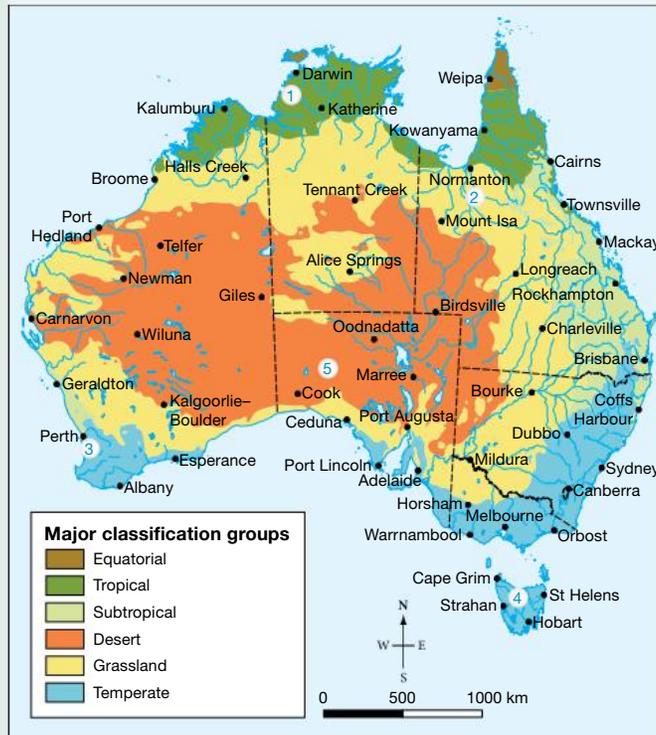
1.4.3 Let me do it

Complete the following activities to practise this skill.

1.4. ACTIVITIES

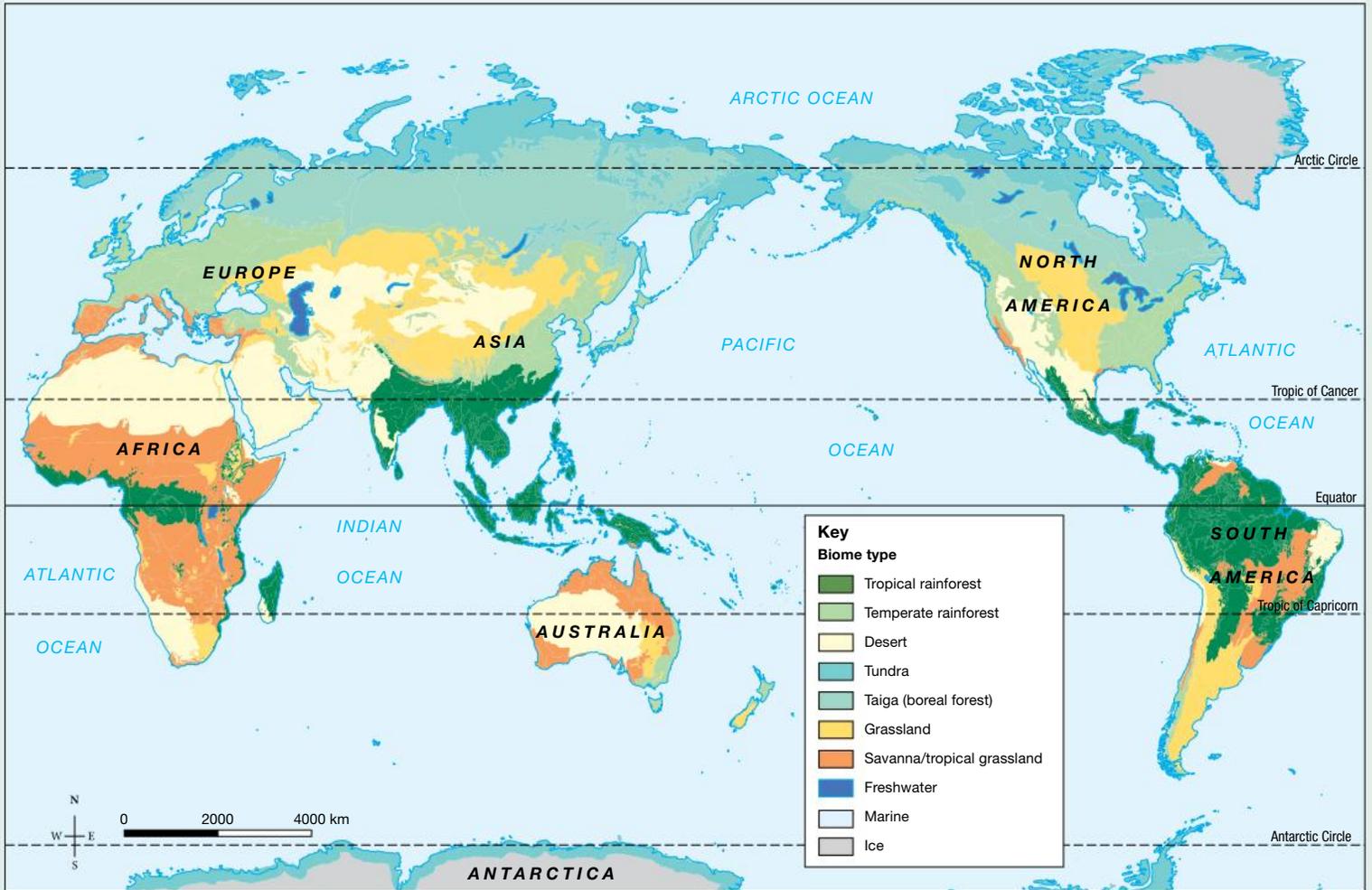
1. Study the thematic maps showing Australia's climate and biomes, shown in **FIGURES 2** and **3**. In a paragraph, describe the **spatial** relationship between biomes and climate in Australia. Use the checklist to ensure you cover all aspects of the task.
2. Based on what you have learned in this lesson, apply your skills to answer the following questions.
 - a. Is there a strong relationship between Australia's arid climates and desert biomes? Explain your answer.
 - b. Is there a **spatial** relationship between Australia's tropical rainforests and climate?
 - c. Is the **spatial** relationship between climate and the savanna (grassland) biome strong or weak? Explain your answer.
 - d. Name the main biome found in Tasmania. Why might there be only one biome on the map?
 - e. Find one biome that does not occur in Australia. Suggest reasons why this is the case.

FIGURE 2 Climate classification of Australia



Source: Data copyright Commonwealth of Australia, 2013 Bureau of Meteorology. Map drawn by Spatial Vision.

FIGURE 3 Major biomes of the world



Source: Redrawn by Spatial Vision based on the information from the Nature Conservancy and GIS Data.

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).

LESSON

1.5 SkillBuilder: Describing divergence graphs

LEARNING INTENTION

By the end of this lesson you should be able to describe the information presented in a divergence graph.

1.5.1 Tell me

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.

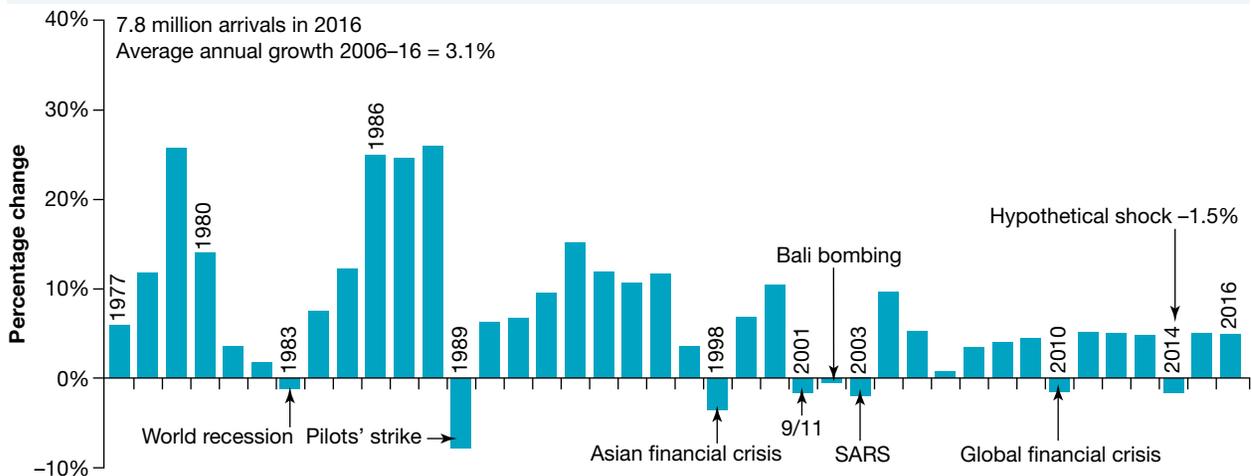
Why is a graph with negative numbers useful?

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.

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 (e.g. about a specific place).

FIGURE 1 Australia's past tourism trends



Australia's tourism industry has experienced fluctuating highs and lows over the 40 years between 1977 and 2017. 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 was not as strong (<10 per cent) between the 1990s and early 2000s. 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 (with negative growth in 2010).

During the COVID-19 pandemic, international arrivals to Australia virtually came to a complete halt (negative growth between 99.7 and 99.2 per cent). Consider the shape of how this compares with the data presented for the 40 years prior in this graph.

1.5.2 Show me

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 40 years.' In your description, include any events that affected the change. 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**).

Resources

 **Video eLesson** Describing divergence graphs (eles-1739)

 **Interactivity** Describing divergence graphs (int-3357)

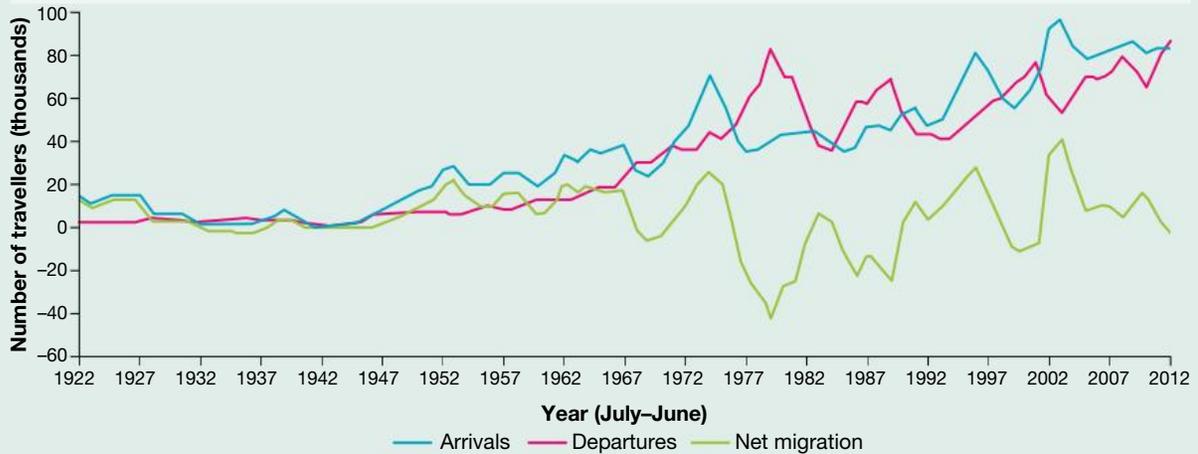
1.5.3 Let me do it

Complete the following activities to practise this skill.

1.5 ACTIVITIES

- Using the graph shown in **FIGURE 2**, explain what has happened to the level of migration in New Zealand. Use the net migration line as the basis for your answer.

FIGURE 2 New Zealand migration trends: Annual permanent and long-term arrivals, departures and net migration, 1922–2012



- Apply your skills to answer the following questions. Use the checklist to ensure you have covered all aspects of the task.
 - What is the trend for the line indicating the number of arrivals?
 - What is the trend for the line indicating the number of departures?
 - In which years did the population of New Zealand lose more people than it gained?
 - Identify a period of time when increases happened slowly and a period when they happened quickly. Identify a period of time when decreases happened slowly and a period when they happened quickly.
 - If net migration is the difference between arrivals and departures, what has happened to people's attitudes towards migration to New Zealand?
- Using the data showing monthly short-term arrivals to Australia collected by the Australian Bureau of Statistics, create a divergence graph that shows the month-by-month impact of the global COVID-19 pandemic on international travellers to Australia.

TABLE 1 Monthly arrivals to Australia for short-term visits (2019–2020)

Month	Arrivals ('000)	% change*
Jul	790.4	2.1
Aug	789.2	6.4
Sep	695.0	0.7
Oct	774.0	2.7
Nov	815.9	1.7
Dec	1077.7	1.9
Jan	766.6	4.8
Feb	685.4	-26.1
Mar	331.9	-60.3

Month	Arrivals ('000)	% change*
Apr	2.2	-99.7
May	3.4	-99.5
Jun	5.4	-99.2
Annual total	6 737.2	-27.9

*Compared to same month in the previous year

Source: ABS, Overseas Arrivals - Unprecedented Fall in 2019-20, Media Release 14 August 2020

- b.** Using the steps in the Show me section, write a short analysis of how tourist arrivals changed in Australia during 2020.

Checklist

I have:

- identified and communicated key features such as patterns, peaks and troughs
- clearly represented and communicated the data about a specific **place**.

LESSON

1.6 SkillBuilder: Describing patterns and correlations on a topographic map

LEARNING INTENTION

By the end of this lesson you should be able to analyse and describe patterns and correlations seen on a topographic map.

1.6.1 Tell me

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.

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

- uses placenames
- 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.

1.6.2 Show me

You will need:

- a topographic map of the place being considered.

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.

pattern the way in which features are distributed or spread
correlation a relationship between the features

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



Source: Spatial Vision.

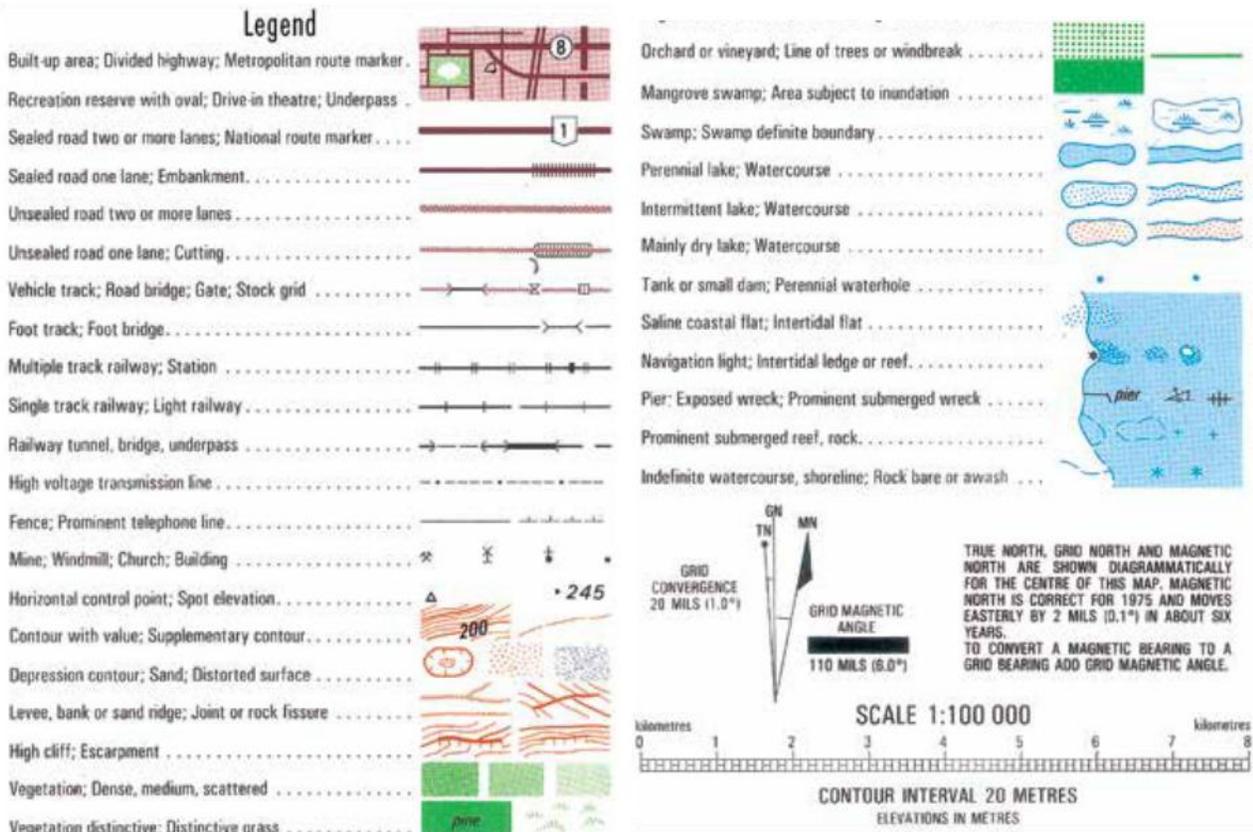


FIGURE 2 Looking across the Clare Valley in South Australia



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

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 model description, 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 model description concludes with the statement: ‘The Clare Valley region is an important vineyard area, adding significantly to the agricultural output of South Australia.’

Resources

-  **Digital document** Topographic map of Clare Valley (doc-27426)
-  **Video eLesson** Describing patterns and correlations on a topographic map (eles-1729)
-  **Interactivity** Describing patterns and correlations on a topographic map (int-3347)
-  **Google Earth** Clare Valley

1.6.3 Let me do it

Complete the following activities to practise this skill.

1.6 ACTIVITIES

1. Using the topographic map extract of the Griffith, NSW, area (**FIGURE 2** in subtopic 12.2) write a paragraph identifying any patterns and correlations that are evident. Use the checklist to ensure you cover all aspects of the task.
2. Apply your skills to answer the following questions.
 - a. Why are the water channels straight? Is there an interconnection between slope and water resources? Explain your answer.
 - b. To what extent is there a correlation between orchards and slope? Explain your answer.
 - c. Describe the direction of development of Griffith township. Suggest why it has developed in this way.
 - d. How do we know that the irrigated orchards are smallholdings?
 - e. Is there a correlation between land slope and agricultural land use?

Checklist

I have:

- used placenames
- 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.

LESSON

1.7 SkillBuilder: Interpreting satellite images to show change over time

LEARNING INTENTION

By the end of this lesson you should be able to identify and interpret some changes shown in satellite images over time.

1.7.1 Tell me

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.

How 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.

A good interpretation of a satellite image:

- translates the false colours
- identifies patterns
- makes logical inferences
- uses distance and direction to locate places.

1.7.2 Show me

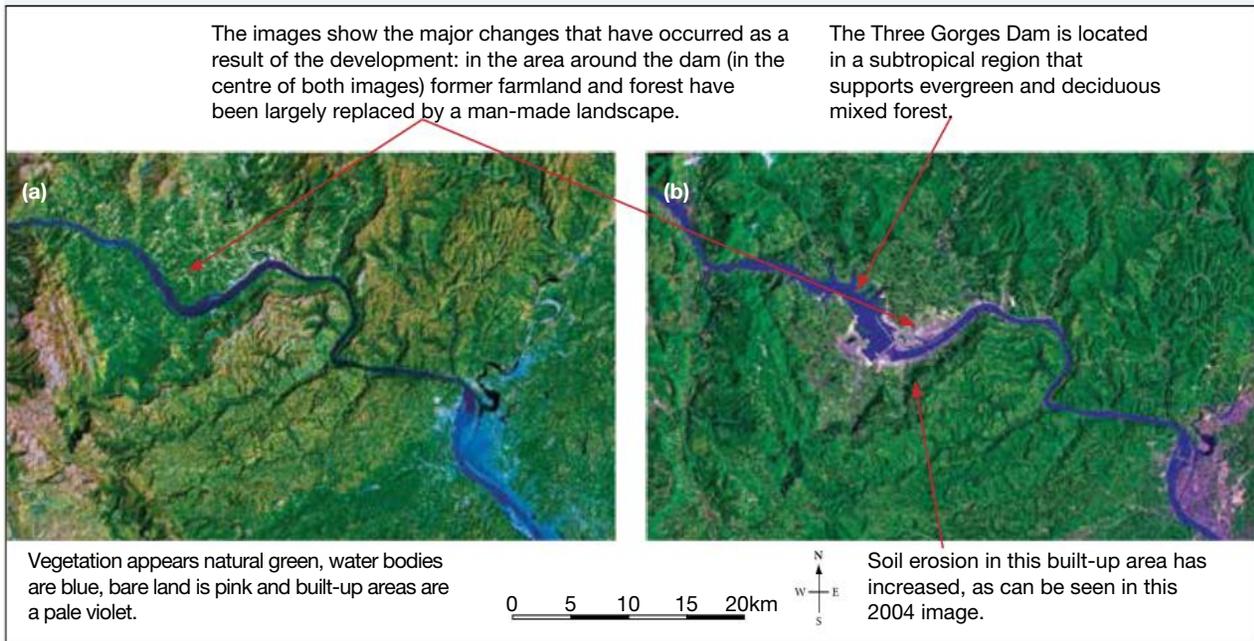
You will need:

- two satellite images of the same place, taken at different times
- an atlas.

Model

The Yangtze River in 1987 was a natural river running through a deep gorge. In the satellite image from 1987 (**FIGURE 1a**), the area is surrounded by high, barren hills and areas of dense subtropical forest (natural green). By 2004 (**FIGURE 1b**), 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.

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



Source: Geoscience Australia.

Procedure

Step 1

Determine the dates for the satellite images. Consider the time span 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 above **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 using the bends in the river as a reference point.

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.

Resources

-  **Video eLesson** Interpreting satellite images to show change over time (eles-1733)
-  **Interactivity** Interpreting satellite images to show change over time (int-3351)

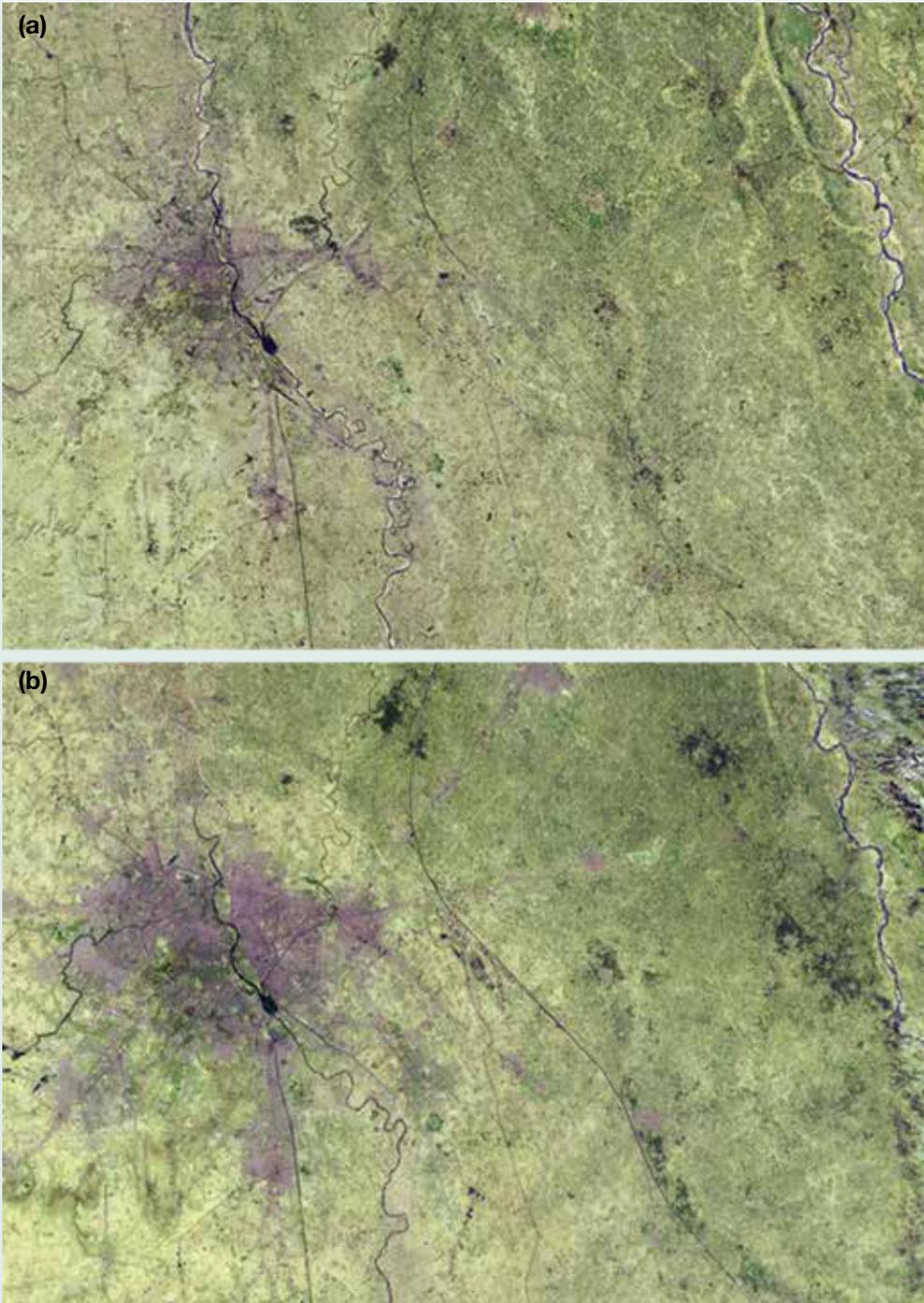
1.7.3 Let me do it

Complete the following activities to practise this skill.

1.7 ACTIVITIES

1. Refer to the satellite images of New Delhi in 1989 and 2018 shown in **FIGURES 2(a)** and **(b)**. Write a description of the change that has occurred over time to the boundaries of New Delhi. Use the checklist to ensure you cover all aspects of the task.
2. Based on what you have learned in this lesson apply your skills to answer the following questions.
 - a. Is New Delhi a growing or declining city? Explain your answer.
 - b. How has the vegetation cover of the area changed?
 - c. How has the road pattern changed?
 - d. Why do you think New Delhi has not expanded into the south-east corner of the satellite image?
 - e. How has the growth of New Delhi affected food security in the area?

FIGURE 2 New Delhi, India in (a) 1989 and (b) 2018



Checklist

I have:

- translated the false colours
- identified patterns
- made logical inferences
- used distance and direction to locate places.

LESSON

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

LEARNING INTENTION

By the end of this lesson you should be able to construct and describe a transect on a topographic map.

1.8.1 Tell me

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.

How are transects useful?

Transects can show:

- 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.

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:

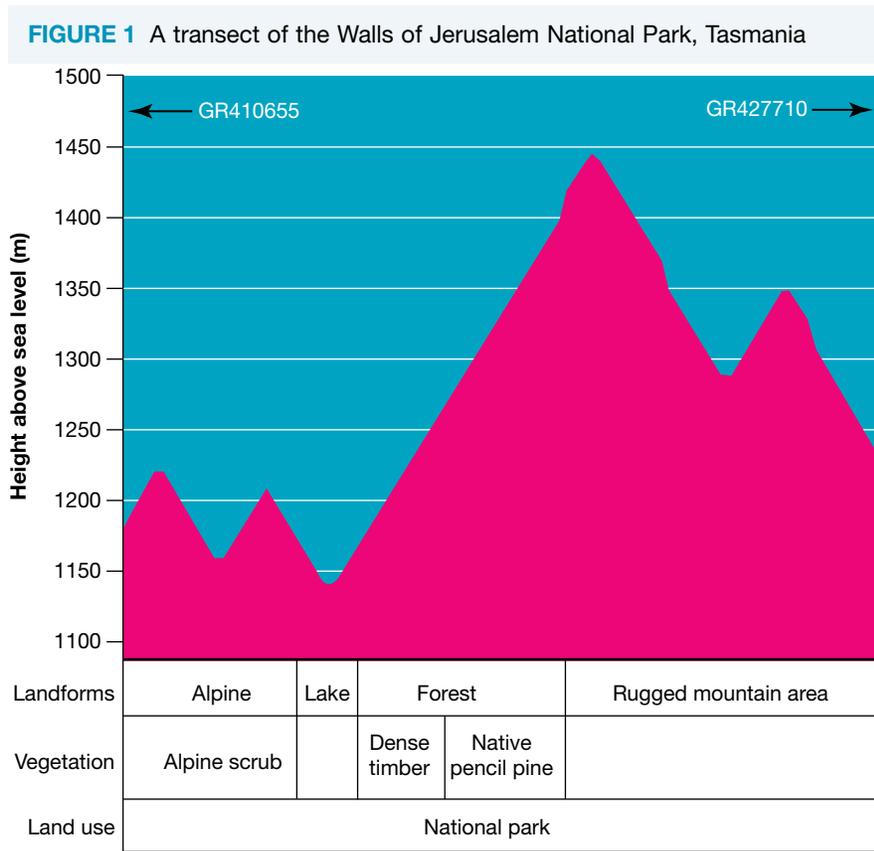
- describes the key aspects of slope, landform, vegetation and land use
- identifies interconnections between key features
- notes any anomalies.

1.8.2 Show me

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.

Model



Description of transect

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.

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.

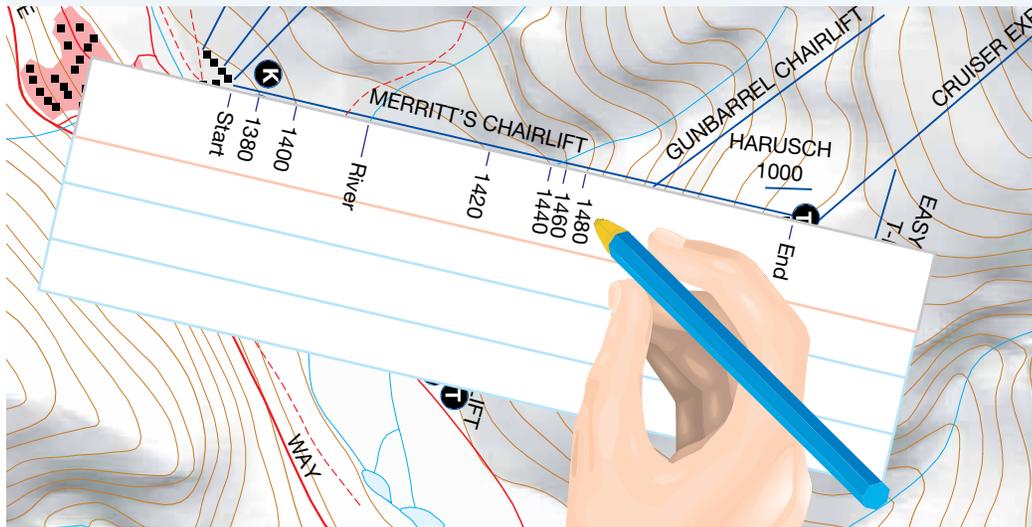
Step 1

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 placenames 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 (see **FIGURE 2**). (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.

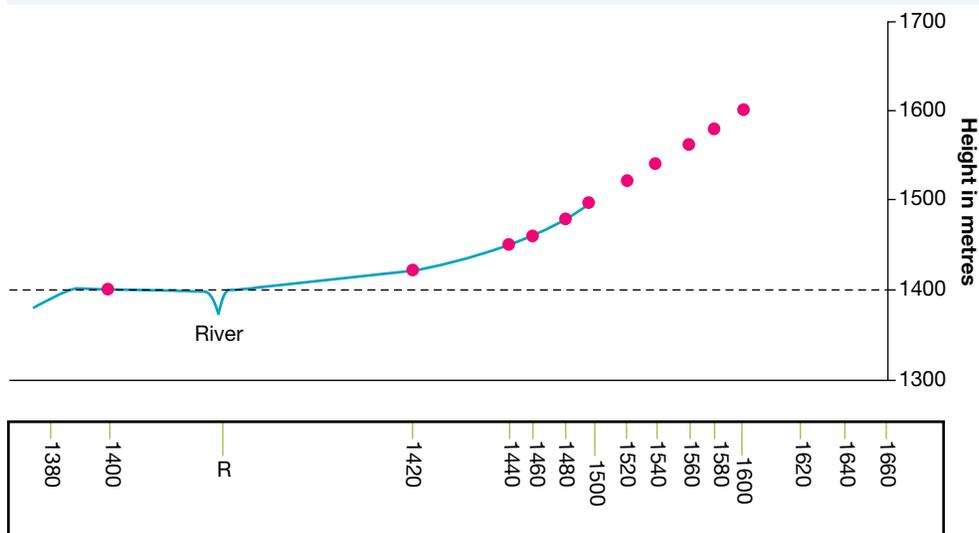
Step 4

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.

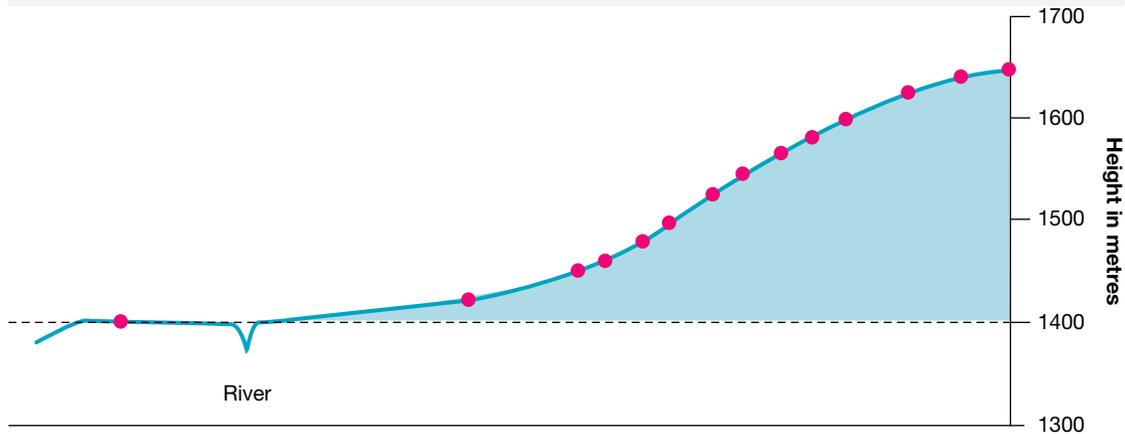
FIGURE 3 Drawing up the shape of the transect



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 (see **FIGURE 4**).

FIGURE 4 The shape of the land is completed.



Step 7

Beneath your completed cross-section, draw a table, like that in **FIGURE 1**, to indicate when a feature changes on the transect. Label each category to the left of the vertical axis, as in **FIGURE 1**. 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 1**. Place your paper edge back onto the topographic map to be accurate. **FIGURE 1** 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'.

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 1**, the original map had a scale of 1 centimetre to 250 metres, and the transect in **FIGURE 1** 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:

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

The 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.

Step 11

Write a description of the transect. Be sure to:

- describe the key aspects of slope, landform, vegetation and land use
- identify interconnections between key features
- make note of any anomalies.

Resources

-  **Digital document** Topographic map of Dalywoi Bay, Northern Territory (doc-11565)
-  **Video eLesson** Constructing and describing a transect on a topographic map (eles-1727)
-  **Interactivity** Constructing and describing a transect on a topographic map (int-3345)

1.8.3 Let me do it

Complete the following activities to practise this skill.

1.8 ACTIVITIES

1. Using the topographic map for Dalywoi Bay provided (you can download a copy of the map from the Resources panel), construct 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. Once complete, write a description of the transect. Use the checklist to ensure you cover all aspects of the task.
2. Based on what you have learned in this lesson apply your skills to answer the following questions.
 - a. List the biomes found on your transect.
 - b. Using the scale, mark the horizontal distance on your transect where the land is affected by water.
 - c. How is the vegetation interconnected with the shape of the land?
 - d. How does the landform affect human activities?
 - e. If you were to build a house on the land shown in your transect, where would you choose to build, and why?

Checklist

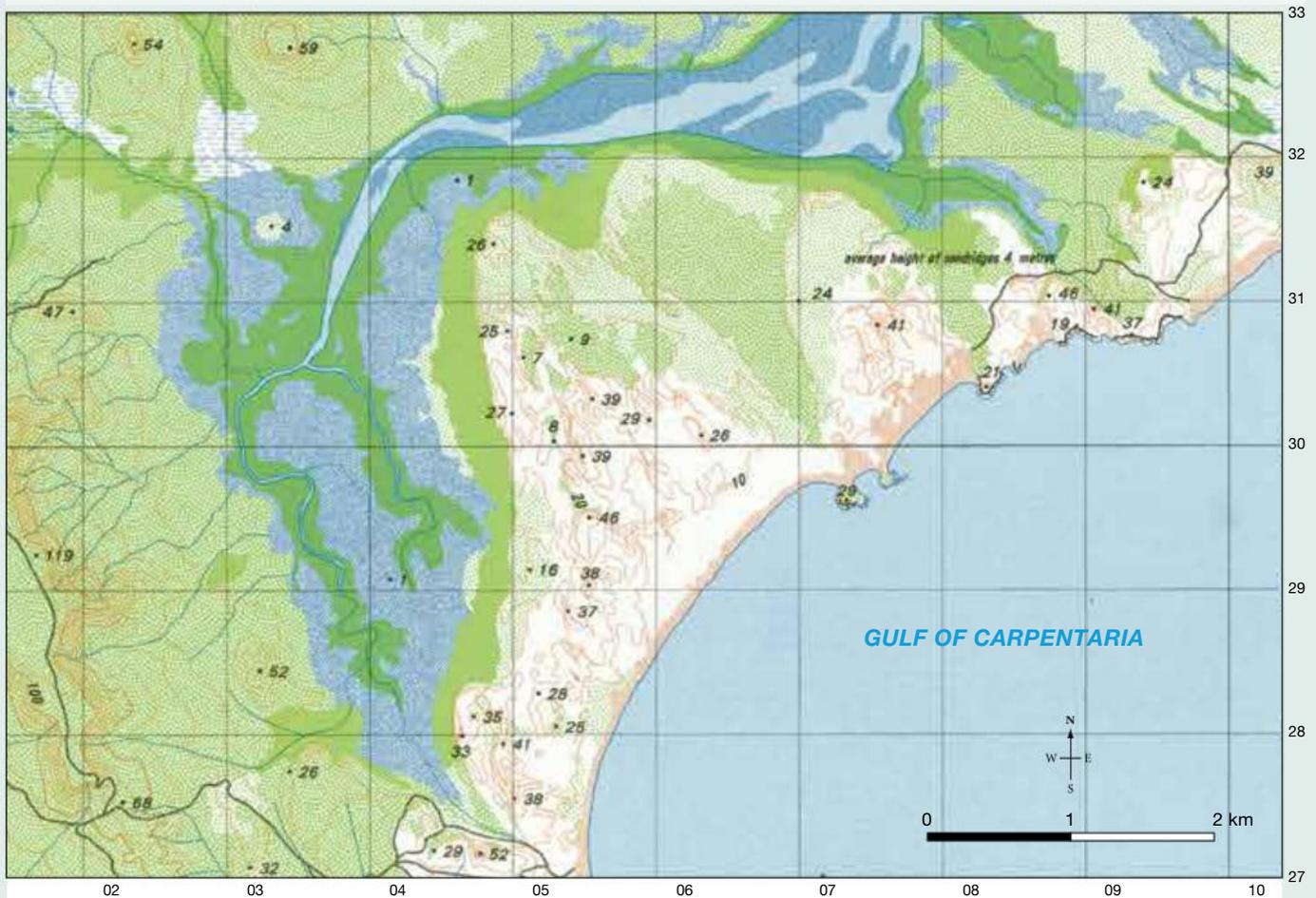
In drawing a transect, I have:

- 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.

FIGURE 5 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	

LESSON

1.9 SkillBuilder: Constructing multiple line and cumulative line graphs

LEARNING INTENTION

By the end of this lesson you should be able to explain the uses for multiple line graphs and cumulative line graphs, and construct these to represent data.

1.9.1 Tell me

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 in a new layer or level. Both formats show change over time, and both show trends effectively.

How 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 for 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.

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.

1.9.2 Show me

You will need:

- data for multiple places or uses shown over time
- access to a computer
- a blank Excel spreadsheet.

FIGURE 1 There are many ways to transform and display a set of data, but understanding the best way to present it is an important part of helping people understand what the data set shows.

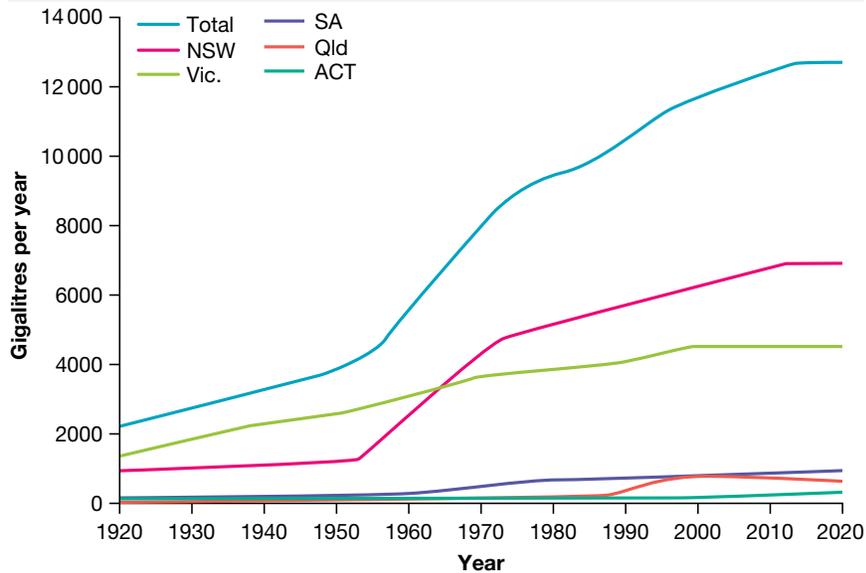


multiple line graphs graphs that include several separate lines on a single graph

cumulative line graphs graphs with new sets of data shown in levels on the one graph, to show how each separate component contributes to the total

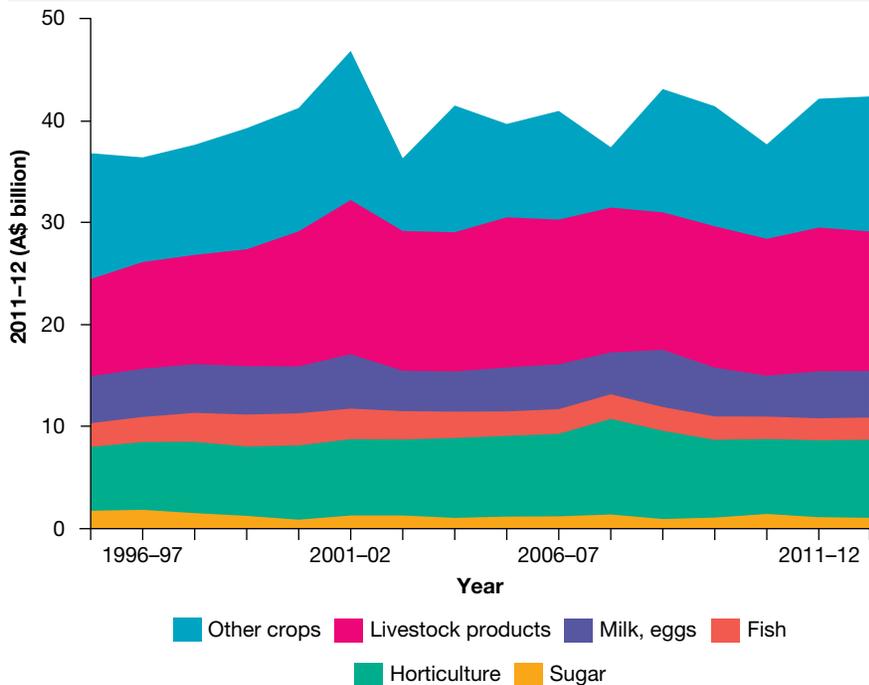
Model

FIGURE 2 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 3 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.

Procedure

Step 1

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.

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	10 822	13 569	21 420	21 834	27 410	21 923
Barley	4257	7160	7997	7865	7995	8349
Oats	748	1502	1160	1162	1128	1274

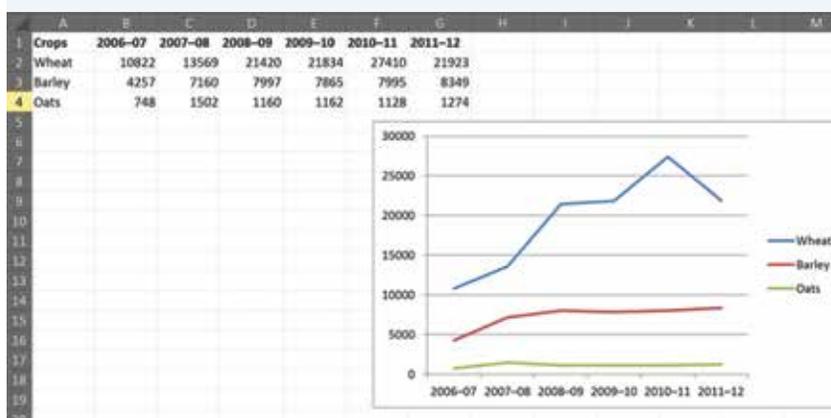
Source: © DAFF 2013, *Australian Food Statistics 2011–12*. Department of Agriculture, Fisheries and Forestry, Canberra. CC BY 3.0.

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.

Step 2

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 (see **FIGURE 4**).

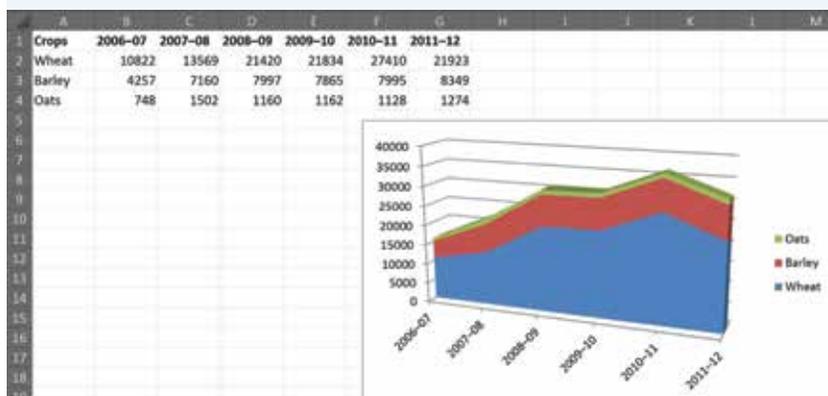
FIGURE 4 An Excel-generated multiple line graph



Step 3

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 (see **FIGURE 5**).

FIGURE 5 An Excel-generated cumulative line graph



Step 4

Check that you have included labels on all axes, units of measurement, and a title or caption.

on Resources

-  **Video eLesson** Constructing multiple line and cumulative line graphs (eles-1740)
-  **Interactivity** Constructing multiple line and cumulative line graphs (int-3358)

1.9.3 Let me do it

Complete the following activities to practise this skill.

1.9 ACTIVITIES

- 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. Use the checklist to ensure you cover all aspects of the task.

TABLE 2 Australian total food exports by selected destination, A\$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.

- Apply your skills to answer the following questions.
 - Which country received the greatest value of food exports from Australia?
 - Which country showed the greatest change in its level of importation of food from Australia?
 - From 2006 to 2012, which country was most consistent in its level of importation of food from Australia?
 - Suggest why these Asian countries need to import food from Australia.
 - Which graph showed you a clearer picture of the data: the multiple line graph or the cumulative line graph? Explain.

Checklist

I have:

- labelled the axes
- included a clear title or caption that identifies places and dates for the data.

LESSON

1.10 SkillBuilder: Constructing a land use map

LEARNING INTENTION

By the end of this lesson you should be able to create a land use map and explain when they are used.

1.10.1 Tell me

A land use map may be drawn from a topographic map, an aerial photograph or a plan, or during fieldwork.

A land use map shows simplified information about the uses made of an area of land. In a built environment, a land use map may show a shopping centre, a local shopping strip, or the types of houses in a street. In a rural environment, a land use map may show vegetation types or agricultural activities.

Why is a land use map useful?

A land use map is useful when focusing on an aspect of an environment or when comparing the interconnections between two or more data sets. It allows us to simplify data and express it in a map format, using blocks of colour to represent generalised information. A land use map breaks down information into key elements and allows us to more readily identify and describe patterns.

Land use maps are useful for:

- displaying historic features of tourist towns
- outlining transport routes
- determining crop plantings
- helping pedestrians to access shops.

A good land use map:

- is drawn in pencil
- is coloured
- incorporates a key/legend
- includes labelled features if necessary
- includes a clear title.

1.10.2 Show me

You will need:

- an aerial photograph or map (topographic or plan) of the area being considered or undertaken as fieldwork
- a base map that is to be coloured
- a predetermined key/legend
- coloured pencils.

Model

Blue Lake Shopping Centre has a range of facilities. Large areas of the centre are devoted to shopping, eating and 'playing', as the key shows. At the centre of the complex is a library and cinema area. In this complex, there are also professional offices such as law firms, dentists and property management firms (which all fall under the 'work' heading). Beside the lake is a restaurant area, and there are other eateries throughout the complex. Shoppers are well catered for, with a variety of transport available to bring them to the centre. Buses service the centre, a taxi rank is provided, and there is ample car parking. Visitors to the shopping centre would find most of their needs fulfilled.

FIGURE 1 Land use maps are often found to help people navigate public areas, such as historic towns.

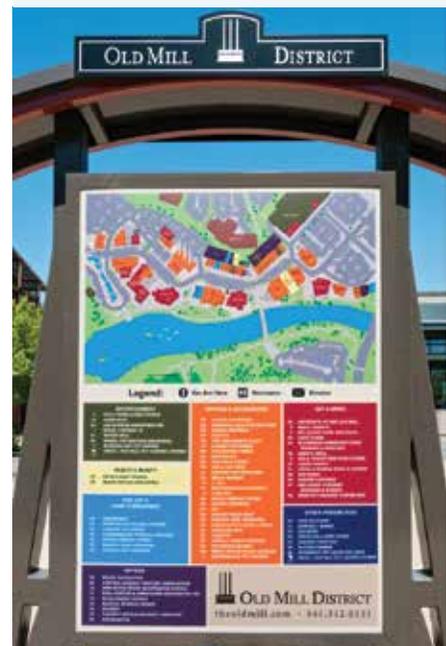
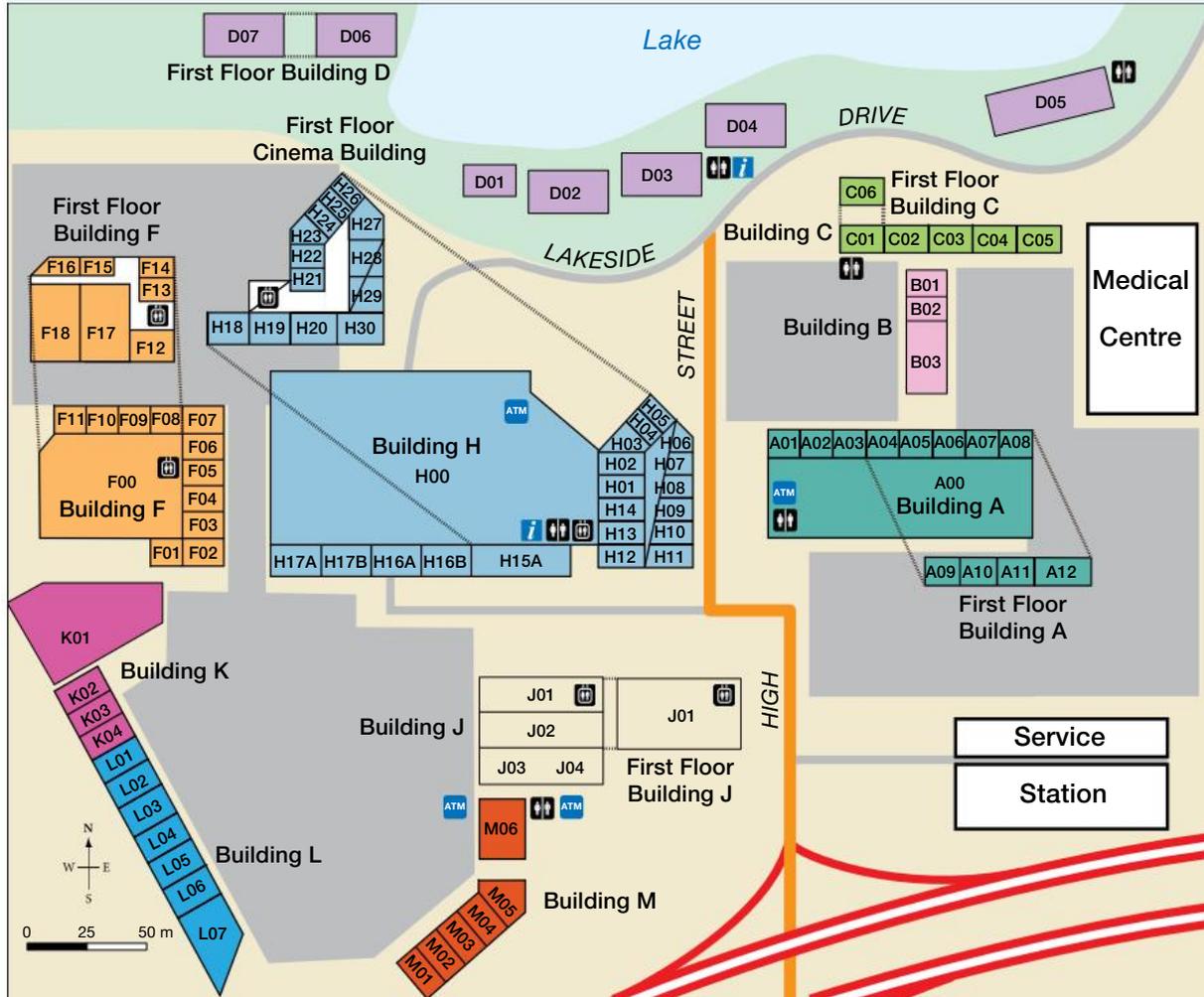


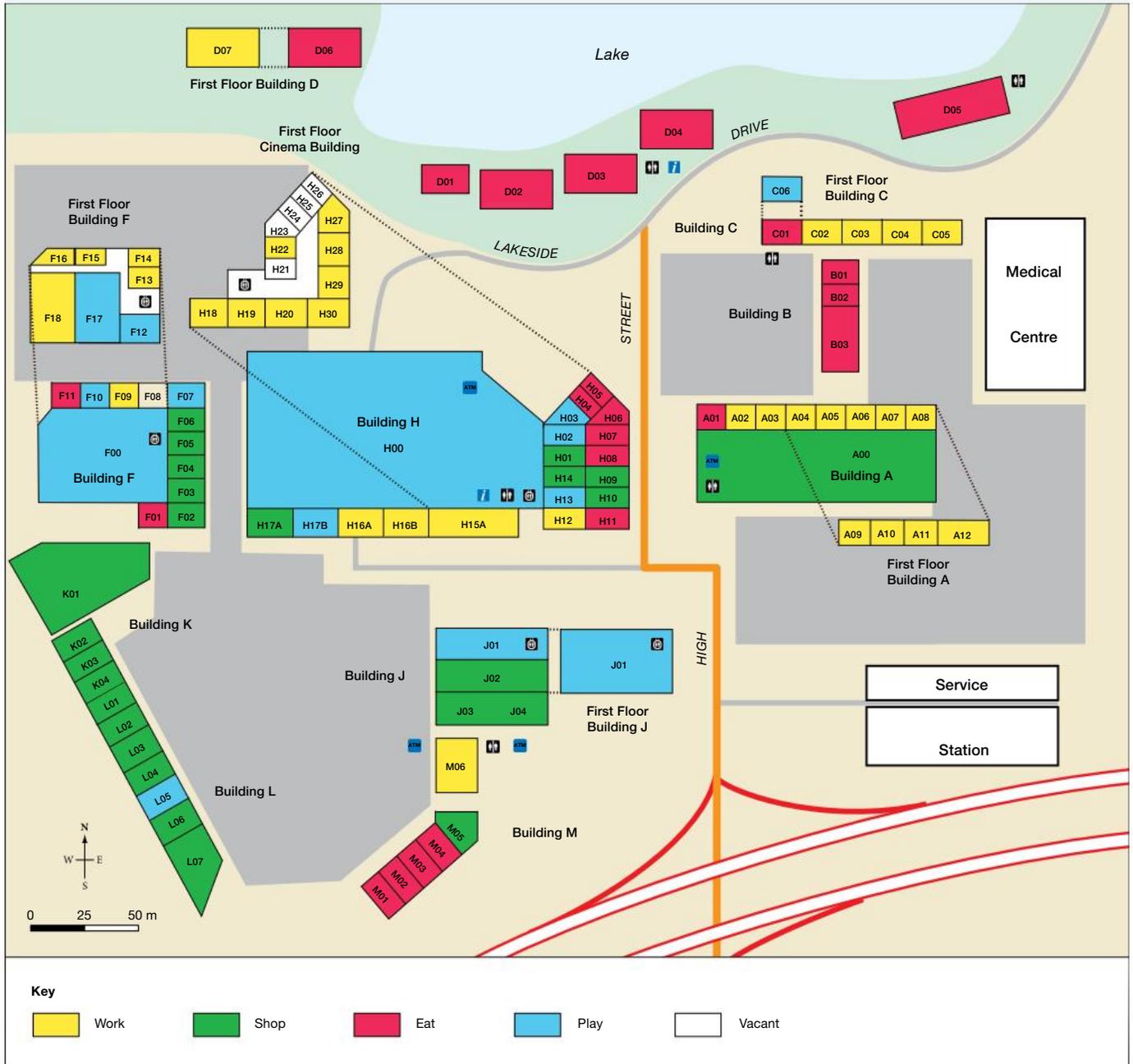
FIGURE 2(a) Blue Lake Shopping Centre plan and key



Work	Shop	Eat	Play
Professional services and banks	A great variety of retail stores	Restaurants, cafés and food	A great range of activities
A01 Family Eye and Vision Centre	A00 Woolworths	A01 Full Moon Café	C06 Bright Star Coaching & Tutoring
A03 Century 21 Victoria Point	F02 Blue Lake Florist	B01 Brian's Meats	F00 Blue Lake Library
A04 Ray White	F03 Black Cat Newsagency	B02 Brian's Meats	F07 La Bohème Nails & Beauty
A05 Shine Lawyers	F04 Black Cat Newsagency	B03 Big Orange Fruit Barn	F10 Painterly Art Classes
A06 Westpac	F05 Black Cat Newsagency	C01 Bo Thai	F12 Yamamoto Music Lessons
A07 Westpac	F06 Point Break Surfswear	D01 Udaipur Indian Restaurant	F17 Blue Lake Library
A08 Westpac	H01 Crystal's Clothing	D02 Paganini's	H00 Cineplex
A09 Frank Bauer & Associates	H09 The Wooden Spoon Kitchenware	D03 Piggy's Café	H02 Crazy Amusement Centre
A10 Centre Management Office	H10 The Point Homewares	D04 Perfumed River Vietnamese	H03 Crazy Amusement Centre
A11 Centre Management Office	H14 Samadi Hair & Beauty Products	D05 Tabouli Lebanese Restaurant	H13 Diane Lane Hair Salon
A12 Place Real Estate	H17A Mathers	D06 The Kasbah	H17B Blue Lake Tattoos
C02 Dignified Funerals	J02 Dwyer's Pharmacy	F01 The Double Shot	J01 WorkOut Gym
C03 JP Ryan	J03 West's Auto Service Centre	F11 Decadent Desserts	L05 Madame Georgia's Dance Academy
C04 The Professionals	J04 West's Auto Service Centre	H04 Time Out Restaurant and Bar	
C05 The Professionals	K01 Spotlight	H05 Time Out Restaurant and Bar	
D07 Weightwatchers	K02 Blue Lake Lawnmowers	H06 Okonomiyaki	
F09 Red Door Acupuncture and Massage	K03 The Outdoor Shop	H07 Bob's Burgers	
F13 Dylan & Perez Financial Planning	K04 The Outdoor Shop	H08 Blue Lake Icecreamery	
F14 Dylan & Perez Financial Planning	L01 Blue Lake Pool Service	H11 Baker's Delight	
F15 Spick & Span Cleaners	L02 Fraser's Fishing and Tackle	M01 Nan & Pop's Bakehouse	
F16 Spick & Span Cleaners	L03 Lifeline Victoria Point	M02 The Battered Cod Fish Restaurant	
F18 Spick & Span Cleaners	L04 Hardy's Lighting	M03 Shanghai Joe's Chinese Restaurant	
H12 Aussie Home Loans	L06 Stegbar	M04 Nonya Malay Restaurant	
H15 H & R Block	L07 Blue Lake Marine Supplies		
H16A Kumar Dentistry	M05 Blue Lake Cleaning Supplies		
H16B Blue Lake Medical Clinic			
H18 Aligned Chiropractors			
H19 Smith & Aziz Chartered Accountants			
H20 Kate Bowen MP			
H22 Fresh Start Training Group			
H27 Wong Podiatry			
H28 Davis & Sharp Lawyers			
H29 Davis & Sharp Lawyers			
H30 Blue Lake Physiotherapy			
M06 Centrelink			

Source: Spatial Vision.

FIGURE 2(b) Land use map of Blue Lake Shopping Centre



Source: Spatial Vision.

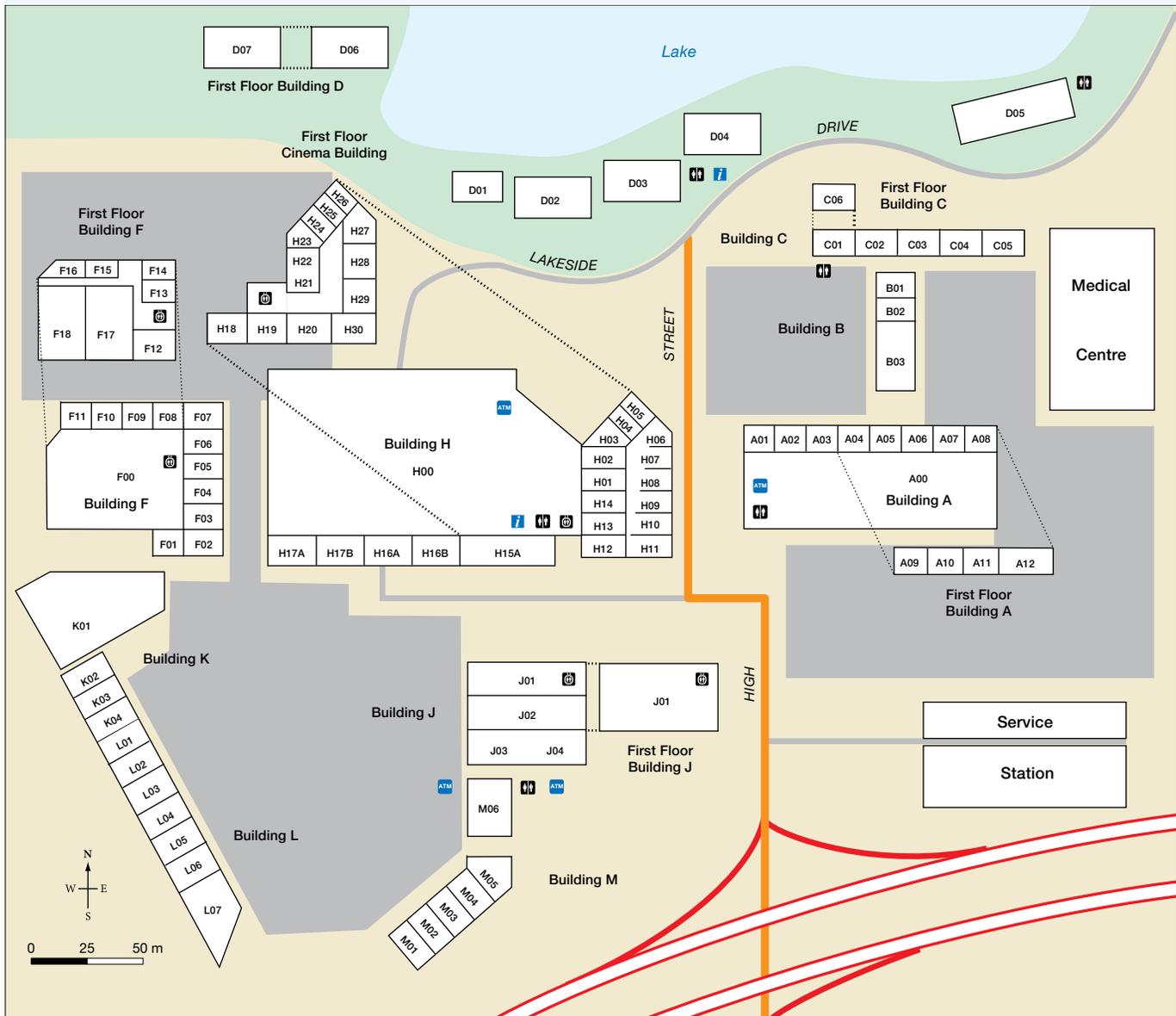
Procedure

To complete a land use map from an aerial photograph or map, or during fieldwork, you must determine the area to be mapped and acquire or create a base map of that area.

Step 1

Orientate the base map and the aerial photograph or, if on fieldwork, orientate yourself with the base map.

FIGURE 3 Base map of Blue Lake shopping complex

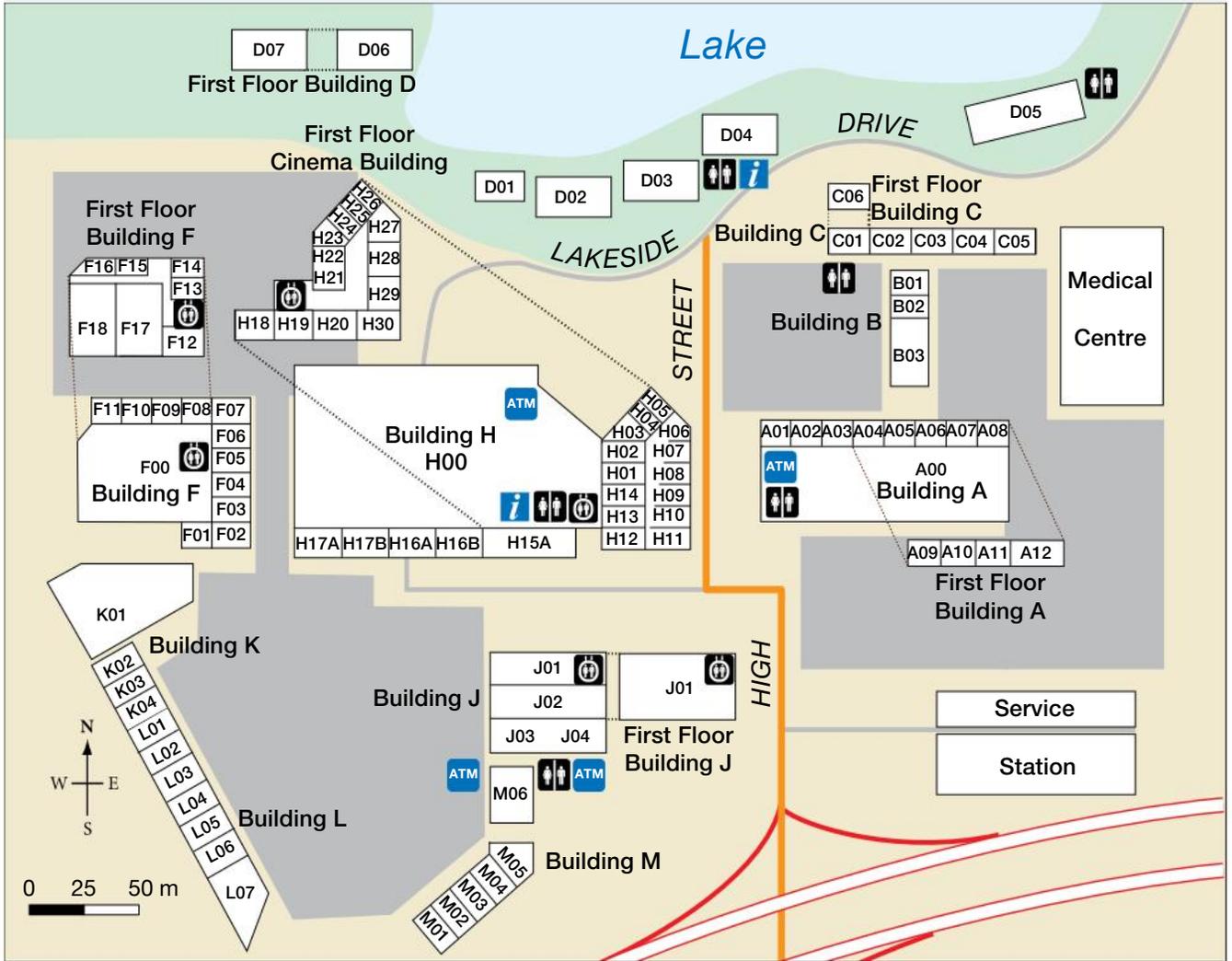


Source: Spatial Vision.

Step 2

What is the theme of your mapping? Is it land use or types of shops, for example? What categories are you expecting to find? Create a key/legend that you will use for the colouring of your map. **FIGURE 2(a)** shows a range of shop types, services and activity areas colour coded in the legend. These have then been simplified into broader activity categories in **FIGURE 2(b)**.

FIGURE 4 Base map with legend



Work
Professional services and banks

- A01 Family Eye and Vision Centre
- A03 Century 21 Victoria Point
- A04 Ray White
- A05 Shine Lawyers
- A06 Westpac
- A07 Westpac
- A08 Westpac
- A09 Frank Bauer & Associates
- A10 Centre Management Office
- A11 Centre Management Office
- A12 Place Real Estate
- C02 Dignified Funerals
- C03 JP Ryan
- C04 The Professionals
- C05 The Professionals
- D07 Weightwatchers
- F09 Red Door Acupuncture and Massage
- F13 Dylan & Perez Financial Planning
- F14 Dylan & Perez Financial Planning
- F15 Spick & Span Cleaners
- F16 Spick & Span Cleaners
- F18 Spick & Span Cleaners
- H12 Aussie Home Loans
- H15 H & R Block
- H16A Kumar Dentistry
- H16B Blue Lake Medical Clinic
- H18 Aligned Chiropractors
- H19 Smith & Aziz Chartered Accountants
- H20 Kate Bowen MP
- H22 Fresh Start Training Group
- H27 Wong Podiatry

- H28 Davis & Sharp Lawyers
- H29 Davis & Sharp Lawyers
- H30 Blue Lake Physiotherapy
- M06 Centrelink

Shop
A great variety of retail stores

- A00 Woolworths
- F02 Blue Lake Florist
- F03 Black Cat Newsagency
- F04 Black Cat Newsagency
- F05 Black Cat Newsagency
- F06 Point Break Surfwear
- H01 Crystal's Clothing
- H09 The Wooden Spoon Kitchenware
- H10 The Point Homewares
- H14 Samadi Hair & Beauty Products
- H17A Mathers
- J02 Dwyer's Pharmacy
- J03 West's Auto Service Centre
- J04 West's Auto Service Centre
- K01 Spotlight
- K02 Blue Lake Lawnmowers
- K03 The Outdoor Shop
- K04 The Outdoor Shop
- L01 Blue Lake Pool Service
- L02 Fraser's Fishing and Tackle
- L03 Lifeline Victoria Point
- L04 Hardy's Lighting
- L06 Stegbar
- L07 Blue Lake Marine Supplies
- M05 Blue Lake Cleaning Supplies

Eat
Restaurants, cafés and food

- A01 Full Moon Café
- B01 Brian's Meats
- B02 Brian's Meats
- B03 Big Orange Fruit Barn
- C01 Bo Thai
- D01 Udaipur Indian Restaurant
- D02 Paganini's
- D03 Piggy's Café
- D04 Perfumed River Vietnamese
- D05 Tabouli Lebanese Restaurant
- D06 The Kasbah
- F01 The Double Shot
- F11 Decadent Desserts
- H04 Time Out Restaurant and Bar
- H05 Time Out Restaurant and Bar
- H06 Okonomiyaki
- H07 Bob's Burgers
- H08 Blue Lake Icecreamery
- H11 Baker's Delight
- M01 Nan & Pop's Bakehouse
- M02 The Battered Cod Fish Restaurant
- M03 Shanghai Joe's Chinese Restaurant
- M04 Nonya Malay Restaurant

Play
A great range of activities

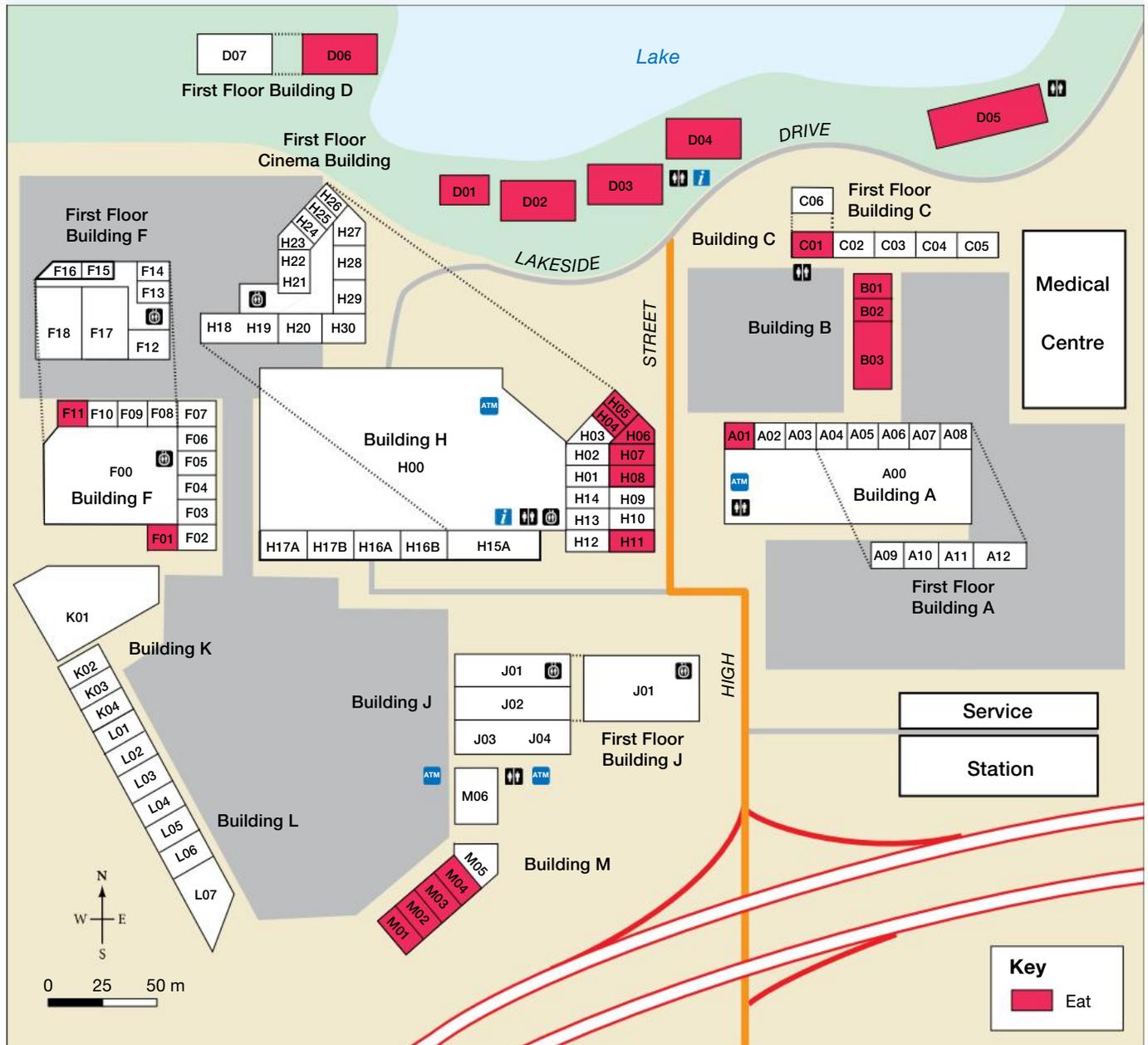
- C06 Bright Star Coaching & Tutoring
- F00 Blue Lake Library
- F07 La Bohème Nails & Beauty
- F10 Painterly Art Classes
- F12 Yamamoto Music Lessons
- F17 Blue Lake Library
- H00 Cineplex
- H02 Crazy Amusement Centre
- H03 Crazy Amusement Centre
- H13 Diane Lane Hair Salon
- H17B Blue Lake Tattoos
- J01 WorkOut Gym
- L05 Madame Georgia's Dance Academy

Source: Spatial Vision.

Step 3

Identify a starting point to colour your base map according to your pre-determined key. Take care to be accurate and neat. Identify reference points to check off on the base map.

FIGURE 5 Colouring of the base map has commenced.



Source: Spatial Vision.

Step 4

When the map is complete, ensure that the key is attached. Check that the BOLTSS are complete.

The map would look like **FIGURE 2(b)**.

on Resources

 **Video eLesson** Constructing a land use map (eles-1755)

 **Interactivity** Constructing a land use map (int-3373)

1.10.3 Let me do it

Complete the following activities to practise this skill.

1.10 ACTIVITIES

1. Complete a land use map of your local area by walking along a street and mapping the land uses. First, create a base map by identifying the main features of the environment such as major roads, waterways, vacant land and parks. Colour the various land uses on your base map and add those colours to the key. Complete the task according to the steps in the Show me section. Use the checklist to ensure you cover all aspects of the task.
2. Apply your skills to answer the following questions.
 - a. With which land use is most of the map taken up?
 - b. Which of the land uses on your map have been built by people?
 - c. What proportion of your land use map is natural environment?
 - d. Suggest why there are trees in the built environment.
 - e. Suggest how the environment might change over time.

Checklist

I have:

- drawn in pencil
- added colour
- incorporated a key/legend
- included labelled features as necessary
- included a clear title.

FIGURE 6 An aerial photo can help significantly in constructing a land use map.



LESSON

1.11 SkillBuilder: Creating a survey

LEARNING INTENTION

By the end of this lesson you should be able to explain why surveys are used in Geography, and create a survey to collect useful data.

1.11.1 Tell me

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.

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.

1.11.2 Show me

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 investigated.

Step 1

Determine the topic that you want to gather data about, and consider why you want this data. In **FIGURE 1**, the questionnaire is about shopping habits.

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 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, that their responses will be used only for research purposes and that 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.

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 _____

 **Video eLesson** Creating a survey (eles-1764)

 **Interactivity** Creating a survey (int-3382)

1.11.3 Let me do it

Complete the following activities to practise this skill.

1.11 ACTIVITIES

1.
 - a. 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. To help you work out what questions to ask in your survey, look at Activities question 2 for details of what you will need to report. Use the checklist for creating a survey to ensure you cover all aspects of the task.
 - b. 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.
2. Apply your skills to answer the following questions.
 - a. From your survey responses, what percentage of people have travelled somewhere as tourists within the past five years?
 - b. What trends emerged from your survey regarding travel within Australia in comparison to overseas travel?
 - c. 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?
 - d. What were the main recreational activities people were involved in when they travelled to other **places** as tourists?
 - e. 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 ten 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.

LESSON

1.12 SkillBuilder: Constructing ternary graphs

LEARNING INTENTION

By the end of this lesson, you should be able to construct a ternary graph.

1.12.1 Tell me

Ternary graphs are triangular graphs that show the relationship or interconnection between three features.

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 represent elements such as 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.

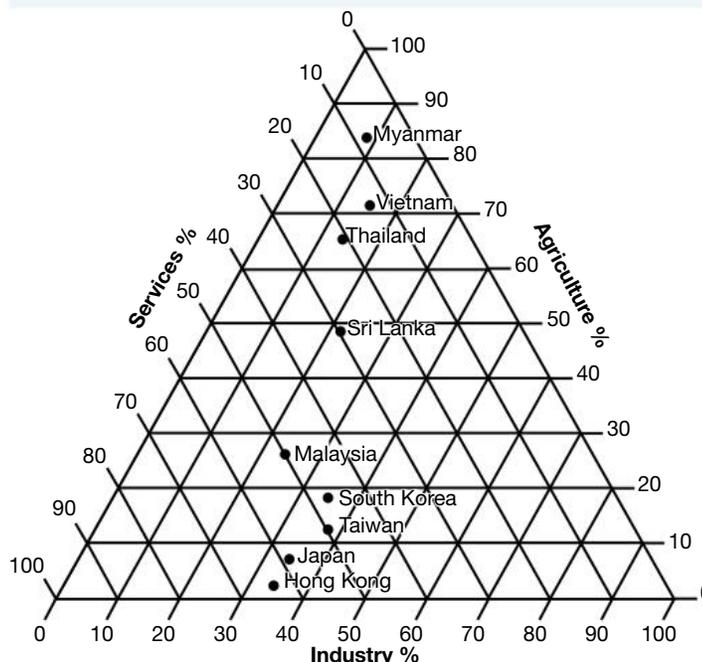
Ternary graphs are useful for:

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

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.

FIGURE 1 Economic activity in selected countries



1.12.2 Show me

You will need:

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

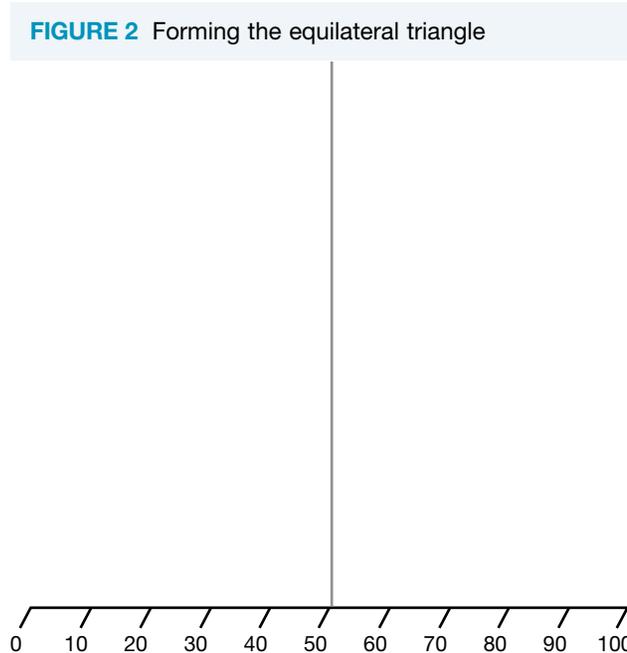
Procedure

Step 1

Create an equilateral triangle — all three sides are equal length 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 ten marks that are 1 cm 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° (see **FIGURE 2**).

Step 2

At the 50 per cent mark, draw a faint vertical line of about 9 cm length, which will help you to draw the other two axes (see **FIGURE 2**). Later, you can rub this line out.



Step 3

From the 0 per cent mark, draw a diagonal line that is 10 cm long and intersects with the vertical line shown in **FIGURE 2**. (It will intersect a few millimetres below the top of the vertical line.) Draw 10 marks that are 1 cm apart along this diagonal axis. However, this time, mark 100 per cent at the bottom of the line and 0 at the top (see **FIGURE 3**).

Step 4

Repeat step 3, but on the other side of the vertical line to complete the triangle, this time reversing 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 4**.

FIGURE 3 Creating a second axis

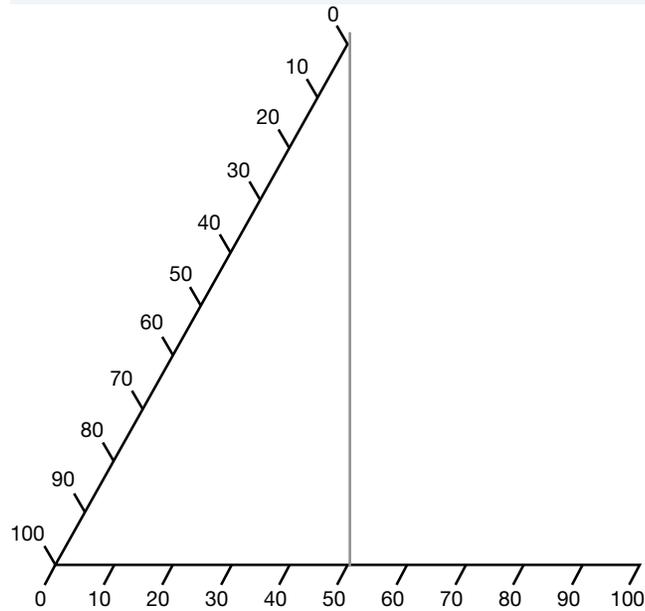
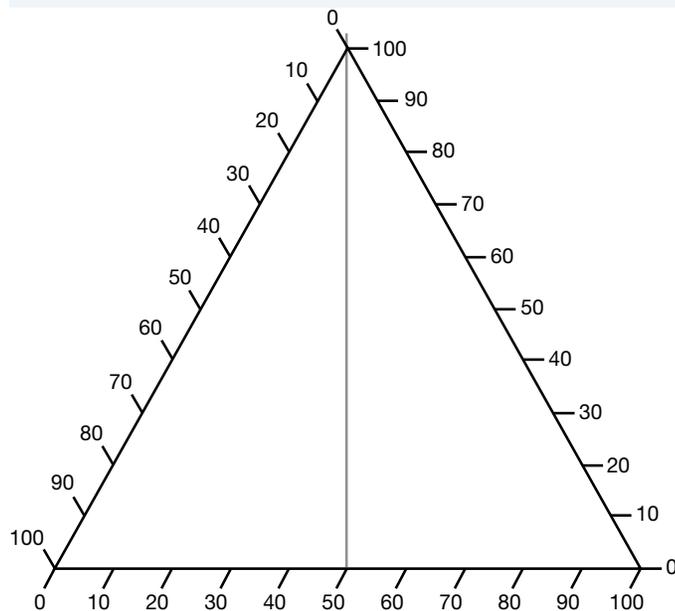


FIGURE 4 A ternary graph outline



Step 5

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

Step 6

Use a ruler to carefully join the points across the triangle that add to 100 per cent. This will provide a grid on which you can plot data (see **FIGURE 5**).

Step 7

Label the axes with the three features that you are going to plot. (In the **FIGURE 1** model, this is Services, Industry and Agriculture.) Put the percentage symbol (%) after each label (see **FIGURE 5**).

Step 8

Sample data for **FIGURE 1** would appear in a table such as **TABLE 1**.

FIGURE 5 A ternary graph with its grid completed and axes labelled

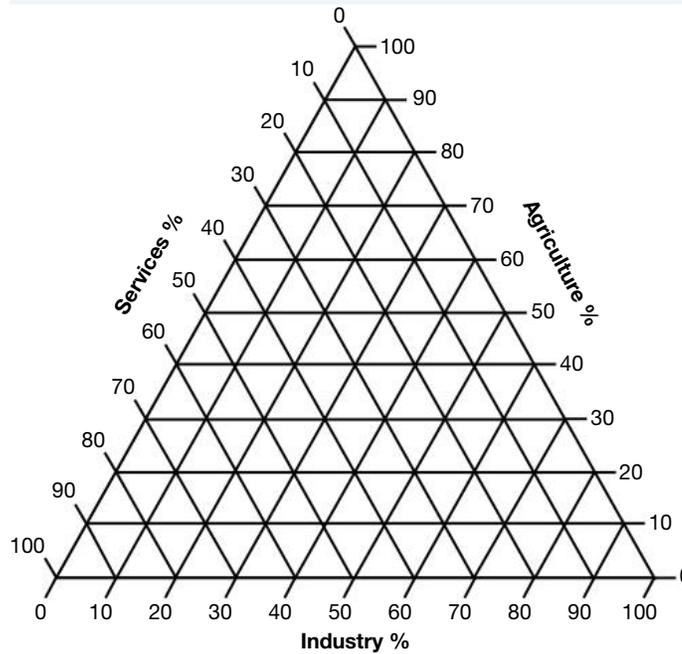
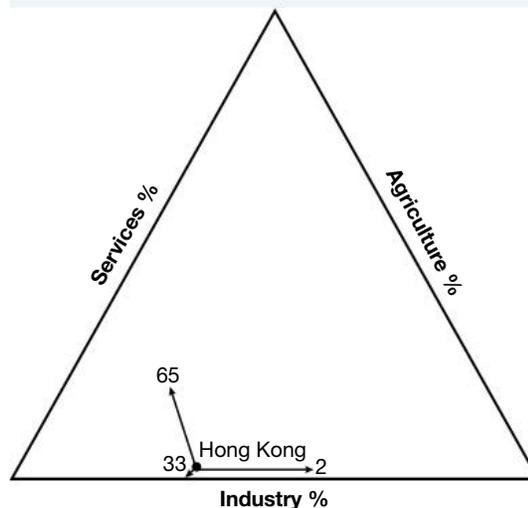


TABLE 1 Sample data on economic activity for selected countries in **FIGURE 1**

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 requires concentration. You need to follow the diagonal lines sloping down from left to right (\setminus) 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 6** to make sure you read the grid correctly. (Correctly angling the markers that fall outside the triangle will help you in plotting and reading the graph.)

FIGURE 6 Reading the grid



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.

on Resources

 **Video eLesson** Constructing ternary graphs (eles-1728)

 **Interactivity** Constructing ternary graphs (int-3346)

1.12.3 Let me do it

Complete the following activities to practise this skill.

1.12 ACTIVITIES

- Use the data presented in **TABLE 2** to construct a ternary graph on labour force by occupation, 2011–12, in selected countries. Use the checklist to ensure you cover all aspects of the task.

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

- Apply your skills to answer the following questions.
 - Which country has the greatest percentage of its population employed in agriculture?
 - Which country has the greatest percentage of its people employed in services?
 - Which countries have the lowest percentage of people employed in manufacturing?
 - Which country has the most even distribution across the three areas of employment?
 - On 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.

LESSON

1.13 SkillBuilder: Constructing and describing proportional circles on maps

LEARNING INTENTION

By the end of this lesson you should be able to construct and describe proportional circles on maps.

1.13.1 Tell me

Proportional circle maps are maps that incorporate circles, drawn to scale, to represent data for particular places.

How are proportional circles useful?

Proportional circles are useful as they provide 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. For example, you might use these to show population size, agricultural production of a specific crop, or endangered species.

Proportional circles are useful for:

- gaining a quick impression of varying amounts over space
- showing relationships on a map.

Some practical applications include:

- economists showing the level of production across a region
- tourism authorities showing the numbers of tourists in particular areas
- emergency management organisations showing the quantities of water moving through a catchment.

A good proportional circle map:

- is drawn in pencil, using 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 good description of a proportional circle map:

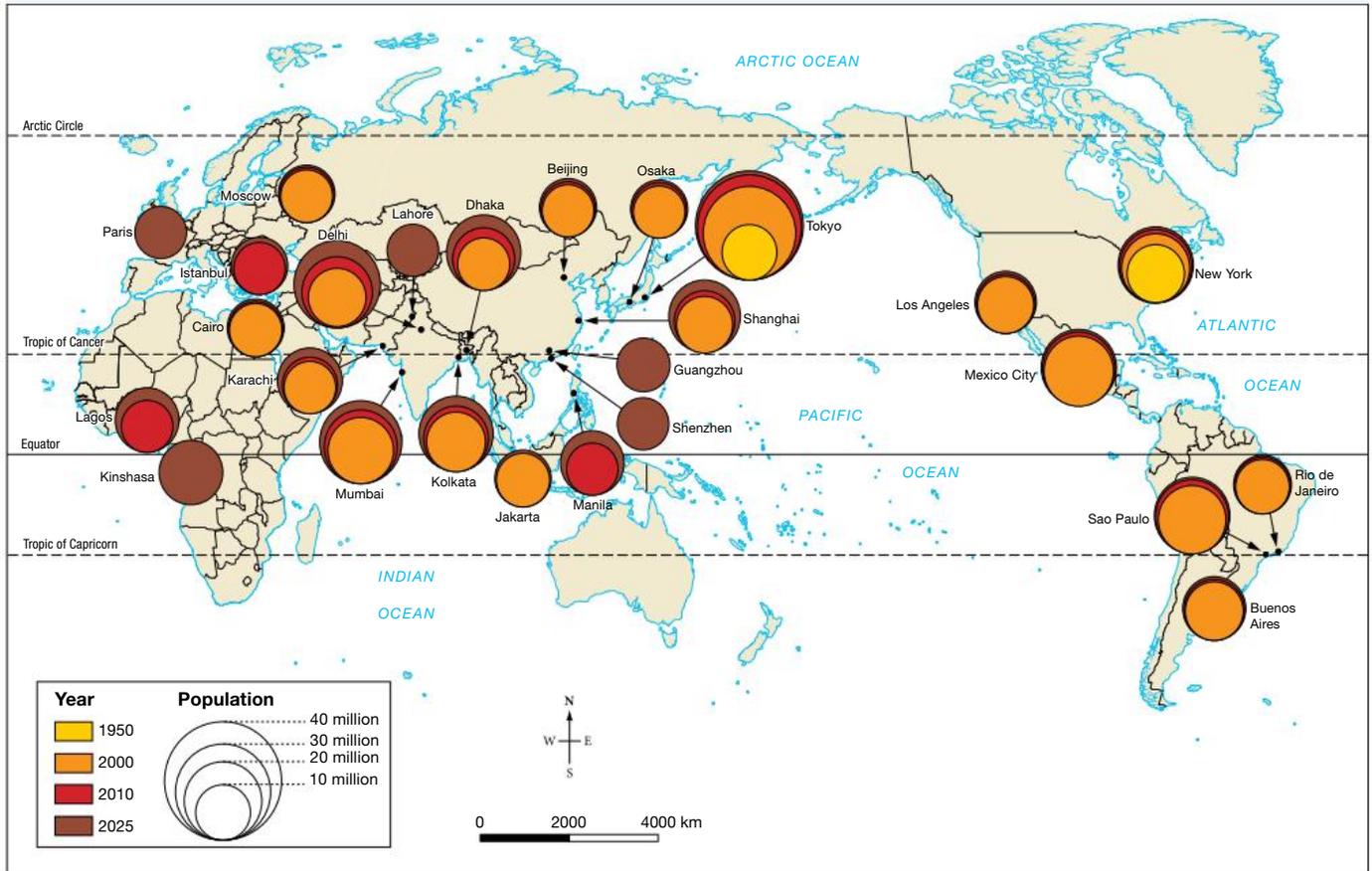
- effectively communicates differences in values over space
- identifies places
- uses directions.

1.13.2 Show me

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.

FIGURE 1 Growth of megacities over time, 1950–2025 (projected)



Source: Spatial Vision.

Model

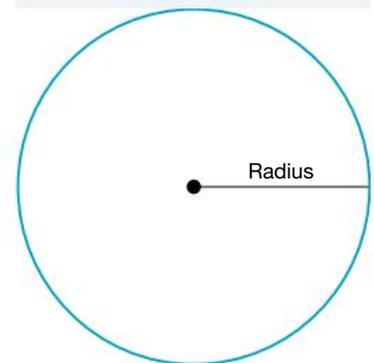
The growth of megacities has been most noticeable across Asia, with 11 of the 18 megacities identified in 2000 located in that region. The only megacities in 1950 were Tokyo and New York, and by 2025 Tokyo is predicted to be the largest megacity. By 2025 Asia will have 14 megacities, with Lahore, Guangzhou 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 had one. By 2025, Africa will have three megacities. Neither Australia nor the Oceania region had cities of this size in 2000 and are not predicted to have any by 2025.

Procedure: 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 the **FIGURE 1** model 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 2010 is around 35 million. Step 2 outlines how circle sizes are calculated.

FIGURE 2 The radius of a circle



Step 2

Circle sizes should be appropriate for the base map you are using. They should not be too large or too small.

Take your data table and rank the values from highest to lowest. Work out the square root ($\sqrt{\quad}$) of each value. TABLE 1 shows the projected population data for megacities in 2025. The largest figure is 6.09, for Tokyo, and the smallest is 3.24, for Lahore. These numbers give us the measurement of the radius of the proportional circles for our map. (*Note:* When working with population figures, you would leave off the ‘millions’ and work simply with the base number, e.g. ‘36’ for 36 million, which would have a square root of 6, and therefore a circle radius measurement of 6 mm.)

TABLE 1 Projected megacity population, 2025 (millions), and radius calculations (mm)

Megacity	2025	$\sqrt{\text{(radius, mm)}}$	Megacity	2025	$\sqrt{\text{(radius, mm)}}$
Tokyo	37.1	6.09	Kolkata	17.3	4.16
Delhi	32.7	5.72	Kinshasa	16.9	4.11
Shanghai	29.4	5.42	Guangzhou	16.7	4.09
Beijing	26.5	5.15	Buenos Aires	16.5	4.06
Mumbai	25.2	5.02	Istanbul	16.0	4.00
Dhaka	24.3	4.93	Manila	15.2	3.90
Mexico City	22.9	4.79	Rio de Janeiro	13.8	3.71
Sao Paulo	22.9	4.79	Los Angeles	12.8	3.58
Cairo	22.4	4.73	Jakarta	12.6	3.55
Karachi	22.0	4.69	Moscow	12.4	3.52
Osaka	20.4	4.52	Shenzhen	12.1	3.48
Lagos	20.0	4.47	Paris	11.6	3.41
New York	19.3	4.39	Lahore	10.5	3.24

Step 3

Construct a scaled group of circles as seen in the legend for **FIGURE 1**. To do this, allow one millimetre to represent one unit. Ensure your largest circle has a radius big enough to encompass the largest figure in your set of square root data. For example, the data for Tokyo’s population has a square root of 6.09, so you would draw your largest circle with a radius of seven millimetres to ensure that the largest megacity, Tokyo, could be plotted with a radius of 6.09 mm.

Use a mathematical compass and ruler, and set the compass to seven millimetres. On your map base, draw a circle with a seven-millimetre radius. Your smallest circle would need a radius of three millimetres to include Lahore. All other data in the table will fit somewhere between these two sizes.

Step 4

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 as a reference, 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. (in groups)

Step 5

Complete the map with the geographical conventions of BOLTSS.

Procedure: Describing a proportional circle map

Step 6

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 (spreading out from one point or place), linear (in a line), clustered (in groups) or sporadic (scattered)?

Resources

-  **Video eLesson** Constructing and describing proportional circles on maps (eles-1735)
-  **Interactivity** Constructing and describing proportional circles on maps (int-3353)

1.13.3 Let me do it

Complete the following activities to practise this skill.

1.13 ACTIVITIES

- Using the data on WFP funding contributors in **TABLE 2**, complete a proportional circles map to show the level of WFP funding across the world in 2018. Use the checklist for drawing proportional circles to ensure you cover all aspects of the task.

TABLE 2 Selected funding contributors to the World Food Programme in 2018 (US\$)

Country	Contribution	Country	Contribution
United States of America	2541 479 166	Italy	35 421 720
Germany	849 141 329	China	32 644 030
United Kingdom	617 188 873	Ireland	28 191 994
Saudi Arabia	247 907 959	France	27 121 738
Canada	222 172 109	Belgium	16 053 224
Sweden	148 185 097	Finland	15 939 371
Japan	130 001 824	Pakistan	15 930 489
Norway	89 996 849	Benin	13 461 901
Switzerland	79 520 814	Luxembourg	11 153 437
Netherlands	71 558 728	Burundi	8 476 285
Australia	71 268 872	New Zealand	5 661 439
Republic of Korea	67 897 569	South Sudan	5 066 242
Denmark	55 940 285	Brazil	444 977
Russian Federation	44 882 539	Colombia	405 856

Note: Figures current as at 28 April 2019.

- Describe the distribution pattern revealed by your map. Use the checklist for describing proportional circles to ensure you cover all aspects of the task.

3. Based on what you have learned in this lesson apply your skills to answer the following questions.
- On which continent are the countries that have made the greatest financial contribution to the WFP?
 - Which other region has a number of countries that have made significant contributions?
 - Describe the pattern of WFP contributions across the world.
 - Are there any countries that surprised you in their level of contribution to the WFP? 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
- 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.

LESSON

1.14 SkillBuilder: Constructing and describing isoline maps

LEARNING INTENTION

By the end of this lesson you should be able to construct and describe an isoline map.

1.14.1 Tell me

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. 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. 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.

Isoline maps are useful for:

- showing data over large areas
- showing trends in data
- allowing you to identify and describe patterns
- comparing maps over different time periods.

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).

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.

1.14.2 Show me

You will need:

- a base map
- a set of data to plot
- a pencil
- an eraser
- an atlas (optional).

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.

FIGURE 1 An isoline map showing places of equal travel time to Copenhagen airport by car



Source: Spatial Vision.

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.

Step 3

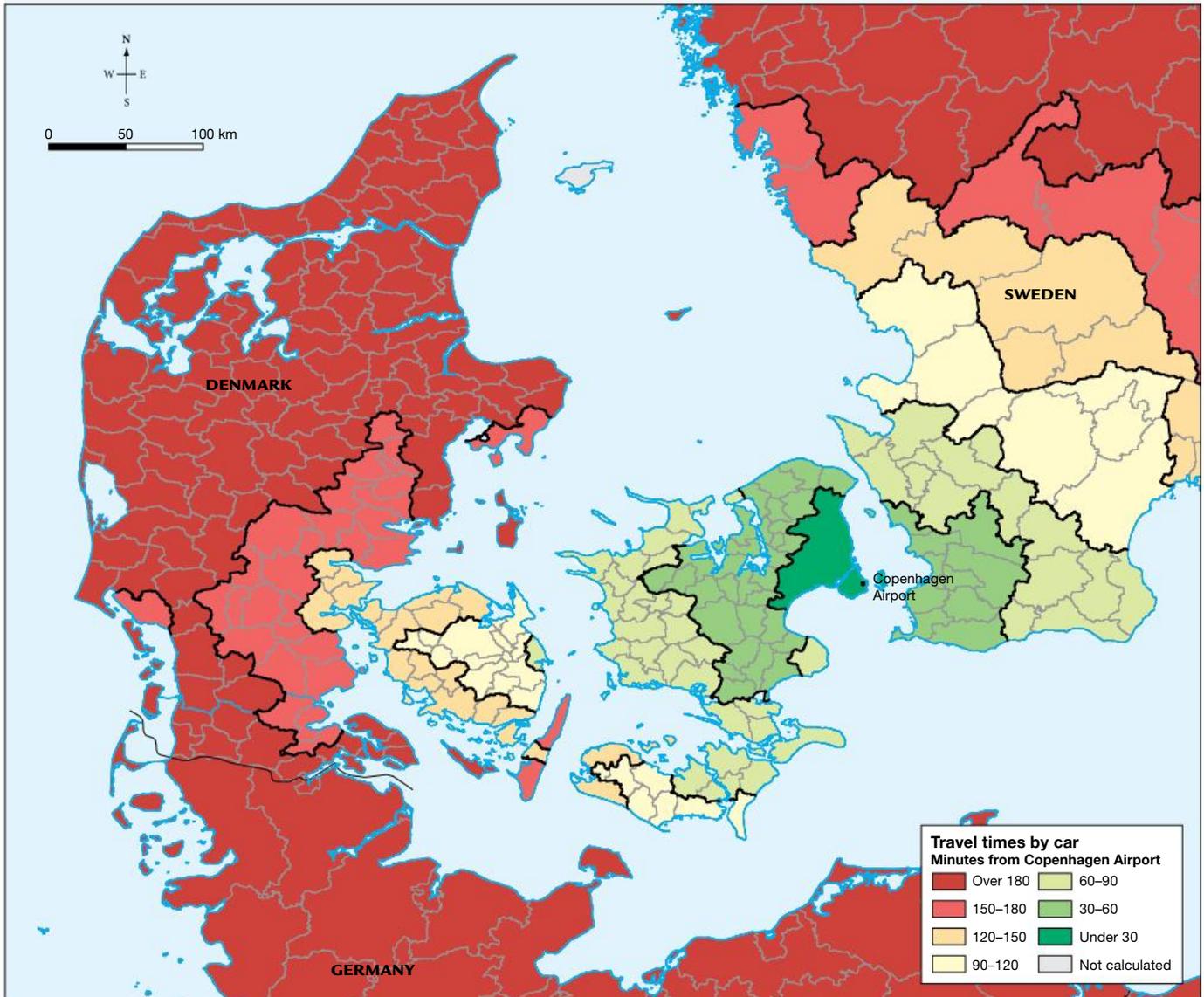
Create a legend for your map with a colour system that indicates a gradation of colour, where the lowest data is the lightest shade and the highest data is the darkest. Shade between the isolines according to the legend. **FIGURE 2** shows a completed coloured isoline map.

Step 4

Don't forget to apply BOLTSS to your map.

Model

FIGURE 2 A coloured isoline map showing travel time to Copenhagen airport by car



Source: Spatial Vision.

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 2**, this feature is travel time by car to Copenhagen airport.

Step 6

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 2**, 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 2** 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.

Model interpretation

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.

on Resources

-  **Video eLesson** Constructing and describing isoline maps (eles-1737)
-  **Interactivity** Constructing and designing isoline maps (int-3355)

1.14.3 Let me do it

Complete the following activities to practise this skill.

1.14 ACTIVITIES

1. 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.
 - a. Plot on the map the number of minutes it takes to travel from each **place** to Copenhagen city centre by writing the number of minutes by the dot beside each placename.
 - b. Draw a line (an isoline) connecting all the **places** from which it would take 30 minutes to travel to the centre of Copenhagen.
 - c. Draw in additional isolines at 5-minute intervals to show travel times to Copenhagen city centre.
2. Describe the pattern evident on your isoline map. Use the checklist for describing isoline maps to ensure you cover all aspects of the task.

TABLE 1 Travel times by bicycle to Copenhagen city centre

Suburb of Copenhagen	Travel time (minutes)
Albertslund	45
Ballerup	48
Brøndby	40
Frederiksberg	25
Furesø	50
Gentofte	33
Glostrup	40
Gladsaxe	38

Suburb of Copenhagen	Travel time (minutes)
Herlev	42
Hvidovre	34
Ishøj	55
Lyngby-Taarbæk	45
Rødovre	35
Tårnby	30

3. Based on what you have learned in this lesson apply your skills to answer the following questions.

FIGURE 3 A base map of the suburbs around Copenhagen city centre



Source: Spatial Vision.

- Is Copenhagen city centre more accessible to Furesø or Hvidovre by bicycle? Use figures in your answer.
- Does Tårnby or Brøndby provide easier bicycle access to the city? Quote the distances involved.
- From which direction would you have the greatest level of access to the city centre by bicycle? Use figures in your answer.
- Which part of the map would encourage cyclists to live in the area? Explain your answer using figures.
- 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.

LESSON

1.15 SkillBuilder: Constructing and describing a flow map

LEARNING INTENTION

By the end of this lesson you should be able to construct and describe a flow map.

1.15.1 Tell me

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.

How 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.

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 good 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.

1.15.2 Show me

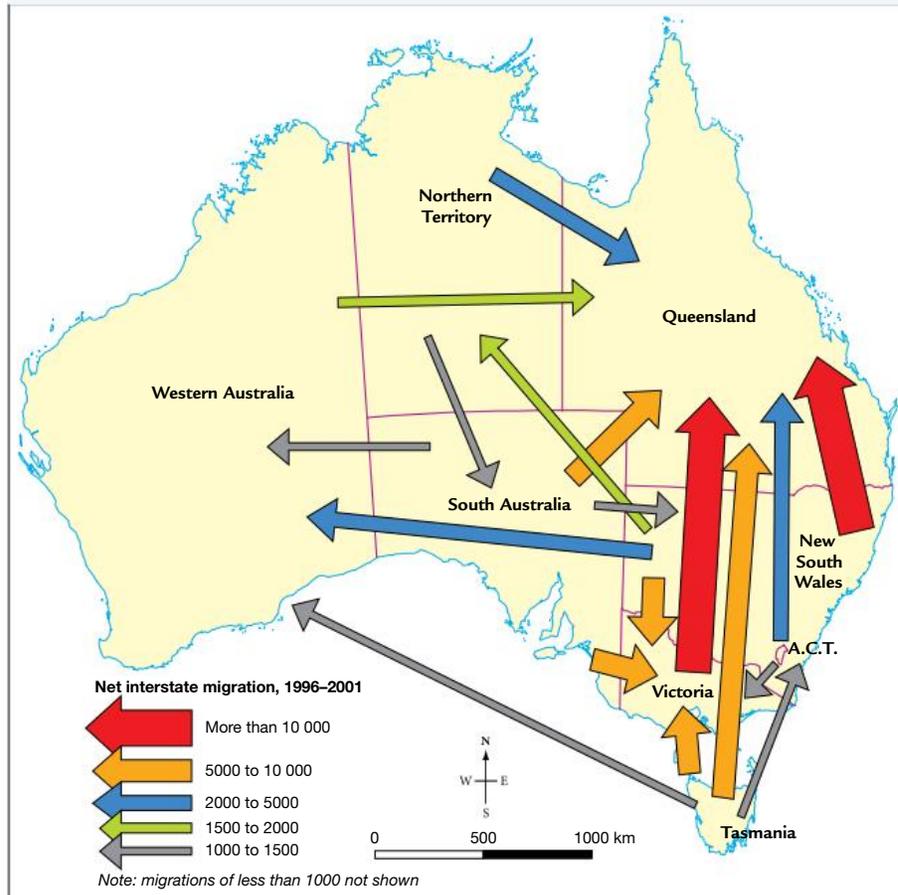
You will need:

- 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.

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 10 000 migrants from each of Victoria and New South Wales, and 5000–10 000 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 16 000 and 31 500), which indicates that Victoria's net loss — more than 10 000 to Queensland — was far less than that of New South Wales, which had a loss of 13 500–17 000 or more.

FIGURE 1 Interstate migration flows, 1996–2001



Source: Spatial Vision.

Procedure

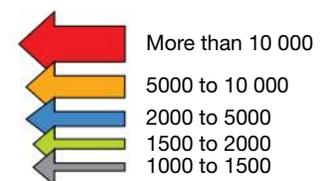
To complete a flow map, you will need to convert a table of data to a coloured map.

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. 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 the **FIGURE 1** model.

FIGURE 2 Scaled arrows for the flow map in **FIGURE 1**

Net interstate migration, 1996–2001



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

Rule an arrow of the 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.

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 the **FIGURE 1** model, 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.

Resources

-  **Digital document** Blackline master: World map (doc-11392)
-  **Video eLesson** Constructing and describing a flow map (eles-1741)
-  **Interactivity** Constructing and describing a flow map (int-3359)

1.15.3 Let me do it

Complete the following activities to practise this skill.

1.15 ACTIVITIES

1. Using a blank world map and the data in **TABLE 1**, construct a flow map of ivory smuggled from Africa to Asia. Think carefully about the **scale** you choose, as the data for China is high. Note that the flow is from Africa to Asia, so the arrows need to go from Africa to the appropriate country in Asia. Use the checklist for drawing a flow map to ensure you cover all aspects of the task.

TABLE 1 Ten Asian countries with the most ivory seized, 1989–2011 — total weight of seizures in kilograms

India	Singapore	Malaysia	Japan	Philippines	Vietnam	Taiwan	Hong Kong	Thailand	China
6758	8028	8527	8618	10659	13426	18370	20638	21364	41095

Source: TRAFFIC, Tom Milliken.

2. Write a description of the supply of smuggled ivory to Asia. Use the checklist for interpreting a flow map to ensure you cover all aspects of the task.
3. Apply your skills in interpreting a flow map to answer the following questions.
 - a. Which Asian country had the most smuggled ivory seized?
 - b. Which Asian country had the least smuggled ivory seized?
 - c. Describe the areas of Asia to which *smaller* quantities of ivory are smuggled and the areas to which *larger* quantities are smuggled.
 - d. Does distance seem to affect the amount of ivory smuggled? Explain your answer, using the map **scale** to help you.
 - e. Does the level of a country's development influence the smuggling of ivory? Explain your answer.

Checklist

In drawing a flow map I have:

- drawn in pencil initially and then coloured appropriately
- used arrows to indicate flow directions
- used **scaled** arrow widths, which are also explained in a key/legend
- included labelled features as necessary
- provided a clear title, which identifies **places** and dates.

In interpreting a flow map I have:

- identified and communicated key features of the movement, patterns and **places** shown
- clearly represented and communicated the data with the use of statistics, **places** and dates.

LESSON

1.16 SkillBuilder: Constructing a table of data for GIS

LEARNING INTENTION

By the end of this lesson you should be able to construct a table of data for GIS.

1.16.1 Tell me

A geographical information system, or GIS, 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 for 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.

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.

1.16.2 Show me

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 (see **FIGURE 1**).

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 (see **FIGURE 1**).

FIGURE 1 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 (see **FIGURE 2**).

FIGURE 2 Work out which are text fields and which are number (integer) fields.

Sample	Address	No_home	No_mobiles

In a GIS, this is a text field because it contains words.

In a GIS, these are integer fields because they contain numbers.

Step 4

Enter the collected data into the table. A thematic map of the data can then be created using GIS software. In this case, there will be 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 (see the **FIGURE 3** model). The map is shown in **FIGURE 4**.

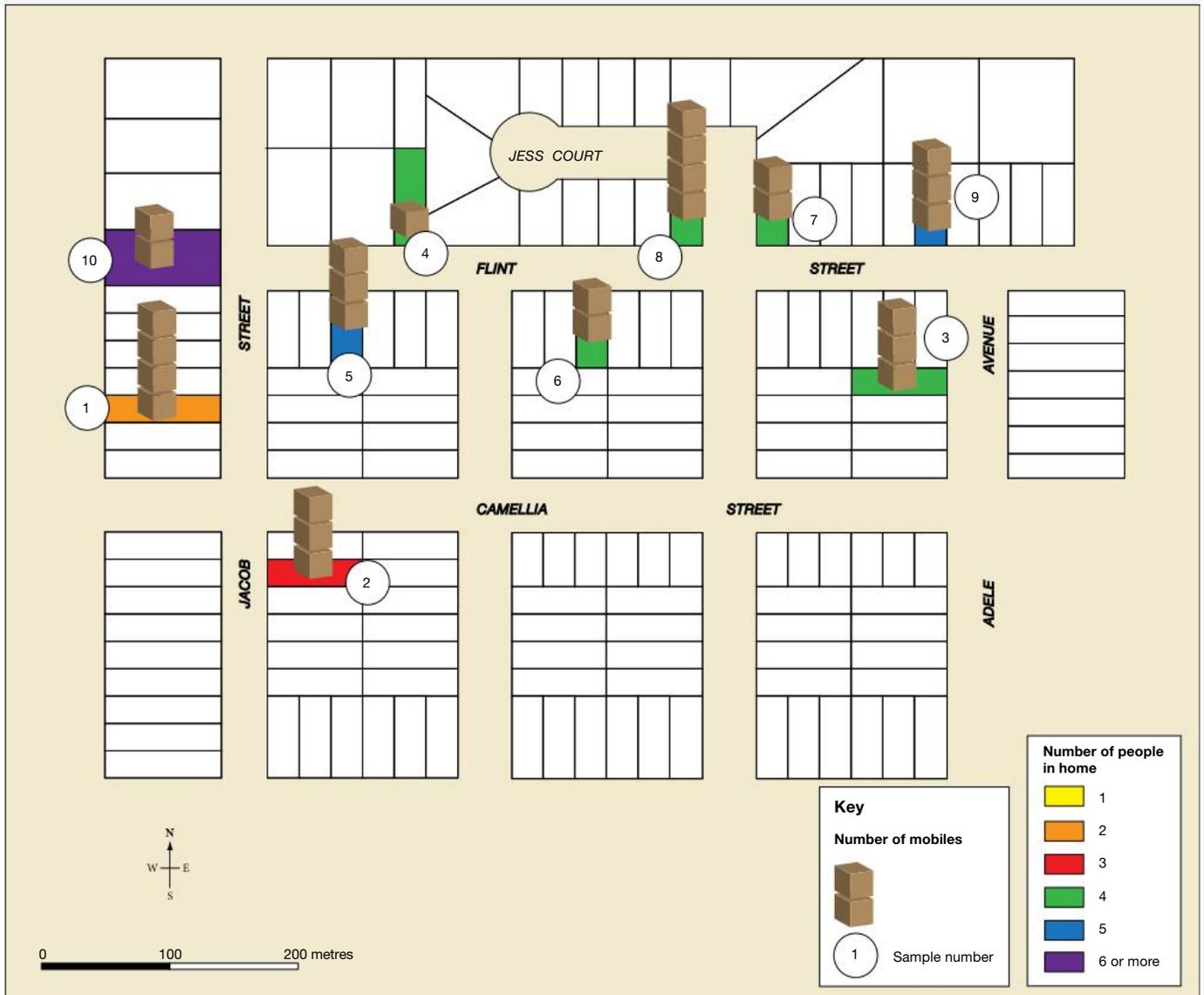
Model

FIGURE 3 Data displayed in table form

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

FIGURE 4 Map showing the number of mobile phones in each home



Source: Spatial Vision.

on Resources

 **Video eLesson** Constructing a table of data for GIS (eles-1743)

 **Interactivity** Constructing a table of data for a GIS (int-3361)

1.16.3 Let me do it

Complete the following activities to practise this skill.

1.16 ACTIVITIES

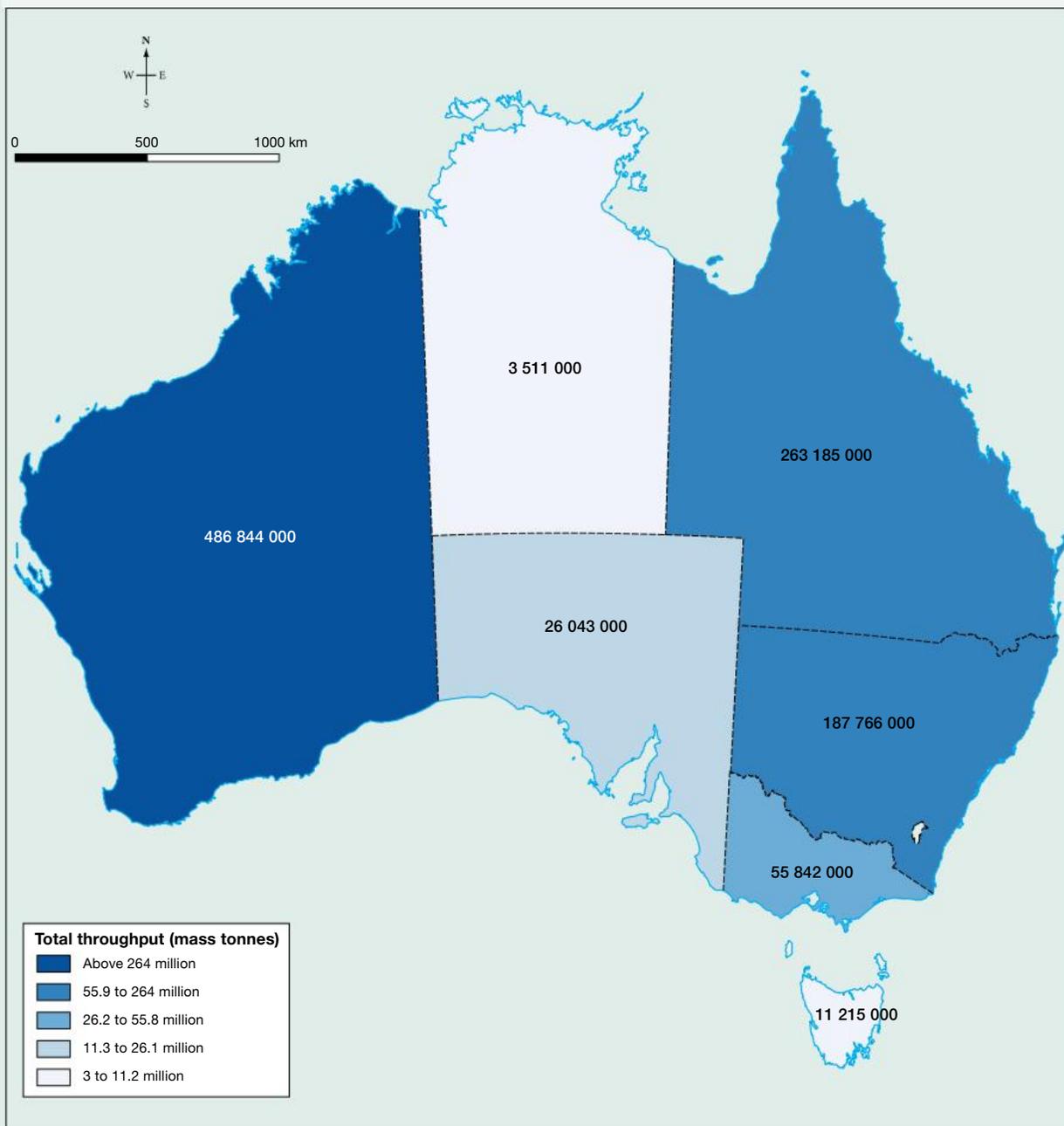
1. Create tables of data for the two maps shown in **FIGURES 5** and **6**. **TABLE 1** should be for the polygons (states) and **TABLE 2** for the points (ports). **TABLE 1** should have two columns, or fields, and **TABLE 2** should have four columns. Identify the text and integer fields in each table. Use the checklist to ensure you cover all aspects of the task.
2. Then apply your skills to answer the following questions.
 - a. Which state handled the most cargo by tonnage in 2011–12, and which two states handled the least cargo?
 - b. Name the two main ports exporting:
 - i. iron ore
 - ii. coal.
 - c. 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?
 - d. Why are the values for wool exports much smaller than those for iron ore and coal?
 - e. Why is wool exported from ports in the southern part of Australia?

Checklist

I have:

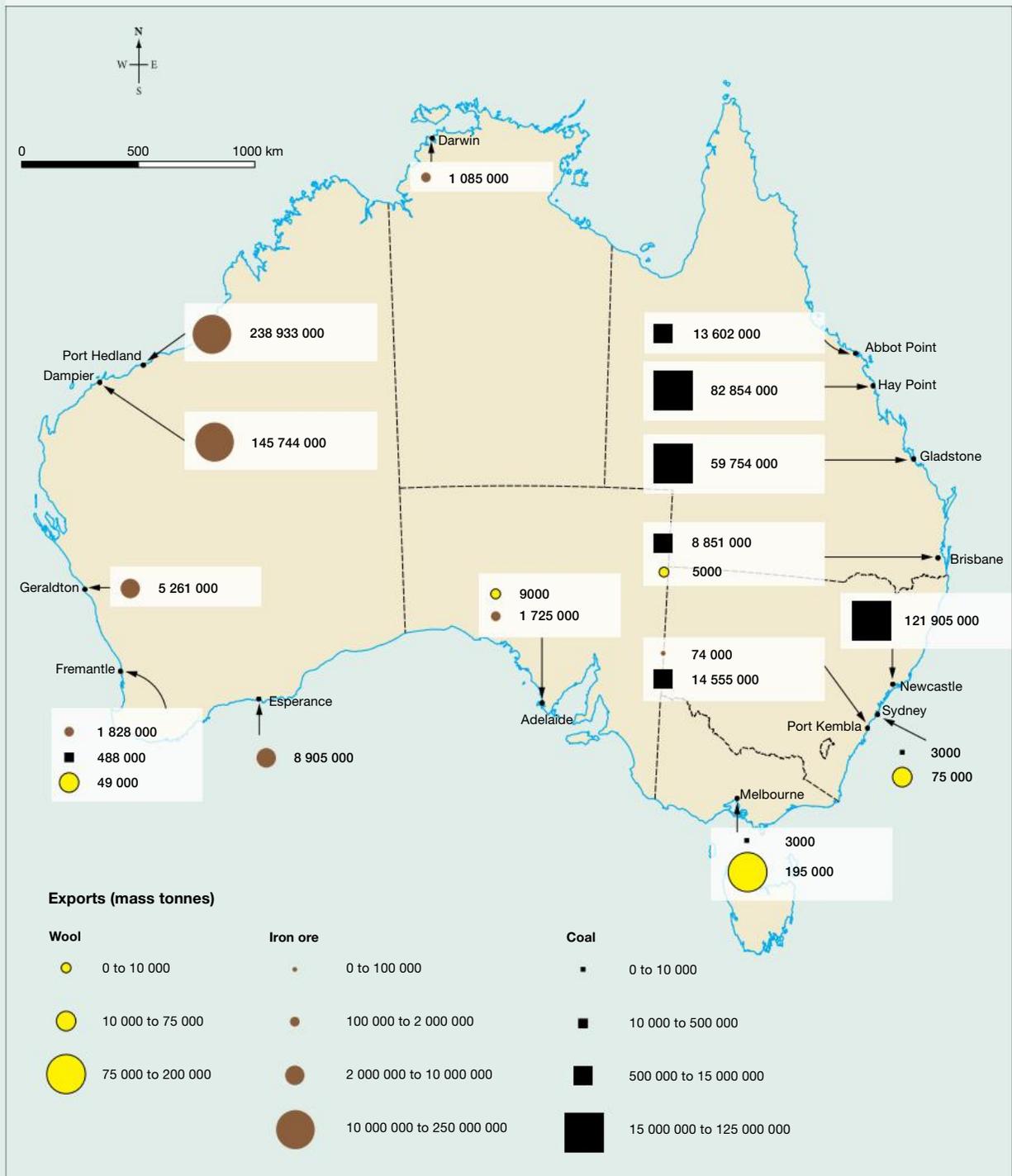
- created separate tables for polygon and point data (and line data, where relevant)
- created rows in the table that relate to the points, lines or polygons on the map
- identified the text and numeric fields
- ensured that the field headings have been shortened if necessary and contain no spaces
- 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.

FIGURE 5 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.

FIGURE 6 Ports exporting iron ore, coal and wool, in mass tonnes, 2011–12



Source: Spatial Vision.

LESSON

1.17 SkillBuilder: GIS — deconstructing a map

LEARNING INTENTION

By the end of this lesson you should be able to deconstruct a topographic map to create a simple GIS overlay map.

1.17.1 Tell me

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 lesson 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.

How 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, policing and public health.

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:

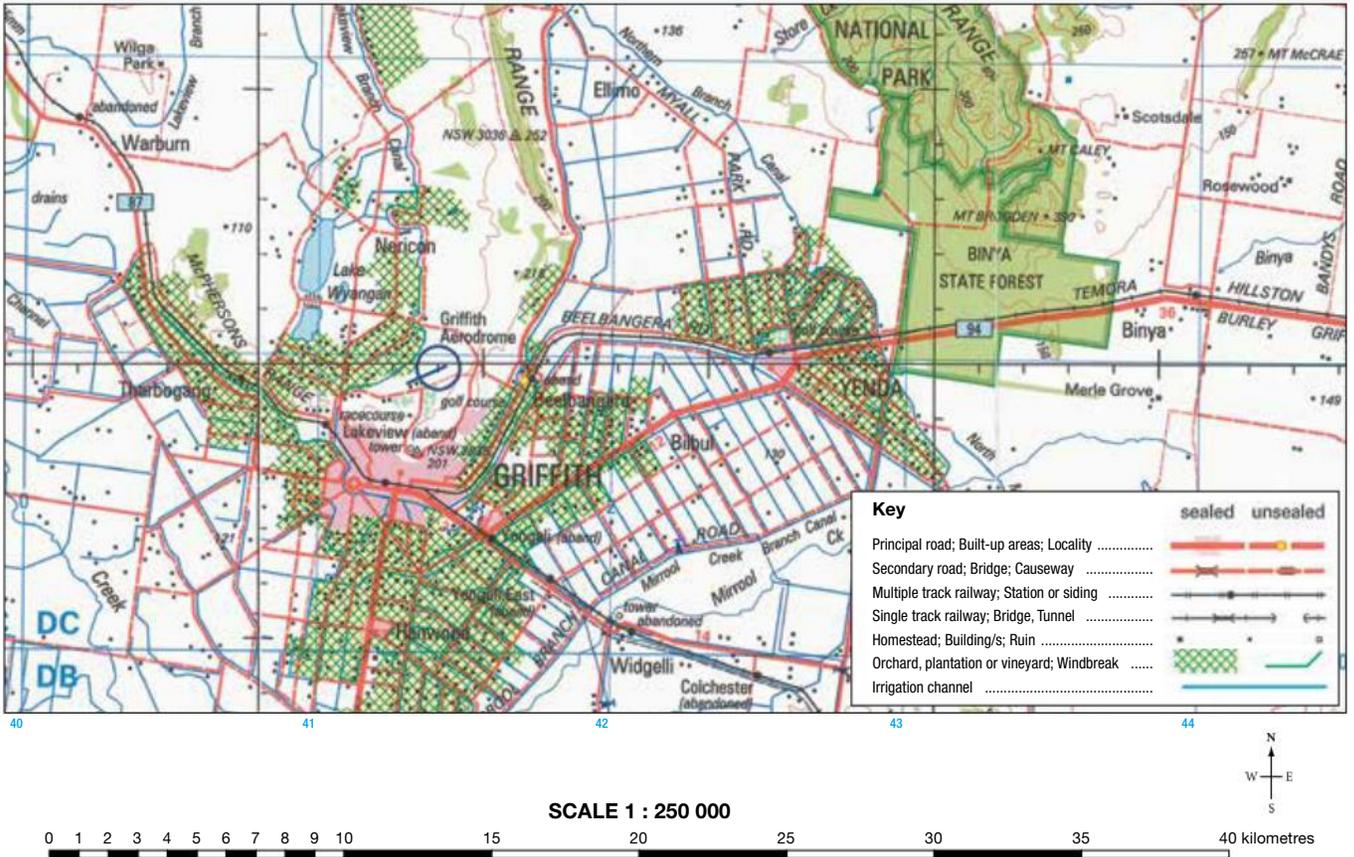
- traces each set of point, line and polygon data onto three pieces of tracing paper or clear transparency sheet
- uses appropriate colours for the features
- layers the features, with points on top, lines underneath and polygons on the bottom
- includes BOLTSS.

1.17.2 Show me

You will need:

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

FIGURE 1 Example of a section of a topographic map: Griffith, New South Wales



Source: © Geoscience Australia.

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.

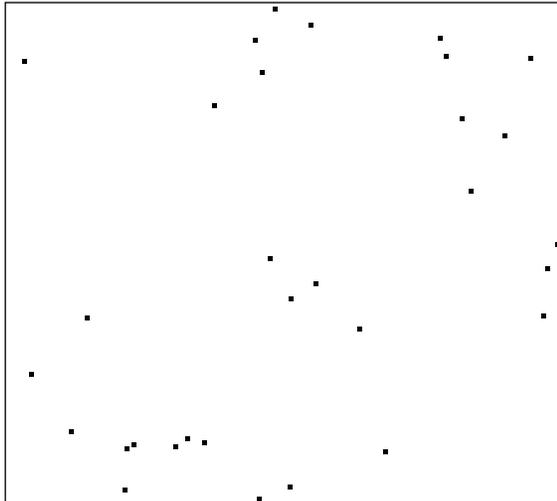
Procedure

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** (**Topographic map of Griffith, New South Wales** digital document in the Resources panel) 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 (or farmsteads) as point data on the tracing paper.

FIGURE 3 Point features are marked on the first layer of tracing paper.

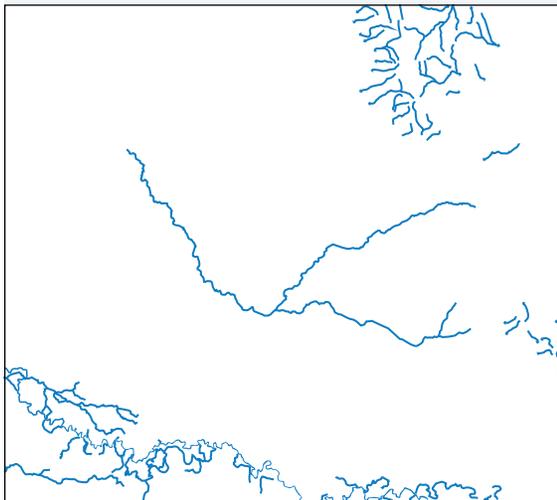


Step 2

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).

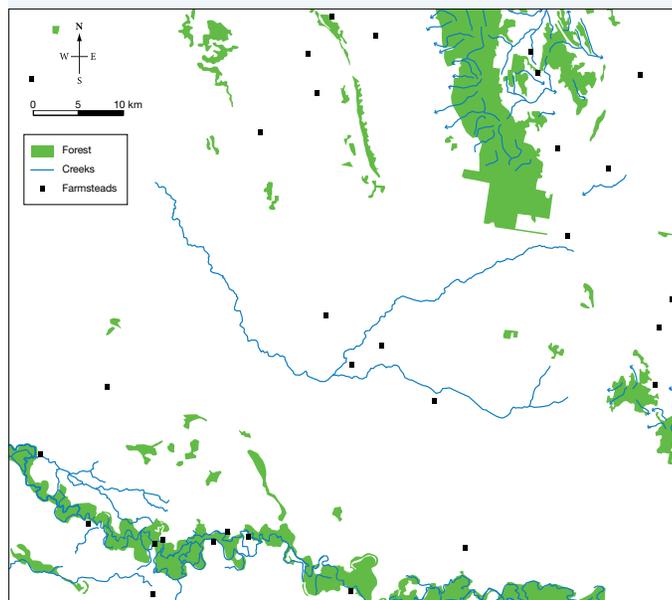
FIGURE 5 The polygon data of forests are traced onto a third piece of tracing paper.



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. This simple GIS overlay map shows farmsteads, rivers, creeks and forest areas in Griffith area.



on Resources

 **Digital document** Topographic map of Griffith, New South Wales (doc-11566)

 **Video eLesson** GIS — deconstructing a map (eles-1730)

 **Interactivity** GIS — deconstructing a map (int-3348)

1.17.3 Let me do it

Complete the following activities to practise this skill.

1.17 ACTIVITIES

1. Use the **FIGURE 1** map of Griffith provided in the Resources panel. 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. Use the checklist to ensure you cover all aspects of the task.
2. Based on what you have learned in this lesson apply your skills to answer the following questions.
 - a. What is the name of the district through which the Murrumbidgee River flows?
 - b. 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?
 - c. 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?
 - d. **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.
 - e. 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.
 - f. 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 a separate piece 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.

LESSON

1.18 SkillBuilder: Interpreting a geographical cartoon

LEARNING INTENTION

By the end of this lesson you should be able to interpret the key messages of a geographical cartoon.

1.18.1 Tell me

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.

How 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
- encouraging a response to an issue, whether in agreement or disagreement with the cartoonist
- presenting information, an issue, or a viewpoint in an interesting way.

A good interpretation of a cartoon:

- recognises the issue
- analyses the components of the cartoon
- identifies the cartoonist's personal opinion or message
- allows a personal response to the geographical topic.

1.18.2 Show me

You will need:

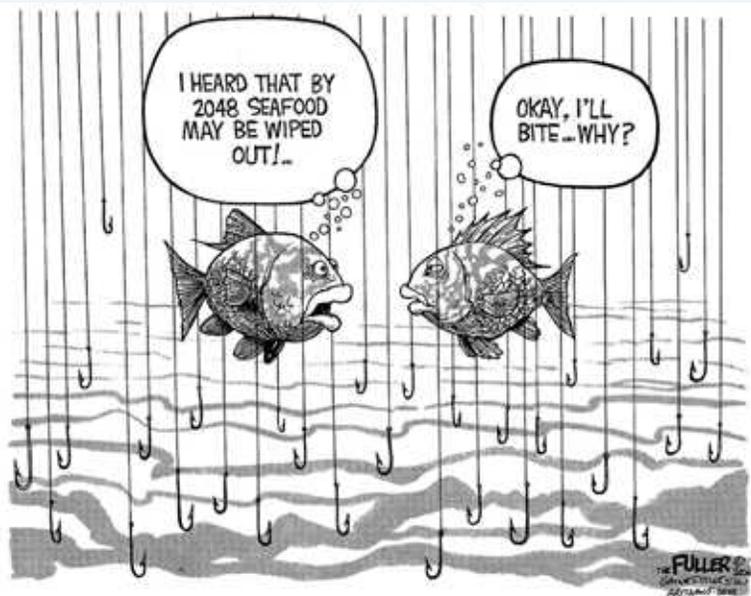
- a geographical cartoon.

Procedure

Step 1

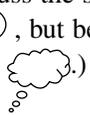
Take the time to study the cartoon and carefully look for the overall idea. Next, focus on the artistic work of the cartoonist and any subtleties that have been included. Consider different relative sizes of parts of the drawing, as well as any wording or attitudes expressed in the image. **FIGURE 1** is about overfishing our oceans. In this case, the subtleties are in the words of the fish — what are the fish really saying?

FIGURE 1 Cartoon on overfishing



Step 2

Consider the overarching issue: in this case, overfishing. What is your general knowledge of 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 overfishing.
- *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

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.

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 (perhaps it's just a random 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 audience — 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.

on Resources

 **Video eLesson** Interpreting a geographical cartoon (eles-1731)

 **Interactivity** Interpreting a geographical cartoon (int-3349)

1.18.3 Let me do it

Complete the following activities to practise this skill.

1.18 ACTIVITIES

- Using the steps outlined in the Show me section, write a paragraph analysing the geographical issue portrayed in the **FIGURE 2** cartoon. Use the checklist to ensure you cover all aspects of the task.
- Based on what you have learned in this lesson apply your skills to answer the following questions.
 - Why is the fishing trawler drawn so small?
 - Has the trawler caught many fish? Explain your answer.
 - Explain the discussion between the two fish.
 - What message do you think is being conveyed in this cartoon?
 - How does this cartoon make you feel?
 - Based on your knowledge of overfishing and your understanding of this cartoon, what is your opinion on this issue?

FIGURE 2 Unsustainable fishing



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.

LESSON

1.19 SkillBuilder: Using advanced survey techniques — interviews

LEARNING INTENTION

By the end of this lesson you should be able to write interview questions that gather both qualitative and quantitative information about a specific topic.

1.19.1 Tell me

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.

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.

1.19.2 Show me

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
- sound- and/or video-recording devices
- a risk assessment carried out by the school to ensure your safety in approaching people — ask your teacher and check with your family that it is okay to conduct an interview.

Procedure

Step 1

Determine the purpose of using the interview technique. What is your topic?

Step 2

Begin by developing 10–15 open questions that allow the interviewee to express their opinion. No question should be answerable with a simple ‘yes’ or ‘no’. The **FIGURE 1** model provides some sample questions.

Step 3

Test your questions on a classmate or family member. Rework any questions to improve clarity of expression and to draw a more extended response from the interviewee.

Step 4

You need to practise an interview on someone so that you are confident when talking to members of the public. When conducting an interview, use the following guidelines.

- Have some form of identification provided by your school so that people know you are genuinely collecting information.
- Introduce yourself and clearly state where you are from. Do not be offended if a person does not want to participate — that is their right.
- 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. Be equally prepared to leave a question out if your interviewee says they would rather not answer a specific question.
- Take notes, using your notetaking 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.

Model

FIGURE 1 Sample interview questions

Interview topic: _____ Date: _____

Location: _____ Interviewee name: _____

1. What are your most common electronic forms of communication?

2. How many computers does your household have? ← A quantitative question

(a) 0 (b) 1 (c) 2 (d) 3 (e) 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

Annotations: "Leave spaces to write answers" with an arrow pointing to the top of the form; "A quantitative question" with an arrow pointing to question 2; "A qualitative question" with an arrow pointing to question 5.

on Resources

 **Video eLesson** Using advanced survey techniques — interviews (eles-1742)

 **Interactivity** Using advanced survey techniques — interviews (int-3360)

1.19.3 Let me do it

Complete the following activities to practise this skill.

1.19 ACTIVITIES

1. Create a set of interview questions that seek the opinion of your local community on technology consumption and e-waste management (look at question 2 to ensure your survey provides you with the information you will need to answer these questions). Conduct your survey, organise your data and summarise your findings. Use the checklist to ensure you cover all aspects of the task.
2. Apply your skills to answer the following questions.
 - a. What did people understand by the term e-waste?
 - b. Does the community dispose of its e-waste effectively?
 - c. Are there enough e-waste recycling depots for the community?
 - d. Is there enough advertising about how to deal with e-waste?
 - e. 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.

LESSON

1.20 SkillBuilder: Writing a fieldwork report as an annotated visual display (AVD)

LEARNING INTENTION

By the end of this lesson you should be able to create an annotated visual display to report on your findings from fieldwork.

1.20.1 Tell me

A fieldwork report helps you process all the information that you have gathered during fieldwork. You sort your data, create tables and graphs, and select images. You interpret the data as text or annotated images then you synthesise, or pull together, all the data in a logical presentation to convey your ideas. Finally, you summarise all you have learned and collected in your fieldwork-based research in a statement or recommendations on the topic. A fieldwork report may be presented as a word-processed report; a wall-mounted, annotated visual display (AVD); an oral presentation, using PowerPoint as support; a podcast; an online publication; or another form of media.

How is a fieldwork report useful?

A fieldwork report is used to summarise the findings from your time in the field. Your fieldwork report will highlight a particular environment, social issue or key inquiry question that you are investigating. You may be presenting this information in order to inform your classmates, to raise community awareness, or to encourage a relevant authority to take action. Many organisations undertake fieldwork investigations to determine future plans.

Fieldwork reports are also useful for:

- synthesising and summarising all the information collected in the field
- displaying your ideas for classmates to see
- resolving land use issues, such as transport infrastructure expansions
- providing input to local and national government planning and strategies
- determining the route of a new bicycle path
- testing for mineral resources.

A good fieldwork report presented as an AVD:

- is clearly structured and has a title
- includes an introduction
- contains statements of findings, which provide a range of data sources, such as graphs (of various types), tables and photographs
- includes evidence that you have identified patterns in the data, been able to describe the current situation, and synthesised data to come up with a clear understanding of the topic clearly states limitations and successes has a conclusion.

1.20.2 Show me

You will need:

- a large piece of chart paper on which to present your material
- a piece of A4 paper for planning the layout
- maps of the location
- data collected in the field that has been selected and processed to produce tables and a range of graphs
- photographs that have been selected for relevance and referred to in the text
- relevant secondary data.

Model

FIGURE 1 An AVD completed from secondary sources

EARTHQUAKES IN AUSTRALIA



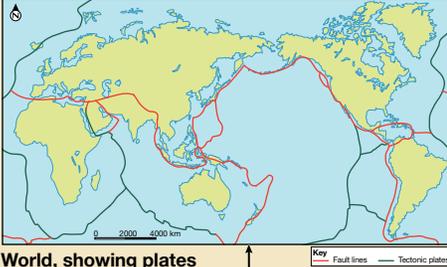
Fault lines in Australia

'We're due for a big one'

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World, showing plates

'Safest country in the world'

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Newcastle

Conclusion

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References

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You can write directly onto the card or stick paper onto it.

Break your information down into several sections rather than having lots of writing. (We've used filler text to demonstrate.)

Spread your maps and photos out to make the presentation interesting.

Remember for every map:
Border,
Orientation,
Legend, **T**itle,
Scale and **S**ource.

Don't forget your list of references. If there are lots of references, you can put them on the back.

Use a large, coloured piece of card for your backing.

Procedure

To complete an AVD you need to have all your information readily available.

Step 1

Determine a simple, short and concise title for your fieldwork study.

Step 2

On a separate sheet of paper, sketch a layout for your work. There are a number of things to consider when positioning material.

- A short and precise introduction should appear in the top left corner (see Step 3).
- A map showing location should be close to the introduction.
- You need to describe your method (see Step 4).
- Findings — the primary data collected — should be presented in tables, graphs and photographs (see Step 5).
- If you include secondary data, decide where it fits into the 'story' that is being told (see Step 6).
- State the limitations and successes of the fieldwork (see Step 7).
- Incorporate a conclusion (see Step 8).

Step 3

Begin with an introduction. This should be short and should state clearly the aims of the fieldwork and the location of the investigation, shown as a map. For example, 'This fieldwork aims to investigate [topic] and was undertaken at [place] on [dates]'.

Step 4

The next section is the method. State where you went within the broader location; what information you gathered; the methods you used to gather information; and why you collected that information. This should be a concise paragraph. For example: 'We visited three places along the coastline. One was a bayside beach

[name], the second a rocky headland [name] and the third an ocean beach [name]. We observed the waves, counted the tourists and photographed sand build-up at each site. We hoped this data would show...'

FIGURE 2 Sample layout of an AVD

Title	Map of location	Method
Introduction		Sketch
Photo Analysis of photo		Analysis of a sketch
Analysis of table Table	Bar graph	Limitations and successes
	Analysis of bar graph	
Secondary data, if used	Conclusion	

Step 5

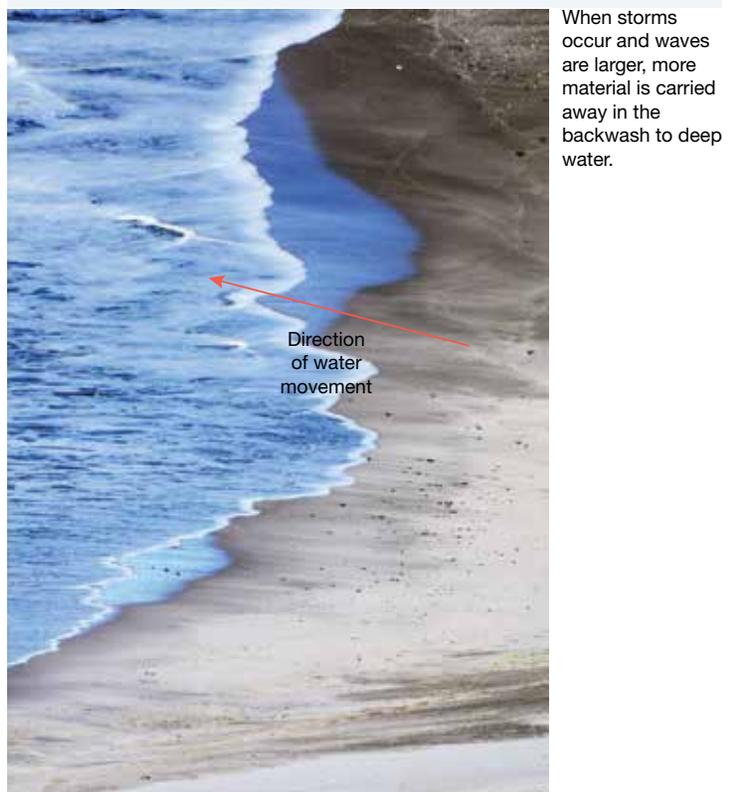
The findings are the main focus of the report. This is where you present the information that you gathered in the field. It is important that your work has a clear structure to guide the reader through the development of the ideas. Look for interconnections between the data, and set out the information in an organised manner. **FIGURE 3** shows a section taken from an AVD.

The various maps, graphs, diagrams and photographs are presented in this section with a discussion of the important findings that each item of data reveals. Place the analysis close to each item of data.

It is a good idea to number the items and refer to the numbering system in the text; this ensures the reader is connecting with the appropriate data. For example, 'FIGURE 2 shows ...' or 'The photograph in FIGURE 5 displays ...'

All data should incorporate the geographic conventions: BOLTSS. Annotations to photographs and diagrams are recommended, because these save space and connect the reader with the data.

FIGURE 3 Sample section showing text and photograph closely connected



Backwash — the movement of water back to the sea is shifting sand, shells, seaweed and other materials down the beach and out to sea.

Step 6

Consider whether you need to include any information from a secondary source. This is information that is reported by someone else and appears in a magazine, newspaper, journal, government report or the internet, or is spoken (in a podcast, speech or interview, for example). This information is not the focus of your work and must only supplement your fieldwork findings. Therefore, it must be very brief. **FIGURE 4** shows how secondary data might be done as a précis in an AVD.

FIGURE 4 A secondary source and a précis of it for the AVD

Residents and beach visitors were treated to a spectacular sight when a large sand dredge began restoring the eroded beach to its former splendour. The beach had gradually been washed away with every winter storm that arrived.

Under a master plan for the area, a total revamp is planned, including recreating the beach. A partnership between council, the community and the state government, will contribute \$5.4 million to the project, including adding 180 000 cubic metres of sand reclaimed from the sea. A new 50-metre-wide stretch of sand over a length of 900 metres will appear.

As the area had been neglected for some time, the master plan is extensive with plantings of native trees, enhancement of wetlands, plantings for shade, a foreshore bicycle trail, sealed parking bays and redevelopment of the Life Saving Club building, including a café. An up-and-coming local sculptor has kindly offered to donate a sculpture 'The Wave' to be placed along the foreshore. Council will support this installation.

The renourished beach is a reflection of Council's commitment to continually improving foreshore amenity for residents of the beach-going population.

The Inquirer, August 10, 2012

Précis of article

The recreated beach is 50 metres wide by 900 metres long. A sand dredge took 180 000 cubic metres of sand from the sea. Trees have been planted to hold soil and provide shade, the wetlands have been developed, and community wellbeing has been enhanced by a bicycle path, car parking and a cafe at the revamped surf lifesaving club.

Step 7

Include a statement about the limitations and successes of the fieldwork. The limitations should cover anything that went wrong or ways in which the fieldwork could be improved. The successes should include new things learned and any interest that you may have gained from the investigation.

Step 8

End your report with a conclusion. This should relate to the aims of the fieldwork. For example, 'From the fieldwork investigation, it is possible to conclude that ...' Go back to your aims and check you have answered what you set out to discover.

on Resources

 **Video eLesson** Writing a fieldwork report as an annotated visual display (AVD) (eles-1747)

 **Interactivity** Writing a fieldwork report as an annotated visual display (AVD) (int-3365)

1.20.3 Let me do it

Complete the following activities to practise this skill.

1.20 ACTIVITIES

1. During Year 9 Geography, your class should undertake fieldwork. This lesson can only be completed after that has taken place. Some of the activities in this topic suggest undertaking fieldwork in the school grounds or at a local **environment**. Practise an AVD layout to report your findings for one of these **environments**. Use the checklist to ensure you cover all aspects of the task.
2. Apply your skills to answer the following questions.
 - a. What forms of land degradation might you find in this **environment**?
 - b. How would you rate your local **environment** in terms of degradation?
 - c. Can you suggest some activities that could help to improve the **environment**?
 - d. Which local authorities ought to be concerned about this **environment**?
 - e. How might you alert the local community to the degradation taking place?

Checklist

I have:

- clearly structured the layout
- included a title and introduction
- provided statements of findings from a range of data sources – various graph types, tables and photographs
- provided evidence that I have identified patterns in the data, been able to describe the current situation, and synthesised data to show a clear understanding of the topic
- clearly stated limitations and successes
- added a conclusion.

1.21.2 Key terms

correlation a relationship between the features

cumulative line graphs graphs with new sets of data shown in levels on the one graph, to show how each separate component contributes to the total

multiple line graphs graphs that include several separate lines on a single graph

pattern the way in which features are distributed or spread

2 Biomes and food production

LESSON SEQUENCE

2.1 Overview	25
2.2 What are the major biomes around the world?	26
2.3 How do we characterise biomes?	30
2.4 What are Australia's major biomes?	35
2.5 What is the importance of biomes to humans?	39
2.6 How is global food production linked to climate?	46
2.7 How and why do we modify biomes for agriculture?	53
2.8 What types of agriculture are practiced in Australia and Asia?	58
2.9 How are the world's biomes and food production interconnected?	66
2.10 How has deforestation changed the forest biome?	70
2.11 How has overfishing changed the ocean biome?	75
2.12 INQUIRY: Overfishing	80
2.13 What are the causes and effects of land degradation?	81
2.14 Why is global biodiversity diminishing?	89
2.15 Investigating topographic maps — Coastal wetland biome in Binydjarrna (Dalywoi/Daliwuy Bay)	94
2.16 Review	97

LESSON

2.1 Overview

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What on Earth are biomes? Are they just another part of the landscape or do we need them to survive?

2.1.1 Introduction

Where do the foods we eat and the natural products we use each day come from? The answer is 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.

Sourcing food is a fundamental part of every organism's life, and for many humans where their next meal will come from is a source of great worry. What are the foods we eat, and why do these vary across the globe? How do we modify biomes to produce the food we need, and how can we build on our understanding of food sourcing and production strategies to feed the world's future generations?

FIGURE 1 Do you know where all of your food comes from and how it is made?



Resources



eWorkbook

Customisable worksheets for this topic (ewbk-13446)



Video eLesson

Bountiful biomes (eles-1717)

LESSON

2.2 What are the major biomes around the world?

LEARNING INTENTION

By the end of this lesson you should be able to describe the distribution of the Earth's major biomes and identify the similar characteristics that biomes share.

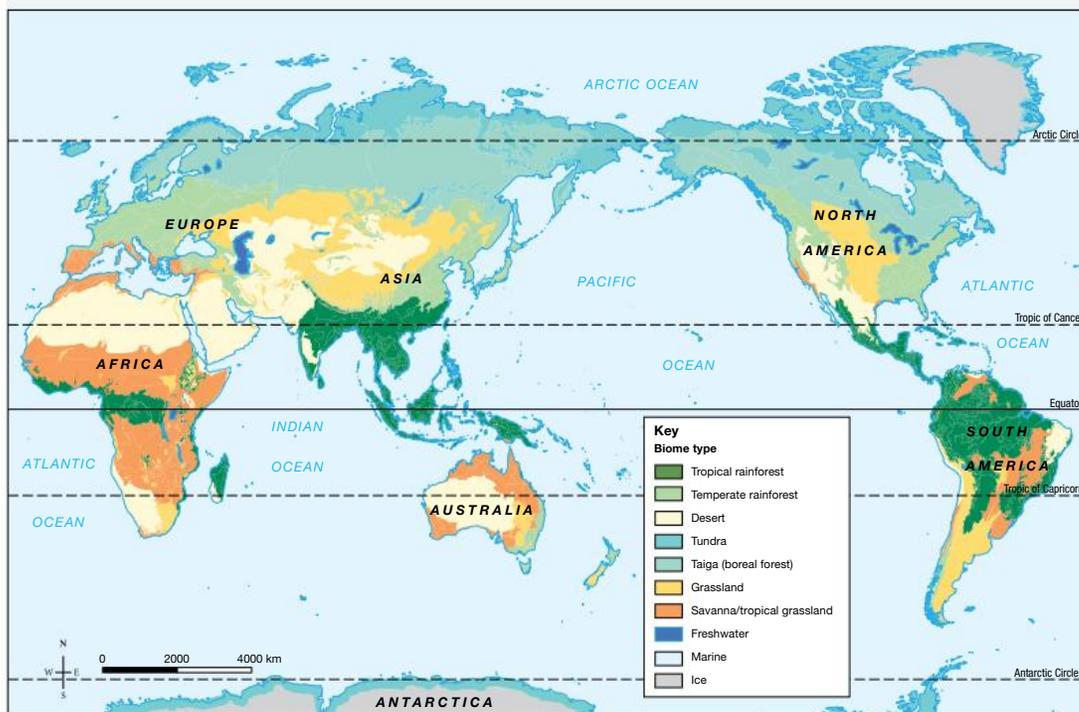
TUNE IN

Refer to **FIGURE 1**. Tropical rainforests are located near the equator, and taiga and tundra are located near the poles.

1. Can you suggest why this is so?
2. Why would the major deserts be located close to the tropics of Cancer and Capricorn?

int-7909

FIGURE 1 Major biomes of the world



Source: Redrawn by Spatial Vision based on the information from the Nature Conservancy and GIS Data.

2.2.1 The world's major biomes

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

Forests

Forests are the most diverse ecosystems on the Earth. Around 1.5 to 1.7 billion people live in forests. Ranging from hot, wet, tropical rainforests to temperate forests, forest biomes have an abundance of 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 more than 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**.

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.

Grasslands

Grasslands can be seen as transitional environments between forest and desert. Dominated by grass, they have small, widely spaced trees or no trees at all. 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 is unsustainable and places grasslands at risk of becoming deserts. More than 1 billion people inhabit the grassland areas of the world.

Tundra

Tundra is found in the coldest regions of the world, and lies beyond the **treeline**. Around 4 million people live in this biome. 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 its plants and animals have little tolerance for environmental changes that reduce snow cover.

FIGURE 2 Forest biome



FIGURE 3 Desert biome



FIGURE 4 Grassland biome



deforestation clearing forests to make way for housing or agricultural development

tundra the area lying beyond the treeline in polar or alpine regions

treeline the edge of the area in which trees are able to grow

Aquatic

Water covers about three-quarters of the Earth. Aquatic biomes can be classified as freshwater 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. Compounds from marine life have also been used in products such as cosmetics and toothpaste. Elements taken from the roots of mangroves have been used in the development of cancer medications.

FIGURE 5 Tundra biome



FIGURE 6 Aquatic biome



on Resources

 **Interactivity** Beautiful biomes (int-3317)

2.2 SKILL ACTIVITY: Questioning and researching using geographical methods

1. **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.
2. **Explore** what this biome is like in another place on Earth. With the aid of a Venn diagram, **compare** the two places.

2.2 Exercise

Learning pathways

■ LEVEL 1

1, 3, 5, 6

■ LEVEL 2

2, 4, 7, 8

■ LEVEL 3

9, 10

These questions are even better in jacPLUS!

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- Access sample responses
- Track results and progress



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Check your understanding

- Identify** which terrestrial biome has the greatest biodiversity.
 - Tundra
 - Aquatic
 - Grassland
 - Forest
- Select** which of the following are the broad characteristics shared by a type of biome. Choose all that apply.
 - Climate
 - Longitude
 - Life forms
 - All of the above
- Identify** the five major biomes of the Earth and classify them as either aquatic or terrestrial.
- Look carefully at **FIGURE 1**. Using geographic terminology and concepts (including reference to latitude), **identify** the location and characteristics of the major biomes.
- Reflect on** what you have learned about forest biomes.
 - Complete the following sentences.
Over _____ of all known plant and animal species are found in _____ rainforests. Forests are the source of over _____ modern medicines, and many fruits and nuts originate in this biome.
 - Explain** why rainforests are sometimes referred to as the Earth's lungs.
- Are all biomes equally important? **Explain** your answer.

Apply your understanding

Communicating

- Explain** the important functions performed by the forest biome.
- Select** one of the categories of biomes described in this lesson. **Suggest** how this biome might be changed and used by humans and what impact this change might have on the environment.

Concluding and decision-making

- Predict** what might happen if the permafrost beneath the Arctic surface thawed.
- 'Deserts are a dry, lifeless plain.' To what extent do you agree with this statement? **Reflect**.

LESSON

2.3 How do we characterise biomes?

LEARNING INTENTION

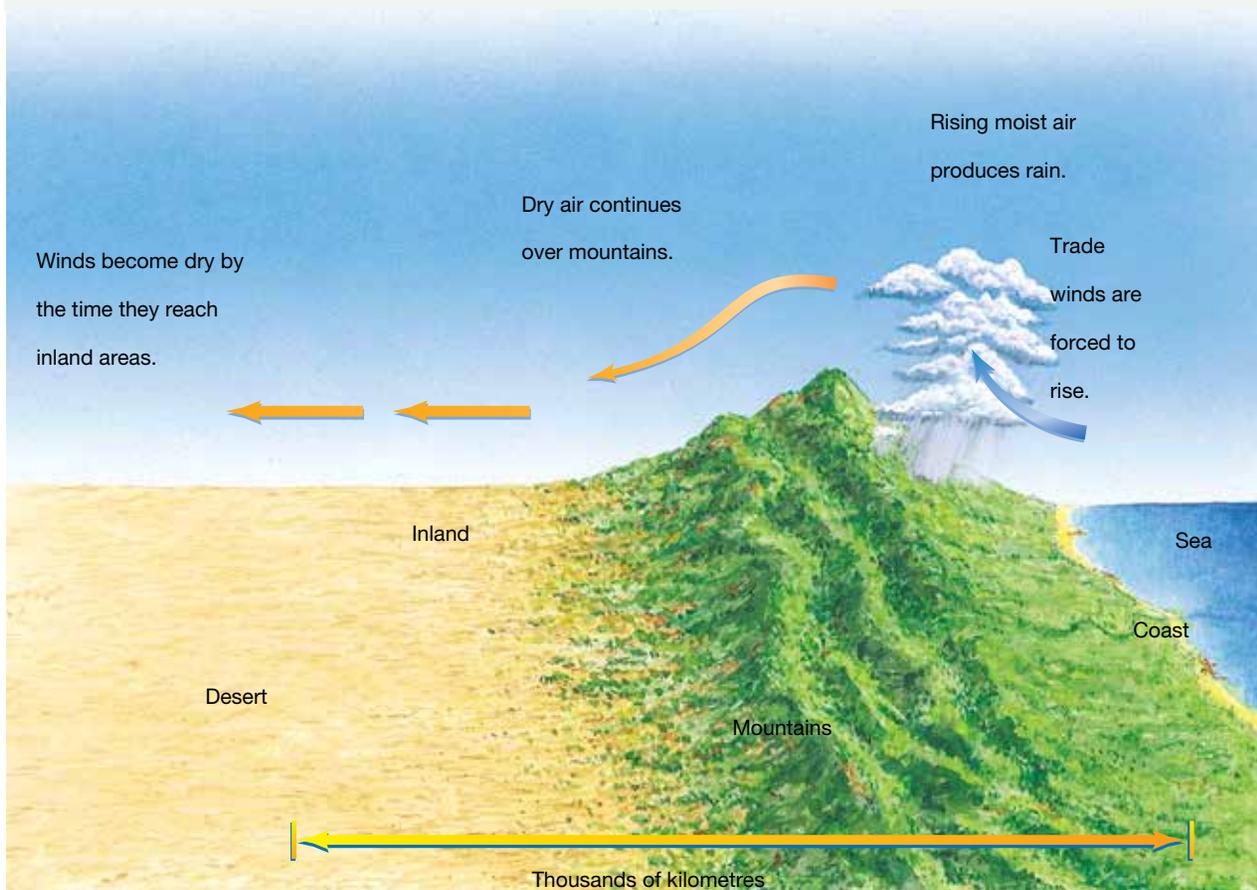
By the end of this lesson you should be able to identify and explain the factors that influence the development of biomes and explain why biomes vary across the surface of the Earth.

TUNE IN



Different biomes are located in different places over the Earth's surface. Variations in temperature and rainfall lead to the development of different soil conditions. The interaction between the different biophysical environmental elements can be used to explain all biodiversity on the planet.

FIGURE 1 The process of rain shadows forming on the leeward side of mountains



Refer to **FIGURE 1**.

1. Describe the seasonal temperature and rainfall variations where you live and comment on how these elements have led to 'your' biome.
2. How can topography create variations within biomes? Also consider the impact of the 'rain shadow effect' in your answer. Refer to **FIGURE 1** for ideas.

2.3.1 Climate's influence on biomes

Biomes are controlled by climate. In turn, climate is influenced by factors such as latitude, 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. Similarities have been found in the adaptations of plant and animal species in mountain regions and those found near the poles.

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

rain shadow the dry area on the leeward side of a mountain range

leeward describes the area behind a mountain range, away from the moist prevailing winds

windward describes the side of the mountain that faces the prevailing winds

FIGURE 2 Mt Kilimanjaro: its altitude is the reason it has snow on its summit.



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 the climate. Temperatures fall by 0.65 °C for every 100 metre increase in elevation. This can be illustrated by Mt Kilimanjaro (**FIGURE 2**), which is located on the border of Tanzania and Kenya, in Africa, at 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 faster. 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 role 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. Recent studies including the Milankovich Cycle suggest there are periodic shifts in the Earth's axial tilt which could explain why ice ages occur.

Ocean currents and air movement

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 Australia's east-coast Pacific Ocean currents are warmer. As a result, Perth on average receives less rainfall than Sydney.

2.3.2 The role of soil in biomes

int-3608

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.

FIGURE 3 Latitude is a key factor in climate.

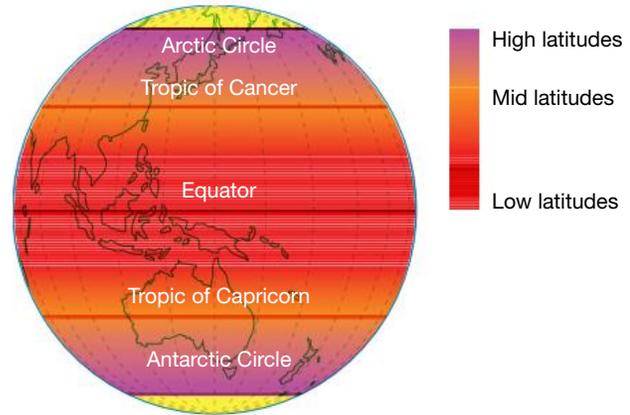


FIGURE 4 A typical soil profile has a number of distinct layers.

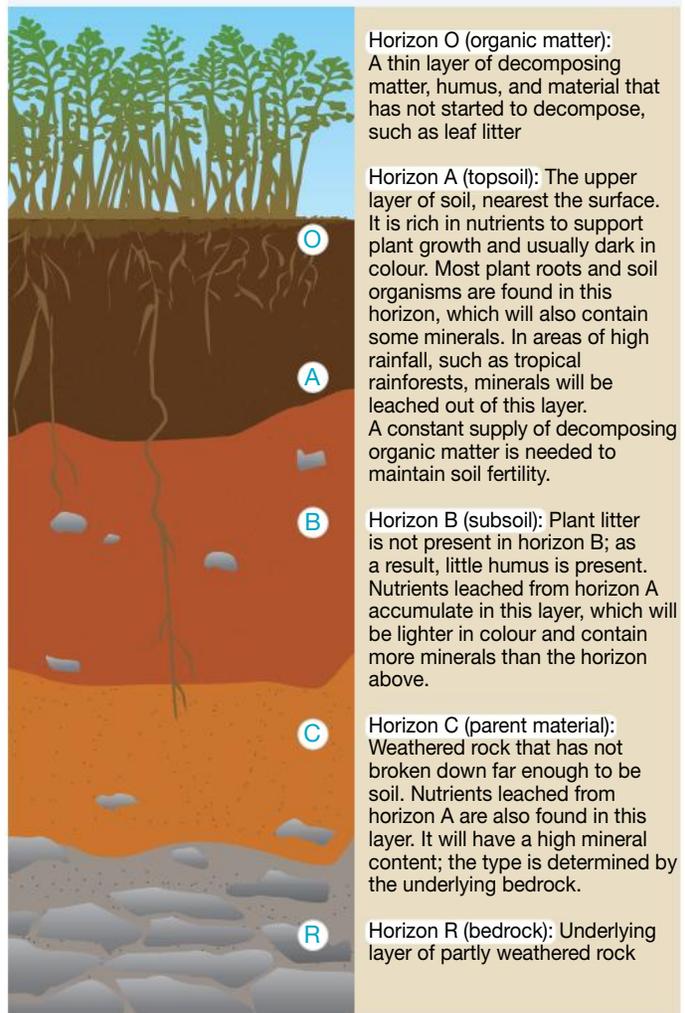
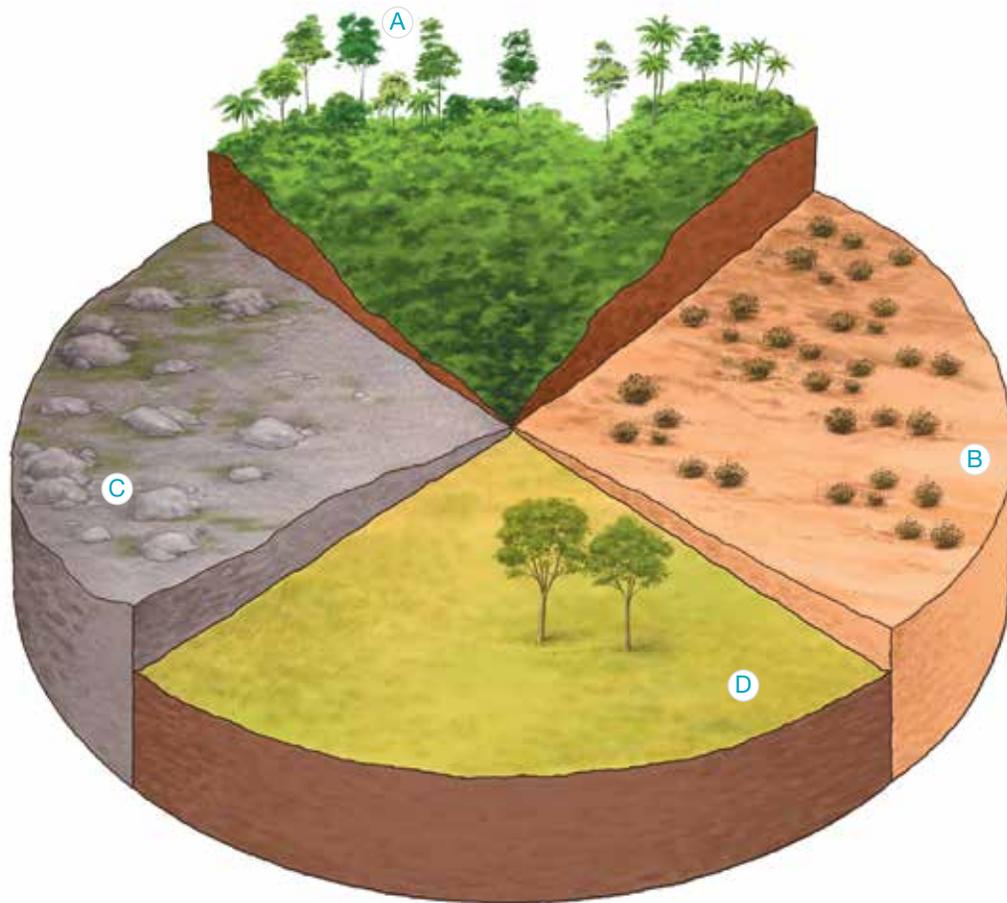


FIGURE 5 Different biomes have different soil and vegetation characteristics.



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 Temperate

- Generally brown in colour, soils have distinctive horizons and are generally about a metre deep.
- Soils are ideal 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.

D Tundra

- Soil is shallow and poorly developed.
- Some layers are frozen for long periods.
- Subsoil may be permanently frozen.
- Soil 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.

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: lower latitude regions generally receive more precipitation than those in higher latitudes.

Temperature and precipitation patterns are important factors in determining the rate of soil development. In addition, 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.

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; these plants in turn die and decompose in a continuous cycle. This is further demonstrated in **FIGURE 5**.

on Resources

-  **Interactivities** Why are biomes different? (int-3319)
The formation of rain-shadow deserts (int-3628)

2.3 SKILL ACTIVITY: Interpreting and analysing geographical data and information

Use your atlas to locate Rwanda in central Africa.

1. What type of biome would you expect to find in Rwanda? **Justify** your answer.
2. What do you think the soil would be like in Rwanda? Use the internet to test your theory.

2.3 Exercise

learn on

2.3 Exercise

Learning pathways

■ LEVEL 1

1, 2, 5, 6

■ LEVEL 2

3, 9

■ LEVEL 3

4, 7, 8, 10

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Check your understanding

1. Water and heat are the major influences on the development of biomes. True or false?
2. The difference between the windward and leeward sides of a mountain range is
 - A. windward is always to the west.
 - B. leeward is close to the sea.
 - C. windward faces the direction of the wind and leeward is on the opposite side of a mountain.
3. **Consider** how temperature and rainfall can influence the development of soil across different biomes.
4. **Investigate** the different characteristics of soils in the tropical rainforest, tundra, desert and temperate biomes.
5. **Describe** the role played by soil organisms in maintaining soil quality and fertility.

Apply your understanding

Communicating

6. **State** why you would expect to find soil variations within biomes. **Justify** your answer.
7. **Predict** the changes that might occur if earthworms or micro-organisms within the soil were no longer present.
8. **Discuss** what type of climate and biomes you would expect to find at the equator. Why?

Interpreting and analysing geographical data and information

2. **Consider** the climate and landscape on Mt Kilimanjaro. Why is there so much variation?
10. **Investigate** some of the factors that create variations in biomes.

LESSON

2.4 What are Australia's major biomes?

LEARNING INTENTION

By the end of this lesson you should be able to explain why Australia has such a diverse range of biomes.

TUNE IN

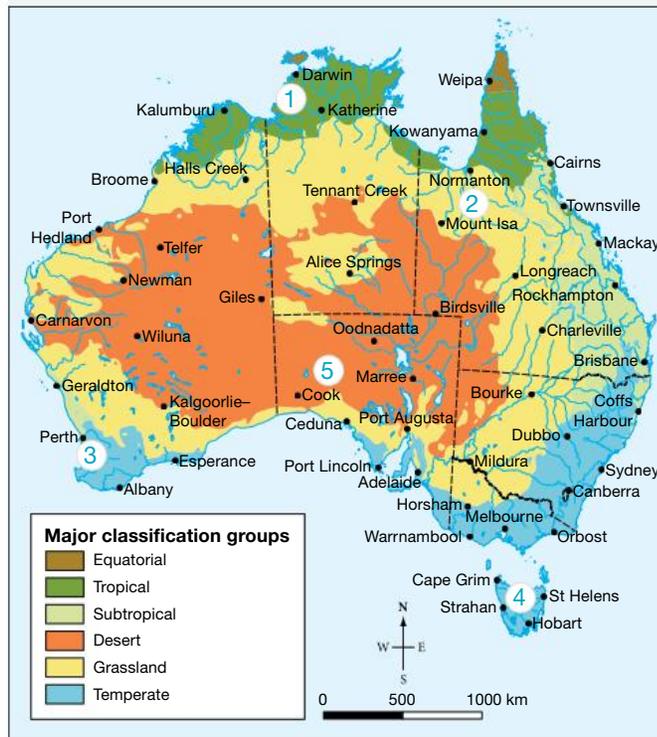
Australia as a landmass has a significant range of contrasting biomes.

Refer to **FIGURE 1**.

1. Which is the largest biome on the map in terms of area?
2. Locate on the map which biome you live in and give its name.

int-5580

FIGURE 1 Climate classification of Australia



Source: Data copyright Commonwealth of Australia, 2013 Bureau of Meteorology. Map drawn by Spatial Vision.

2.4.1 Factors shaping Australian biomes

Australia is a land of contrasts. Its mountain ranges and river systems are small by world standards. In the north there are tropical rainforests and savanna grasslands. In the centre there 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 traditional 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.

Wetlands and rivers

In tropical northern Australia, wetlands have been inhabited by First Nations Australian Peoples since the beginning of The Dreaming (more than 50 000 years). These areas provided them with food and water, and they use 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.

Savanna (grasslands)

Grassland, pampas, savanna, chaparral, cerrado, prairie, rangeland and steppe all refer to a generally flat landscape that is dominated by grass. This biome generally has few or no trees, though there may be more tree cover in adjoining areas, such as along riverbanks.

Grasslands are found in places where there is not enough rain to support a forest but there is too much rain for a desert; for this reason they are sometimes referred to as a transitional landscape. They occur 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 are very fragile and without careful management can quickly change to desert. 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. For many native animal species, grasslands also provide vital habitat and protection from predators. First Nations Australian Peoples hunted for food in grasslands, using low-burning fires to flush out wildlife; however, since European occupation grasslands have been used extensively for grazing and access to native animal populations has decreased.

Seagrass meadows

Seagrasses are submerged flowering plants that form colonies off long, sandy ocean beaches, creating dense areas that resemble meadows. Of the 60

FIGURE 2 This billabong in Kakadu National Park is part of an extensive wetland system.



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.



known species of seagrass, at least half are found in Australia's tropical and temperate waters. Western Australia is home to some of the largest seagrass meadows, including the Wooramel seagrass bank in the Shark Bay World Heritage area, the largest seagrass bank 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.

Old-growth forests

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. It is estimated that **clear-felling** of Tasmania's old-growth forests would release as much as 650 tonnes of carbon per hectare into the atmosphere.

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



FIGURE 6 Vegetation in desert biomes has specific adaptations that enable it to survive.



Deserts

Australian deserts are places of temperature extremes. During the day, temperatures sometimes exceed 50 °C, but at night this can drop to freezing. Some, such as the Simpson Desert and the Great Sandy Desert, are dominated by sand. The Nullarbor Plain and Barkly Tableland 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.

logging large-scale cutting down, processing and removal of trees from an area
biodiversity the variety of plant and animal life within an area
clear-felling the removal of all trees in an area

2.4 SKILL ACTIVITY: Interpreting and analysing geographical data and information, Communicating

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 **discuss** how it has changed over time. What do you think should be done to protect it?

2.4 Exercise

Learning pathways

■ LEVEL 1

1, 2, 5, 6, 7

■ LEVEL 2

3, 4, 8

■ LEVEL 3

9, 10

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Check your understanding

- Complete the following sentence:
Biodiversity refers to the _____ of flora and _____ in an area. It is an _____ component of ensuring a _____ environment and maintaining the _____ of ecosystems.
- Identify** the eight types of biomes you would expect to find in Australia.
 - Old-growth forests
 - Seagrass meadows
 - Savanna
 - Wetlands and rivers
 - Prairie
 - Tropical rainforests
 - Coral reefs
 - Mountains
 - Steppe
 - Desert
- Most of Australia's native grasslands have disappeared due to the introduction of European plants. True or false?
- With the aid of a flow diagram, **reflect** on how the Australian environment changed when European occupiers arrived. Include the following: natural processes, wetland draining, land clearing, introduced species, irrigation.
- Explain** why Australia has such a wide variety of biomes.

Apply your understanding

Communicating

- Identify** three environmental impacts of clear-felling Australia's old-growth forests.
 - Creation of new habitats
 - Large amounts of carbon released into the atmosphere
 - Forests replaced by plantation timber
 - Reduction in biodiversity
 - Increased sediment in waterways
- Judge** the impact of draining wetlands on native and migratory birds.
- Predict** what might happen if Australia's old-growth forests were logged.
- Propose** why burning is an essential element in maintaining the grassland biome.
- Justify** why seagrass meadows are often referred to as 'the forests of the sea'.

LESSON

2.5 What is the importance of biomes to humans?

LEARNING INTENTION

By the end of this lesson you should be able to describe the characteristics, role and importance of at least one biome.

TUNE IN

Humans have created their own biomes by selectively planting cereal crops and developing grassland to feed grazing animals for food production.

FIGURE 1 Human induced grasslands used for grazing farm animals



Refer to **FIGURE 1**.

The grassland shown in **FIGURE 1** is typical of rolling country suited to grazing animals. The image indicates that the land has been cleared of trees with some evidence of what would have been the natural biome for the area.

1. Why would a farmer retain some trees on grazing land?
2. Why would this property be unsuited to growing cereal crops such as wheat?

2.5.1 Grasslands

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, they can support a high density

of grazing animals, and they regenerate quickly after fire.

Some grasses can be up to 2 metres in height, with roots extending up to 1 metre below the soil. The biome depends on annual regeneration of its grasses, so it is almost impossible to re-establish a grassland ecosystem once desert has taken over.

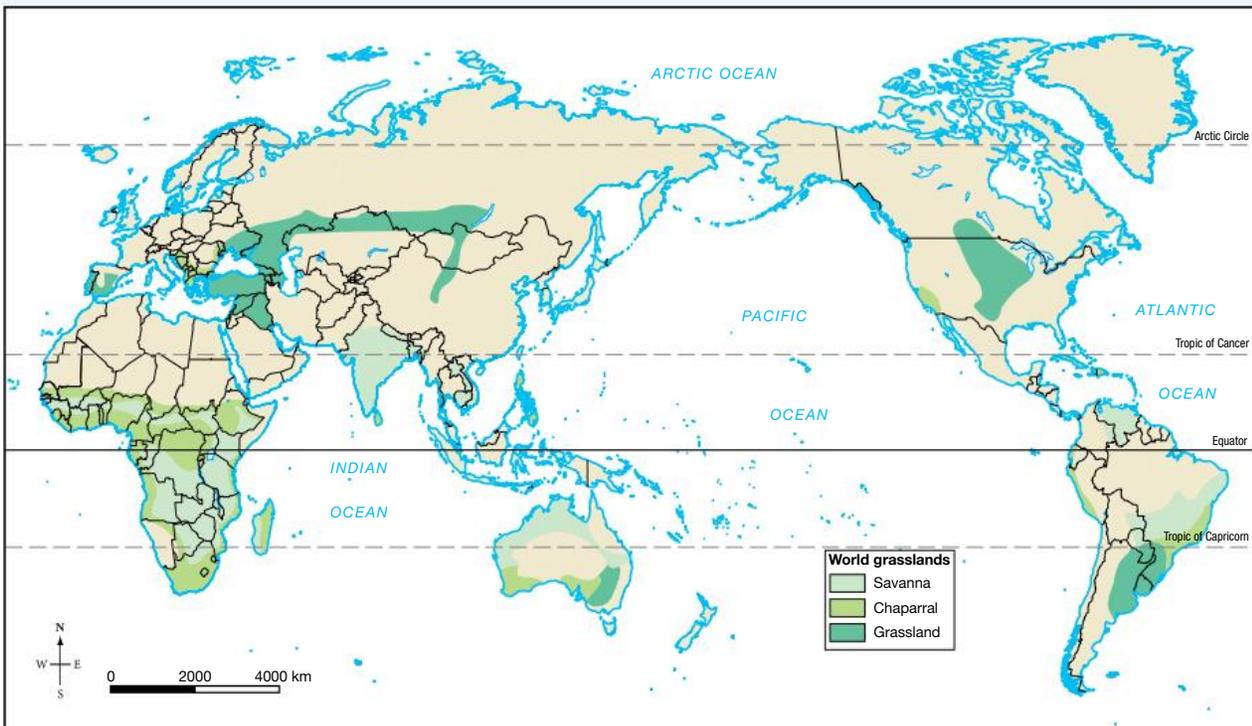
Grasslands are the most useful biome for agriculture because the soils are generally deep and fertile. Almost 1 billion people depend on grasslands for their livelihood or as a food source. Grasslands are ideally suited for growing crops or creating pasture for grazing animals. The prairies of North America, for example, are one of the richest agricultural regions on Earth.

FIGURE 2 Wheat production in Australia brings about \$5 billion to the Australian economy annually.



int-7913

FIGURE 3 Grasslands occupy about a quarter of the Earth's land surface.



Source: Map drawn by Spatial Vision.

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, with people flocking 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 useful for treating headaches and toothache.

urbanisation the growth and spread of cities

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.

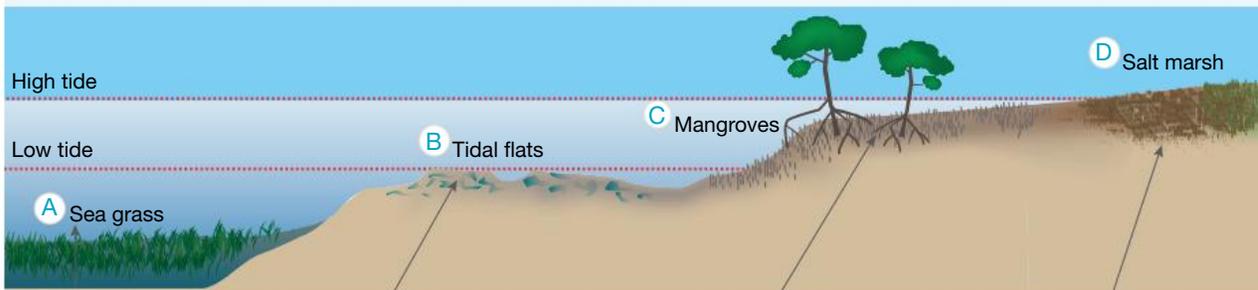
Once, grasslands occupied about 42 per cent of the Earth's land surface, but today they make up about 25 per cent. In Australia today, less than one per cent of native grasslands survive, and they are now considered one of the most threatened Australian habitats. Since European occupation, most native 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 4 Grasslands can support a high density of grazing animals. In Australia, this includes fine wool production.



int-5576

FIGURE 5 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.

organic matter decomposing remains of plant or animal matter
pneumatophores exposed root system of mangroves, which enables them to take in air when the tide is in

2.5.2 Coastal 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.

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 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 5** shows a cross-section through a mangrove wetland.

FIGURE 6 Pneumatophores — the exposed root system of mangroves



FIGURE 7 The Ord River Delta in Western Australia, with mangroves lining the water channels



2.5.3 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 by secreting calcium carbonate underneath their body to create the hard coral structures seen in a coral reef. 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. Coral reefs are one of the oldest and most diverse ecosystems on Earth and also one of the most vulnerable to human activity.

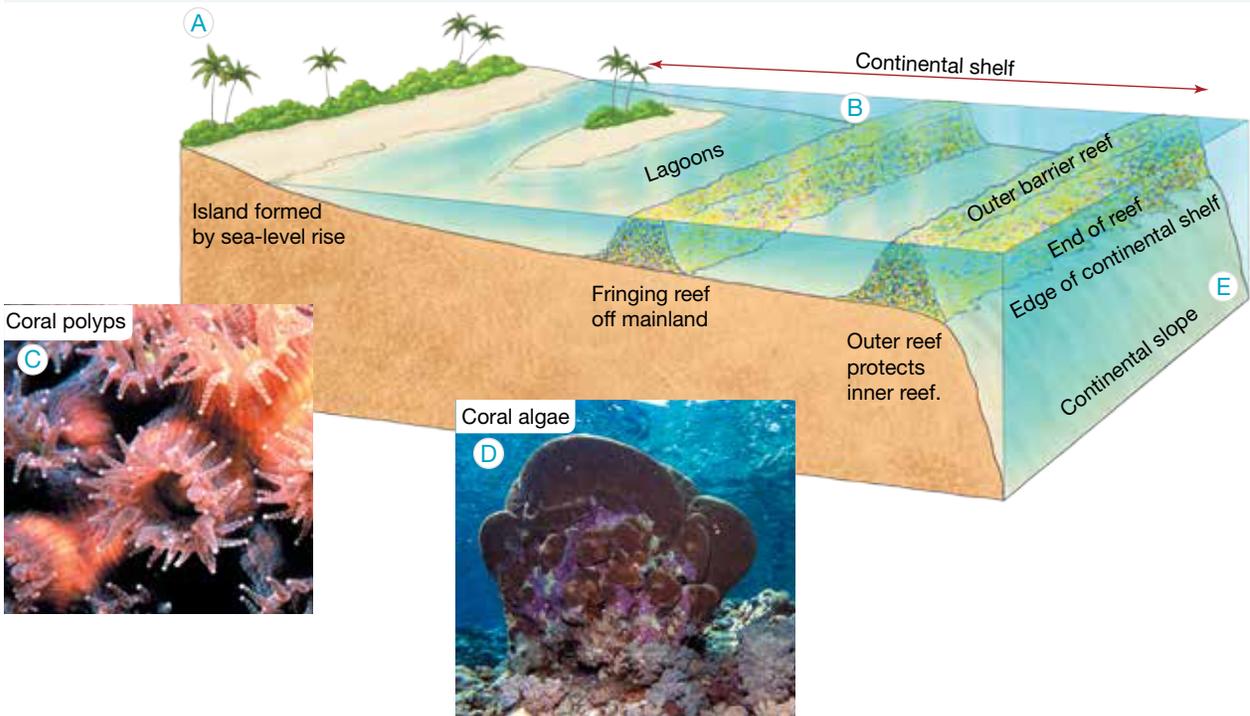
FIGURE 8 outlines the anatomy of a coral reef, and provides a close-up image of some of the millions of coral polyps that combine to form a reef. **FIGURE 9** shows how different reefs are formed over time.

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 each year, generating more than A\$2 billion for the local economy. Nearly one-third of all tourists who visit Australia visit the Great Barrier Reef. Ningaloo Reef does not attract quite as many tourists, but it is one of the world’s longest fringing reefs — and one of the easiest to access as it is so close to shore. Tourist numbers to the area have been increasing by around 10 per cent each year.

FIGURE 8 Anatomy of a coral reef

int-7914



- A** Continental island and fringing reef
- B**
 - Corals form in warm shallow saltwater 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.

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

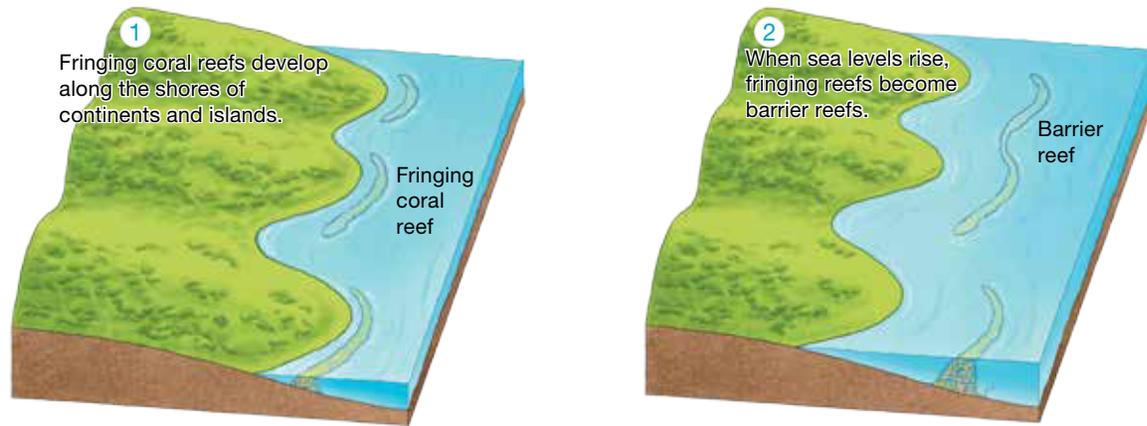
- Painkillers have been developed from the venom of cone shells.
- Some cancer treatments come from algae.
- Treatments for cardiovascular disease and HIV include compounds that were originally found in coral reefs.

Threats to coral reefs

Reefs face a variety of threats:

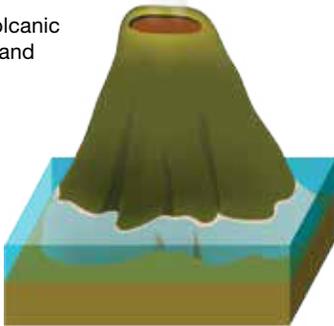
- Urban development requires land clearing and wetland drainage, which increases erosion. Sediment washed into water prevents sunlight penetrating the water.
- Contamination by fossil fuels, chemical waste and agricultural fertilisers pollutes the sea.
- Tourism damages coral through boats dropping anchor, or tourists taking 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.
- Ocean acidification which changes the pH of the water leading to a hostile environment.

FIGURE 9 The formation of fringing reefs, barrier reefs and coral atolls



3 Formation of a coral atoll

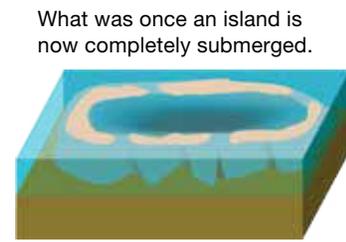
a Volcanic island



b Eroded volcanic island has been partly submerged by rising sea



c Sandy island forms on reef from eroded coral and shell



DISCUSS

Few people realise that less than one per cent of Australia’s native grasslands survives. 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? How would each of the following groups perceive the value of grasslands?

- a.** Graziers (sheep and cattle farmers)
- b.** City dwellers
- c.** Environmentalists
- d.** International tourists
- e.** Traditional owners

on Resources

Interactivities Grass, grains and grazing (int-3318)

2.5 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Grasslands are located on six of the Earth’s seven continents. **Investigate** one of the grassland biomes. Using ICT, **create** a presentation on your chosen biome that covers the following:

- a.** the characteristics of the environment, including climate and the types of grasses that dominate this place

- b. the animals that are commonly found there
- c. how the environment is used and changed for the production of food, fibre and wood products
- d. threats to this particular grassland, including the scale of these threats
- e. what is being done to manage this grassland environment in a sustainable manner.



2.5 Exercise

learnon

2.5 Exercise

Learning pathways

LEVEL 1

1, 2, 4, 6, 7, 12

LEVEL 2

5, 8, 9, 11

LEVEL 3

3, 10

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Check your understanding

1. Mangroves are adapted to survive in their wetland environment. A wetland is:
 - A. a biome that is permanently covered with water.
 - B. a biome that is covered with water in the morning.
 - C. a biome where the ground is saturated either permanently or seasonally.
 - D. a biome that only exists in winter and spring.
2. **Select** all of the statements that are true.
 - A. Fringing reefs develop close to the shoreline, whereas barrier reefs develop further from the shore.
 - B. Barrier reefs develop close to the shoreline, whereas fringing reefs develop further from the shore.
 - C. Barrier reefs are sometimes referred to as outer reefs and provide protection for inner (fringing) reefs.
 - D. Barrier reefs are often separated from the shore by shallow water.
3. **Explain** why Australian grasslands are under threat.
4. **Explain** what a grassland is.
5. **Explain** why mangroves are able to survive in wetlands.
6. **Describe** the global distribution of grasslands. (Use **FIGURE 3** to help you.) Include at least three observations in your descriptions:
 - one about how much of the Earth is grassland
 - one about where the grasslands are located
 - one about the kind of climate where you would find grasslands.
7. **Identify** and **describe** three major threats to coral reefs and **explain** whether each threat is likely to increase or decrease with global warming.

Apply your understanding

Communicating

8. In some places, attempts are being made to re-establish native grasses. **Discuss** why it is important to re-establish native grasslands.
9. Wetlands have been described as a natural purification system. **Identify** which part of the wetland environment would perform this function. **State** reasons for your answer.
10. Wetlands were once described as 'a waste of space'. Do you think this is an accurate description?
11. Coral reefs are highly susceptible to climate change.
 - a. **Explain** what you understand by the term 'climate change'.
 - b. **Explain** how the coral reef environment would change if sea temperatures were to rise by 2 °C.
12. **Explain** five key threats to coral reefs.

LESSON

2.6 How is global food production linked to climate?

LEARNING INTENTION

By the end of this lesson you should be able to identify the major staple foods throughout the world, and how the production of these is interconnected with climate.

TUNE IN



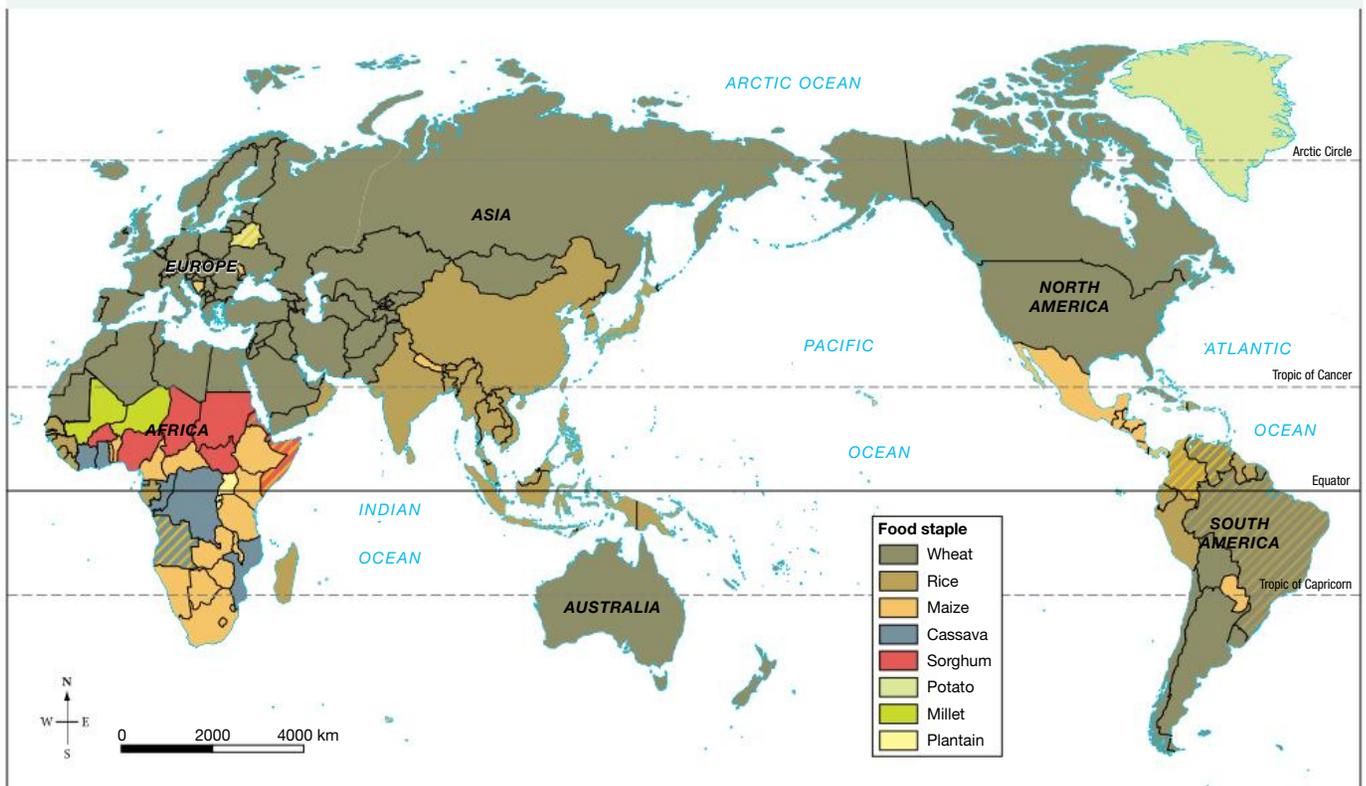
int-7917

Cereal crops are a vital source of food for over half of the world's population.

Refer to **FIGURE 1**.

1. Why would there be such a variety of food staples over the African continent?
2. The map maker for **FIGURE 1** decided to show all of Australia as a wheat producing area. Can you suggest why this approach was taken considering that Australia also produces other staple crops?

FIGURE 1 Staple foods around the world



Source: Based on data from FAO. Map drawn by Spatial Vision.

2.6.1 The major food staples

Global food production, especially of staple foods, has a significant impact on the world's biomes. 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. 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 (corn) 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 soybeans and sago; fruits, such as breadfruit and plantains (a type of banana); and fish.

2.6.2 Wheat, maize and fish

Wheat

Wheat is a cereal grain that is cultivated across the world. In 2019, the total world production of wheat was nearly 735 million tons, making it the second most produced cereal after maize (1.1 billion tons) and above rice (496 million tons). World trade in wheat is greater than for all other crops combined.

Wheat was one of the first crops to be easily cultivated on a large scale, with 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.

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



Maize

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, thanks 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, covering 70–100 million acres of farmland in the United States alone, which accounts for nearly 40 per cent of all maize grown in the world.

biofuel fuel that comes from renewable sources

TABLE 1 Top 10 maize producers, 2021

Rank	Countries	Production of maize in 2021 (Tons)
1	United States of America	347 047 570
2	China, mainland	260 778 900
3	Brazil	101 138 617
4	Argentina	56 860 704
5	Ukraine	35 880 050
6	Indonesia	30 693 355
7	India	27 715 100
8	Mexico	27 228 242
9	Romania	17 432 220
10	Russian Federation	14 282 352

FIGURE 3 Corn cobs drying outside in Serbia



Source: Food and Agriculture Organization of the United Nations. FAOSTAT. [Top 10 World’s Biggest Maize-Producing countries, The Science Agriculture].

Fish

Fish is a staple food in many societies. The oceans provide an irreplaceable, renewable source of food and nutrition essential to good health. 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 3 billion people rely on fish as their primary source of animal protein.

2.6.3 Challenges to feeding the global population

At the beginning of the twentieth century, the world population was less than 2 billion people. The current world population is more than 7.9 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 for everyone?

FIGURE 7 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 16.6 square kilometres 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.

arable describes land that can be used for growing crops
per capita per person

2.6.4 Food production increases

Agricultural yields vary widely around the world depending on climate, management practices and the types of crops grown. Globally, 15 million square kilometres of land is used for growing crops — altogether, that's about the size of South America. Approximately 32 million square kilometres of land around the world is 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 UN Food and Agriculture Organization (FAO), the three main factors that have affected recent increases in world crop food production are:

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

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 6** shows the growth in crop yields in developing countries from 1961 to the growth that is predicted for 2030. Rice, maize and wheat have had significant increases in yield.

FIGURE 4 A fish haul in Bali, Indonesia

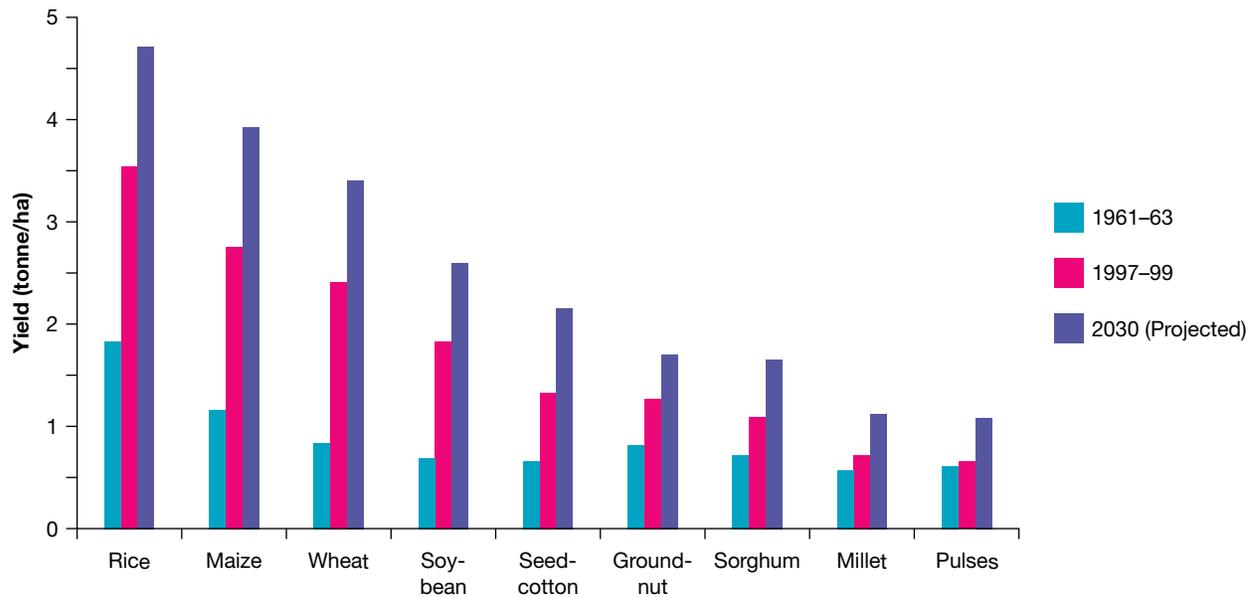


FIGURE 5 Farmers in a village in Kenya use a laptop to examine information on plant diseases at a plant health clinic. They can also consult a plant pathologist and show them samples of their crops.



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 (see **FIGURE 5**). In this way, the nutritional content of crops can be increased.

FIGURE 6 Crop yields in developing countries, 1961–2030



Source: Food and Agriculture Organization of the United Nations, 2002, World agriculture towards 2015/2030 - Summary report], <https://www.fao.org/global-perspectives-studies/resources/detail/en/c/411230/>. Reproduced with permission.

2.6.5 Increasing our food production

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 until 2014, total world cropland increased by only around 10 per cent, but total agricultural production grew by 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.

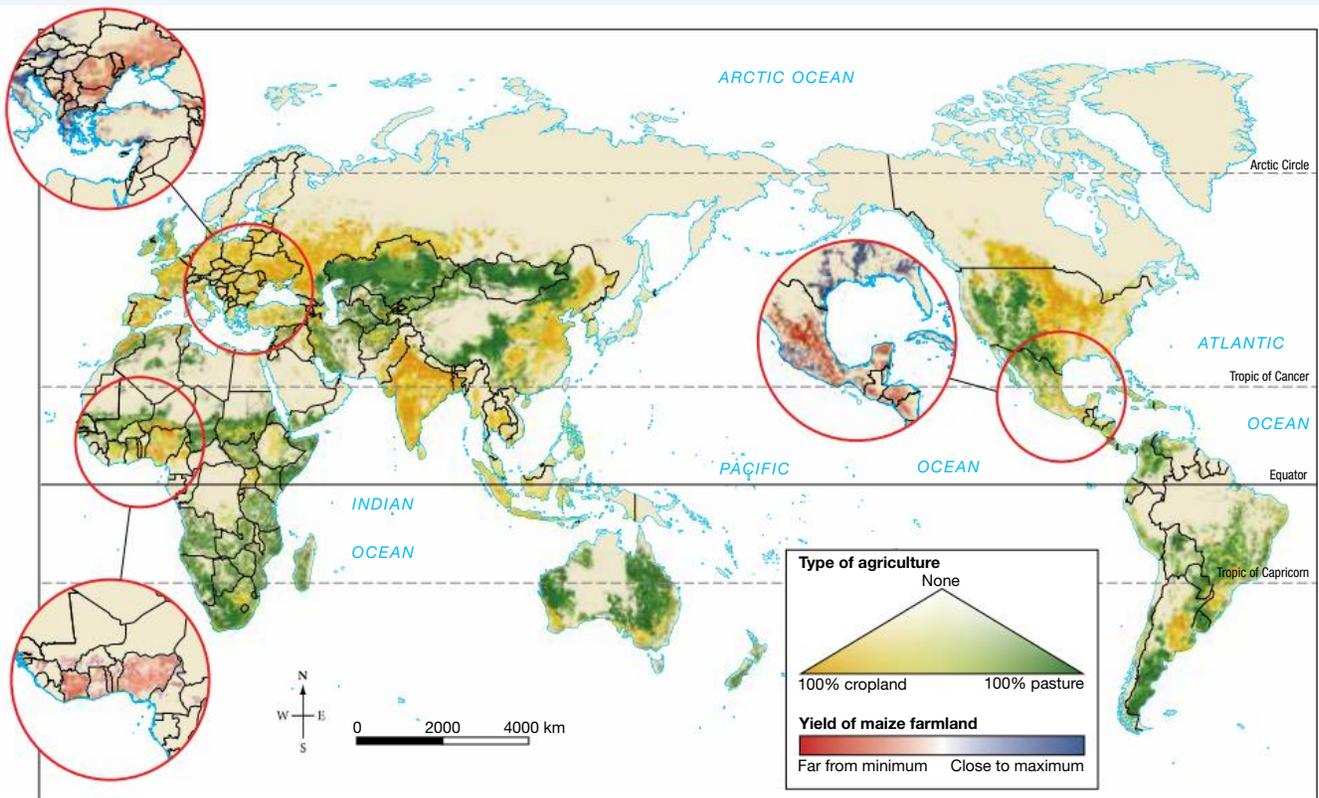
Since the 1960s agriculture has been more productive, with world per capita agricultural production increasing by 25 per cent in response to a doubling of the world population.

It is possible to get even more food out of the land we are already using. For example, **FIGURE 7** shows the places where maize yields could increase and become more **sustainable** by improving nutrient and water management, seed types and markets.

innovation new and original improvement to something, such as a piece of technology or a variety of plant or seed

sustainable describes the use by people of the Earth's environmental resources at a rate such that the capacity for renewal is ensured

FIGURE 7 World distribution of cropland, pasture and maize. More maize could be grown if improvements were made to seeds, irrigation, fertiliser and markets.



Source: Map drawn by Spatial Vision.

2.6.6 The impact of the Green Revolution

The Green Revolution was a result of the development and planting of new **hybrids** of rice and wheat, which led to 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.

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 those 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 only a little over twice as large.

Planting of high-yield crop varieties coincided with expanded irrigation areas and fertiliser use, leading to significant increases in cereal output and calorie availability.

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

2.6 SKILL ACTIVITY: Questioning and researching using geographical methods

Research the background of the Green Revolution — why it occurred, the key places involved and the changes that resulted. **Create** a dot-point summary of your findings. For help with notetaking efficiency, go to 13.5 SkillBuilder: Using and referencing quotes, or 13.4 SkillBuilder: Using Cornell Notetaking.

FIGURE 8 Applying fertiliser to crops in the Punjab, India



on Resources

 **Video eLesson** A plate full of biomes (eles-1718)

2.6 Exercise

learn on

2.6 Exercise

Learning pathways

■ **LEVEL 1**

1, 2, 7, 8

■ **LEVEL 2**

3, 4, 5, 10

■ **LEVEL 3**

6, 9, 11, 12

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Check your understanding

1. **Select** the main staple foods of the world for the places (continents) they are grown. (Note some areas may have more than one staple to include.)

Region	Staples
Asia	Maize
Europe	Wheat
North America	Rice
Sub-Saharan Africa	Millet
Central America	Sorghum

2. From the following reasons **select** why plants, rather than animals, typically dominate as the major staple foods of the world.
 - A. Plants are cheaper.
 - B. Plants are more easily available.
 - C. People can grow what suits their region.
 - D. All of the above
3. Australia is a major exporter of wheat. **Explain** why Australia is able to produce such a surplus.
4. Refer to **FIGURE 7** and **describe** the distribution of places in the world with pasture and grasslands.
5. **Explain** how crop production could be increased in places such as Eastern Europe or Western Africa.
6. **Discuss** why agricultural innovations can change food production.

Apply your understanding

Communicating

7. With the increase in world population and greater pressure on fish stocks, **explain** what can be done to sustain fish stocks in oceans and lakes.
8. Maize is currently used as feed for animals, as biofuel, and as food for humans. **Explain** why this might become an unsustainable environmental practice in the future.

Concluding and decision-making

9. **Elaborate** why, even though fish is a staple food for many people, it can't be a staple food for everyone.
10. **Consider FIGURE 7.**
 - a. **Suggest** reasons why some regions are much higher crop producers than others.
 - b. **Suggest** how a potential increase in maize crop yields could be of benefit to a future world population.
11. Would food production be secure if we grew fewer crops and caught fewer fish? **Justify** your view, giving specific examples to support your ideas.
12. **FIGURE 6** 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? **Justify** your answer.

LESSON

2.7 How and why do we modify biomes for agriculture?

LEARNING INTENTION

By the end of this lesson you should be able to explain the ways in which we modify climate, soils and landscapes, and describe how humans use new processes and technologies to improve food production.

TUNE IN

Greenhouses are an important innovation that humans have developed to make growing crops possible despite the restrictions of local temperature and rainfall conditions.

Refer to **FIGURE 1**.

1. What food crops can you see in **FIGURE 1**?
If you are unsure, have a guess at what food crops could be grown in a greenhouse environment.
2. Can you give reasons as to why the food crops are growing so well in this greenhouse environment?

FIGURE 1 Vegetables growing inside a greenhouse



2.7.1 Using 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, newer processes and technology produced additional gains in food production.

Across the world, people 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.

2.7.2 Modified climate

Irrigation is the artificial application of water to the land or soil to supplement natural rainfall. It helps to increase agricultural 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.

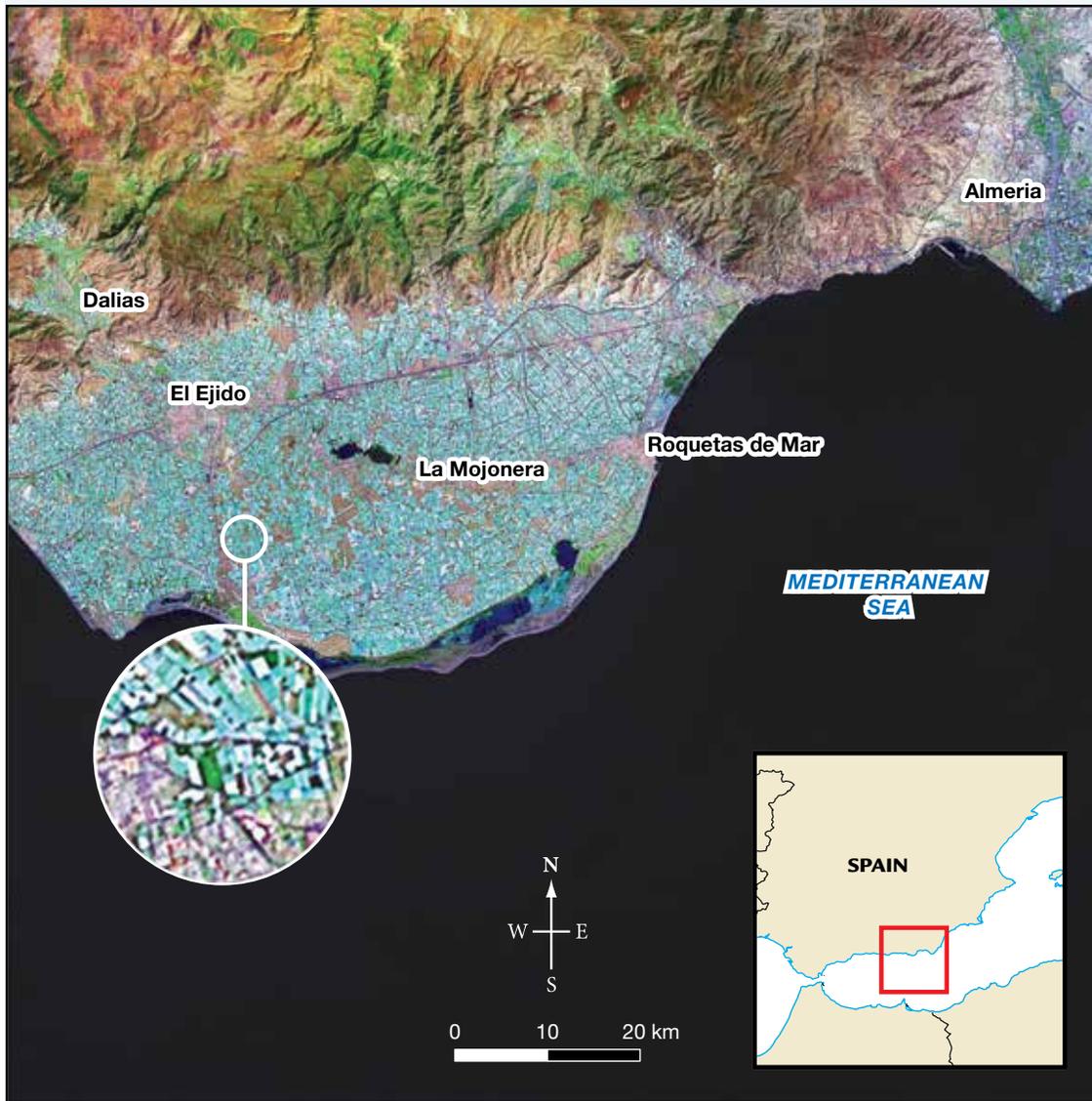
Modern irrigation methods include computer-controlled drip systems that deliver precise amounts of water to a plant's root zone.

Another way of modifying climate is with the use of greenhouses (or glasshouses), which are used for growing flowers, vegetables, fruits and tobacco (see **FIGURE 1**). 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, so they are especially important in high-latitude countries.

The largest expanse of plastic greenhouses in the world is around the city of Almeria, in south-east Spain (see **FIGURE 2**). Here, since the 1970s, semi-arid pasture land has been replaced by greenhouse **horticulture**. Today, Almeria has become Europe's market garden. In order to grow food all year round, the region has about 26 000 hectares of greenhouses. (For help understanding this satellite image, go to 1.7 SkillBuilder: Interpreting satellite images to show change over time.)

horticulture the practice of growing fruit and vegetables

FIGURE 2 False-colour satellite image of greenhouses in the Almeria region



Source: American Geophysical Union and Google Maps/Spatial Vision.

2.7.3 Soil modification

Fertilisers are organic or inorganic materials that are added to soils to supply one or more essential plant nutrients. Fertilisers play a key role in producing high-yield harvests; it is estimated that about 40 to 60 per cent of crop yields are due to fertiliser use, and that by adding fertiliser to crops, food for almost half the people on Earth is produced. The global fertiliser use of 208 million tonnes in 2020 represents a 30 per cent increase since 2008.

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

Region/nutrient	Fertiliser use			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

Source: 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>.

TABLE 2 Percentage share of crop production increases, 1961–2030*

	Arable land expansion (1)		Increases in cropping intensity (2)		Harvested land expansion (1+2)		Yield increases	
	1961–99	1997/99–2030	1961–99	1997/99–2030	1961–99	1997/99–2030	1961–99	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
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	

* projected

Source: © FAO.

2.7.4 Landscape modification

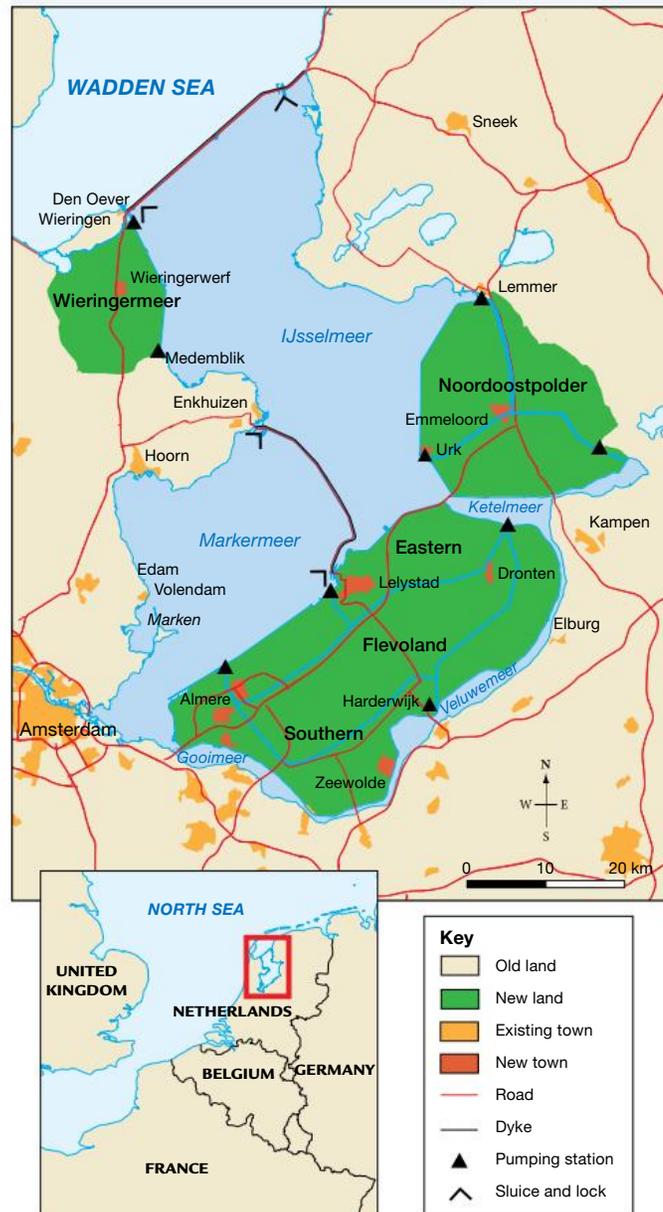
People change landscapes in order to produce food. **Undulating** land can be flattened, steep slopes terraced or stepped, and wetlands drained. Land reclamation is the process of creating new land from seas, rivers or lakes. In addition, it can involve turning previously unfarmed land, or degraded land,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

undulating describes an area with gentle hills

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.

int-9058

FIGURE 3 Land reclamation in the Netherlands



Source: Map drawn by Spatial Vision.

Resources

-  **Interactivity** Changing nature (int-3321)
-  **Weblink** Modifying biomes for agriculture

SkillBuilders to support skill development

- 1.7 Interpreting satellite images to show change over time

2.7 SKILL ACTIVITY: Questioning and researching using geographical methods

Investigate one fibre or grain product that can only be grown commercially in Australia by modifying the biome. **Create** a PMI chart to show the positive, negative and unanswered questions surrounding the production of this crop in Australia. **Consider** the positive and negative environmental, social and economic impacts.

2.7 Exercise

learnon

2.7 Exercise

Learning pathways

LEVEL 1

1, 6

LEVEL 2

2, 3, 7, 8

LEVEL 3

4, 5, 9, 10

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Check your understanding

1. What is the most common form of irrigation in the world?
 - A. Computer-controlled drip systems
 - B. Sprinklers
 - C. Flood irrigation
 - D. Dams
2. What changes to the landscape are made by land reclamation?
 - A. Flattening the land
 - B. Terracing slopes
 - C. Draining wetlands
 - D. All of the above
3. To improve food production, climate, soils and landscapes can be modified. True or false?
4. **Discuss** what greenhouse horticulture is.
5. **Elaborate** how fertilisers improve crop yields.

Apply your understanding

Communicating

6. Refer to **FIGURES 1 and 2**. **Explain** how greenhouses modify spaces and places on the Earth's surface.
7. **Summarise** how land that is reclaimed from the sea, such as the Netherlands' *polders*, is made productive for farming and food production.

Interpreting and analysing geographical data and information

8. Refer to **FIGURE 3**. Use the scale to calculate the approximate area of new land created in Flevoland.
9. Study **FIGURE 3**. **Discuss** what the purpose of the pumping stations might be.
10. People can modify landscapes in order to produce food. **Elaborate on** what can be done with:
 - a. undulating land
 - b. steep slopes
 - c. wetlands.

LESSON

2.8 What types of agriculture are practiced in Australia and Asia?

LEARNING INTENTION

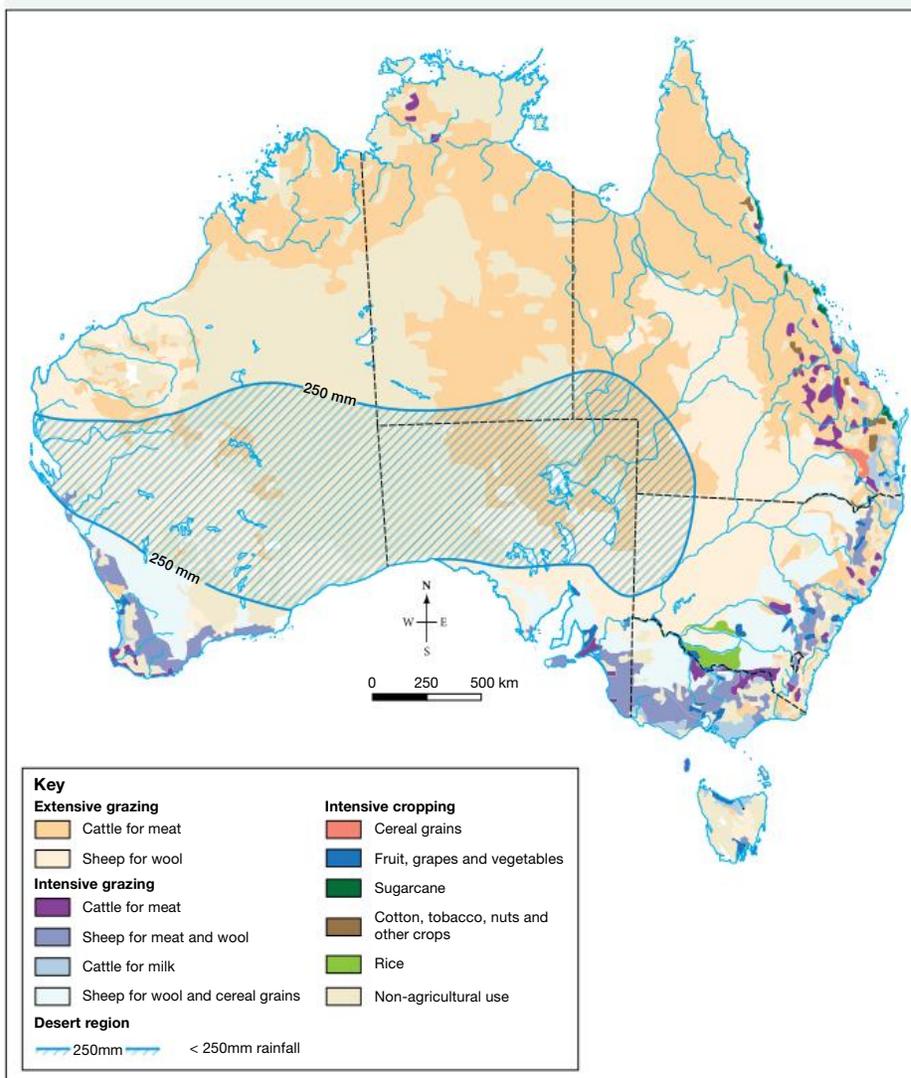
By the end of this lesson you should be able to outline the different types of agriculture practised in Australia and Asia and explain the interconnections between climate, soils and land use.

TUNE IN

Most of Australia's intensive grazing and intensive cropping agriculture practices are located relatively close to the coast.

int-9059
tlvd-10684

FIGURE 1 Types of agriculture in Australia



Source: Based on data from Commonwealth of Australia Geoscience Australia 2013. Map redrawn by Spatial Vision.

Refer to **FIGURE 1**.

1. Can you think of reasons why most intensive agricultural practices are relatively close to the coast in Australia?
2. What aspects, as shown on the map, indicate that agricultural practices would be difficult in the central part of Australia? Hint: think of distance from markets and climate.

Wheat farms

About 30 000 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 the 2020/2021 season was 33.7 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 millimetres. 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 4 Harvesting wheat



mallee vegetation areas characterised by small, multi-trunked eucalypts found in the semi-arid areas of southern Australia

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 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 can often be 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. Farms 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.

CASE STUDY: Horticulture around Carnarvon, Western Australia

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.

Carnarvon, located in the Gascoyne region of Western Australia, is an important horticulture and food-growing centre for the state. The farmland in the area around the Gascoyne River delta is very

FIGURE 5 A banana plantation near Carnarvon

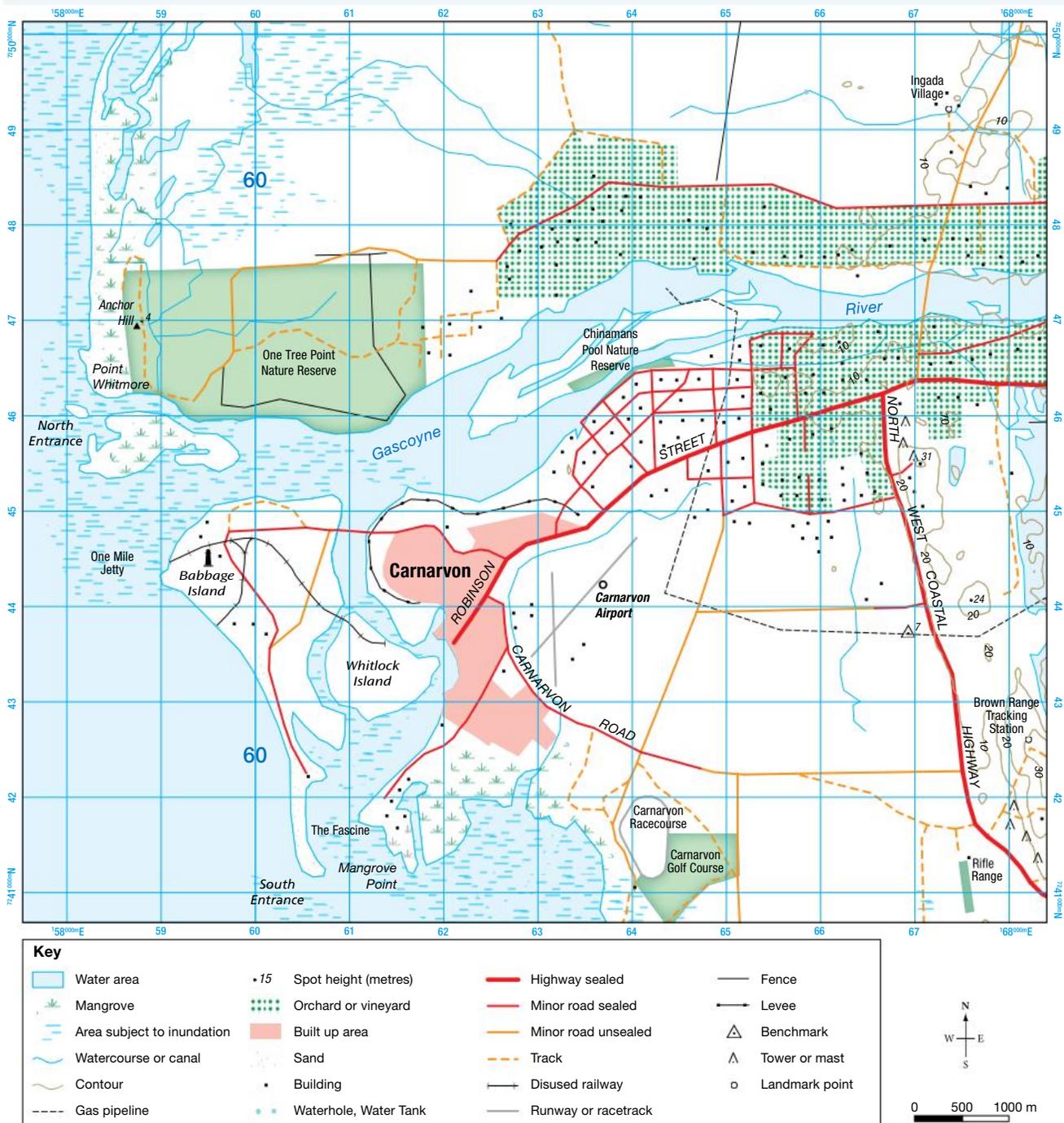


fertile, but because the river does not regularly flow, fruit and vegetable production relies on irrigation from aquifers. Some pastoral leases close to the coast also have access to Carnarvon Artesian Basin for irrigating food for stock.

The wider Gascoyne region has a diverse agricultural sector. The most important commodities in the region include fruit and vegetables (approximately \$97 million annually) and livestock, predominantly cattle (approximately \$27 million annually). The 2016 census showed that of the 999 businesses in the area, 28.5 per cent were in the agriculture, forestry or fishing industries, with construction the next highest at just under 16 per cent. The 2000 hectares of zoned horticultural land close to Carnarvon produce a range of fresh produce including avocados, bananas, capsicums, tomatoes and mangoes.

To investigate the area in more detail, study the topographic map shown in **FIGURE 6**.

FIGURE 6 Topographic map extract, Carnarvon, Western Australia



Source: Based on data from Commonwealth of Australia Geoscience Australia 2020. Map redrawn by Spatial Vision.

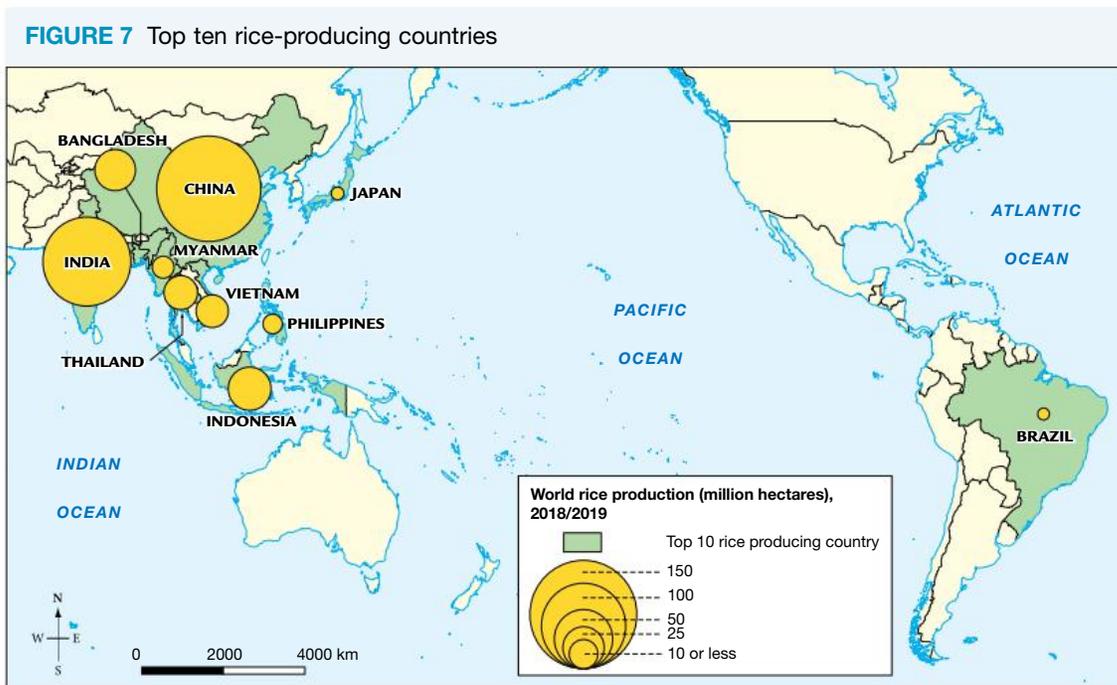
-  **Digital document** Topographic map of Carnarvon (doc-35187)
-  **Weblinks** First Nations Australians food and agriculture
Fish River Station

2.8.3 Rice – an important food crop

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 2021–22 approximately 510 million tonnes of rice were produced worldwide.

FIGURE 7 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: Based on data from Largest Rice-Producing Countries, World Atlas. Retrieved from: <https://www.worldatlas.com/articles/largest-rice-producing-countries.html>. Map redrawn by Spatial Vision.

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 include 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 8**). The terraces stop erosion and surface run-off.

FIGURE 8 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 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 or 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 is available compared to rice grown in paddy fields.

Impacts on potential yield

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.

FIGURE 9 Planting rice in paddy fields in north-east Thailand



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.

In the Philippines, through cross-breeding rather than genetic engineering, a new strain of rice has been developed that grows well in soils lacking phosphorus (see **FIGURE 10**). This could have a significant positive impact on crop yields.

FIGURE 10 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.

2.8 SKILL ACTIVITY: Communicating

Collect information on the percentage of land used for the different forms of farming in Australia and present this data in a graph. Comment on the details shown in your graph.

2.8 Exercise

learnon

2.8 Exercise

Learning pathways

LEVEL 1

1, 2, 3, 4, 6, 9

LEVEL 2

5, 8

LEVEL 3

7, 10

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Check your understanding

1. **Determine** whether the following statements are true or false.
 - a. Cattle ranching is closest to urban centres.
 - b. Orchards are an example of intensive farming.
2. Extensive, large-scale sheep farms are typically located in _____ and _____ regions of Australia.
3. Refer to **FIGURE 7**. **Select** which two countries produce most of the world's rice.
4. Using the **FIGURE 1** map of agriculture types in Australia, **describe** and **explain** the location of:
 - a. cereal farms
 - b. dairy farms.

Apply your understanding

Interpreting and analysing geographical data and information

5. **Consider** the location of the orchards in **FIGURE 6**. **Suggest** two reasons why this land might have been chosen for growing fruits and vegetables. Consider the environment and the need for transporting produce to consumers.
6. **Describe** what the impact of flood or drought would be on any of the commercial methods of food production.
7. **Predict** the impact of the growth of Australian capital cities on the sustainability of surrounding market gardens.

Communicating

8. **Consider** why much of Australia's food production is available for export.
9.
 - a. **Identify** the other top-ten rice-producing countries in the world. What is the geographical location of these places?
 - b. **Explain** why places in Asia are ideally suited to rice growing.
10. Study **FIGURE 6** to **investigate** the following questions.
 - a. Using the contour lines and spot heights as a guide, estimate the average elevation of the map area.
 - b. What is the importance of topography (the shape of the land) to irrigation?
 - c. Why might orchards not have been established on the land immediately north of the One Tree Point Nature Reserve?
 - d. Approximately what percentage of the map area is labelled as land used for orchards or vineyards?
 - e. What would be the advantages and disadvantages of locating processing factories close to growing areas?
 - f. In 2015, Tropical Cyclone Olwyn caused significant damage to plantations in Carnarvon. Based on the location of farm allotments shown in **FIGURE 6**, what other hazards, apart from strong winds, might fruit and vegetable growers near Carnarvon have faced as a result of TC Olwyn?

LESSON

2.9 How are the world's biomes and food production interconnected?

LEARNING INTENTION

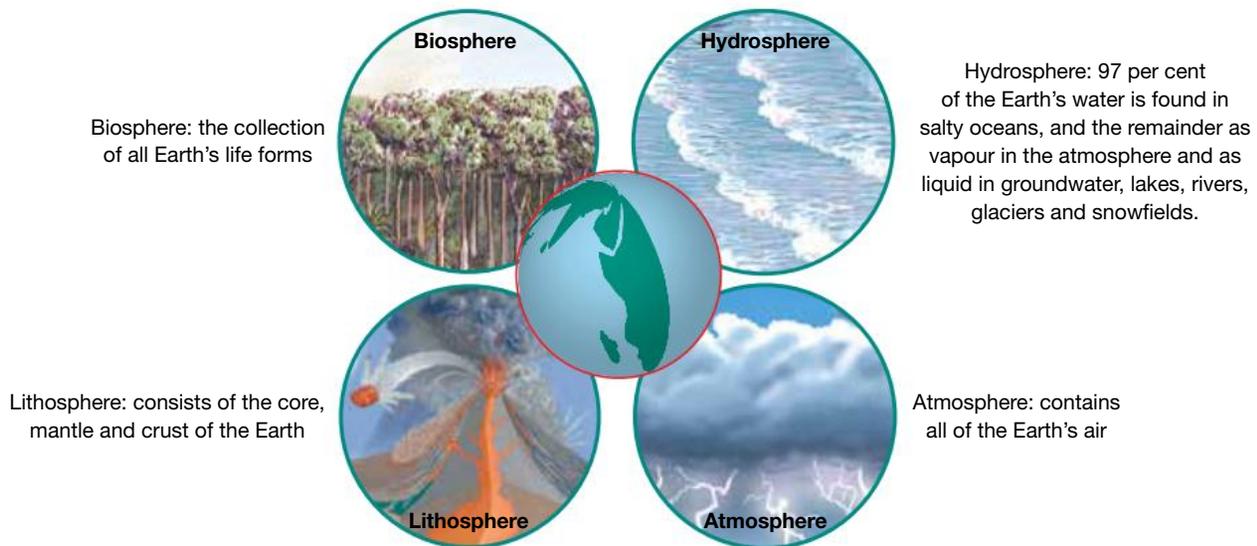
By the end of this lesson you should be able to list Earth's four biophysical spheres, explain the interconnection between the world's biomes and food production and discuss effects of food production on the environment.

TUNE IN

The four spheres of planet Earth, being the atmosphere, hydrosphere, lithosphere and biosphere, control all forms of agricultural production. In fact, the biosphere is largely a product of the forces that operate in the atmosphere, hydrosphere and lithosphere with which it closely interacts.

int-7919

FIGURE 1 The Earth's four spheres



Refer to **FIGURE 1**.

1. Can you think why the atmosphere and hydrosphere are critical to food production?
2. Brainstorm the ways agriculture might have an impact on a natural biome.
3. What effect do you think it would have on the plants and animals?

2.9.1 Our biophysical world

Food is essential to human life, and over the past centuries we have been able to produce more to feed our growing population. But 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 deterioration of 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 natural or **biophysical 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 evaporate and return to the atmosphere. (It is interesting to note that 97 per cent of the Earth's water

biophysical environment the natural environment, made up of the Earth's four spheres — the atmosphere, biosphere, lithosphere and hydrosphere

is found in salty oceans, and the remainder as vapour in the atmosphere and as liquid in **groundwater**, lakes, rivers, glaciers and snowfields.)

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. In doing so, it increases the likelihood of food insecurity. **TABLE 1** shows how food production can affect the biophysical world. As can be seen, activities such as land clearing and **irrigation** can have impacts on all four of the Earth's spheres.

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
irrigation the supply of water by artificial means to agricultural areas

TABLE 1 How food production affects the biophysical world

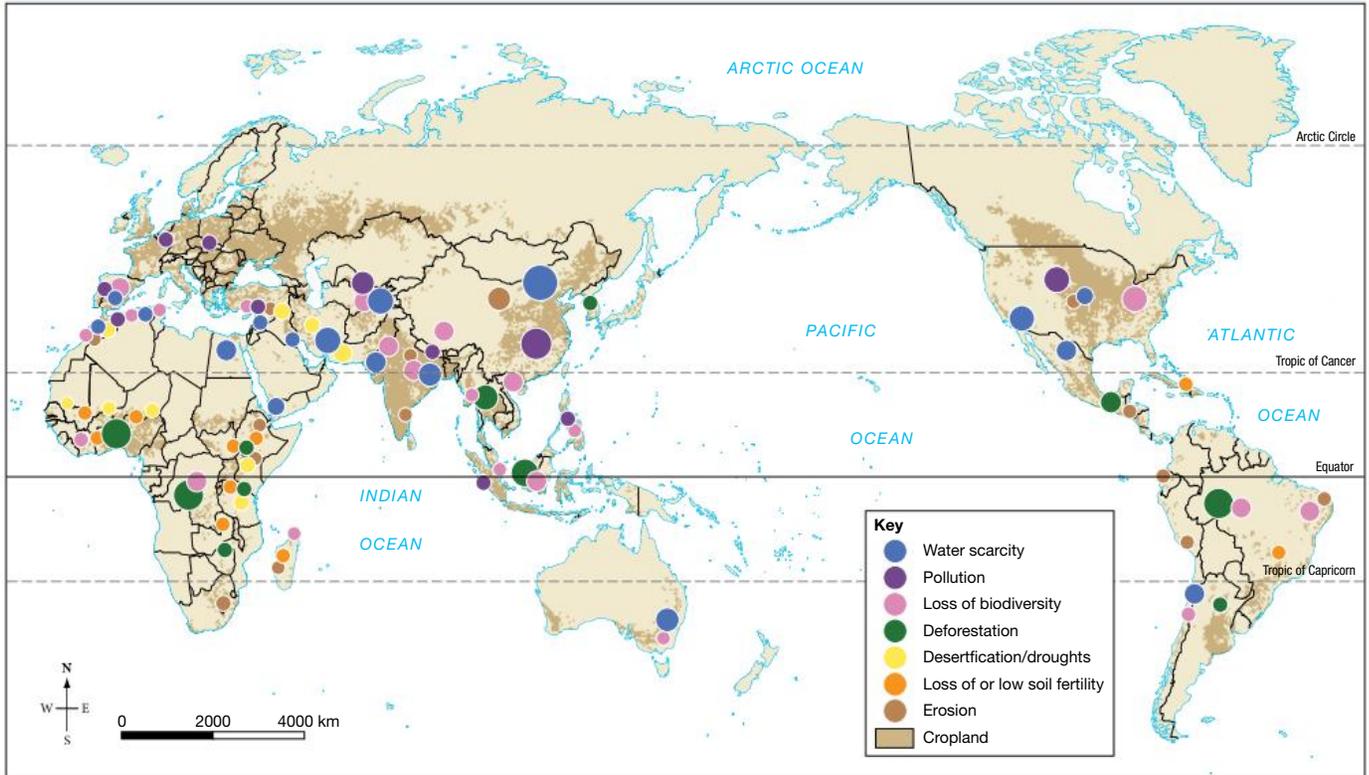
Activities	Atmosphere	Lithosphere	Biosphere	Hydrosphere
Clearing of native vegetation for agriculture	x	x	x	x
Overgrazing animals		x	x	x
Overusing irrigation water, causing saline soils		x	x	x
Burning forests to clear land for cultivation	x	x	x	x
Run-off of pesticides and fertilisers into streams		x	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	

2.9.2 Changing our biophysical world

Currently, the world produces enough food to feed all 7.9 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 rate of 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: Data courtesy of the Institute on the Environment IonE, University of Minnesota. Map drawn by Spatial Vision.

on Resources

- Video eLesson** Trashing our biomes (eles-1719)
- Interactivities** Degrading our farmland (int-3323)

2.9 SKILL ACTIVITY: Communicating

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 is left bare and exposed to wind and water erosion.
- There is less evaporation of water from vegetation.
- There is a loss of habitat for birds, animals and insects.
- Increased water runs off from exposed land.
- Increased sediment builds up in streams.

2.9 Exercise

Learning pathways

■ LEVEL 1

1, 4, 6, 7

■ LEVEL 2

2, 5, 8, 9

■ LEVEL 3

3, 10

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Check your understanding

- Determine** whether the following statements are true or false.
 - Technology has enabled us to increase our food production rapidly over time.
 - The expected population of the world in 2050 is 9.7 billion.
 - 97 per cent of the Earth's water is found in ponds, lakes and rivers.
- Refer to **TABLE 1**. Producing greenhouse gases by grazing animals and rice farming affects the
 - atmosphere.
 - biosphere.
 - hydrosphere.
 - lithosphere.
- Refer to **TABLE 1**. Overcropping soils affects the
 - atmosphere.
 - biosphere.
 - hydrosphere.
 - lithosphere.
- Describe** the biophysical environment of your local area.
- Using **FIGURE 1**, **explain** how a bird might interconnect with the four Earth spheres.
- Refer to **FIGURE 2** and your atlas.
 - Distinguish** the main environmental issues facing Australia's food production.
 - Decide** in which places in the world deforestation is a major concern.
 - Identify** which continents suffer from water scarcity.
 - Discuss** what you notice about the location and distribution of regions that do not have environmental problems relating to food production.

Apply your understanding

Concluding and decision-making

- Identify** which of Earth's spheres will be most impacted by each of the following activities.
 - Application of organic fertilisers to soil
 - Introduction of an aquatic pest species into a fish-farming enterprise
 - Excessive pumping of groundwater for irrigation
 - Construction of large-scale dams in semi-arid regions

Communicating

- Explain** which of the activities in question 7 could have a positive impact on the affected sphere.
- Refer to **FIGURE 2**.
 - Explain** why water scarcity is an issue for all continents except Europe.
 - Explain** one way in which pollution may impact on food production.
- If climate change was to lead to a higher frequency of drought in the southern hemisphere, **predict** how this might affect Australia's land and water resources.

LESSON

2.10 How has deforestation changed the forest biome?

LEARNING INTENTION

By the end of this lesson you should be able to describe how large-scale deforestation has occurred around the world as forests have been cleared to create land for food production and to be used for timber products, and the environmental consequences of this.

TUNE IN

Forests are an important part of the biosphere, being often referred to as the 'lungs of the Earth'. Yet paradoxically they are under threat from land clearance by humans for agriculture.

FIGURE 1 Rainforest in Serra dos Orgaos National Park (Rio de Janeiro state, Brazil)



Refer to **FIGURE 1**.

1. What elements of this environment do you notice that are different from a farmed area?
2. Why would this be a place of greater biodiversity when compared to a palm oil plantation or a cattle ranch?

2.10.1 Why are forests important?

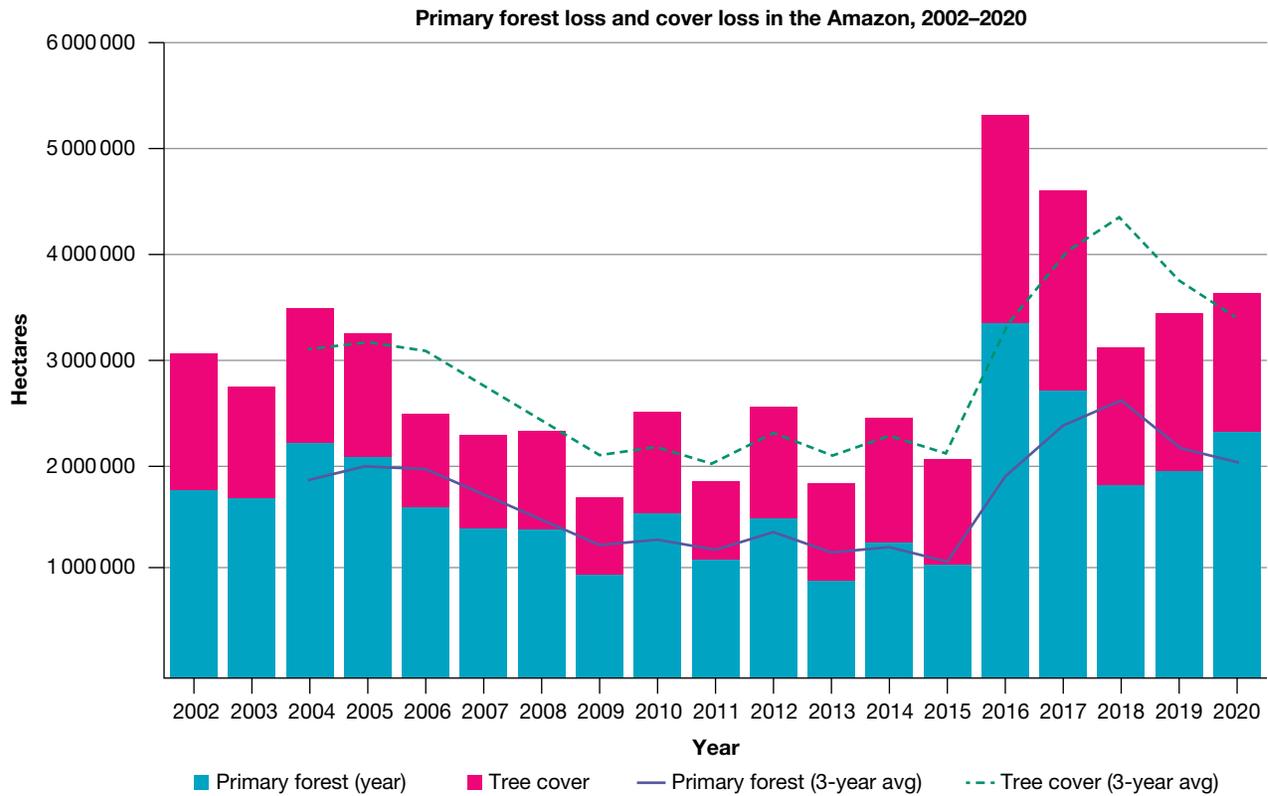
In pre-industrial times, nearly 45 per cent of the world's land surface was covered in forest. Today, this figure is only 30 per cent. With industrialisation, technological development and population growth, large-scale deforestation has occurred as a result of the increasing need over time for timber products and land for food. It is estimated that of the forest cover lost, 85 per cent can be readily attributed to human activity — with 30 per cent due to clearing, 20 per cent through degradation and 35 per cent through fragmentation. Agricultural use now accounts for 37 per cent of the Earth's land surface.

Human society, the global economy and forests are interconnected, with more than 1 billion people depending on forests and forest products. Forest biomes offer us many goods and services, from providing 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**. Despite the growing awareness of the value of preserving forests, large-scale clearing continues. **FIGURE 2** shows the annual rate of deforestation in Brazil, while **FIGURE 3** shows the cumulative amount of forest lost over time.

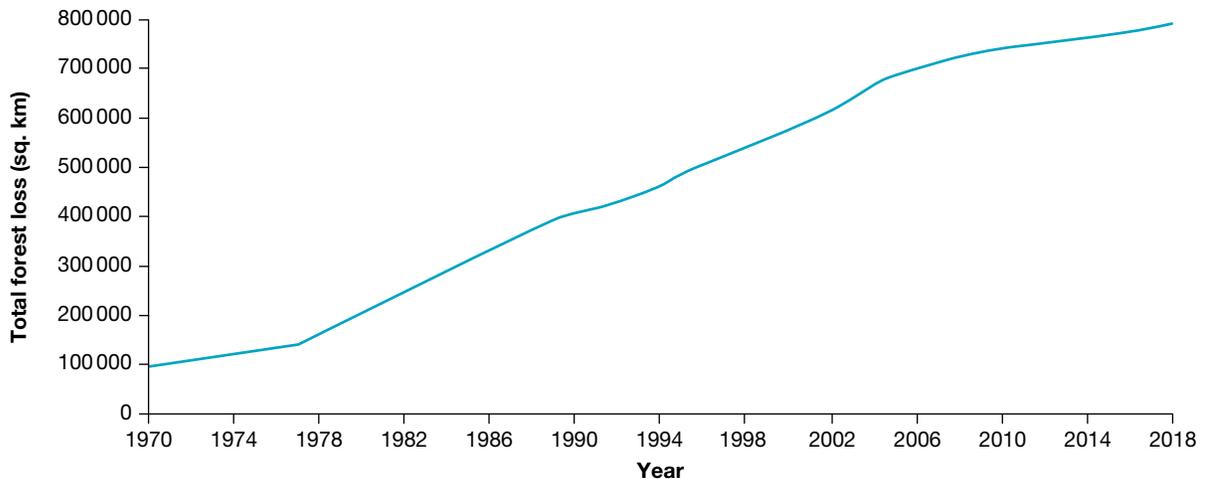
greenhouse gases any of the gases that absorb solar radiation and are responsible for the greenhouse effect. These include water vapour, carbon dioxide, methane, nitrous oxide and various fluorinated gases.

FIGURE 2 Annual loss of Amazon forest, Brazil, 2002–2020



Source: © Mongabay.

FIGURE 3 Total loss of Amazon forest, Brazil, since 1970



Source: © Mongabay.

2.10.2 Why do we clear forests?

By clearing forests, trees can be harvested for timber and paper production, and valuable ores and minerals can be mined from 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.

plantation an area in which trees or other large crops have been planted for commercial purposes

Road construction, usually funded by governments, also plays a part in changing rainforest environments (see **FIGURE 4**). 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 mining resources and forest timbers, and are better able to establish large cattle ranches and farms.

FIGURE 4 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.



Source: NASA Earth Observatory.

2.10.3 The impacts of forest clearing

FIGURE 5 illustrates some changes that forest clearing in the Amazon can have on the environment.

int-5578

FIGURE 5 Impacts of clearing the Amazon forest



- 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 the 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 the 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.

2.10 SKILL ACTIVITY: Interpreting and analysing geographical data and information

Research soybean farming in the Amazon. How does it compare with cattle ranching in terms of environmental sustainability?

2.10 Exercise

learnon

2.10 Exercise

Learning pathways

LEVEL 1

1, 2, 5, 6, 7

LEVEL 2

4, 8, 9

LEVEL 3

3, 10

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Check your understanding

1. **Determine** whether the following statements are true or false.
 - a. Subsistence farming in the Amazon could be referred to as slash-and-burn farming.
 - b. Forests covered 45 per cent of the Earth's land in pre-industrial times, but human activity has decreased this to 30 per cent through large-scale deforestation.
2. The advantage of road building in the Amazon is:
 - A. faster travel times.
 - B. animals crossing the road are easy to see.
 - C. better visibility across a region.
3. The large-scale clearing of tropical rainforests is considered to be an _____ practice.
4. **Consider** what ways the environmental changes of small-scale subsistence farming differ from those of large-scale soybean cropping.
5. Refer to **FIGURE 3**. **Describe** the total loss in Brazilian forests since 1970. Use data to **justify** your answer.

Apply your understanding

Concluding and decision-making

6. Opening up the rainforest with roads can lead to fragmentation of the forest. **State** what the effect of this might be on:
 - a. native animals
 - b. local indigenous populations.

Communicating

7. **Identify** how a small-scale farmer from the Amazon and an environmentalist from another country might view the resources of a rainforest.
8. Refer to **FIGURE 5**. **Consider** three changes to the river as a result of forest clearing.
9. **Judge** how changes as a result of forest clearing might affect farming downstream.
10. **Discuss** two methods that could be used in the Amazon to reduce the amount of sediment washing into the river. Propose a plan for how this might be achieved and the outcomes you would expect.

LESSON

2.11 How has overfishing changed the ocean biome?

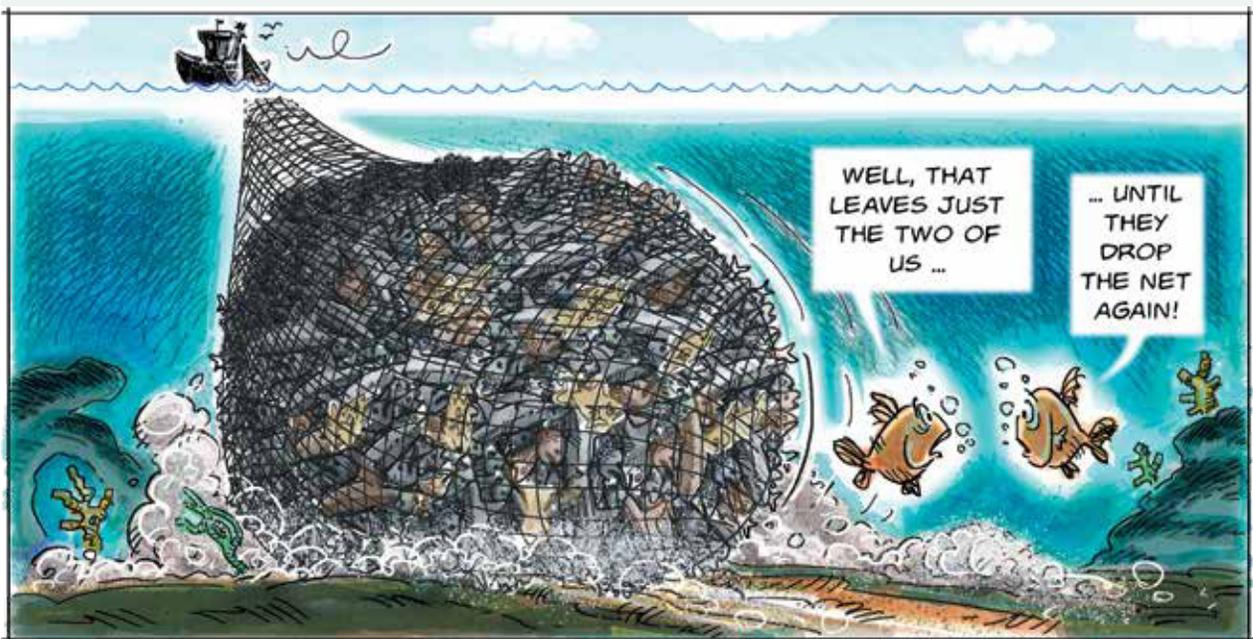
LEARNING INTENTION

By the end of this lesson you should be able to outline the problem of overfishing and discuss the benefits and problems with aquaculture.

TUNE IN

Over 75 per cent of the Earth's surface is covered by oceans and seas, which have their own unique biome structure.

FIGURE 1 Unsustainable fishing



Refer to **FIGURE 1**.

1. What does this image indicate about sustainability in the ocean biome?
2. How could fishing be more sustainable into the future?

2.11.1 Overfishing — causes and consequences

The ocean biome has always been seen as an unlimited source 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 more than 1 billion people worldwide. **Aquaculture** is a possible solution but, at the same time, it contributes to the decline in fish stocks.

aquaculture the farming of aquatic plants and aquatic animals such as fish, crustaceans and molluscs

Overfishing is simply catching fish at a rate higher than the rate at which fish species can repopulate. 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, sonar and factory ships ensures that fish can be caught, processed and frozen while still at sea.

Globally, fish is the most important animal protein consumed (see **FIGURE 3**). Historically, a lack of conservation and management of fisheries, combined with rising demand for fish products, has seen a ‘boom and bust’ mentality. 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.

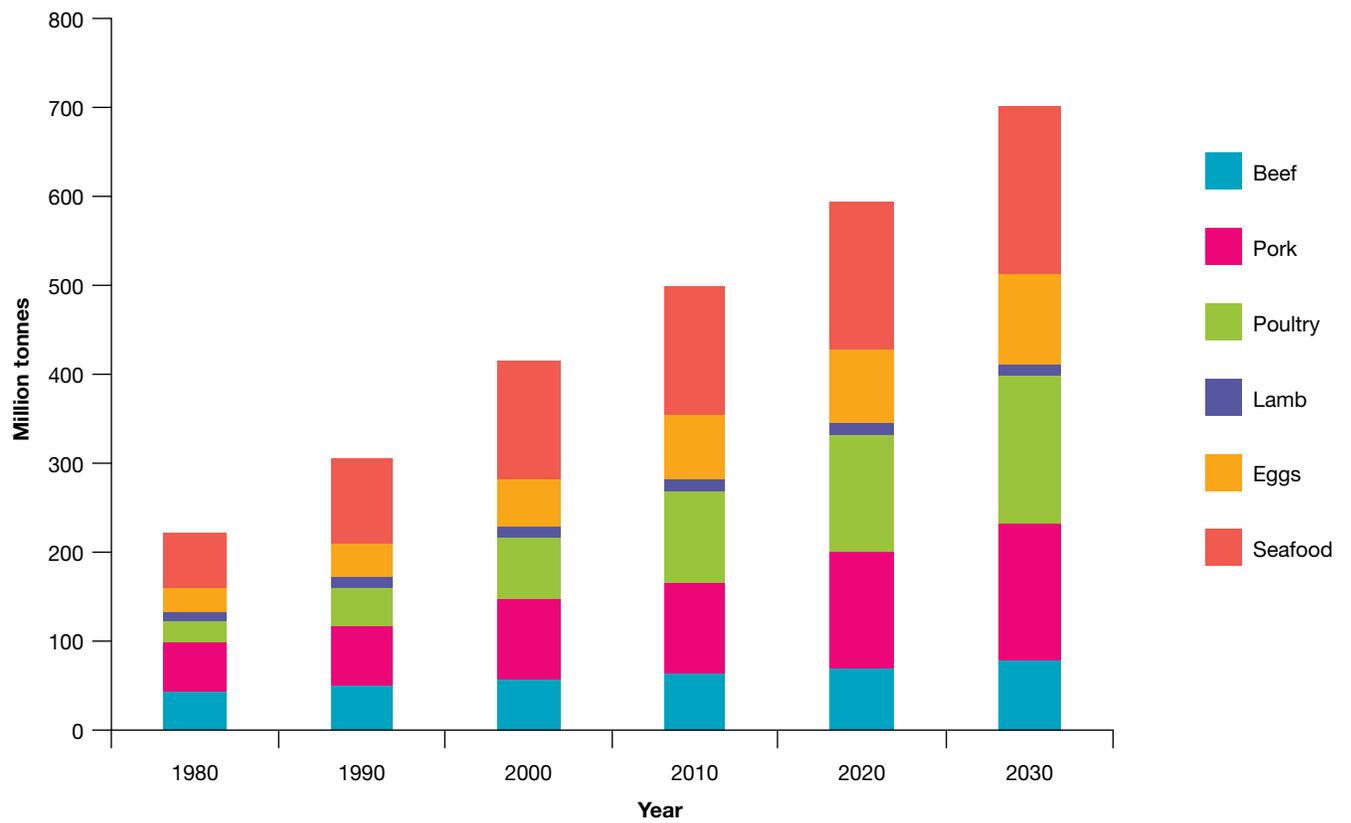
FIGURE 2 Fish farms are a form of aquaculture where fish are bred and raised in underwater mesh cages to mainly be sold as food.



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 are wasted (see **FIGURE 4**).
- 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 that could have been consumed by people is converted to fishmeal to feed the aquaculture industry, to fatten up pigs and chickens, and to feed pet cats. In Australia, the average cat eats 13.7 kilograms of fish a year. The average Australian eats 15 kilograms per year.
- Coastal habitats are under pressure. Coral reefs, mangrove wetlands and seagrass meadows, all critical habitats for fish breeding, are being reduced through coastal development, overfishing and pollution.

FIGURE 3 Global protein demand, 1980–2030 (million tonnes)



Source: OECD-FAO Agricultural Outlook.

FIGURE 4 Up to 80 per cent of some fish catches is by-catch.

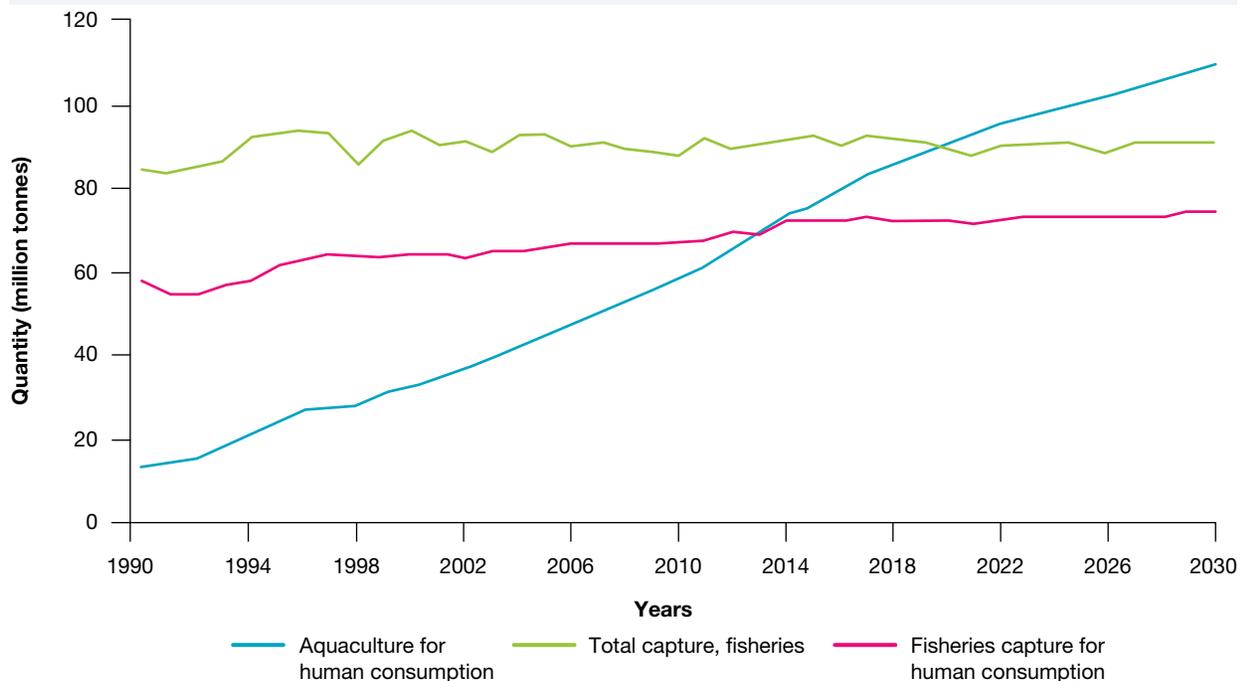


2.11.2 Aquaculture

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 5**).

Since 2014, fish farming has produced more fish than fish caught in the wild; the total fisheries and aquaculture production reached an all-time record of 214 million tonnes in 2020. In 2020, these producers accounted for almost 49 per cent of total global capture production: China, Indonesia, Peru, Russian Federation, the United States and Vietnam. Australia's history of fish farming started more than 6000 years ago, when First Nations Australians created a series of fish traps in Lake Condah, in south-west Victoria, to capture a reliable source of eels. Today, aquaculture is Australia's fastest growing primary industry, producing approximately 60 per cent of Australia's seafood.

FIGURE 5 Global fish and aquaculture 1990–2030



Source: Food and Agriculture Organization of the United States. In Briefs: The State of World Fisheries and Aquaculture 2018. Meeting the Sustainable Development Goals.

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 below.

- **Pollution.** Many fish species are fed a diet of artificial food in dry pellets (see **FIGURE 6**). 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 1 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.

FIGURE 6 Feeding fish in pens, Thailand



- *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 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.

on Resources

 **Interactivity** Hook, line and sinker (int-3324)

2.11 SKILL ACTIVITY: Communicating

Collect photographs and other information to create an annotated poster showing one of the destructive fishing practices mentioned in this lesson.

2.11 Exercise

learn **on**

2.11 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3, 4, 5, 6

■ LEVEL 2

7, 8

■ LEVEL 3

9, 10

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Check your understanding

1. Overfishing can lead to a loss of biodiversity. True or false?
2. Aquaculture is the _____ of aquatic plants and animals such as _____, crustaceans and _____.
3. The most important animal protein consumed is:
 - A. beef.
 - B. pork.
 - C. cactus.
 - D. seafood.
4. **Identify** three benefits and three drawbacks of fish farming.
5. **State** why is it difficult to manage wild fish capture and prevent overfishing.
6. **Define** 'by-catch'.

Apply your understanding

Communicating

7. **Consider** the photograph in **FIGURE 4** and describe the by-catch that you see.

Interpreting and analysing geographical data and information

8. Refer to **FIGURE 3**. **Reflect on** how important fish is as a source of protein compared with other sources. Use figures in your answer.
9. Refer to **FIGURE 5**. **Compare** the **predicted** growth of fisheries capture (fish caught in the ocean) with aquaculture production to 2030.
10. What do you think the future of aquaculture might be? **Explain** your view using data to support your predictions.

LESSON

2.12 INQUIRY: Overfishing

LEARNING INTENTION

By the end of this lesson you should have a comprehensive understanding of the impact of overfishing, how we can implement more sustainable approach to fishing and the importance of food security.

Background

A conference has been organised for secondary Geography students studying biomes and food security. You have been invited to give a presentation on a current issue relating to food security, in this case overfishing, and to outline some of the responses that take into account economic, social and environmental factors. Following the guidelines provided in the Inquiry Steps section, conduct some background research and then produce a presentation to highlight the threat that overfishing presents to the world's food security.



Before you begin

Access the **Inquiry rubric** in the digital documents section of the Resources panel to guide you in completing this task at your level. At the end of the inquiry task you can use this rubric to self-assess.

Inquiry steps

Discuss the following:

- What do you know about overfishing?
- How could food security be improved for people who rely heavily on food from the ocean?

Step 1: Questioning and researching using geographical methods

Write your selected **inquiry question** based on the focus of this topic.

Investigate your inquiry question.

Include:

- a brief explanation and details of the global scale of overfishing (include data)
- details of factors (a minimum of three) that have contributed to overfishing; for example, improvements in technology, lack of regulations and international laws, the open sea, illegal fishing and factory ships.

Step 2: Interpreting and analysing geographical data and information

- Create** a summary table outlining the impacts of overfishing on both the environment and people.
- Explain** what you believe to be the greatest reason for overfishing and why.

Step 3: Concluding and decision-making

- Discuss** two responses that could contribute to a more sustainable approach to fishing and the social, economic and environmental implications of each. Is one more likely to be more effective? Why?

Step 4: Communicating

- Decide** how you will **communicate** your findings whether it be in the form of a written report, multi-media presentation, poster or slide presentation.

Complete your self-assessment using the **Inquiry rubric**.

LESSON

2.13 What are the causes and effects of land degradation?

LEARNING INTENTION

By the end of this lesson you should be able to outline the causes and effects of land degradation on our food-producing lands, and discuss how poor food-production practices are creating environmental degradation and threatening biodiversity.

TUNE IN

Land degradation can be a side effect of poor agricultural practices leading to biome destruction as well as dwindling agricultural productivity in an area.

FIGURE 1 Soil erosion as a result of overgrazing in Australia



Refer to **FIGURE 1**.

1. What clues can you see in the environment to suggest this place is suffering from land degradation?
2. Can you suggest what could be done to restore this landscape to a more natural environment?

2.13.1 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, 75 per cent of the Earth's land area is substantially degraded. The rate of fertile soil loss is now averaging 24 billion tons per year globally. 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.

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

degradation deterioration in the quality of land and water resources caused by excessive exploitation

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

salinity the presence of salt on the surface of the land, in soil or rocks, or dissolved in rivers and groundwater

humus an organic substance in the soil that is formed by the decomposition of leaves and other plant and animal material

FIGURE 2 Dust storms can destroy much needed healthy soil in minutes



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* — this 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.

Biophysical causes

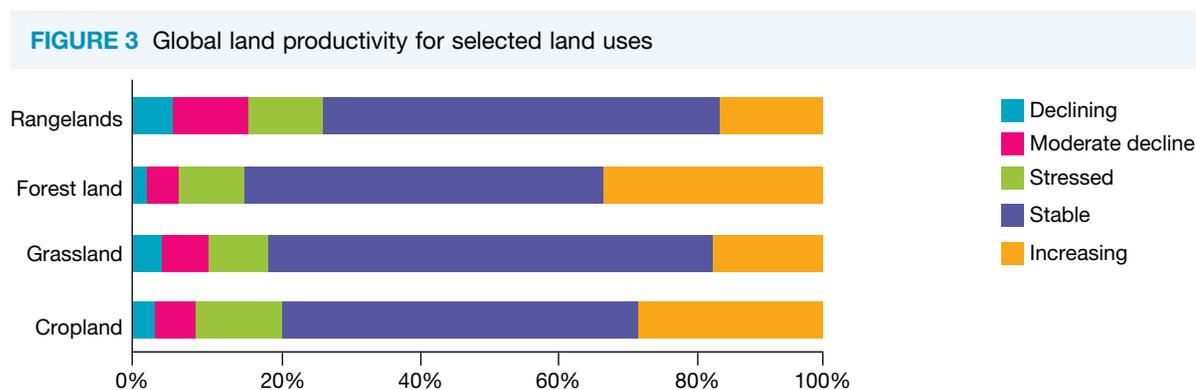
Natural processes such as prolonged drought can also lead to land degradation. However, land can sometimes recover after a drought period. Topography and the degree of slope can also influence soil erosion. A steep slope is more prone to erosion than flat land.

2.13.2 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 3 illustrates global land productivity for different land uses, which is an important indicator of land degradation. Twenty per cent of the world's cropland shows declining or stressed land productivity, despite the efforts and resources being used to maintain food production.



Notes:

Rangelands refers to shrublands mostly used for grazing.

Forest land applies to land with more than 40 per cent tree cover.

Grassland includes natural grasslands and pasture for grazing.

Cropland includes all arable land and where 50 per cent of land is used for crops.

Source: © European Union, 1995-2019. Cherlet, M., Hutchinson, C., Reynolds, J., Hill, J., Sommer, S., von Maltitz, G. Eds., *World Atlas of Desertification*, Publication Office of the European Union, Luxembourg, 2018.

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. There is a strong interconnection between land degradation, migration and political instability. If declining soil quality and an increase in droughts due to climate change continue, between 50 and 700 million people could be forced to move by 2050.

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 more than 2 billion people, 90 per cent of whom live in developing nations. Economically, drylands support 44 per cent of the world's food production and 50 per cent of the world's livestock. Although traditional grazing and cropping has taken place in dryland regions for centuries, population growth and the demand for food have put enormous pressure on land resources. Overclearing of vegetation, overgrazing and overcultivation are a recipe for desertification.

2.13.3 The effects of farmland irrigation on the land

Food production and security is directly related to water availability. Water is a finite resource and, 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.

Most of the world's food production is rain fed or 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 3 Irrigation allows for pasture to be grown in times of drought. Compare the irrigated with the non-irrigated paddocks.



on Resources

- **Interactivities** How is rice grown? (int-3322)
Losing land (int-3325)

2.13.4 Environmental impacts of irrigation

While irrigation has resulted in increased food production and greater food security, it has also created major changes to the biomes where it is used. Irrigation changes the natural environment by extracting water from rivers and lakes and through the building of structures to store, transfer and dispose of water. The topography, or shape of the land, is often changed too, such as 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 lead to changes in soil composition, and **waterlogging** and salinity problems.

How does irrigation create salinity problems?

Overwatering of shallow-rooted crops adds excess water to the **watertable**, causing it to rise (see **FIGURE 5**).

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.

Globally, some 62 million hectares of land (an area the size of France) has been lost due to such issues. Salinity is also a major cause of land degradation in Australia (see **FIGURE 6**).

As population increases, so too does demand for water. Moreover, there are always competing demands for water from the domestic, industrial and environmental sectors. For countries that have growing populations and limited water resources, water deficits and food insecurity are a growing concern. 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.

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 and underground **aquifers** shrink. 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.

waterlogging saturation of the soil with groundwater such 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

aquifer a body of permeable rock below the Earth's surface, which contains water, known as groundwater

FIGURE 5 The development of irrigation salinity

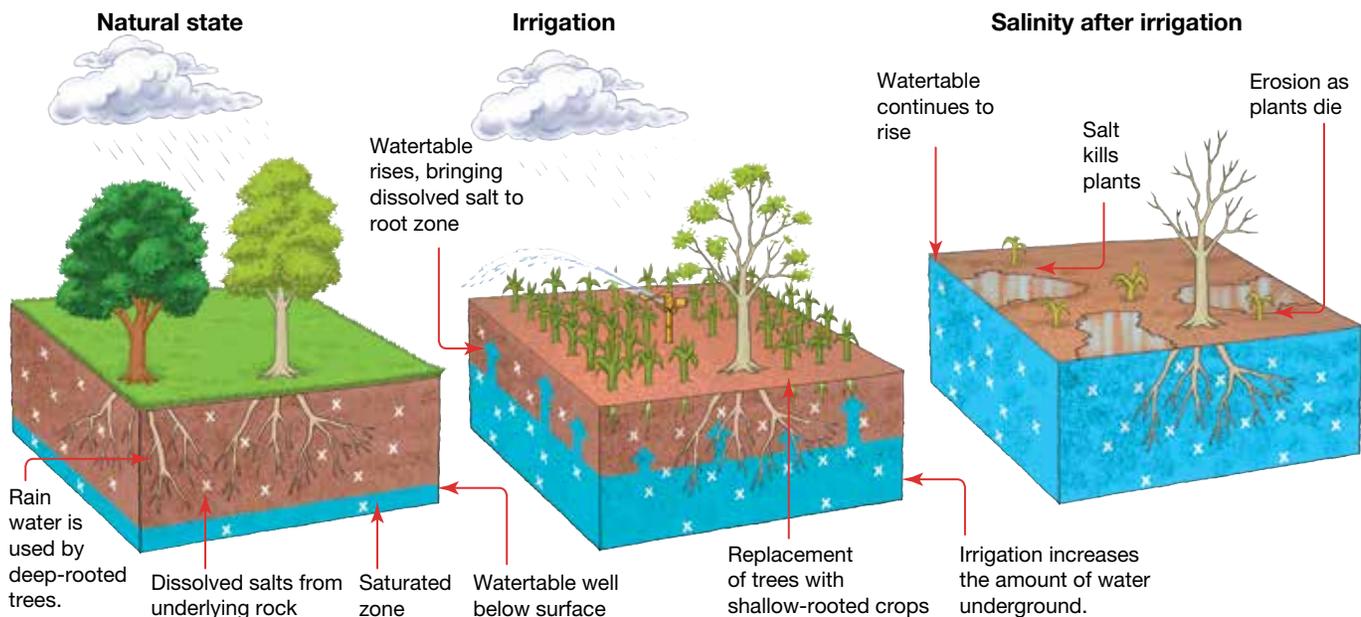
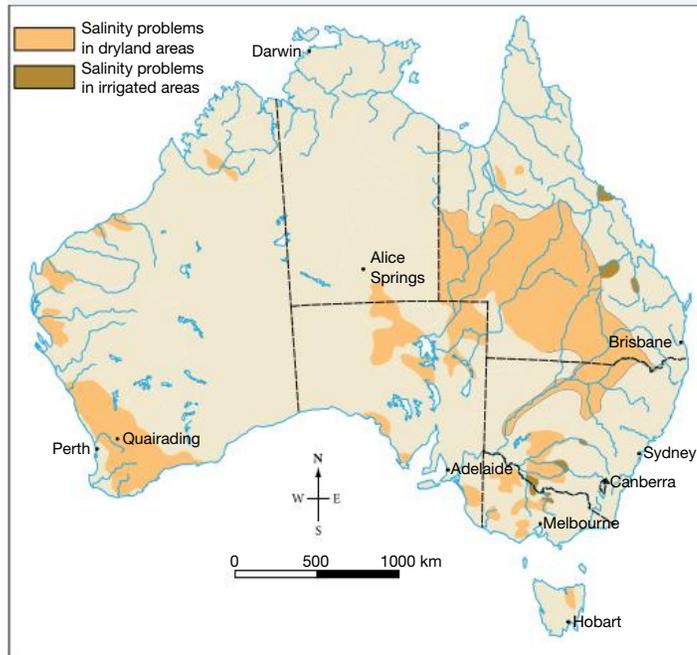


FIGURE 6 The distribution of salinity in Australia.

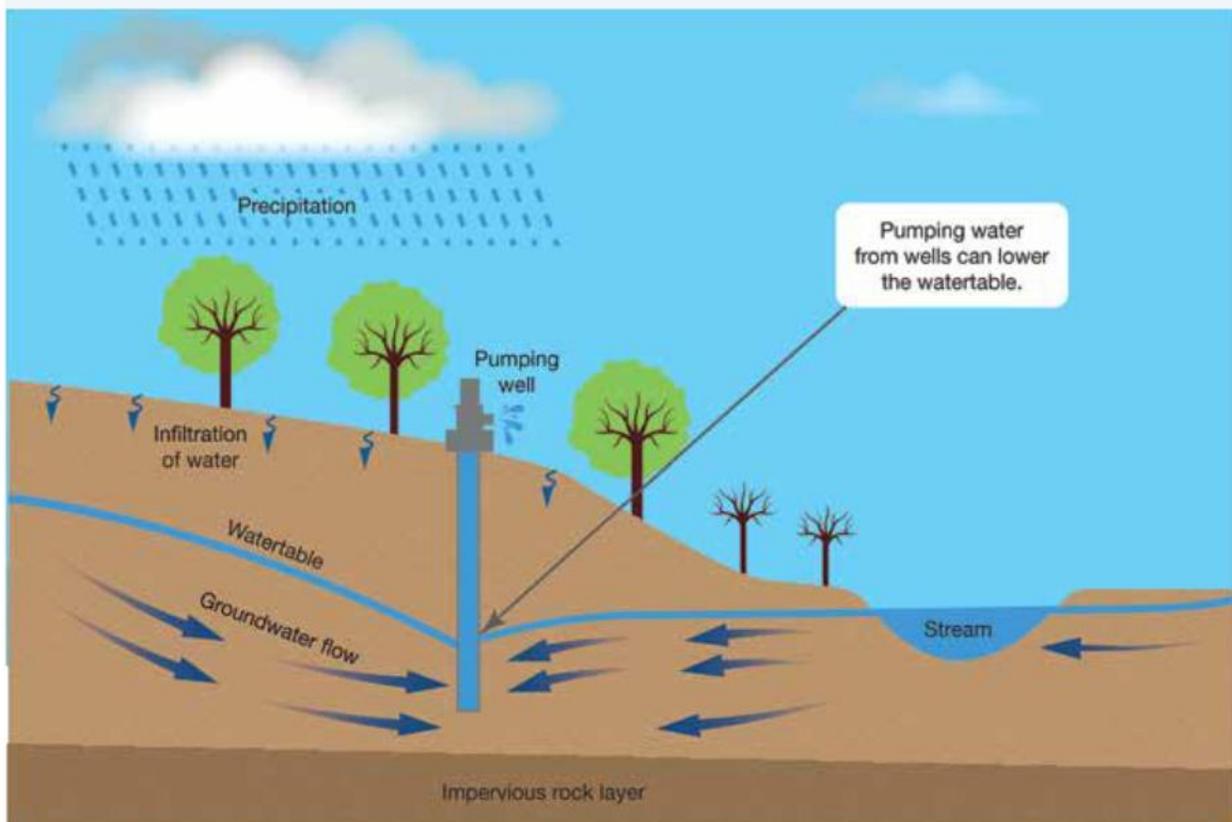


Source: Map drawn by Spatial Vision.

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 7**).

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

FIGURE 7 Diagram showing the use of groundwater as a water source for farming



flow), then watertables fall. Water extraction then becomes harder and more expensive. 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 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 (see **FIGURE 9**). 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 8 Irrigated cropland relies heavily on water from the Ogallala Aquifer.



FIGURE 9 The size of the Ogallala Aquifer in the central United States



Source: Based on data from the USGS. Map drawn by Spatial Vision.

2.13 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

1. **Investigate** methods used in Australia to reduce the environmental effects of salinity.
2. Using **FIGURE 5** as a model, **create** a similar sketch depicting the development of irrigation salinity. Based on your research findings, **annotate** your drawing with suggestions for how to reduce the effects of irrigation salinity.

2.13 Exercise

learnon

2.13 Exercise

Learning pathways

■ LEVEL 1

1, 2, 4, 8, 9

■ LEVEL 2

3, 5, 6

■ LEVEL 3

7, 10

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Check your understanding

1. **Identify** four human causes of land degradation.
 - A. Over-cultivation
 - B. Steep slopes
 - C. Over-irrigation
 - D. Farming on marginal lands (for example, steep slopes or poor soils)
 - E. The introduction of feral plant species
 - F. Floods
2. **Identify** three natural causes of land degradation.
 - A. The introduction of feral animal species
 - B. Steep slopes
 - C. Drought
 - D. Clearing of vegetation
 - E. Flood
 - F. Overgrazing
3. **Identify** what percentage of the world's fresh water is consumed by irrigation.
 - A. 90 per cent
 - B. 25 per cent
 - C. 70 per cent
 - D. 75 per cent
4. **Identify** the different types of water resources that can be used to supply water for food production.
5. **Consider** the photograph in **FIGURE 1**. Why would it be difficult to either graze animals or grow crops on this land?

Apply your understanding

Interpreting and analysing geographical data and information

6. **Analyse** three changes to the environment that are needed in order to irrigate land for agriculture.
7. Study the **FIGURE 6** map, which shows the distribution of salinity in Australia. **Justify** why you think dryland salinity covers a larger area than irrigation salinity.
8. **State** the advantages and disadvantages of using groundwater and surface water for farming.

Communicating

9. Refer to **FIGURE 3**.
 - a. **Name** the land use that has the greatest percentage of stressed and declining productivity.
 - b. What type of farming activities could **explain** the increased productivity in croplands?
10. Study **FIGURE 7**. **Discuss** how pumping groundwater can lower watertables.

LESSON

2.14 Why is global biodiversity diminishing?

LEARNING INTENTION

By the end of this lesson you should be able to outline how global biodiversity and specifically agricultural biodiversity are on the decline — largely as a result of human activities, particularly the production of foods and fibres.

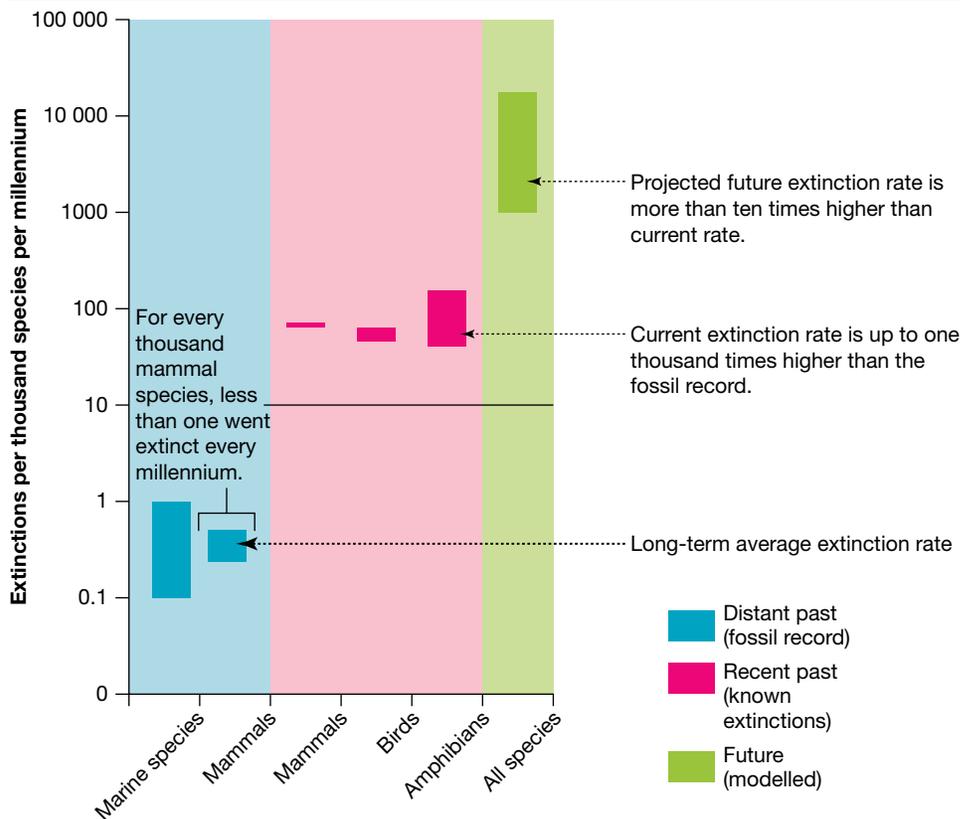
TUNE IN

Many people are concerned that plant and animal species are becoming extinct due to human-induced changes to biomes.

Refer to **FIGURE 1**.

1. Can you give reasons why amphibians (water-based animals) such as frogs have such a high extinction rate?
2. **FIGURE 1** shows that in the distant past, low numbers of species of mammals went extinct (humans are also mammals). Can you suggest based on your understanding of biomes why this is the case?

FIGURE 1 Extinctions per thousand species per millennium



Source: World Resources Institute.

2.14.1 The loss of biodiversity

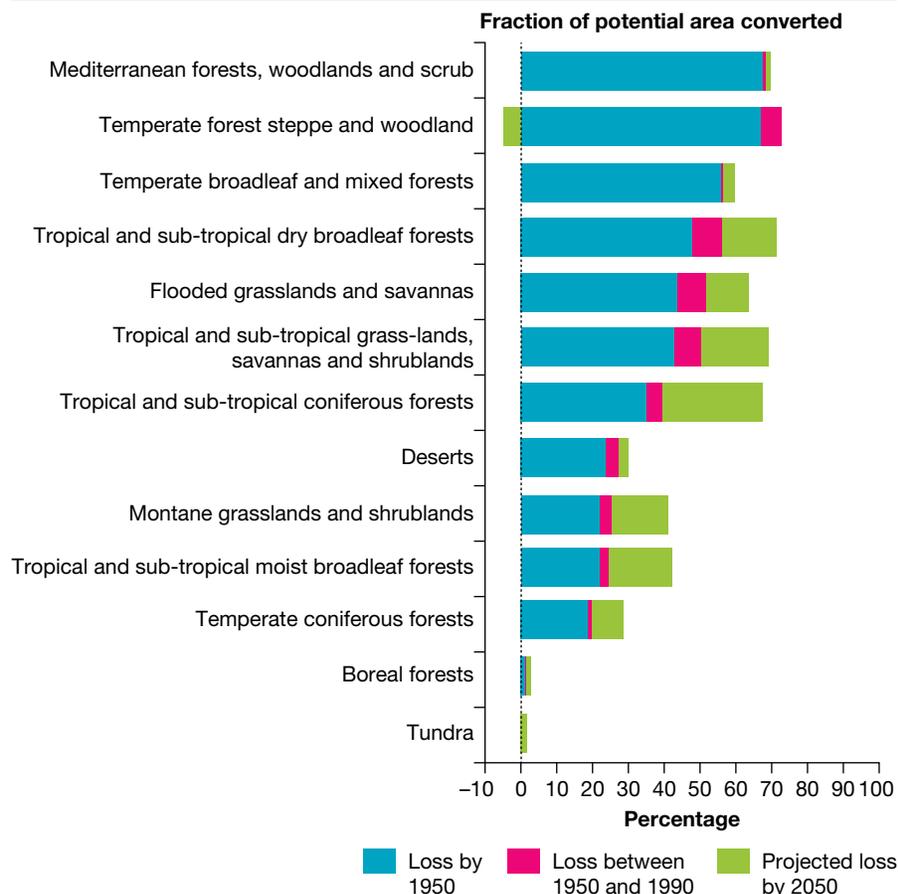
The past few centuries have seen the greatest rate of species extinction in the history of the planet (see **FIGURE 1**). The population of most species is decreasing, and genetic diversity is declining, especially among species that are cultivated for human use. Six of the world's most important land 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, more than 3000 types of 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?

Reasons for the decline in biodiversity:

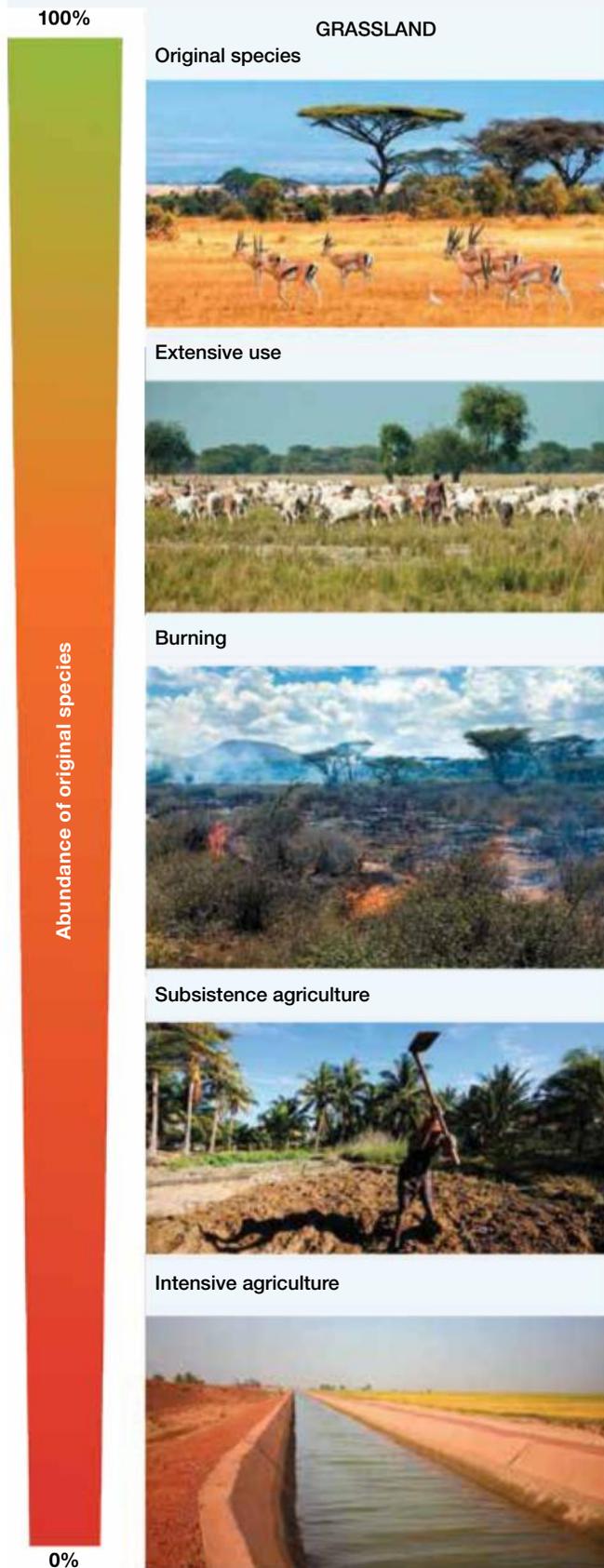
- Industrial-scale farming and new high-yielding, genetically uniform crops replace thousands of different traditional species. Two new rice varieties in the Philippines account for 98 per cent of cropland.
- Converting natural habitats to cropland and other uses replaces systems that are rich in biodiversity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

FIGURE 2 Percentage of biomes converted to agriculture over time



Source: National Research Council 2010, Understanding the Changing Planet: Strategic Directions for the Geographical Sciences, The National Academies Press, Washington, DC, p. 32.

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



2.14.2 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. This makes Australia one of only 17 countries, along with China, Brazil, the United States and others, 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.

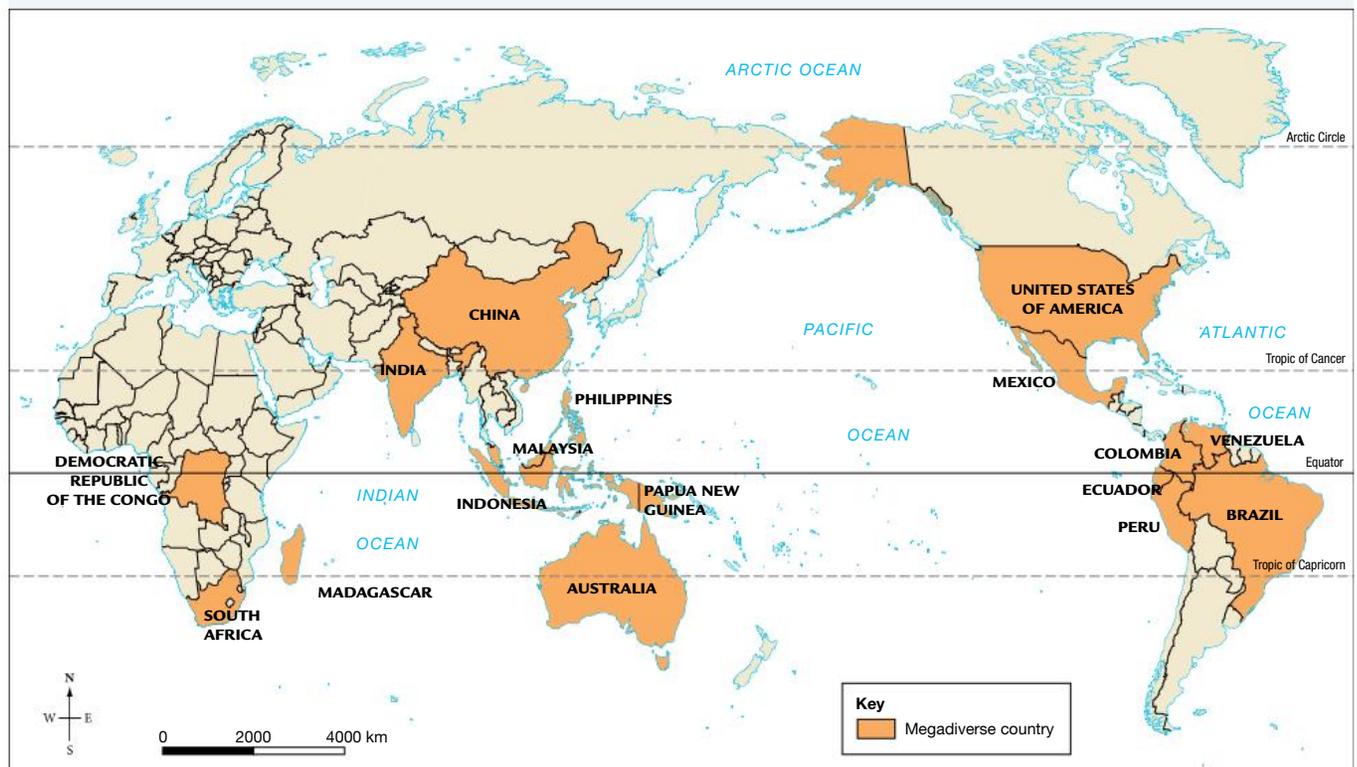
endemic describes species that occur naturally in only one region

However, Australia has experienced the largest documented decline in biodiversity of any continent over the past 200 years. It is thought that 48 plant species and 50 species of animals (27 mammal species and 23 bird species) are now extinct.

The sustainable land and resource management practices of First Nations Peoples of Australia carried out over many thousands of years ensured food security for the people and respect for the biodiversity of the lands, waterways, lakes and marine environments that sustained them.

At the time of European occupation in 1788, their deep knowledge and close association with the land allowed for sustainable management of the ecosystems and biomes in which they lived. Rotational land occupation, sustainable fishing practices and controlled burning ensured that both biodiversity and food security were maintained. 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 stewardship.

FIGURE 4 Distribution of megadiverse countries



Source: Map drawn by Spatial Vision.

2.14 SKILL ACTIVITY: Questioning and researching using geographical methods, Concluding and decision-making

Australia has experienced the largest documented decline in biodiversity of any continent over the past 200 years.

1. Investigate:

- land management practices that were used in your area before European colonisation
- the plant and animal species that are endangered or threatened in your area.

2. How might a more Earth-centred approach help to protect these species? (As research, you could ask local First Nations Elders.) **Suggest** at least three strategies.

2.14 Exercise

learnon

2.14 Exercise

Learning pathways

LEVEL 1

1, 2, 3, 6, 7

LEVEL 2

4, 8, 9

LEVEL 3

5, 10

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Check your understanding

- Human activities can lead to a loss of biodiversity. True or false?
- Australia is considered a megadiverse country. True or false?
- 'Endemic' describes _____ that occur _____ in only one _____.
- Analyse** FIGURE 2.
 - Which three biomes have seen the greatest percentage change in areas converted to agriculture? Use figures in your answer.
 - Suggest** why these three have had the most change.
- Study the information in FIGURE 3. **Evaluate** the changes to the grassland biome as seen over time.

Apply your understanding

Interpreting and analysing geographical data and information

- Elaborate** on the ways that First Nations Australian Peoples' practice of rotational land occupation has helped maintain biodiversity before European occupation.
- Does it matter that we have fewer species of apples or goats? **Explain** your view with reference to what you have learned in this lesson.
- Identify** impacts genetically modified crops might have on species diversity.
- Compare** how the environmental impacts of a traditional small-scale farm might compare with a large-scale producer.

Communicating

- Do you think it will be possible, in the future, for Australia to maintain its megadiverse status? **Predict** what actions might contribute to this.

LESSON

2.15 Investigating topographic maps — Coastal wetland biome in Binydjarrna (Dalywoi/Daliwuy Bay)

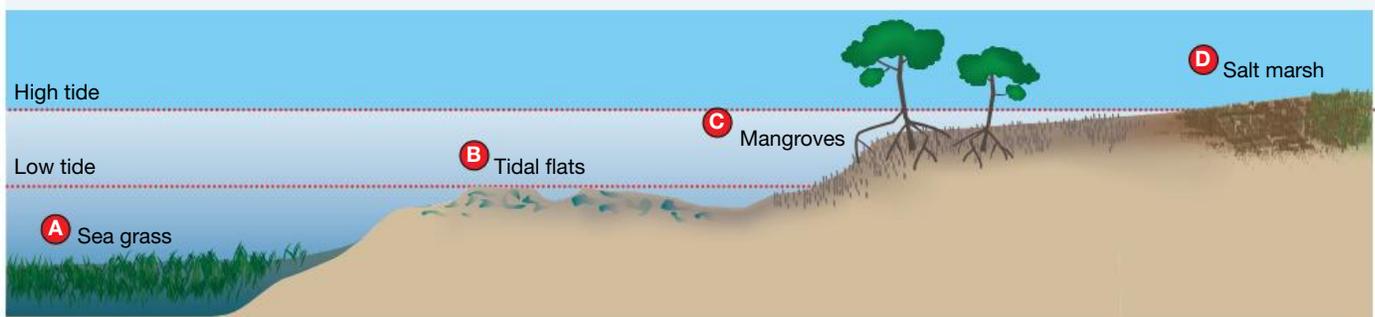
LEARNING INTENTION

By the end of this lesson you should be able to explain how aspects of the wetland biome in Binydjarrna (Dalywoi/Daliwuy Bay) function using examples from a topographic map.

2.15.1 Coastal wetlands at Binydjarrna (Dalywoi/Daliwuy Bay)

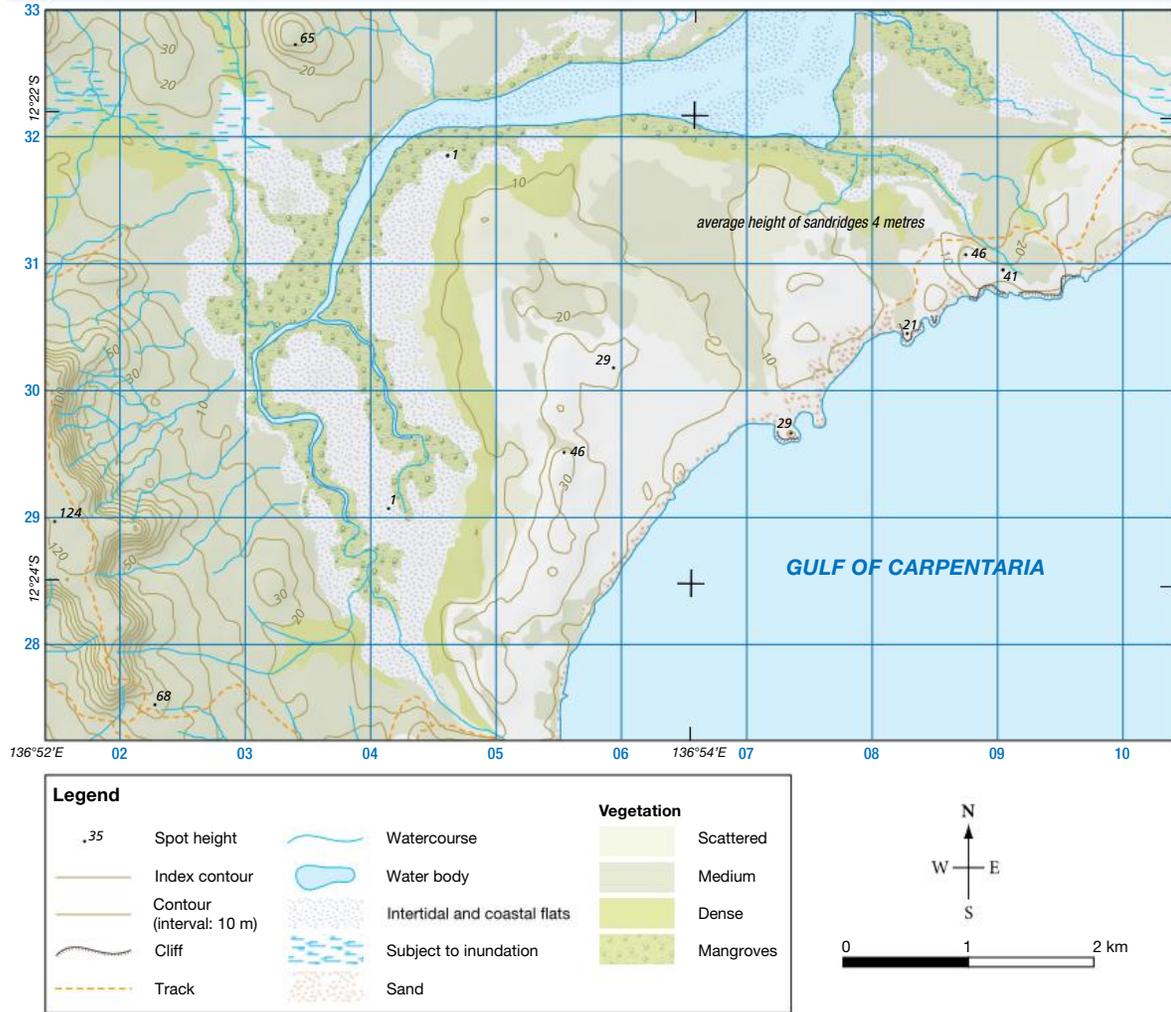
Wetlands are biomes where the ground is saturated, either permanently or seasonally. They are found on every continent except Antarctica. Wetlands include areas that are commonly referred to as marshes, swamps and bogs. Refer to section 2.5.2 for further information about coastal wetlands.

FIGURE 1 Cross-section of a mangrove 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 Topographic map extract, Binydjarrna (Daliwuy Bay), Northern Territory



Source: Adapted from Geoscience Australia, The Australian Army © Commonwealth of Australia (1999).

Resources

-  **eWorkbook** Investigating topographic maps — Coastal wetlands in Daliwuy Bay (ewbk-10606)
-  **Digital document** Topographic map extract of Binydjarrna (Daliwuy/Dalywoi Bay) (doc-36265)
-  **Video eLesson** Investigating topographic maps — Coastal wetlands in Dalywoi Bay — Key concepts (eles-6116)
-  **Google Earth** Binydjarrna (Daliwuy/Dalywoi Bay)

2.15 Exercise

Learning pathways

■ LEVEL 1

1, 2

■ LEVEL 2

3, 4

■ LEVEL 3

5, 6

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Check your understanding

1. **Describe** the natural functions of wetlands in the environment.
2. **Identify** the following features on the map.
 - a. The highest point
 - b. An area that is subject to inundation
 - c. A track to the beach
3. Refer to **FIGURE 2** and **describe** the environment at the following locations.
 - a. GR042309
 - b. GR071329
 - c. GR030320
 - d. GR042285

Apply your understanding

4. Refer to **FIGURE 2**.
 - a. Locate the grid square bounded by the following grid references: GR030300, GR030310, GR040030, GR040310.
 - b. **Describe** the natural environment in this area.
 - c. **Describe** how this environment would change over the course of the day.
 - d. **Explain** how this environment would be impacted if there was a cyclone in the area.
5. How do mangrove wetlands help to stop erosion of coastlines?

Explore your understanding

6. A proposal has been put forward to construct a canal housing estate in the square bounded by the following grid references in **FIGURE 2**: GR030300, GR030310, GR040030, GR040310. Based on the features and topography in this area, is this proposal a good idea?

LESSON

2.16 Review

Hey students! Now that it's time to revise this topic, go online to:



Review your results



Watch teacher-led videos



Practise questions with immediate feedback

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2.16.1 Key knowledge summary

Use this dot point summary to review the content covered in this topic.

2.2 What are the major biomes around the world?

- Biomes are sometimes referred to as ecosystems.
- Biomes share similar climates and life forms.
- The Earth has five major biomes: forest, desert, grassland, tundra and aquatic. There are variations within each biome.

2.3 How do we characterise biomes?

- Biomes are controlled by climate.
- Climate is influenced by latitude, landform, ocean currents and air movement.
- Climate determines the type of soil that develops and the life forms that a biome can support.
- The characteristics of soil are determined by temperature, rainfall and the rocks and minerals that make up the underlying bedrock.
- There are more microbes in a teaspoon of soil than there are people on Earth.

2.4 What are Australia's major biomes?

- All the major biome types, with the exception of tundra, are found in Australia.
- After European settlement, significant changes have been made to Australia's biomes.
- All the major food grains that we use today have their origins in the grassland biome.

2.5 What is the importance of biomes to humans?

- Grasslands can occur naturally or as a result of human activity.
- Forty-two per cent of the planet was once covered in grasslands; today they make up just 25 per cent of the Earth's land area.
- Grassland soils are generally deep and fertile, which makes them ideal for agricultural production.
- Wetlands are saturated either permanently or seasonally. They are often tidal and provide important breeding grounds and habitats for both marine and freshwater species.
- Wetlands are a natural filtering system and regulate river flow.
- Coral reefs require specific temperature and sea conditions to develop and survive.
- The top part of the reef is alive; it comprises living coral polyps growing on the remains of dead coral. Not only are they an important tourism resource, but they also have compounds that are used in painkillers and other medicines.
- The reef ecosystem is fragile and easily damaged.

2.6 How is global food production linked to climate?

- Staple foods are those that are eaten regularly and in such quantities that they constitute a dominant portion of a diet.
- Staple food production is interconnected with climate, environment, culture and traditions.
- Most staple foods are cereals, such as wheat, barley, rye, oats, maize (corn) and rice; or root vegetables, such as potatoes, yams, taro and cassava.
- Other staple foods include legumes, such as soybeans and sago; fruits, such as breadfruit and plantain (a type of banana); and fish.
- The ongoing provision of food for an ever-increasing world population requires new thinking in sustainable food production.
- The three main factors that have affected recent increases in world crop food production are increased cropland and rangeland area, increased yield per unit area and greater cropping intensity.
- Agricultural innovations have changed and increased global food production.
- The Green Revolution was a result of the development and planting of new hybrids of rice and wheat, combined with expanded irrigation and use of fertilisers, which have led to greatly increased yields.

2.7 How and why do we modify biomes for agriculture?

- Rapid global population growth has an impact on food production and the consequent modification of biomes.
- Modifications to climate include the use of irrigation and greenhouses.
- Soils can be modified through the use of fertilisers.
- Landscapes can be modified through measures such as flattening, terracing or draining. Land reclamation involves creating new land from seas, rivers or lakes.

2.8 What types of agriculture are practiced in Australia and Asia?

- Climate and distance to markets are major factors in the control of all forms of agriculture in Australia.
- Types of farming in Australia include extensive farming of sheep or cattle, extensive cereal crop farming, and intensive farming such as dairy, horticulture and market garden cropping.
- Many nations in Asia have a high reliance on rice and associated aquaculture farming.

2.9 How are the world's biomes and food production interconnected?

- Earth is made up of four interconnected spheres: the atmosphere, hydrosphere, lithosphere and biosphere.
- Natural events and human activities can create changes to these spheres.
- New technologies and improvements in farming methods have increased our rate of food production but have also caused loss of biodiversity and unsustainable degradation of land and water.

2.10 How has deforestation changed the forest biome?

- Forest biomes provide resources for a wide range of goods and services, and they support wide biodiversity.
- The need for farmland and forest products has seen large-scale clearing of the world's forests.
- Deforestation creates a range of environmental impacts, examples of which can be seen in the Amazon rainforest.

2.11 How has overfishing changed the ocean biome?

- Fish is an important source of food for more than 1 billion people around the world.
- Improvements in technology have enabled larger quantities of fish to be captured, processed and stored at greater distances from the coast.
- A 'boom and bust' mentality has seen large-scale overfishing and the decline in fish species.
- Aquaculture is now outstripping wild fish capture as an important supplier of fish and fish products.
- Aquaculture, if poorly managed, can create environmental change.

2.12 INQUIRY: Overfishing

- Overfishing is causing the collapse of many of our most important marine ecosystems.
- Overfishing is simply catching fish at a rate higher than the rate at which fish species can repopulate. It is an unsustainable use of our oceans and freshwater biomes.
- Aquaculture is often seen as a sustainable and eco-friendly solution to overfishing, but its rapid growth and poor management in many places has created large-scale environmental change.

2.13 What are the causes and effects of land degradation?

- Land that is poorly managed or overworked is susceptible to degradation. Erosion, salinity and pest invasions are all causes of land degradation.
- Land degradation can result from both natural and human causes and can lead to a loss of productivity.
- There is a strong interconnection between land degradation and food insecurity.
- Food production and security is linked to water availability.
- Irrigation is the biggest user of water in the world, consuming 70 per cent of freshwater resources.
- Irrigation can contribute to an increase in type, yield and the seasonality of food production.
- However, poorly managed irrigation has environmental costs, such as soil salinity and waterlogging.
- Diversion of surface water and extraction of underground water need to be carried out in a sustainable manner, or watertables will fall and groundwater sources will run dry.

2.14 Why is global biodiversity diminishing?

- Globally, there is a decline in the number and population of most species.
- Changes in agriculture, large-scale changes to habitats and modern breeding of plants and animals all contribute to a loss of biodiversity.
- Australia is considered a megadiverse country, with one of the highest levels of biodiversity in the world.

2.15 Investigating topographic maps – Coastal wetland biome in Binydjarrnga (Dalywoi/Dalywoi Bay)

- Binydjarrnga (Daliwuy Bay) is located in the Northern Territory, east of Darwin.
- This area is known for their wetlands which are biomes where the ground is saturated, either permanently or seasonally. Wetlands include marshes, swamps and bogs.
- Mangrove wetlands are common in Binydjarrnga and they consist of seagrass meadows, tidal flats, mangroves and salt marshes.

2.16.2 Key terms

agribusiness business set up to support, process and distribute agricultural products

aquaculture the farming of aquatic plants and aquatic animals such as fish, crustaceans and molluscs

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

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

clear-felling the removal of all trees in an area

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

endemic describes species that occur naturally in only one region

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

extensive farm farm that extends over a large area and requires only small inputs of labour, capital, fertiliser and pesticides

greenhouse gases any of the gases that absorb solar radiation and are responsible for the greenhouse effect. These include water vapour, carbon dioxide, methane, nitrous oxide and various fluorinated gases.

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

horticulture the practice of growing fruit and vegetables

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

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

leeward describes the area behind a mountain range, away from the moist prevailing winds

logging large-scale cutting down, processing and removal of trees from an area

mallee vegetation areas characterised by small, multi-trunked eucalypts found in the semi-arid areas of southern Australia

organic matter decomposing remains of plant or animal matter

per capita per person

plantation an area in which trees or other large crops have been planted for commercial purposes

pneumatophores exposed root system of mangroves, which enables them to take in air when the tide is in

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

rain shadow the dry area on the leeward side of a mountain range

salinity the presence of salt on the surface of the land, in soil or rocks, or dissolved in rivers and groundwater

sustainable describes the use by people of the Earth's environmental resources at a rate such that the capacity for renewal is ensured

treeline the edge of the area in which trees are able to grow

tundra the area lying beyond the treeline in polar or alpine regions

undulating describes an area with gentle hills

urbanisation the growth and spread of cities

waterlogging saturation of the soil with groundwater such 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

windward describes the side of the mountain that faces the prevailing winds

2.16.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

What on Earth are biomes? Are they just another part of the landscape or do we need them to survive?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question outlining your views.

Resources

-  **eWorksheets** Customisable worksheets for this topic (ewbk-13446)
Reflection (ewbk-10602)
Crossword (ewbk-10603)
-  **Interactivity** The impacts of global food production crossword (int-7646)

2.16 Review exercise

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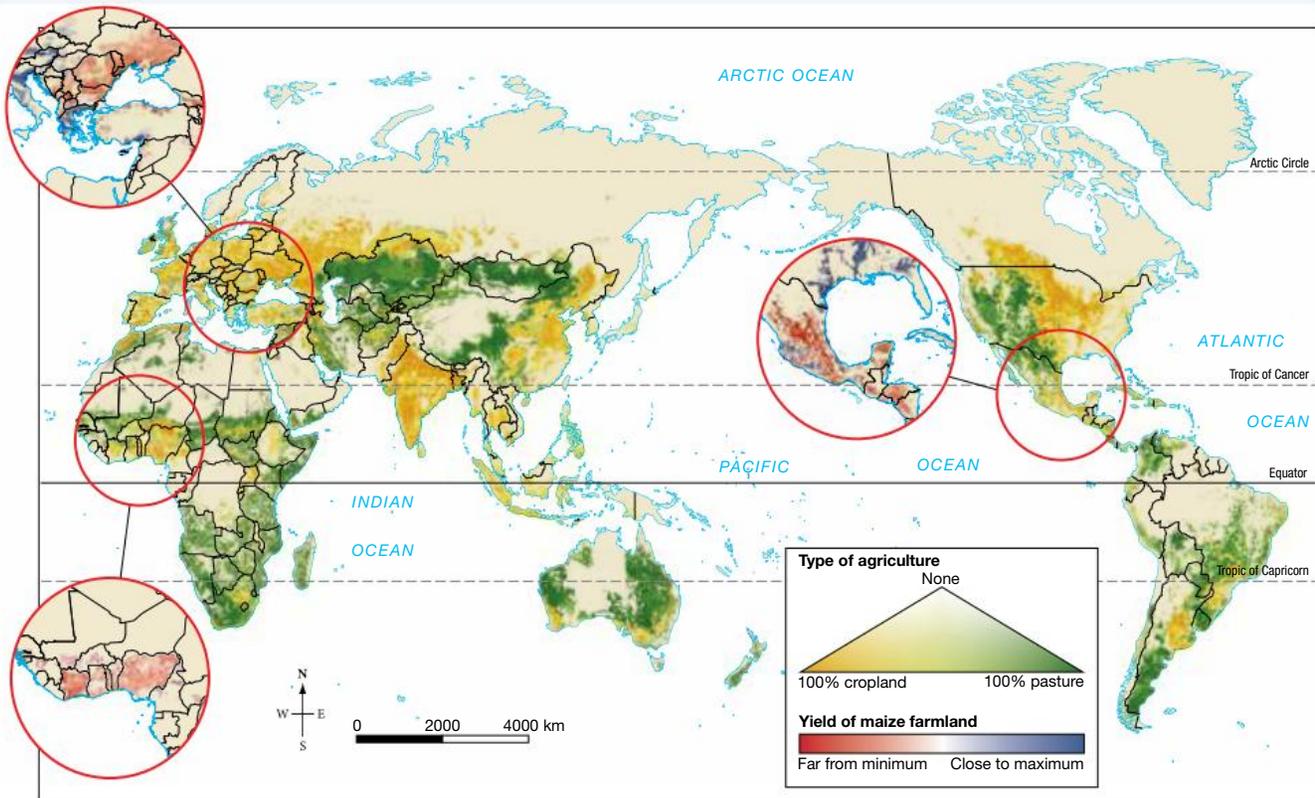
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Multiple choice

- Which two of the following are not characteristics of the forest biome?
 - Regulates global climate
 - Teeming with plant and animal life
 - Source of a range of modern foods and medicines
 - Dominated by grass
 - Produces the oxygen that sustains life
 - Recycles water
 - Places of temperature extremes
- Identify each of the following statements that are true.
 - Grasslands are found on every continent.
 - Grasslands make up 35 per cent of the Earth's land area.
 - Grasslands are the least threatened biome.
 - Grasslands are the most useful biome for agriculture.
- A coastal wetland is
 - a biome that is permanently covered with water.
 - a biome that is covered with water in the morning.
 - a biome where the ground is saturated either permanently or seasonally.
 - a biome that only exists in winter and spring.
- What gives coral its colour?
 - Fungus
 - Algae
 - Sunlight
 - Minerals
- In which biome would make-up sponges be sourced?
 - Forest
 - Ocean
 - Grassland
 - Desert
- Based on **FIGURE 7** from lesson 2.6, if food production were to increase in the future, identify **three** places that might experience this expansion.
 - Australia
 - South-East Asia
 - Eastern Europe
 - Scandinavia
 - West Africa
 - Central America
 - Canada

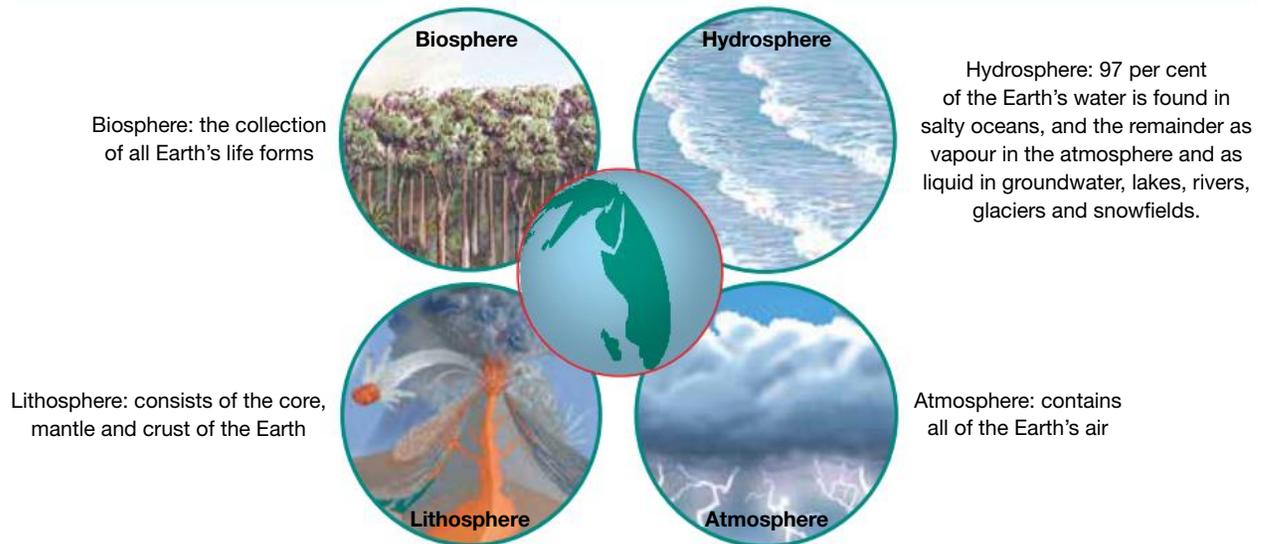
FIGURE 1 World distribution of cropland, pasture and maize. More maize could be grown if improvements were made to seeds, irrigation, fertiliser and markets.



Source: Map drawn by Spatial Vision.

7. There are more than 50 000 edible plants; however, people rely on only a small group of staple foods. Identify three factors that explain this.
- It is difficult to grow most crops on a large scale.
 - Most of the staples are cereal crops that store well over long periods.
 - Staples are foods that grow under a variety of climatic conditions.
 - Many of the 50 000 crops are perishable and have a short shelf life.
 - Only crops with a short growing season are suitable as staple foods.
8. The Earth's sphere that is most affected by the production of food is the
- biosphere.
 - lithosphere.
 - atmosphere.
 - hydrosphere.

FIGURE 2 The Earth's four spheres



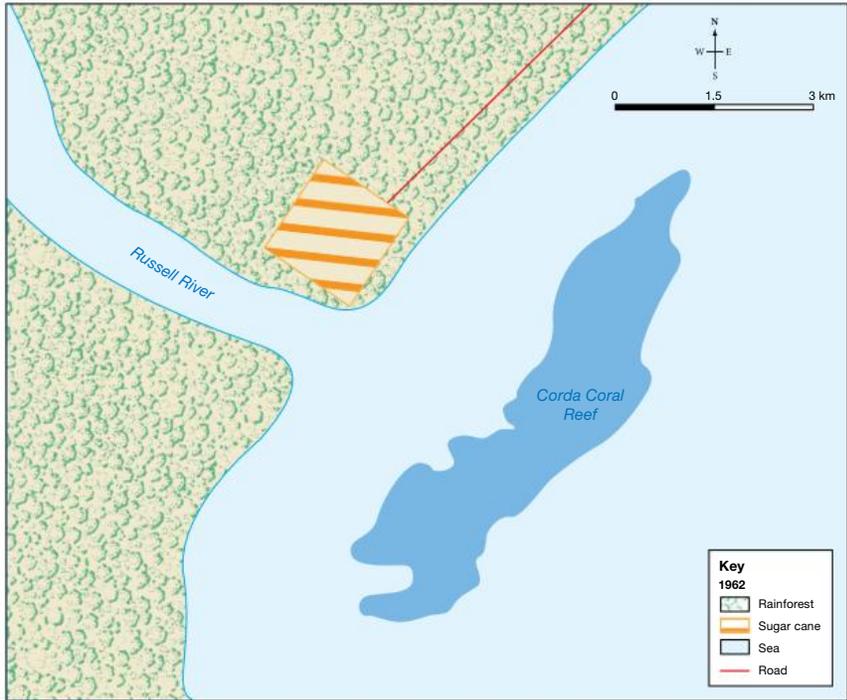
9. As the world's population has increased, which three of the following have enabled food production to keep pace?
- A. Improved technology
 - B. Climate change
 - C. More labour
 - D. Irrigation
 - E. Better economy
 - F. Use of fertilisers and pesticides
10. Which three of the following are advantages of irrigated farming over rain-fed farming?
- A. Increased fertiliser use
 - B. Increased yields
 - C. Fewer pests
 - D. Reduced threat of droughts
 - E. Less labour required
 - F. Lower climates
 - G. Reliable water supply

Short answer

Communicating

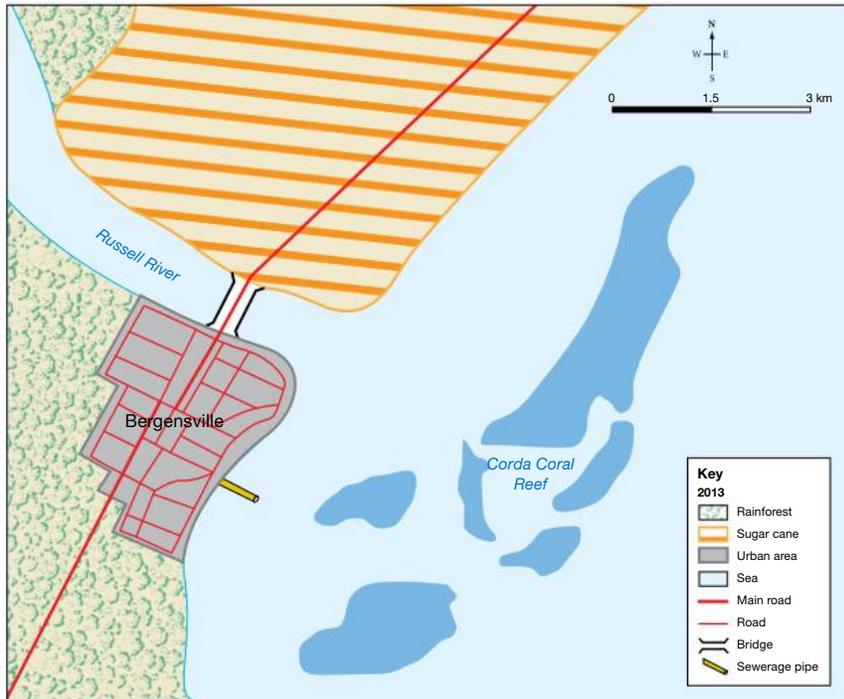
11. a. **Describe** the environment found in the place shown in **FIGURE 3**.
- b. **Describe** the changes that took place in this environment between 1962 and 2013. Include reference to the scale of this change in your response.
- c. **Explain** the interconnection between human activity and the decline of the coral reef environment in this place.

FIGURE 3(A) 1962



Source: Map drawn by Spatial Vision.

FIGURE 3(B) 2013



Source: Map drawn by Spatial Vision.

12. Make a list of the types of human activities that can contribute to land degradation.
13. Is the increasing use of groundwater a sustainable option for future farming? **Justify** your answer.
14. Palau, a small country of 22 000 people and more than 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. How do you view the decision of the Palau Government? Is this the best way to reduce the environmental threat of overfishing of a species?
15. 'It is easy to restore or recreate biomes.' **Discuss**.

FIGURE 4 Koror Island, home to the commercial centre of Palau



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3 Food security

LESSON SEQUENCE

3.1 Overview	107
3.2 What is global food security?	108
3.3 What are the impacts of land loss on food security?	113
3.4 How does access to water supplies impact food security?	120
3.5 What challenges does climate change pose for food security?	125
3.6 How will we feed the future?	130
3.7 How do we improve food production and distribution?	134
3.8 How do First Nations Australians use and alter biomes for food production?	142
3.9 INQUIRY: Famine crisis report	145
3.10 Investigating topographic maps — Lake Victoria as a food source	148
3.11 Review	151



LESSON

3.1 Overview

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How do we protect the world's food security for today and tomorrow?

3.1.1 Introduction

tlvd-0432

Currently the world produces enough food to adequately feed everyone, but that doesn't mean that everyone is well fed. The food that is produced is far from equally distributed. It is estimated that approximately one in every nine people (around 850 million) are going hungry.

What is preventing everyone getting enough to eat? And if this is the current situation, what will happen in the future, with our population set to rise to nearly 10 billion by 2050? How can we ensure food security for all the people of our ever-growing world population?

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.

FIGURE 1 For these children, in a tent camp for people displaced by flooding in northern India, the only hope for food security is humanitarian aid.



Resources



eWorkbook

Customisable worksheets for this topic (ewbk-13448)



Video eLesson

Food for thought (eles-1720)

LESSON

3.2 What is global food security?

LEARNING INTENTION

By the end of this lesson you should be able to explain the concept of food security and understand some of the reasons for food insecurity.

TUNE IN

According to the United Nations Food and Agriculture Organization, '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'.

FIGURE 1 Food is essential to our survival, but not every person on this planet has equal access to food.



1. What words or images come to mind when you think of hunger?
2. How would you define hunger?
3. How would you measure hunger?
4. How can we protect ourselves against hunger?

3.2.1 Defining 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 available at the next mealtime.

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. Further, access to a wide variety of foods varies from place to place. For example, consider the range of foods available in the two markets in **FIGURE 2**.

FIGURE 2 Fresh produce market in (a) a developed country and (b) a developing country



3.2.2 Measuring food security

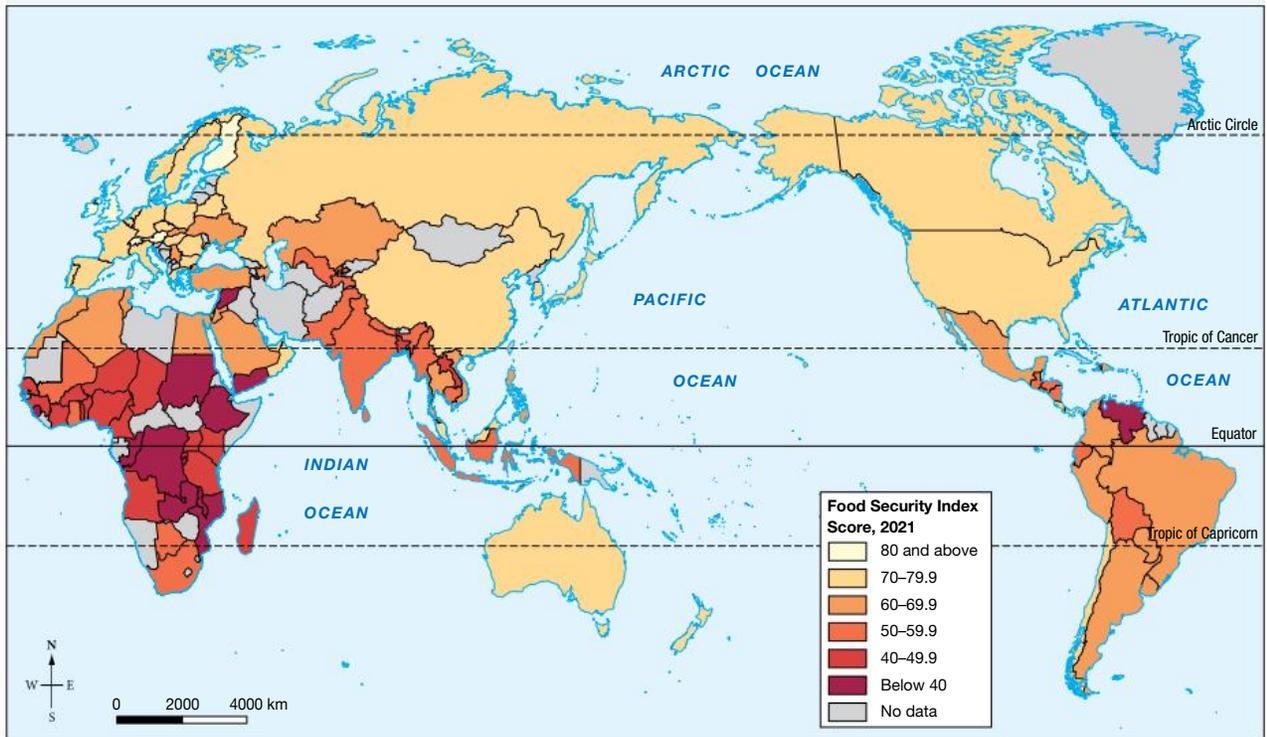
The map in **FIGURE 3** shows the countries of the world, scored according to the Global Food Security Index. This is based on a range of 12 different **indicators**, including the:

- affordability of food
- accessibility of food
- nutritional value of food
- safety of food
- nutritional and health status of the population.

Countries that have a high rating on the index are able to produce more food than they require, so they can export their surplus or they are able to afford to import all of their food needs, as is the case for Singapore.

indicators things that provide a pointer, especially to a trend

FIGURE 3 The Food Security Index, 2021



Source: Based on data from Global Food Security Index 2021. © The Economist Group 2021. Map drawn by Spatial Vision.

In Australia, we produce three times as much food as we consume. We are a major exporter of both fresh and processed food, and can trade competitively in cereals, oil seeds, beef, lamb, sugar and dairy products. About 90 per cent of our food is grown here in Australia. Of the remaining 10 per cent that we import, many foods are either processed or out of season in Australia; 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 lack of food 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.

3.2.3 Food insecurity

FIGURE 3 also shows those countries that have a low Food Security Index score. It is estimated that more than 850 million people — one in every nine people in the world — are **undernourished**, with diets that are minimal or below the level of sustenance. Poor diet and limited access to food create large-scale food insecurity in many parts of Africa and southern Asia. 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. India is home to 24 per cent of the world’s **malnourished**, and 30 per cent (46.6 million) of the world’s children under five with stunted growth due to poor and inadequate diets.

Paradoxically there is also an interconnection between food insecurity and obesity. When fresh food is scarce or expensive, people will choose cheaper food that is often high in kilojoules but low in nutrients. This is quite common in urban areas of middle- and high-income countries. Of the world’s population of over 7.7 billion, 2 billion are now overweight — a condition that contributes to significant health issues such as diabetes and heart disease.

undernourished describes someone who is not getting enough calories in their diet; that is, not enough to eat

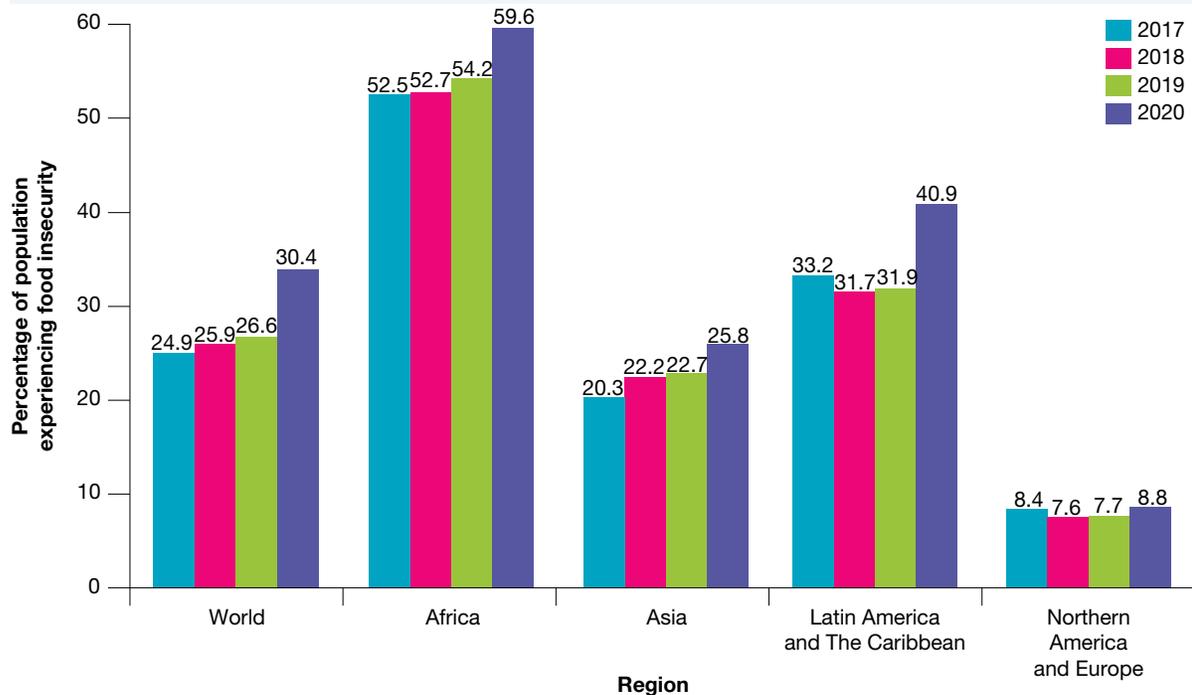
malnourished describes someone who is not getting the right amount of the vitamins, minerals and other nutrients to maintain healthy tissues and organ function

3.2.4 Causes of food insecurity

Global food production now provides one-third more calories than are needed to feed the entire world. Since the beginning of this century there has been an increase in production from 2716 to 2904 calories per person per day. Increases from 2083 to 2358 calories have also occurred in the least developed countries. There is, however, unequal access to **arable** land, technology, education and employment opportunities. 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 4**. Since 2017, severe food insecurity has actually risen in Africa, Latin America, and the world as a whole.

arable describes land that can be used for growing crops

FIGURE 4 Regional food insecurity, 2017–2020



Source: FAO, IFAD, UNICEF, WFP and WHO, 2021. The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. <https://doi.org/10.4060/cb4474en>.

Some of the reasons for food insecurity include:

- poverty
- population growth
- weak economy and/or political systems
- conflict
- natural disasters such as drought or a pandemic.

3.2 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Research the impact of COVID-19 on food security. **Select** one of the developed countries most affected (e.g. the United States or Spain) and answer the following questions.

- Did the availability of food change?
- Did people's ability to access food change?
- Did specific segments of the community or country experience greater food insecurity?

Create a poster for the class which will aid a discussion on the factors affecting food security in developed countries.

3.2 Exercise

Learning pathways

■ LEVEL 1

1, 2

■ LEVEL 2

3, 4, 5, 6, 7

■ LEVEL 3

8, 9, 10

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Check your understanding

1. Food being able to cover all food tastes, including sweet, salty and sour, are considered important for food security. True or false?
2. For people living in a country with low risk of food security a variety of food items would be _____ available at _____ prices. There would be little if any day-to-day concerns over the supply or availability of food. _____ costs of food could restrict people's choices of food items.
3. Which one of the following statements applies to people living in countries with low risk of food insecurity?
 - A. A variety of food items would be rarely available at affordable prices. There would be day-to-day concerns over the supply or availability of food.
 - B. A variety of food items would be easily available at affordable prices. There would be little, if any, day-to-day concerns over the supply or availability of food.
 - C. A variety of food items would not be easily available and would be expensive. There would be concerns over the availability of foods.
 - D. All of the above.
4. **Compare** the two photographs in **FIGURE 2**.
 - a. What are the similarities and differences between the two markets?
 - b. Do you think all food groups would be available in both markets? Why or why not?
5. The food security index was based on the following five indicators:
 - affordability of food
 - accessibility of food
 - nutritional value of food
 - safety of food
 - nutritional and health status of the population.

Why do you think indicators such as accessibility and safety were included?

Apply your understanding

Interpreting and analysing geographical data and information

6. **Clarify** how climate change affects Australia's food security.
7. **Explain** what natural or human events could disrupt our food security.
8. **Compare** and **contrast** undernutrition and malnutrition. What are the key differences?
9. **Investigate** **FIGURE 4**.
 - a. Using dates and percentages, **describe** the main trend in food security throughout the world for 2017–2020.
 - b. **Compare** the trends in food security for Africa and North America/Europe over time. Use figures in your answer.

Concluding and decision-making

10. **Suggest** five steps you think would reduce a country's risk of food insecurity. **Justify** the reasons for your choices.

LESSON

3.3 What are the impacts of land loss on food security?

LEARNING INTENTION

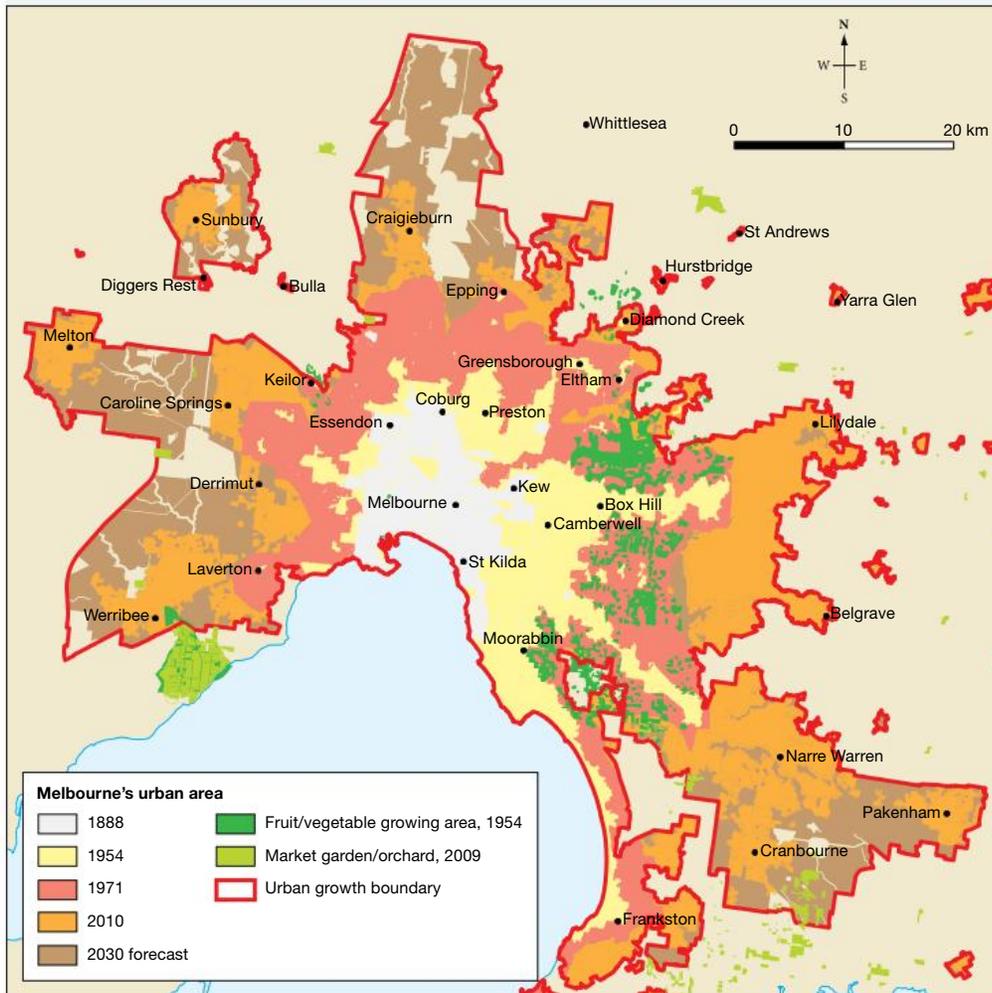
By the end of this lesson you should be able to describe the impacts of land degradation. You should also be able to discuss the competing demands to land on food security.

TUNE IN

int-9060

The City of Melbourne is growing rapidly. When a population changes significantly in a short period of time there are a range of challenges that can arise for the existing residents as well as those who have moved to the growing area.

FIGURE 1 Growing food in Melbourne's urban area



Source: Based on data from © The State of Victoria, Department of Environment and Primary Industries 2013. Map drawn by Spatial Vision.

1. Using the map, describe the urban growth of Melbourne over the past few decades.
2. Which land has been most affected by Melbourne's continuing growth?
3. Explain the challenges of this urban growth into the future.

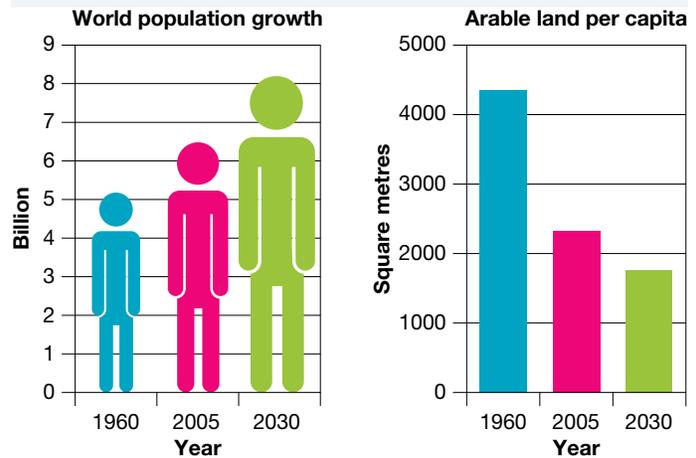
3.3.1 Causes of land loss

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 2** 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.

FIGURE 2 Comparison of world population growth and arable land per capita



desertification the transformation of arable land into desert, which can result from climate change or from human practices such as deforestation and overgrazing

FIGURE 3 Evidence of soil erosion in a crop



Land degradation

tlvd-10687

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 4**). More than 75 per cent of the planet's land is considered degraded, which has an impact on the lives of more than 3 billion people. In China, erosion affects over 40 per cent of the land area; up to 10 million hectares are contaminated by pollutants.

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. Melbourne currently produces enough food to supply 41 per cent its needs. With an estimated population of 7–8 million and the consequent growth in city size by the year 2050, the city will need 60 per cent more food. The capacity of current farmland will provide only 18 per cent of the city's needs.

Creeping cities

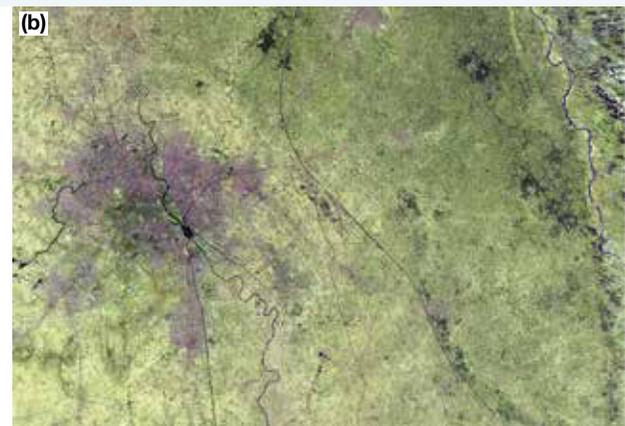
Cities tend to develop in places that are agriculturally productive. However, as they expand, they encroach on valuable farmland. Approximately 3 per cent of the world's land areas are urbanised, but this is expected to increase to 4–5 per cent by 2050.

FIGURE 4 Land degradation caused by deforestation in Madagascar



int-7923

FIGURE 5 Satellite image of New Delhi, India, in (a) 1989 and (b) 2018 — the expansion of the city has taken over valuable arable land.



Growing fuel

Traditionally, the main forms of biofuel have been wood and charcoal. Almost 90 per cent of the wood harvested in Africa and 40 per cent of that harvested in Asia is used for heating and cooking. Today, people are seeking more renewable energy sources and they want 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 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.

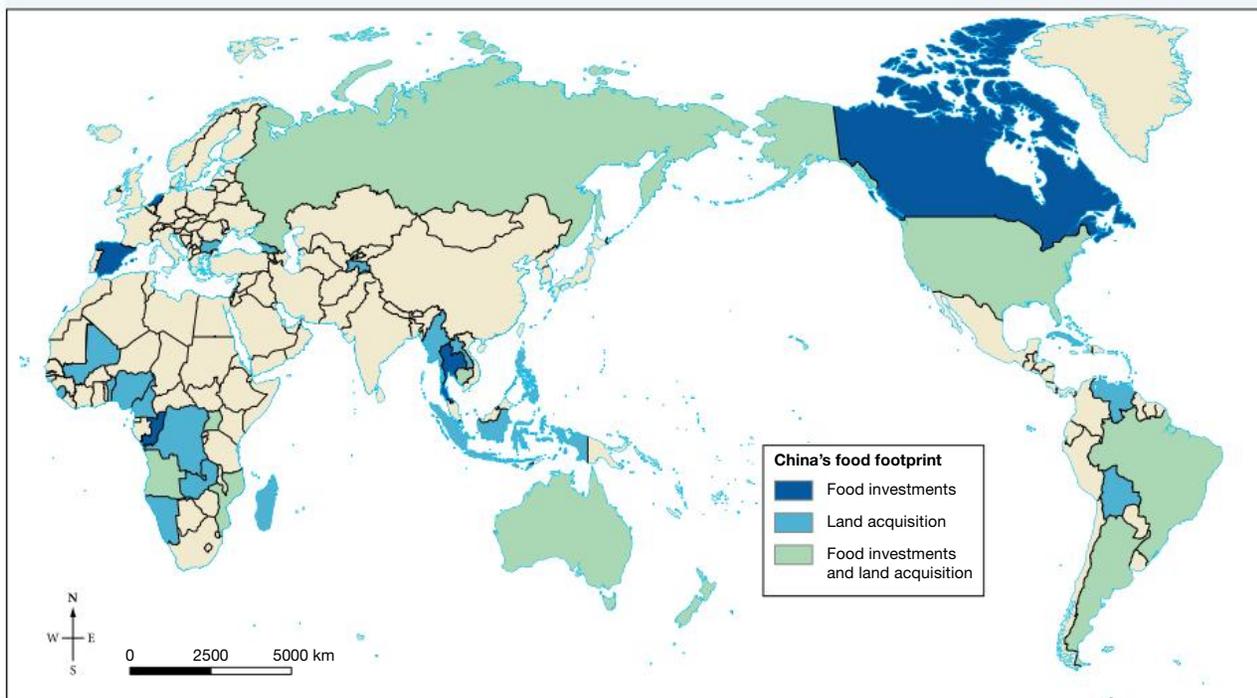
Land grabs

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 2000, foreign investors have acquired over 26 million hectares around the world to produce food crops and biofuels. **FIGURE 6** shows the extent of China’s expansion into other countries with investments in land and agricultural businesses.

jatropha any plant of the genus *Jatropha*, but especially *Jatropha curcas*, which is used as a biofuel
marginal land describes agricultural land that is on the margin of cultivated zones and is at the lower limits of being arable

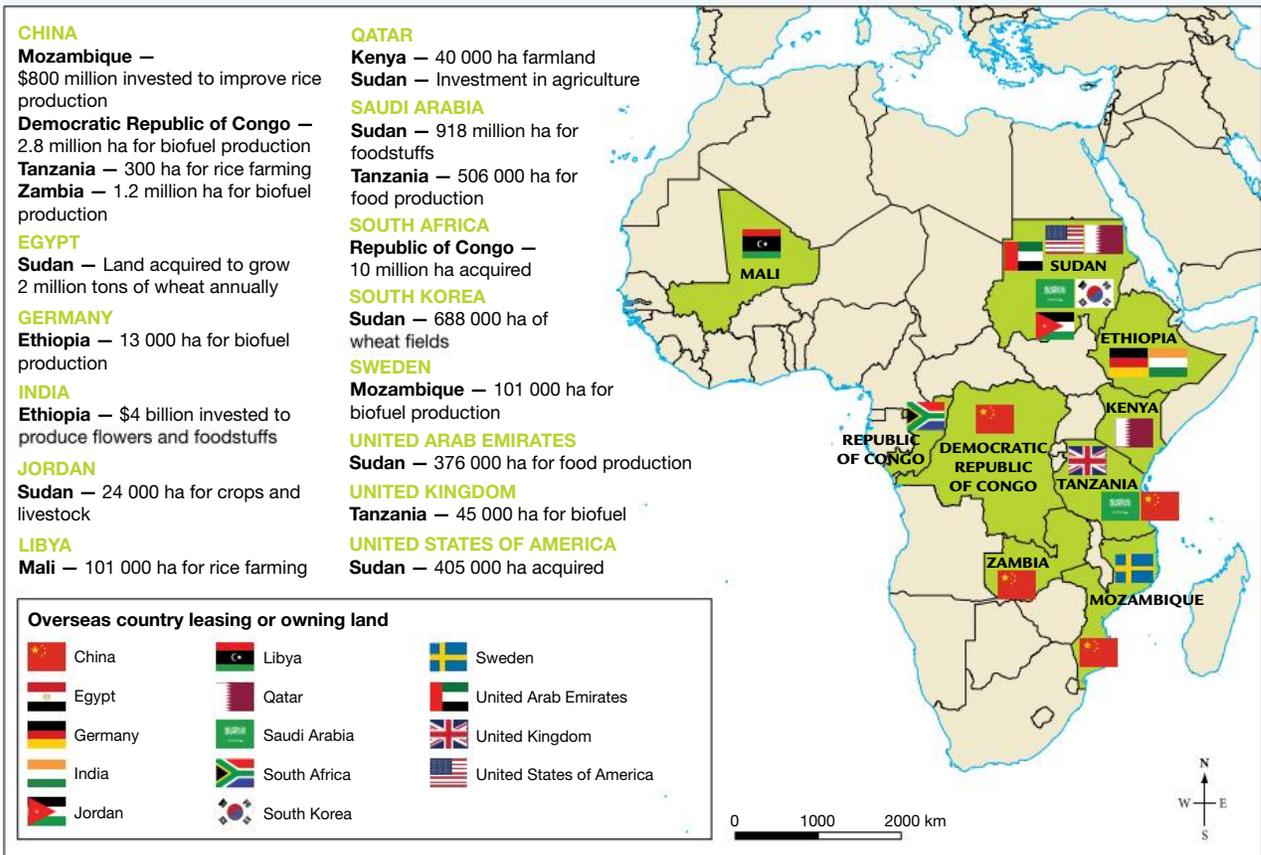
FIGURE 6 Global map of China’s land and food footprint



Source: Based on data from The Heritage Foundation, GRAIN.org, Bloomberg. Map drawn by Spatial Vision.

Forty-two per cent of global acquisitions have occurred in Africa, examples of which can be seen in **FIGURE 7**. Africa’s appeal is based on the fact that the continent accounts for 60 per cent of the world’s arable land and yet most countries within it currently achieve less than 25 per cent of their potential yield.

FIGURE 7 Examples of land grabs in Africa



Source: Based on data from Food and Agriculture Organization, International Food Policy Research Institute. Map redrawn by Spatial Vision.

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 7**).
- *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.

3.3.2 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. In many instances, land that is purchased is already occupied and used by small-scale farmers, often 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 watering 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.

Not all farmland grab projects have been successful. At least 17.5 million hectares of foreign-controlled land have failed. There are a number of interconnected reasons, including a lack of understanding of local

conditions, natural disasters, failed accounting, and, increasingly, challenges from local communities that have been displaced. When projects collapse, communities rarely get their lands back or are compensated for their loss. Promises of new schools, health clinics, infrastructure and jobs simply disappear.

It has been estimated that the land taken up by foreign investors for biofuel projects could feed as many as 190 to 370 million people, or even more, if yields were raised to the level of industrialised western farming. In addition to these human costs, there are important concerns about environmental risks that are associated with monoculture farming and the loss of biodiversity in the region.

DISCUSS

'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 arguments are logical and supported with evidence.

3.3 SKILL ACTIVITY: Concluding and decision-making, Communicating

Australia is a huge country — there's plenty of land, unfortunately not all of it is usable for food production. Think about deserts, not much grows there that we can produce to eat. Australian farmers have to stick to the more fertile areas of the country for their farms. Because of this, their farms can grow quite large.

Research one of the extensive farming activities that's happening near your school, suburb or town and report on the following:

- What is the activity? What is it producing?
- Why is it located where it is? **Consider** the environment, weather patterns and products being produced.
- What was the original use of the land? What was the original biome?
- How has the biome been altered by farming?
- Offer suggestions on how the biome can be sustainably managed into the future.

Present your findings as a report.

on Resources

 **Google Earth** New Delhi

3.3 Exercise

learn **on**

3.3 Exercise

Learning pathways

■ LEVEL 1

1, 3

■ LEVEL 2

2, 4, 5

■ LEVEL 3

6, 7, 8, 9, 10

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Check your understanding

- The two main ways in which _____ can be lost are _____ of land quality through _____ desertification and _____ and competition from other land uses, such as _____ growth and biofuel crops.

erosion

salinity

degradation

urban

farmland

2. Why is the use of corn as a biofuel a threat to food security? **Select** all possible answers.
 - A. The use of corn as a biofuel is not a threat to food security.
 - B. Corn is a staple food item and could be used to feed humans.
 - C. The use of corn as a biofuel is too expensive.
 - D. The use of corn as a biofuel forces disadvantaged groups, such as women and the landless poor, to compete against the might of the biofuel industry.
3. 'Land grab' refers to the _____ practice of countries purchasing or leasing land in other countries, in order to produce food to export back home. Countries usually do this to _____ their own food security, especially when their own environment may be _____ to types of farming (e.g. _____), the population is large and growing (e.g. _____) or where there is insufficient land to cultivate (e.g. _____).
4. Refer to **FIGURE 2**. Decide whether the following statements are true or false.
 - a. These graphs indicate that there is a decreasing risk of food insecurity. True or false?
 - b. There have been significant changes in population growth and arable land per person between 1960 and 2030. During this period, the world's population has grown from 5 to 8 billion people while the amount of arable land has decreased from 4300 square metres to 1800 square metres per person. True or false?
5. **Identify** the advantages and disadvantages for developing nations of using traditional biofuels such as wood and charcoal instead of oil and gas.

Apply your understanding

Communicating

6. Answer the following questions.
 - i. **Explain** what a jatophra is.
 - A. A plant that has seeds that can be used as a food crop
 - B. A type of soil that can be used as a fertiliser
 - C. A drought-resistant perennial plant that can be planted in relatively poor soils
 - D. A short-lived plant that can be used as a biofuel without being refined first.
 - ii. **Recall** the benefits of growing jatophra rather than corn and other biofuels.

Concluding and decision-making

7. **Determine** whether the following statement is true or false.
Australia will not need to purchase farmland overseas as it is largely food sufficient and there is little need to purchase additional land.
8. Are 'land grabs' an effective solution for establishing a country's food security? **Summarise** your view.
9. Refer to **FIGURE 6**.
 - a. **Describe** the distribution of countries in which China has acquired land.
 - b. **Clarify** reasons why China might invest in food production and land in Australia.
10. **Elaborate** on how the growth of the biofuel industry can potentially affect food security.

LESSON

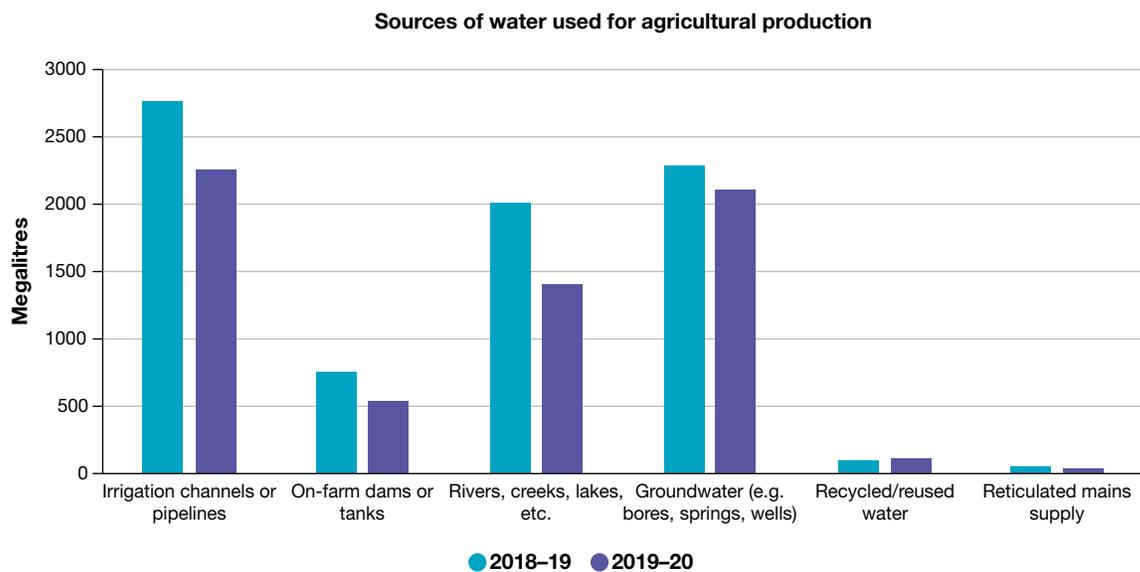
3.4 How does access to water supplies impact food security?

LEARNING INTENTION

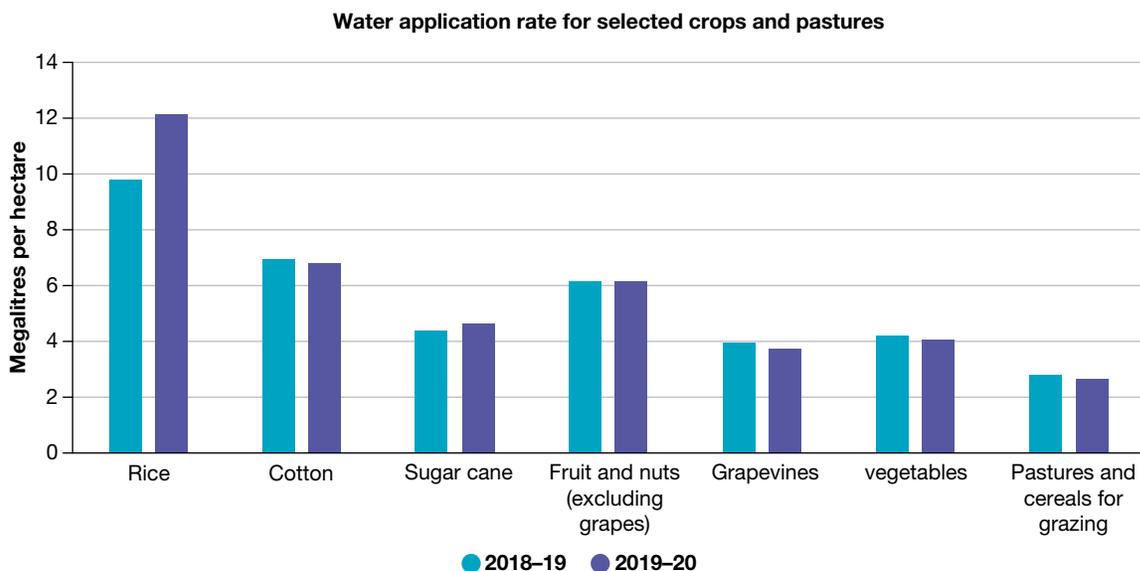
By the end of this lesson you should be able to explain the pressures placed on surface water and groundwater. You should also be able to discuss the relationship between water supply and food security.

TUNE IN

FIGURE 1 Sources of water used for agricultural production and the water application rate for selected crops and pastures



Source: Australian Bureau of Statistics, Water use on Australian Farms 2019-20 financial year.



Source: Australian Bureau of Statistics, Water use on Australian Farms 2019-20 financial year.

1. Where is most of the water used for farming sourced from?
2. Why do you think the amount of water sourced from rivers and creeks was less in 2019–2020?
3. What trends do you notice about the use of water for Australia’s crops?
4. What relationship does water security have with food security?

3.4.1 Causes of water insecurity

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.

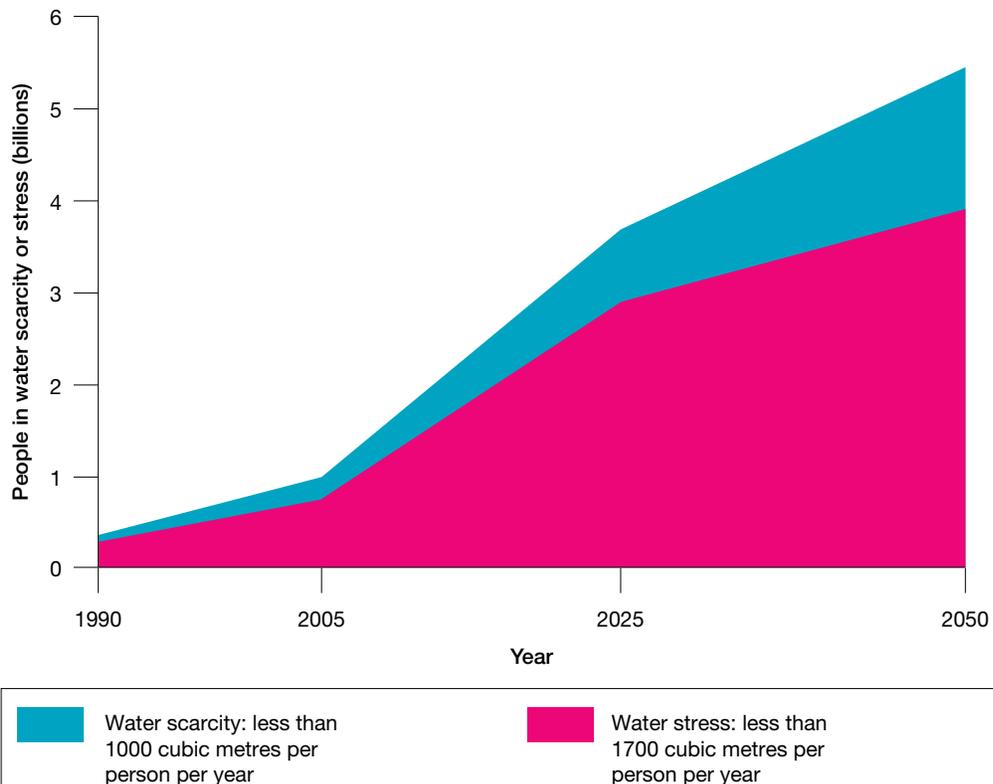
To feed an additional 2 billion people by 2050, the world will need to generate more food and use more water. The two main concerns that threaten future water security are water quantity and water quality.

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.

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.

aquifer a body of permeable rock below the Earth’s surface, which contains water, known as groundwater
water stress situation that occurs when water demand exceeds the amount available or when poor quality restricts its use

FIGURE 2 People facing water stress and water scarcity



When water availability drops below 1.5 million litres per person per year, a country needs to start importing food; this makes the country vulnerable to changes in global prices. Developing countries that experience water

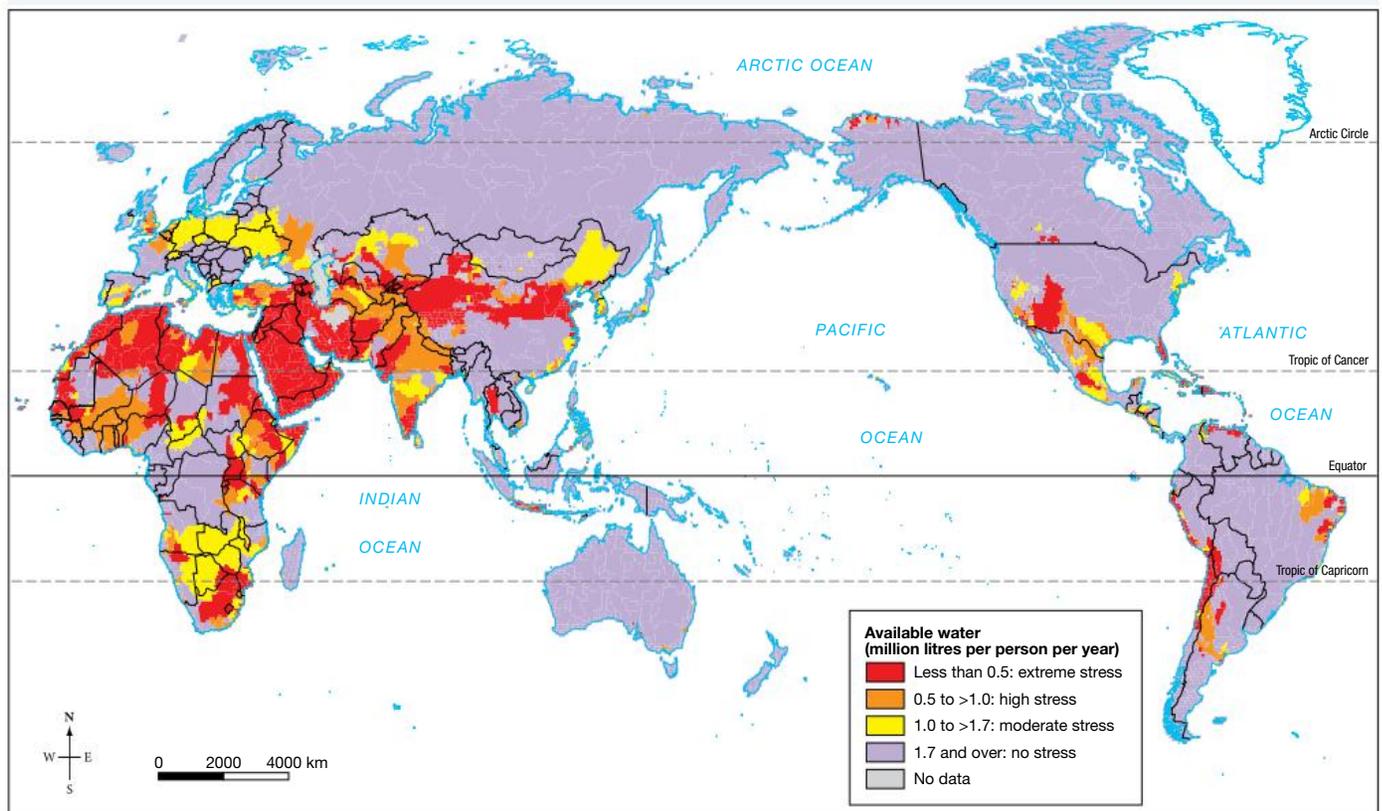
stress cannot afford to import food. They are also more vulnerable to environmental disasters. In developing countries 70 per cent of food emergencies are brought on by drought.

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.

int-9062

FIGURE 3 Projected changes in water availability due to temperature, population and industrialisation increase, 2050s



Source: Based on data from the Centre for Environmental Systems Research, University of Kassel. Map drawn by Spatial Vision.

3.4.2 Deteriorating water quality

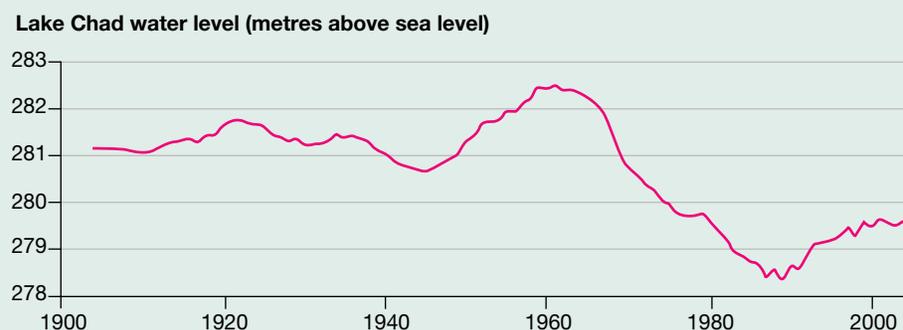
Agriculture is a major contributor to water pollution. Excess nutrients, pesticides, sediment and other pollutants can run off farmland or leach into soils, groundwater, streams and lakes. Excessive irrigation can cause waterlogging or soil salinity. This salty water not only poisons the soil but also 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 and other medical problems, such as

heavy-metal poisoning, to people. Pollution is an important contributor to the scarcity of clean, **potable** water.

potable drinkable; safe to drink

3.4 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Lake Chad, one of the largest lakes in the African continent, has been slowly deteriorating. Using the link in your Resources panel, **The rise and fall of Africa's great lake**, investigate some of the reasons for this deterioration and how this affects Chad's food security.



1. Look at the images of Lake Chad between 1973 and 1979. What do you notice?
2. Viewing the rainfall chart, what is the relationship between rainfall and Lake Chad's water level?
3. What impact does Lake Chad's water security have on the food security of the surrounding countries?
4. **Research** two or three strategies that are being used, or could be used, to ensure Lake Chad's water security and the continent's food security.
5. Present your research as a report to the United Nations.

on Resources

-  **Interactivity** The last drop (int-3328)
-  **Weblinks**
 - Water use
 - Water availability
 - The rise and fall of Africa's great lake

3.4 Exercise

Learning pathways

■ LEVEL 1
2, 3

■ LEVEL 2
1, 4, 5

■ LEVEL 3
6, 7, 8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
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Check your understanding

- Underground water is held in the pore spaces of rock and hence very large volumes can be held in rock formations beneath the ground. Surface water is easily evaporated or infiltrates the soil to join groundwater. True or false?
- Study **FIGURE 3**. The places in the world which are predicted to be in 'high' to 'extreme' water stress are found in the _____ East, central _____, northern and southern _____, and scattered regions through most of the continents, even as far north as Alaska.
- What changes might your family need to implement if the cost of household water were to more than double?
- Examine FIGURE 2**.
 - How will the number of people affected by water stress change between 1990 and 2050?
 - How do these changes compare with figures for water scarcity?
- What happens when a country's water supply drops below 1.5 million litres per person, per year?

Apply your understanding

Concluding and decision-making

- Determine** ways water managers could prevent water scarcity from affecting future food security. **Select** the option that applies.
 - Improve irrigation
 - Increase use of desalinated water
 - Design ways of reducing evaporation from water storages
 - Improve trade in food items between places of food surplus and food deficit
 - All of the above
- State** one natural and two human activities or events that could cause a decline in the quality or potability of a water resource.
- Identify** reasons why groundwater is often used for food production at an unsustainable rate.
- Propose** an argument that would help convince people to reduce their meat consumption as a means of reducing our water needs.
- Suggest** why underground aquifers would be able to hold more water than surface rivers and lakes.

LESSON

3.5 What challenges does climate change pose for food security?

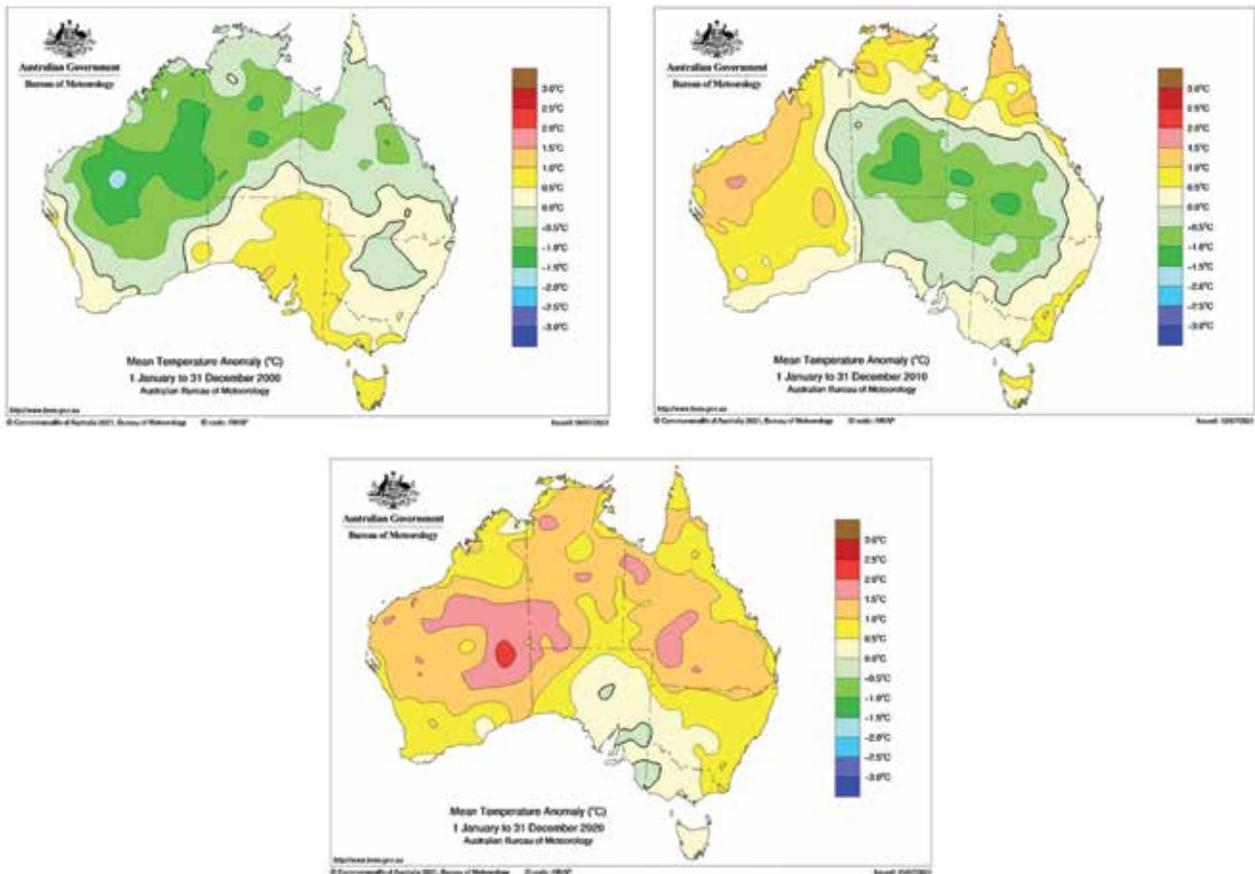
LEARNING INTENTION

By the end of this lesson you should be able to describe and explain the possible impacts of climate change on food production.

TUNE IN

Study the three maps below then answer the questions.

FIGURE 1 Temperature anomalies from 2000 to 2020



1. What do you notice about mean temperature for Australia from the year 2000 to 2020?
2. What do you think is the cause of these temperature fluctuations?
3. What impact do you think these temperatures have on Australia's food security?

3.5.1 Impacts of climate change on food production

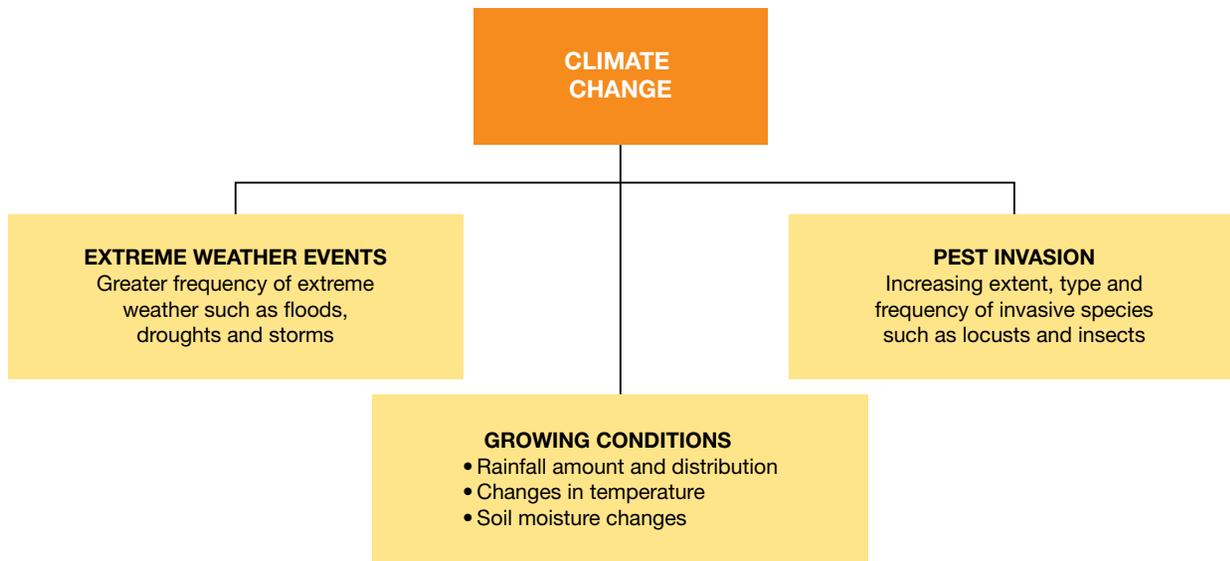
The impacts of climate change on future world food security are a case of give and take. Some regions of the world will benefit from increases in temperature and rainfall, while others will face the threat of greater climatic uncertainty, lower rainfall and more frequent drought. In either case, food 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 26 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 an average of 54 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 2**), as well as different predictions from scientists (see **FIGURE 3**).

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 4** demonstrates the effects of climate change on cereal crops, while **FIGURE 5** shows the range of potential impacts across Europe.

FIGURE 2 Possible impacts of climate change on food production

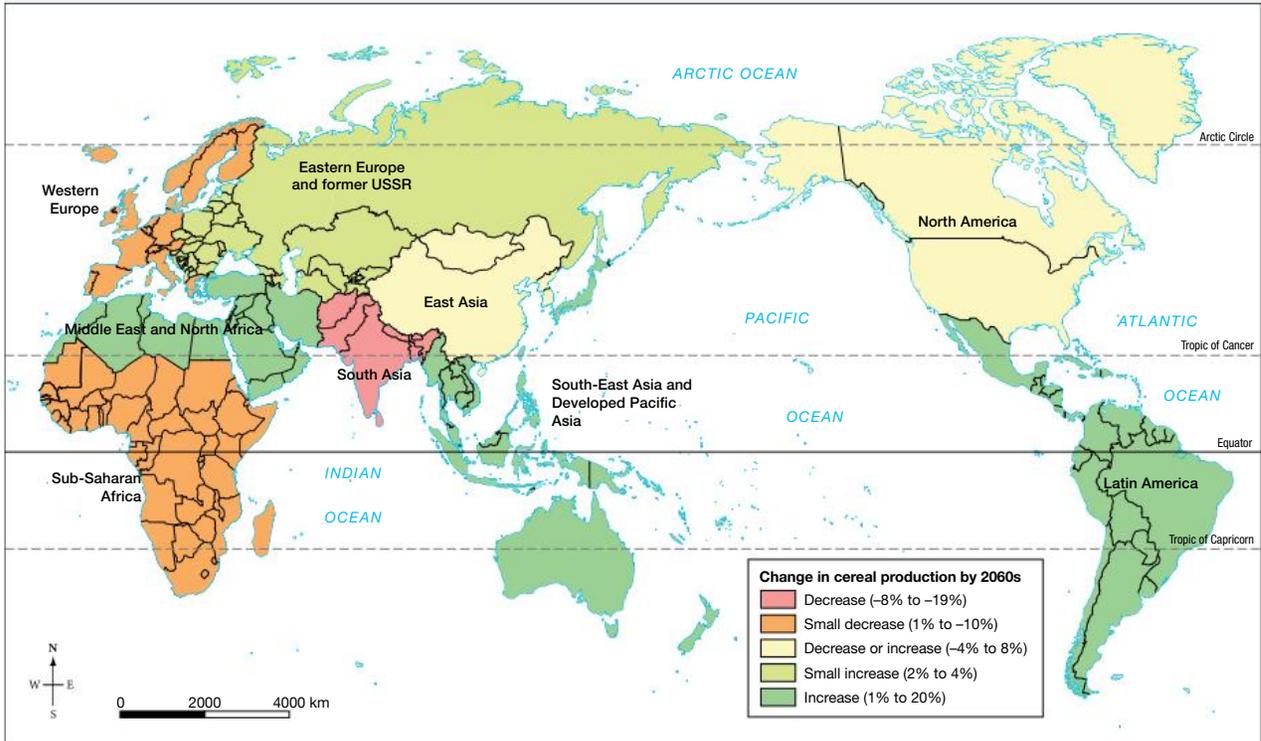


Essentially, hundreds of millions of people are at risk of increased food insecurity if they have to become more dependent on imported food. This will be evident in the poorer countries of Asia and sub-Saharan Africa, where agriculture dominates the economy. There is also a risk of greater numbers of **environmental refugees** or people fleeing places of food insecurity.

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

int-7925

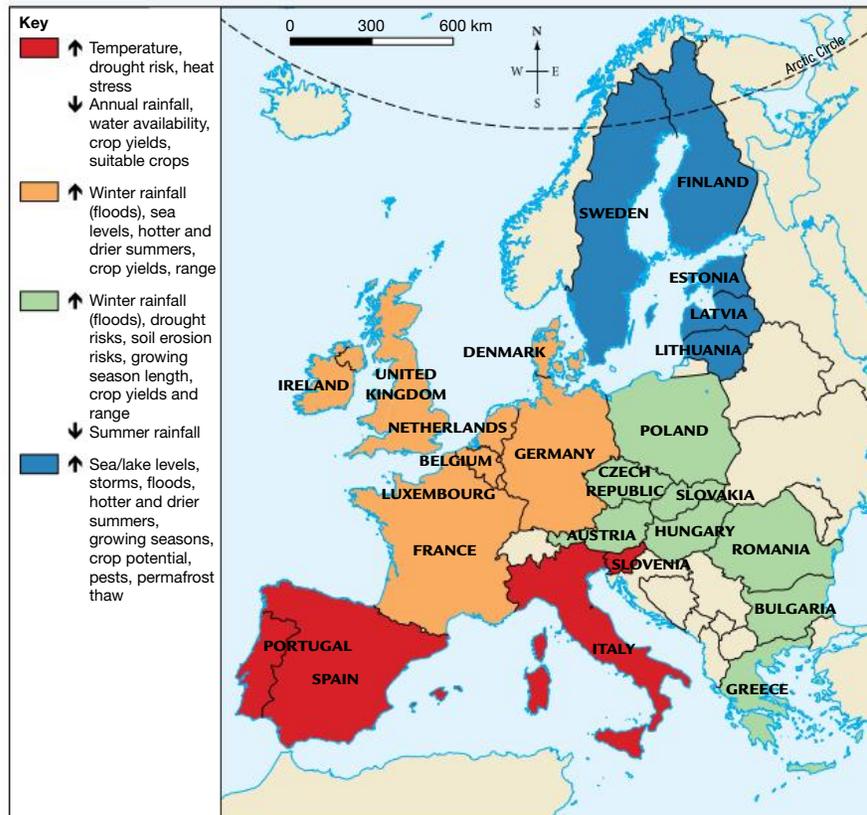
FIGURE 3 Predictions of the effects of climate change on cereal crops



Source: Based on data from Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000•2080 by Tubiello F N, Fisher G in Technological Forecasting and Social Change 2007, 747: 1030-56. Map drawn by Spatial Vision.

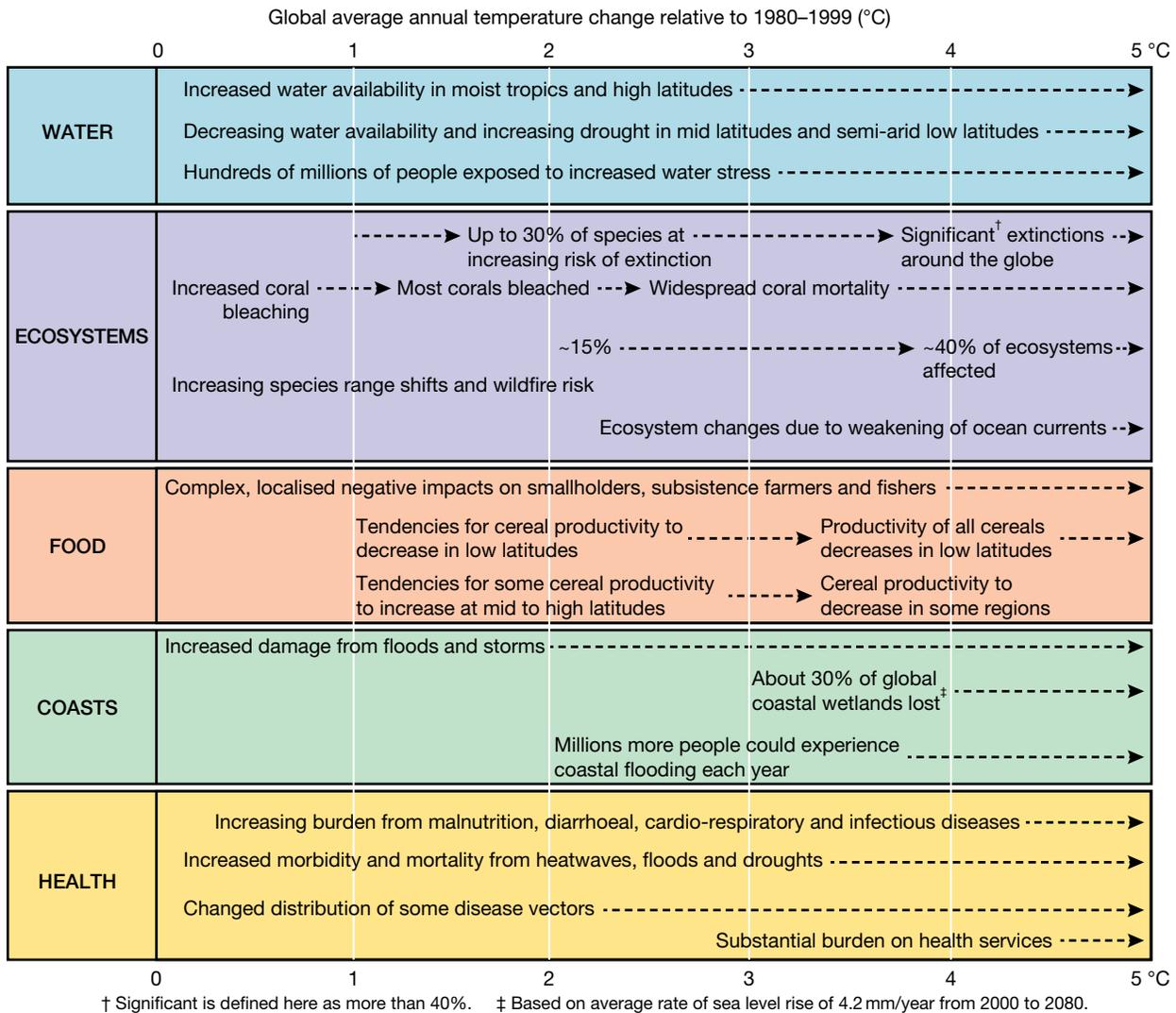
int-9063

FIGURE 4 Examples of potential consequences of climate change in selected European countries



Source: Based on data from the European Commission. Map drawn by Spatial Vision.

FIGURE 5 Projected consequences of climate change



DISCUSS

Should food be shared more equitably around the world? How might this be achieved?

3.5 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Use the **How to feed the world in 2050** and the **Feeding 9 billion** weblinks in your Resources panel to find out more about the impact of climate change on food security.

- As you watch the video, and explore the five steps, take note of the strategies that are being discussed.
- Choose one strategy to expand on and **research** in depth.
- Present a proposal that you can present to the class which answers the question: ‘How can we feed the world in 2050?’

Resources

-  **Weblinks** How to feed the world in 2050
Feeding 9 billion

3.5 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3

■ LEVEL 2

4, 5

■ LEVEL 3

6, 7, 8, 9, 10

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Check your understanding

- Countries with a _____ proportion of their population working in _____ are more vulnerable to the impacts of _____ as their income and food security will be affected if crops fail or are destroyed in storms
- Which impacts of climate change may be beneficial to food production in certain places?
 - Longer growing seasons
 - Higher rainfall
 - Warmer temperatures
 - Greater soil moisture
 - All of the above
- Determine** whether the following statements are true or false.
 - Possible impacts of extreme weather events include reduced yields, loss of livestock due to drought, loss of crops from storm or flood damage, and damage to crops due to increased frost.
 - The impacts of climate change on future world food security will affect all regions of the world in the same way.
 - Climate change may cause an increase in pests and plant diseases due to changes in temperatures and rainfall.
- How might technologies such as glasshouses and irrigation help reduce the impacts of global warming?
- Describe** the interconnection between environmental refugees and climate change.

Apply your understanding

Concluding and decision-making

- Determine** how a country such as Australia might best prepare its food production systems to cope with potential changes in climate? Select all possible answers from the options below.
 - Improvements in water recycling
 - Increasing the amount of imported food
 - Improvements in desalination
 - Developing agriculture in areas expected to have higher rainfall
- Analyse** the flowchart in **FIGURE 5** and decide whether the following statements are true or false.
 - If temperatures increase to 3 °C, you would expect to see crop yields rising around the equator.
 - Changes in extreme weather events are unlikely unless temperatures increase by at least 1 °C.
 - Food insecurity will be felt greatly in developing regions if temperatures rise above 4 °C.
 - Places that are likely to experience decreasing crop yields will be found in the higher latitudes.

Communicating

- Explain** why the impacts of climate change are more likely to be felt more in those countries with a high percentage of their population in the agricultural workforce.
- Reflect** on **FIGURE 4**.
 - Which countries in Europe will benefit from climate change in terms of food production and which countries are likely to suffer negative outcomes?
 - Would increased irrigation be a sustainable solution for growing food in Spain? **Explain** your answer.
- Agriculture is important for food security, but agricultural practices also contribute considerably to climate change. **Summarise** how agricultural practices and livestock farming contribute to climate change.

LESSON

3.6 How will we feed the future?

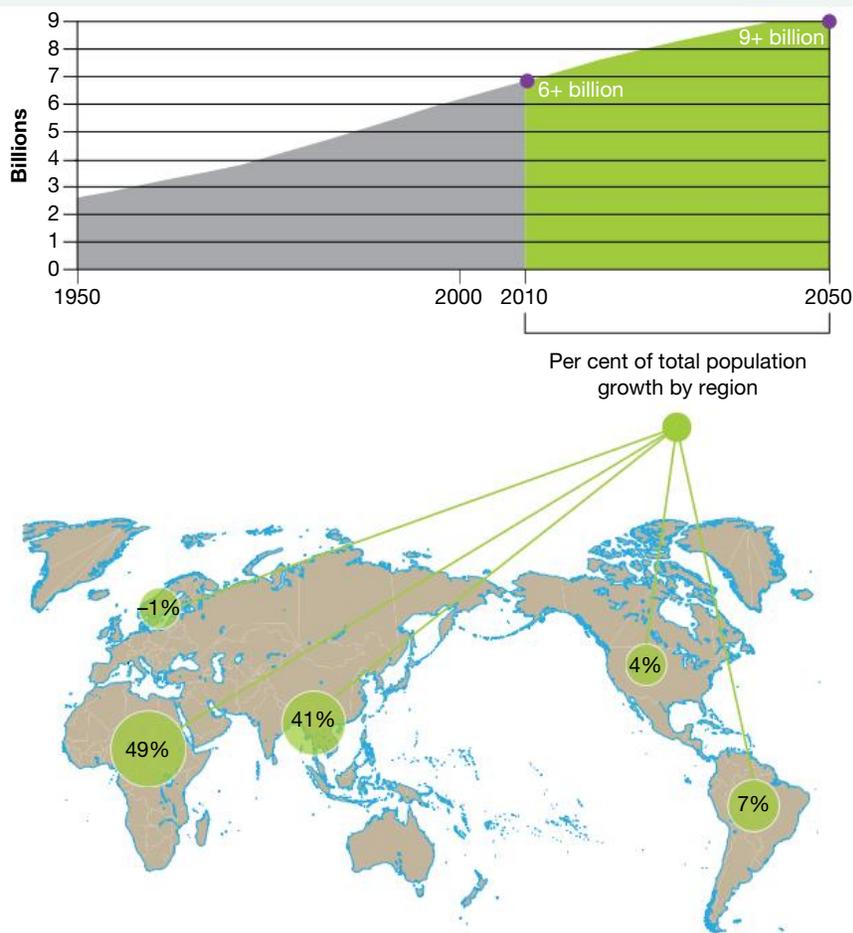
LEARNING INTENTION

By the end of this lesson you should be able to explain the prevalence of hunger and discuss the challenges to food production. You should also be able to explain the factors affecting food production.

TUNE IN

Every person on this planet deserves to be able to access food and to have food security. Sadly this isn't the case for millions around the world.

FIGURE 1 Global population growth and percentage of total population growth by region, 2010–2050



Source: Redrawn from an image by Global Harvest Initiative (2011 GAP Report[®]: Measuring Global Agricultural Productivity), data from the United Nations.

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. Why do you think we have so many people hungry when there is enough food produced in the world?
7. How do you think the world will feed its future population?

3.6.1 The prevalence and impacts of hunger

According to the World Health Organization, over 1.9 billion adults in the world are overweight, while 821 million go hungry each day. What can we do to change this imbalance and ensure equal, sustainable access to food for people across the globe?

3.6.2 Challenges to food production

The distribution of the world's population and the availability of arable land per person is uneven. Regions with the fastest-growing future populations (see **FIGURE 1**) are also those where there is limited arable land per person.

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.

The impact of hunger on people cannot be overstated. Hunger kills more people each year than malaria, AIDS and tuberculosis combined. 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. Population growth and limited supplies of arable land will affect how much food can be produced.

Preventing hunger on a global scale is important, but action also needs to be taken on a local scale. Over 70 per cent of the world's poor live in rural areas; 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.

Factors affecting 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. Some of these are outlined in **FIGURE 2**.

As urban areas grow, the amount of available arable land 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 what 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 forests and land for infrastructure.

As mentioned, the growing populations of the future will be found in places where expansion of land for agriculture 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. One such example is the Ord River irrigation scheme in the East Kimberley region of Western Australia, which is transforming this semi-arid region and providing food in huge quantities for our Asian neighbours.

FIGURE 2 Factors affecting farming yields

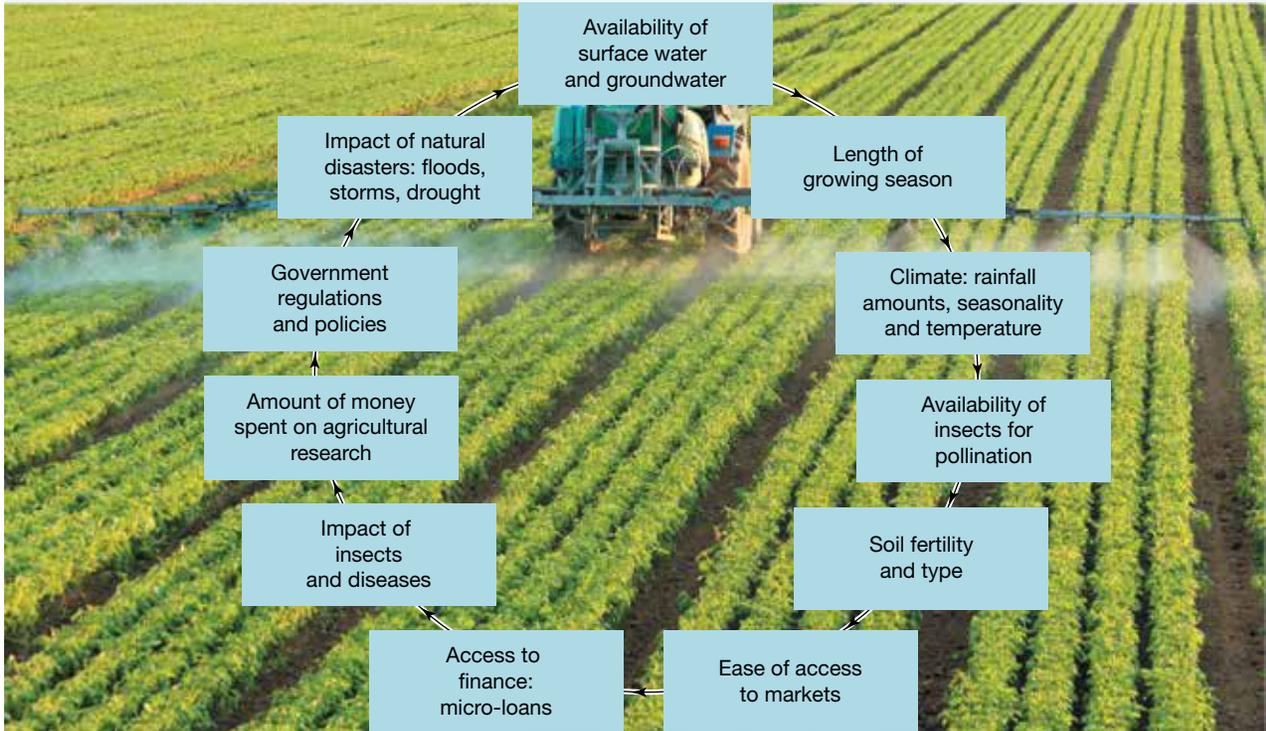


FIGURE 3 The Ord River Irrigation Scheme has allowed great expansion of the available farming area in the region.



3.6 SKILL ACTIVITY: Questioning and researching using geographical methods

As well as the effect on people's health, a shortage of food can have social and political effects. Conduct **research** into the series of food riots that occurred in several countries around the world in 2015.

- Where did these riots occur?
- What were the causes of these riots?
- How can governments work to prevent this situation from occurring again?

3.6 Exercise

3.6 Exercise

Learning pathways

LEVEL 1

1, 2, 3, 4

LEVEL 2

5

LEVEL 3

6, 7, 8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress



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Check your understanding

- How much more food is it estimated we will need to produce in order to feed future populations?
 - 0–30 per cent
 - 30–60 per cent
 - 60–80 per cent
 - 70–100 per cent
- Determine** whether the following statements are true or false.
 - Hunger is such a serious issue because it threatens people's health and is responsible for more deaths than malaria, AIDS and tuberculosis combined.
 - The world has an extra 2.8 billion hectares of unused potential farmland, which is almost twice what is currently farmed.
 - Population growth and limited supplies of arable land will have an impact on the ability to produce food to feed future populations.
- What is the relationship between areas with fast-growing populations and the amount of arable land per person?
- Over _____ per cent of the world's poor live in rural areas.
- Which of the following strategies might help to ensure there is enough food in the future for people who live in places with growing populations and limited arable land?
 - Explain** the reasons for your answer.

Apply your understanding

Interpreting and analysing geographical data and information

- Examine** FIGURE 1 and answer the following questions.
 - Which region's population is predicted to decrease by 2050?
 - Which two continents are expected to have the greatest increase in population?
 - What is the population expected to be in 2050?

Communicating

- Describe** three factors affecting farming yields and identify them as either environmental, economic or social/political factors.
- Justify** how a growing world population puts pressure on food supplies.
- Lack of food has caused people to leave their homes and move to cities in search of employment and food. **Predict** the places in the world where this is most likely to happen.
- Identify** three factors affecting farming yields: one environmental, one economic and one social/political. **Explain** how these factors impact production levels, and ways they can be either harnessed or mitigated to help ensure food security.

LESSON

3.7 How do we improve food production and distribution?

LEARNING INTENTION

By the end of this lesson you should be able to compare and evaluate various strategies for improving food production. You should also be able to discuss ways to reduce food waste and explain sustainable ways to improve food production and distribution.

TUNE IN

Think about your most recent dinner. Your household may consume and source food differently than others.

1. What did you have for dinner last night? Was it a meal prepared at home? Did you eat out? Was it takeaway?
2. Did you eat all your meal?
3. Did all members of your family eat all their meal?

FIGURE 1 A young family enjoying their nutritious meal.



3.7.1 Improving food yield

There are many strategies that can be used to create greater efficiencies and increased food production.

FIGURE 2 summarises some of these.

The strategy that is likely to be the most important in increasing future crop production is the reduction of the **yield gap**. This means that farmers who are currently less productive will need to implement farming methods that will lead to increased yields so that their outputs are closer to those of more productive farmers. There is a serious yield gap in more than 157 countries (see **FIGURE 3**). If this gap could be closed, larger amounts of food would be available without the need for 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.

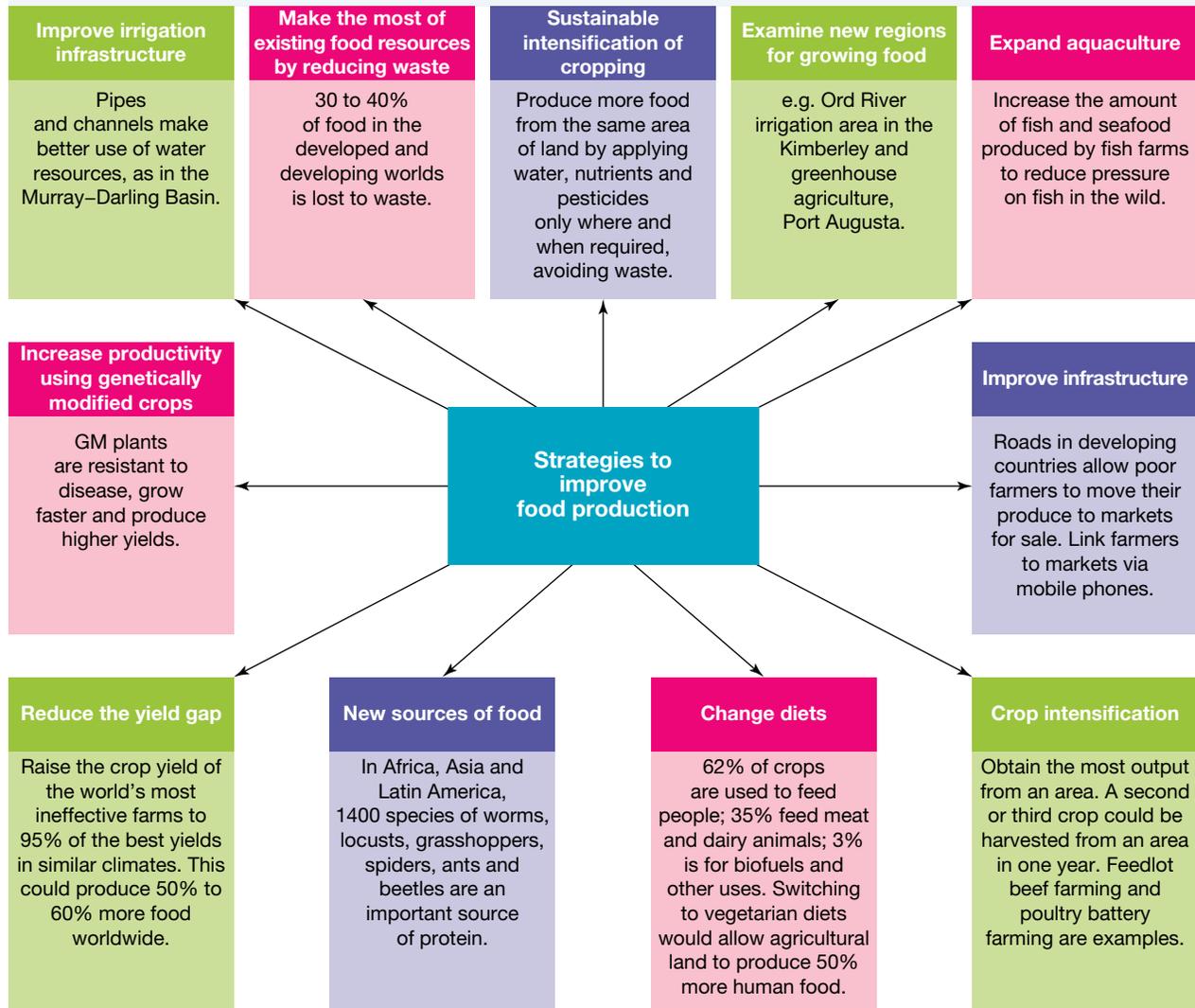
The use of **genetically modified** (GM) foods has increased, and this has also increased crop yields. However, there is some opposition to GM crops because of concerns about:

- 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.

yield gap the gap between a certain crop's average yield and its maximum potential yield

genetically modified describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques

FIGURE 2 Strategies for improving food production



3.7.2 Innovative production solutions

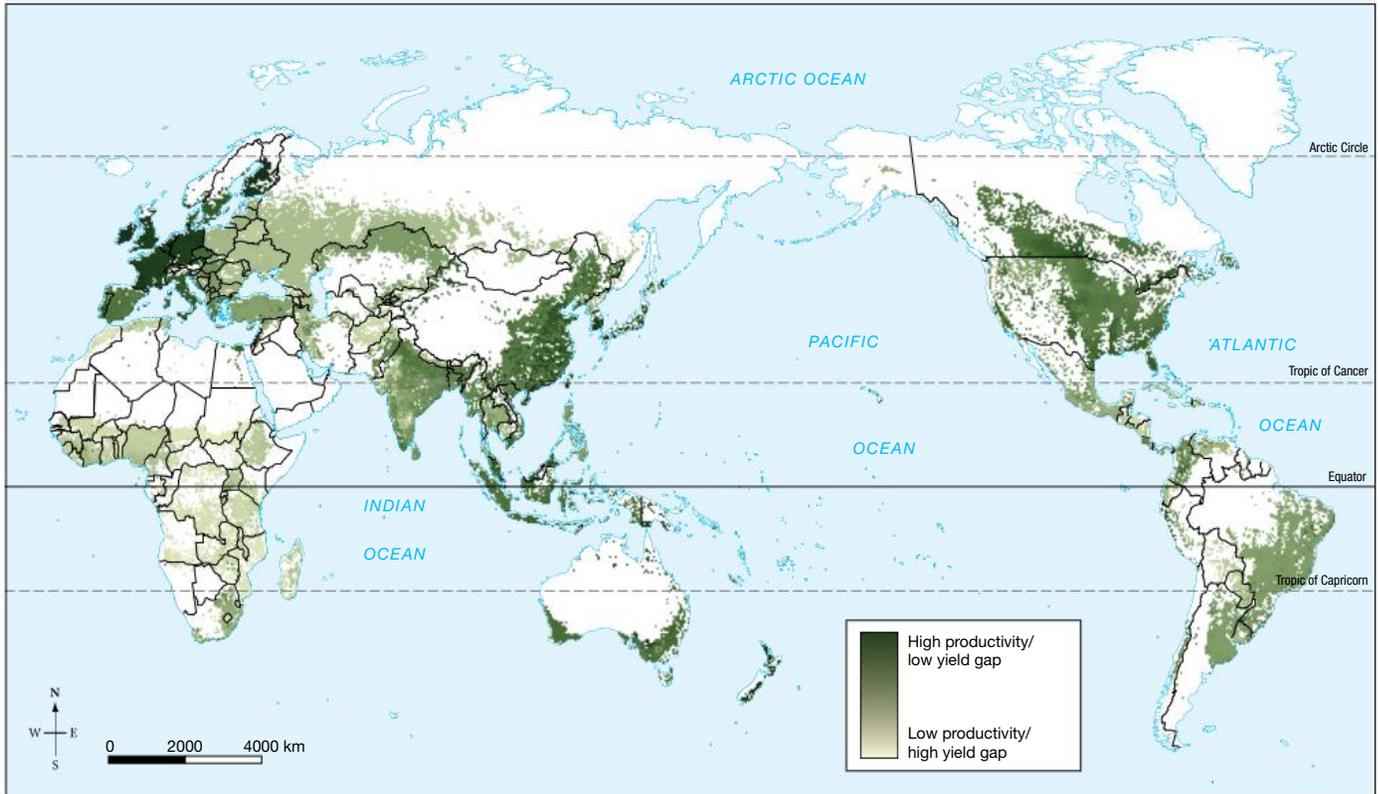
Because agriculture uses around 70 per cent of the planet’s increasingly scarce freshwater resources, any method that can produce food without needing fresh water at all is a great advance.

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.

In 2016, a 20-hectare greenhouse was opened, powered by a 115-metre solar tower with 23 000 mirrors. The mirrors concentrate the sun’s energy and the collected heat creates steam to drive electricity production, heat the greenhouse and desalinate sea water from the Spencer Gulf, producing up to 1 million litres of fresh water a day for crop irrigation. The greenhouse aims to satisfy approximately 10 per cent of Australia’s truss tomato demand and its sustainably farmed produce is already being sold at Coles supermarkets.

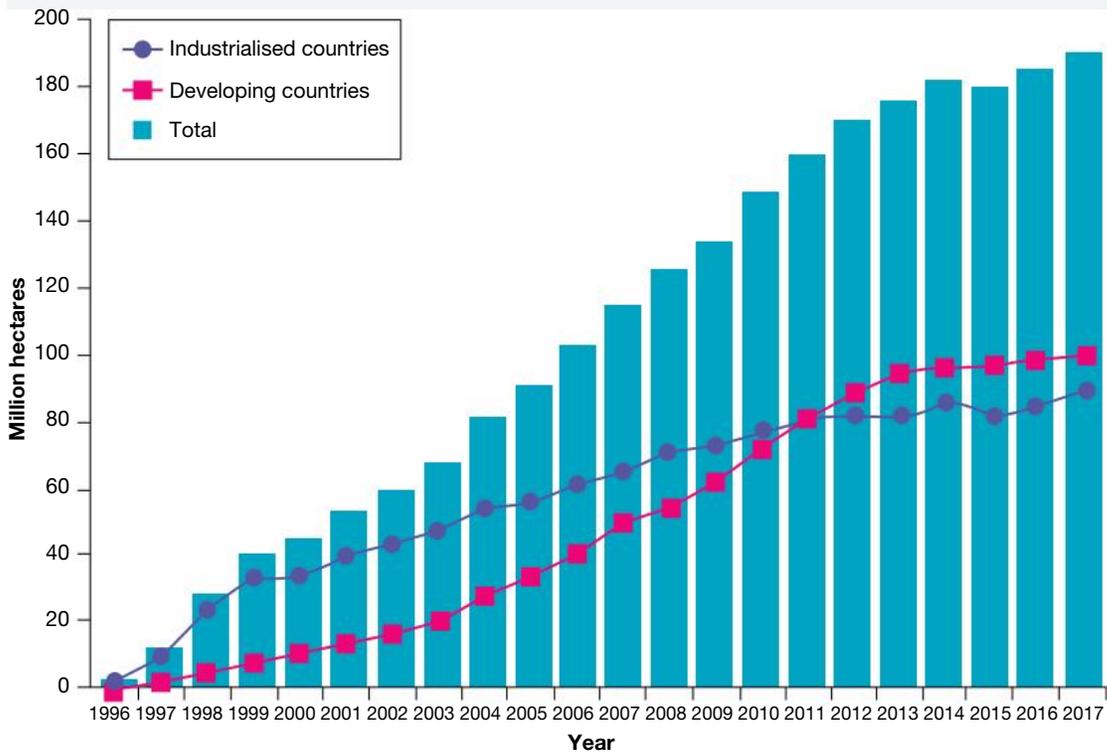
It is hoped that this type of technology can be used in more places in Australia and around the world that have hot, arid climates previously considered unsuitable for horticulture. The technology has the potential to supply millions of people with healthy food in a sustainable manner.

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 industrialised and developing countries 1996–2017



Source: © ISAAA 2017. ISAAA. 2017. Global Status of Commercialized Biotech/GM Crops in 2017: Biotech Crop Adoption Surges as Economic Benefits Accumulate in 22 Years. ISAAA Brief No. 53. ISAAA: Ithaca, NY. pp. 3 & 4.

FIGURE 5 The world's first Sundrop Farm is situated in Port Augusta, South Australia.



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 \$3.1 billion in 2019–20.
- 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 vision, laser, radar and conductivity sensors — including GPS and thermal sensors.

Food sustainability in Norway

According to the United Nations, in 2021, one in ten people went to bed hungry. The world has limited resources, so the whole world needs to focus on sustainable farming and food production if we are to ensure a stable food supply for future generations. Norway is leading the charge in sustainable farming practices, incorporating new technology to improve their farms' yields and efficiency.

In agriculture and food production, new technology includes:

- milking robots to improve animal welfare
- fertiliser produced from local manure and renewable energy
- the use of steam to clear soil of fungi, weeds and seeds
- irrigation sensors to limit water loss.

Technology is also being used to improve sustainability in Norway's food consumption. Food packaging that monitors temperature to indicate remaining shelf life has been introduced along with apps designed to monitor food expiry for consumers and restaurants.

3.7.3 Quantifying food wastage

What food have you thrown out today? Across the world, one-third of all food produced is wasted. Each year, around 1.6 million tonnes of food, worth up to \$1.2 trillion, is dumped while more than 850 million people remain undernourished. According to the United Nations' Food and Agriculture Organization, one-quarter of the food wasted each year could feed all of the world's hungry people.

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. Although the world does produce sufficient food for everyone, distribution and affordability prevent it from getting to everyone who

needs it. However, dealing with food waste could certainly help to reduce food vulnerability.

Food waste 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 1 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. Food waste now contributes 8 per cent of global greenhouse gas emissions.

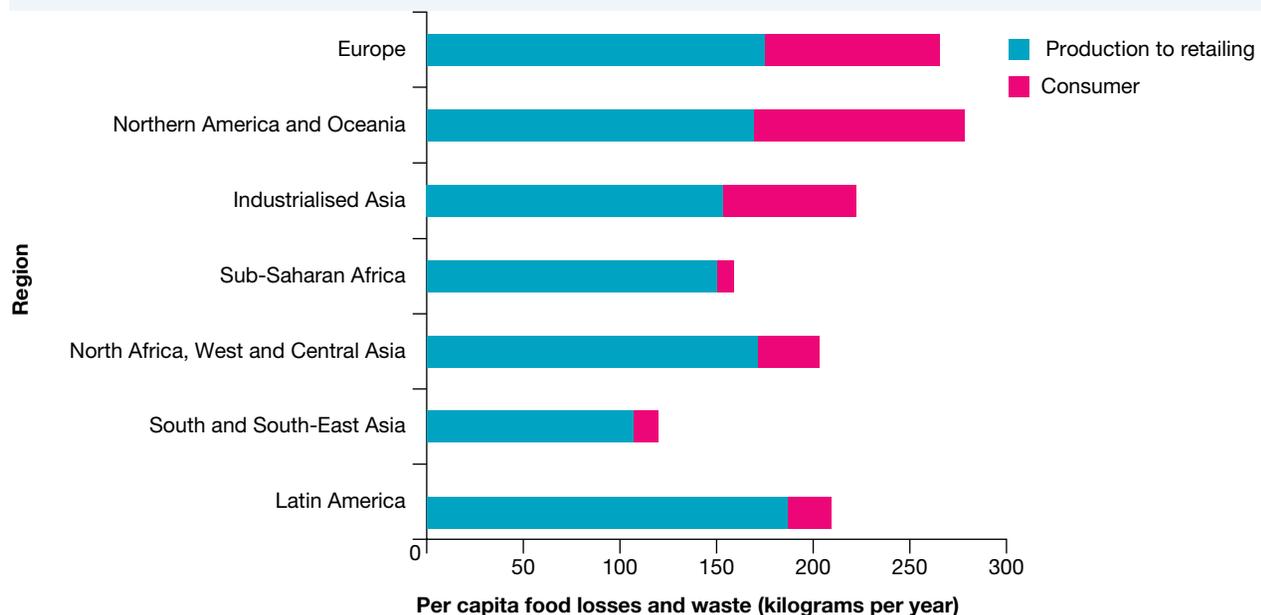
Food waste exists in all countries, regardless of their levels of development, although the causes of wastage vary. **FIGURE 7** shows the breakdown of food wastage on a regional basis.

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.

FIGURE 6 Surplus tomatoes dumped in Tenerife, Canary Islands



FIGURE 7 World food losses per region



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 unblemished, 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.

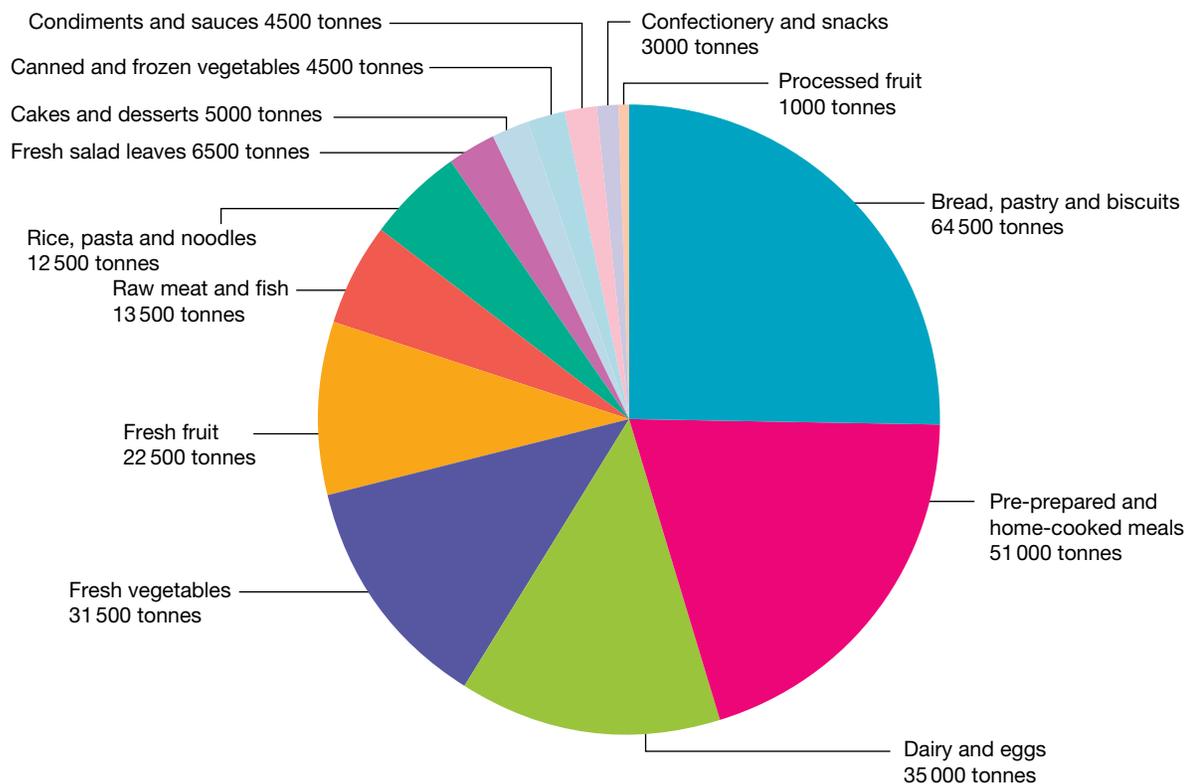
What is wasted in Australia?

Australia produces enough food for 60 million people, and this enables us to trade the surplus. Yet each person wastes an average of 361 kilograms of food each year. This costs the economy \$20 billion annually. At the same time, 4 million Australians have experienced some form of food insecurity in the past year. This means that around 18 per cent of the population have not had enough food for themselves and their family, or could not afford to purchase food at some stage over the 12-month period.

As an example of the extent of the waste in Australia, consider the example of Victoria, where food wastage costs \$5.4 billion annually. The average household throws away \$42 worth of food per week. **FIGURE 8** shows the composition of the 255 000 tonnes of food thrown into rubbish bins in Victoria each year.

tlvd-10688

FIGURE 8 Household food waste in Victoria, per year



3.7.4 Reducing 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:

- Farmers in Ghana are trialling a new phone app that shows farmers, food transporters and traders the fastest route to market, which reduces food spoilage. In addition, the app can identify illegal roadblocks set up to take bribes from drivers.
- In France, an estimated 10 million tonnes of food is wasted each year. A new law now compels restaurants to provide 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. All Parisian households have a biowaste recycling bin for food scraps. Waste is collected and converted into fertiliser or biofuels.

- 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. In South Korea 95 per cent of food waste is recycled into compost, animal feed or fuel. Landfilling of food waste is banned.
- Australia has now set a target to reduce the amount of food waste by 50 per cent by 2030. Much of this will come from supporting food rescue operations such as Second Bite and Foodbank Australia. These organisations collect and redistribute surplus food. Foodbank provides relief to 710 000 Australians every month, 26 per cent of whom are under 19 years old.

FIGURE 9 Billions of tonnes of food produced each year is wasted. This overwhelming figure must change.



3.7 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Norway is at the forefront of revolutionising the agriculture and aquaculture industries. But what are Australian farmers doing to help with food distribution and production?

- Start with the **Australia for Agriculture 4.0** weblink in your Resources panel to get you thinking about what Australian farmers are doing.
- Research** some of the innovations and developments that are happening in Australia, and how farmers here are using technology to secure Australia's food supply.
- Select** one of these innovations and answer the question, 'How will this innovation help with feeding Australia in the future?'
- Create** a video or YouTube clip which explains this innovation to the class. Be sure to include images and graphics.

on Resources

-  **Interactivity** More, or less, food (int-3329)
-  **Weblinks**
 - Vertical farming
 - WA Waste Authority
 - Australia for Agriculture 4.0

3.7 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3

■ LEVEL 2

4, 5

■ LEVEL 3

6, 7, 8, 9, 10

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- Receive immediate feedback
- Access sample responses
- Track results and progress



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Check your understanding

- What is meant by the term 'yield gap'?
 - The difference between a particular crop's average yield and its maximum potential yield
 - The sum of a particular crop's average yield and its maximum potential yield
 - A particular crop's average yield
 - A particular crop's maximum potential yield
- Determine** whether the following statements are true or false.
 - Each of the following three strategies can improve food production. Reducing food wastage, improving irrigation infrastructure and increasing aquaculture catch.
 - The use of genetically modified (GM) foods has led to an increase in crop yields.
 - According to the United Nations, 20 per cent of all food produced is wasted.
- One _____ of all food wasted each year could _____ world hunger. Like other _____ such as water, food is not evenly _____, and millions of people cannot access or afford to purchase food.

distributed

reduce

purchase

quarter

resources

- Explain** the interconnection between food waste and climate change.
- Why is there more food wasted by retailers and in homes in developed countries than in developing countries?

Apply your understanding

Interpreting and analysing geographical data and information

- Summarise** why food waste is a global problem.
- Investigate** FIGURE 7.
Which regions of the world waste the greatest amount of food in the production-to-retailing and consumer sectors? Refer to data in your answer.

Concluding and decision-making

- Consider** South Korea's and Australia's plans to reduce food waste.
 - In table form, use a dot-point summary to compare the strengths and weaknesses of each plan.
 - Which of the two plans do you think will be the most effective and why?
- Goal 12 of the United Nations Sustainable Development Goals aims to 'by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains'. **Explain** whether you think this is possible. **Justify** your reasons.
- Many Australian cities have large housing estates on their outskirts. This land was often used for market gardens or farmland. **Clarify** what impact the loss of this productive land might have on the price of food.

LESSON

3.8 How do First Nations Australians use and alter biomes for food production?

LEARNING INTENTION

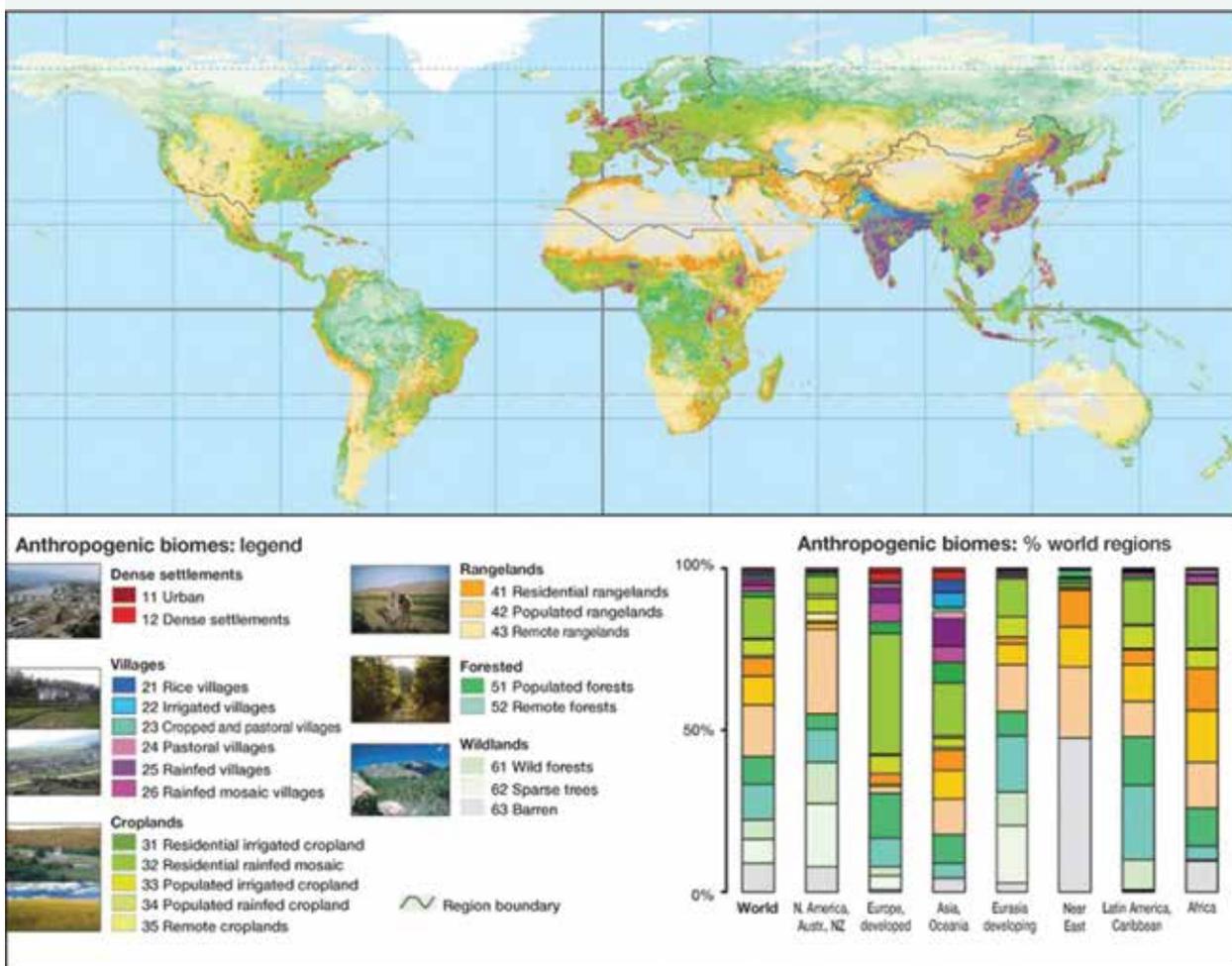
By the end of this lesson you should be able to explain how First Nations Australians manage the land and discuss how First Nations Australians use traditional methods to ensure food security.

TUNE IN

Analyse **FIGURE 1** to explore the different settlements, the use of biomes and the link between biome use and food production.

1. Which region has the most urban and densely populated settlements?
2. What do you notice about the use of biomes in the Asia, Oceania region?
3. What impact do you think this use of biomes has on food production?

FIGURE 1 Anthropogenic biomes around the world



3.8.1 First Nations Australians and land care

Prior to European colonisation, the First Nations Peoples of Australia used a complex system of land management to plan and predict plant growth. With this system they were able to attract animals for hunting. First Nations Australians used land-management techniques that worked with the environment to sustainably manage Country.

One way that First Nations Australians maintained the land, and make it productive, is through fire management. Communities used fire to create vast grasslands that, in turn, attracted kangaroos, which were then hunted for food. The use of traditional fire burning also led to a growth of biodiversity in the area. The burning encouraged the regeneration of plants for food, cooking and warmth, thus lessening the impact and danger of wild bushfires. Today, First Nations Australians continue to use traditional land-management techniques, such as fire burning.

3.8.2 First Nations Australian farming

First Nations Australians were efficient and effective farmers. Using traditional methods, they grew crops of yam daisy, grain, macadamia nut, fruits and berries.

Sustainability is a key driver for First Nations Australians. The land is their family, and they don't want to deprive it of its limited resources. To that end, First Nations Australian farmers only took what they needed and spent a great deal of time cultivating the land to ensure that what was taken could regrow.

Some of the common food farmed by First Nations Australians were:

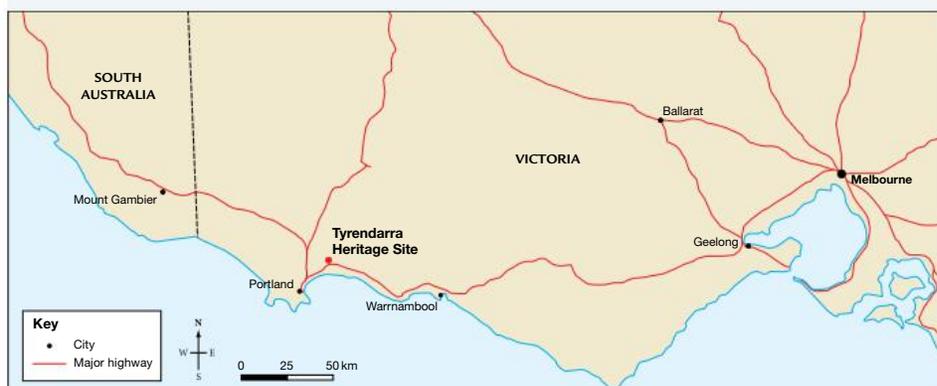
- fruits such as figs, lily pillies, quandong, bush apples and plums
- bush potatoes and yams, the bulbs of water lilies
- insects, such as witchetty grubs and green ants
- birds, such as emus, jabirus, budgies.

Farming by First Nations Australians was centred on the use of controlled fire to clear undergrowth, thin forests of trees and open clearings. And much like today's farmers, they distributed seeds and plant communities. The reason was two-fold: to provide feed for animals and shelter.

CASE STUDY: Anthropogenic biomes — The Budj Bim Cultural Landscape

In 2019, the Budj Bim Cultural Landscape near Portland, in southwest Victoria, was added to the UNESCO World Heritage List. The Budj Bim Cultural Landscape is on the land of the Gunditjmara people and is an example of an **anthropogenic biome**. That is, a biome that has been altered by human beings.

FIGURE 2 A map of the Tyrendarra Heritage Site



Source: Based on data from Natural Earth data. Map redrawn by Spatial Vision.

The UNESCO site lists the Budj Bim Cultural Landscape as having one of the world's most extensive and oldest aquaculture systems. A series of dams, weirs and channels were developed by the Gunditjmara people over 6000 years to trap, store and harvest kooyang (eels).

To capture the eels, the Gunditjmara people constructed eel traps out of the local reeds and then placed them between the stone channels. The eels would then swim up the channels in low tide and get trapped. Gunditjmara people would smoke the eels and either eat them, store them or trade them with neighbouring clans.

The Budj Bim Cultural Landscape is an example of the First Nations Australians managing and cultivating the biomes of their Country to secure their food supply. Over 100 square kilometres of constructed, modified land has been mapped, including a network of channels and connected wetlands. For more information on this sacred site and to learn more about how the Gunditjmara people managed their Country, use the weblinks in your Resources panel.

FIGURE 3 Budj Bim senior ranger Greg Shelton carrying an eel trap



3.8 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

First Nations Australians altered the biomes of Country so they could live sustainably and show care and respect for the land and environment.

1. Working in pairs or small groups, **investigate** how First Nations Australians altered biomes (such as the Budj Bim Cultural Landscape) for food, fibres and production.
2. How did these changes affect the environment?
3. Report your findings as a website (using website builders such as Weebly or Google Sites). You will need to include maps and images of how the landscape was changed, and any potential environmental consequences.

on Resources

-  **Weblinks** The Budj Bim Cultural Landscape
UNESCO Budj Bim Cultural Landscape Listing
The detective work behind the Budj Bim eel trap

3.8 Exercise

learn **on**

3.8 Exercise

Learning pathways

■ **LEVEL 1**
2, 3, 4

■ **LEVEL 2**
1, 5

■ **LEVEL 3**
6, 7, 8, 9, 10

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Check your understanding

1. In what year was the Budj Bim Cultural Landscape added to the UNESCO World Heritage List?
A. 2022
B. 2004
C. 2019

2. First Nations Australians used controlled burning to attract sources of food and to safely manage the land. True or false?
3. Some of the common foods farmed by First Nations Australians were:
 - A. witchetty grubs.
 - B. kangaroos.
 - C. emus.
 - D. bush apples.
 - E. All of the above.
4. An _____ biome is a biome that has been altered by human beings.
5. How is the Budj Bim Cultural Landscape an example of an anthropogenic biome?

Apply your understanding

Communicating

6. **Describe** how fire was used in First Nations Australian farming.
7. **Explain** how the fire-management techniques of First Nations Australians can be applied to today's land management.

Concluding and decision-making

8. **Summarise** why sustainability was a key driver for First Nations Australian farmers.
9. **Discuss** why the Budj Bim Cultural Landscape was added to the UNESCO World Heritage List.
10. **Reflect** on **FIGURE 2** in lesson 3.7. Based on what you have learnt about the way First Nations Australians use and alter biomes for food production, what strategies are being used to improve food production?

LESSON

3.9 INQUIRY: Famine crisis report

LEARNING INTENTION

By the end of this lesson you should have a comprehensive understanding of food security in relation to famine crises.

Background

While many countries across the globe face food insecurity, it is rare for a country or region to be officially declared in famine, the worst form of food insecurity. By definition, a famine is an extreme crisis of access to adequate food, resulting in widespread malnutrition and loss of life due to starvation and infectious diseases. While the number of famines is on the decline, the twentieth century saw more than 70 million people die from famine across the globe.

There are three key indicators that the United Nations uses to identify and declare a famine:

1. Twenty per cent of the population experiences an acute shortage of food, eating only small amounts of one or two of the twelve food groups (usually grains) and cannot access four litres of safe water per person per day.
2. More than 30 per cent of children are acutely malnourished.
3. Within the community, two adults or four children out of every 10 000 are dying of malnutrition and disease each day.

People who are experiencing famine have lost the means of earning an income and have few, if any, resources to sustain themselves. In general, there is no one cause of famine; rather, it is a series of overlapping factors including climate extremes, crop failures, poor governance and, most importantly, conflict. Conflicts, such as civil wars, can prevent people from producing food, create large-scale movement of people fleeing the fighting and prevent aid from reaching people. Often governments do not have the resources, planning or will to deal with the issue and international assistance is needed.



Your inquiry task

Conduct **research** into and prepare a report explaining the situation in relation to a famine crisis. This could be a current famine, or one that has occurred in recent years. Your research report should allow you to fully **explain** the famine situation to the UN, and help them to formulate a response.

Before you begin

Access the **Inquiry rubric** in the digital documents section of the Resources panel to guide you in completing this task at your level. At the end of the inquiry task you can use this rubric to self-assess.

Inquiry steps

Step 1: Questioning and researching using geographical methods

- What are the factors contributing to the famine?
 - **Describe** the factors that have caused the famine, and if possible, which factors were particularly important.
- What are the impacts of this famine?
 - **Describe** the impacts of the famine. Try to **identify** what might be short-term and long-term impacts of the famine.
- What are the responses to the famine?
 - In your research try to find what is being done about the famine. You can look at this at the national scale and the international scale.

Step 2: Interpreting and analysing geographical data and information

Create a table that describes three different types of responses to famine in general. You might need to look at other recent famines and how they were dealt with or **investigate** what steps organisations such as World Vision take in assisting people experiencing famine. For each response **suggest** possible advantages and disadvantages.

Step 3: Concluding and decision-making

- From your study, **suggest** ways that the UN can assist the people and country experiencing the famine. For ideas, you may wish to research how the UN has responded to famines in the past. As you are the expert, recommend how you think the country could improve its food security in the future.
- Prioritise the top two or three actions the country should take and **justify** their importance.
- What is likely to happen over the next few years as the country recovers from the famine? You might be able to **predict** different scenarios.

Step 4: Communicating

Your report and presentation to the UN should include:

- a brief snapshot of the country, including details of population, life expectancy, GDP, and one or two other relevant features
- a location map that shows that region/country suffering from the famine
- data on the number of people affected, death rates and other relevant statistics
- details of the short-term and long-term impacts of the famine
- a table that **describes** three different types of responses to famine in general, and that **suggests** possible advantages and disadvantages of each response
- a recommendation about how the UN can assist the people and the country experiencing the famine, and how the country can improve its food security in the future
- a reference list detailing your information sources

You may wish to prepare a PowerPoint presentation to present key aspects of your research and your recommendations.

Complete your self-assessment using the **Inquiry rubric** or access the 3.9 exercise set to complete it online.



on Resources

 **Digital document** Inquiry rubric (doc-39693)

LESSON

3.10 Investigating topographic maps — Lake Victoria as a food source

LEARNING INTENTION

By the end of this lesson you will be able to locate and describe the features of the Lake Victoria area from a topographic map, and discuss how changes to the environment might affect food production in the area.

3.10.1 Lake Victoria

Lake Victoria, with a surface area of 68 800 km², is Africa's largest freshwater lake and a source of water for the Nile River. The lake supports a population of over 30 million people in east Africa through fishing, agriculture, local industry, forestry, hydro-electric power, transport and tourism.

Lake Victoria is shared by Uganda, Kenya and Tanzania, and its catchment area includes Rwanda and Burundi.

High levels of hunger exist within the densely populated communities (see **FIGURE 1**) that live around Lake Victoria. Crops grown within the river catchment include beans, coffee, cotton, maize, sisal (a fibrous plant used for making rope), sugarcane and tobacco.

The lake also supports a productive fishing industry (**FIGURE 2**); however, fish stocks in recent years have declined due to overfishing and increased environmental pressures. Invasive weeds, such as the water hyacinth, have contributed to a decline in fish stock, increased the incidence of waterborne diseases, reduced water quality and increased turbidity.

FIGURE 1 Densely populated areas along the shores of Lake Victoria

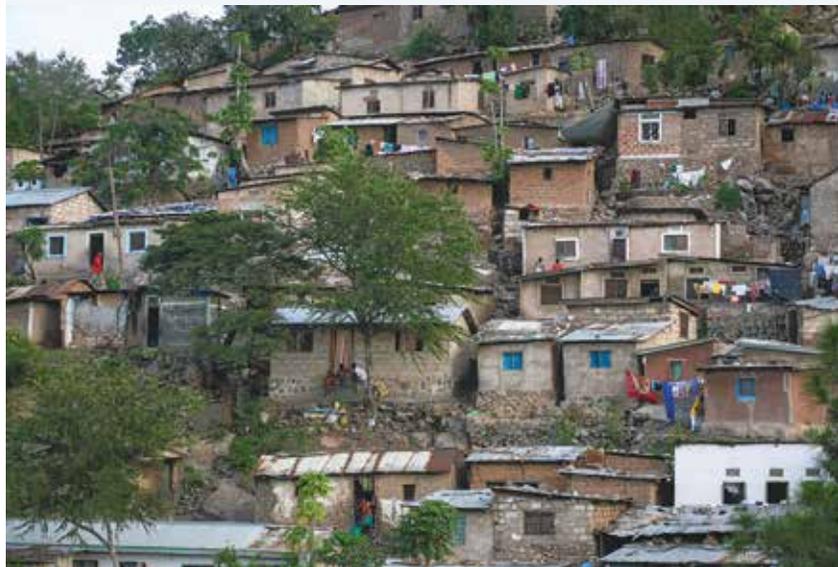


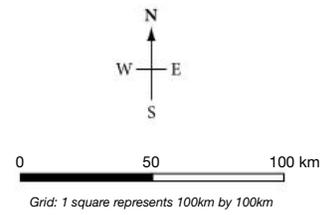
FIGURE 2 Fishermen carrying their catch from Lake Victoria onshore



FIGURE 3 Topographic map extract, of Lake Victoria



Legend	
1271	Spot height
	Airport
KAMPALA	Capital city
Itari	Populated place
	International boundary
	Provincial boundary
	Highway
	Major road
	Minor road
	Railway
	Index contour
	Contour (interval 250 m)
	River
	Stream
	Water body
	Forest
	Swamp
	Urban area
	National park or reserve



Source: Map data © OpenStreetMap contributors, <https://openstreetmap.org>. Data is available under the Open Database Licence, <https://opendatacommons.org/licenses/odbl/>; elevation data sourced from USGS. Map drawn by Spatial Vision.

on Resources

-  **eWorkbook** Investigating topographic maps — Lake Victoria as a food source (ewbk-10628)
-  **Digital document** Topographic map of Lake Victoria (doc-36318)
-  **Video eLesson** Investigating topographic maps — Lake Victoria as a food source — Key concepts (eles-6117)
-  **Google Earth** Lake Victoria

SkillBuilders to support skill development

- 1.6 SkillBuilder: Describing patterns and correlations on a topographic map
- 1.8 SkillBuilder: Constructing and describing a transect on a topographic map

3.10 Exercise

learnon

3.10 Exercise

Learning pathways

■ **LEVEL 1**
1, 2

■ **LEVEL 2**
4, 6

■ **LEVEL 3**
3, 5

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Check your understanding

Refer to **FIGURE 3** to answer the following questions.

1. List the names of each of the countries that share the edge of Lake Victoria.
2. Which country is to the east of Lake Victoria?
3. How many kilometres would a plane travel on a trip from Entebbe airport to Mwanza airport, then to Kisumu airport, before a return trip to Entebbe?

Apply your understanding

4. **Explain** the factors that lead to the high levels of hunger in the communities around Lake Victoria. In your explanation, outline whether the factor could be considered political, economic, environmental or social/cultural.
5. What impacts are humans likely to be having on the water quality of Lake Victoria? Predict whether and how the water quality will change in the next 50 years.
6. Refer to **FIGURE 3**. Propose one strategy that would help the three countries in which Lake Victoria is located to manage the resources in the lake equitably.

FIGURE 4 True colour satellite image, Lake Victoria, Africa



LESSON

3.11 Review

Hey students! Now that it's time to revise this topic, go online to:



Review your results



Watch teacher-led videos



Practise questions with immediate feedback

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3.11.1 Key knowledge summary

Use this dot point summary to review the content covered in this topic.

3.2 What is global food security?

- Food security means having a sufficiently healthy and reliable daily diet.
- The proportion of people who have food security is not distributed evenly around the world.
- People who do not have food security suffer from illnesses and a shorter life expectancy.
- There are several interconnected reasons for global food insecurity.

3.3 What was the impact of land loss on food security?

- The global loss of productive land essentially comes from land degradation and/or competition from other land uses.
- The main types of land degradation are erosion, salinity, desertification, pest invasion and loss of biodiversity.
- Fertile farmland is often converted to urban land as cities expand.
- Many countries now aim to improve their food security by investing in land and agricultural businesses in other countries, but there can be social, economic and environmental impacts.

3.4 How does access to water supplies impact food security?

- To provide a growing world population with food security there needs to be water security as well; both quantity and quality are important.
- There is an interconnection between increasing demand for water, population growth and climate change predictions.
- A number of economic, political and social factors contribute to growing water shortages.

3.5 What challenges does climate change pose for food security?

- Climate change will create both positive and negative impacts on the environment, societies, food production and food security.
- Farming in many places of the world will benefit from changes in climatic patterns while other places may suffer from changed climate conditions.
- People living in countries that are ill equipped to cope with changing climatic conditions run the risk of food insecurity and the possibility of becoming environmental refugees.

3.6 How will we feed the future?

- One in nine people on Earth do not have enough to eat, while around a quarter of the population is overweight.
- Hunger kills more people each year than disease.
- The distribution of the world's arable land is uneven, and the fastest-growing parts of the world do not have enough land to grow sufficient food for this expanding population.
- Seventy per cent of the world's poorest people live in rural areas where trade is limited.
- Improving roads and other infrastructure would improve opportunities for trade.
- As urban areas grow, the amount of available arable land decreases.

- Farming yields are affected by a variety of factors, such as access to water, length of growing season, climate, soil types, access to finance and markets, impacts of insects and diseases, funds allocated to agricultural research, government regulations and policies, and the impact of weather events such as floods, storms and drought.
- Better use of current farming areas, better use of technology and more efficient methods of farming will improve food production.

3.7 How do we improve food production and distribution?

- Strategies to improve food production include reducing the yield gap, developing genetically modified (GM) crops, expanding aquaculture, improving infrastructure, and developing sustainable intensification of cropping.
- There are some concerns over the use of GM crops, including health risks and loss of seed variety.
- In Australia, there is an experimental greenhouse farming facility in Port Augusta, which produces fresh vegetables; other developing technologies are also being tested for their application in improving efficiency in agricultural production.
- Norway is developing innovative new technology and approaches to improve its food production capability and make it more sustainable.
- There is sufficient food being produced to feed the world's population. However, it is unevenly distributed, unaffordable and wasted.
- Food wastage occurs everywhere, but more is wasted in developed countries, especially in the retail and home sectors.
- Several different countries, including Australia, are trialling new methods to reduce food waste.

3.8 How do First Nations Australians use and alter biomes for food production?

- First Nations Australians use a complex system of farming and land-management techniques.
- First Nations Australians used fire to create productive farms.
- The Budj Bim Cultural Landscape is an example of an anthropogenic biome.

3.9 INQUIRY: Famine crisis report

- While the number of famines is on the decline, the twentieth century saw more than 70 million people die from famine across the globe.

3.10 Investigating topographic maps – Lake Victoria as a food source

- The lake supports a population of over 30 million people in east Africa through fishing, agriculture, local industry, forestry, hydro-electric power, transport and tourism.
- Lake Victoria is shared by Uganda, Kenya and Tanzania, and its catchment area includes Rwanda and Burundi.

3.11.2 Key terms

anthropogenic resulting from human activity (man-made)

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

desertification the transformation of arable land into desert, which can result from climate change or from human practices such as deforestation and overgrazing

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

genetically modified describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques

indicators things that provide a pointer, especially to a trend

jatropha any plant of the genus *Jatropha*, but especially *Jatropha curcas*, which is used as a biofuel

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

potable drinkable; safe to drink

undernourished describes someone who is not getting enough calories in their diet; that is, not enough to eat
water stress situation that occurs when water demand exceeds the amount available or when poor quality restricts its use
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
yield gap the gap between a certain crop's average yield and its maximum potential yield

3.11.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

How do we protect the world's food security for today and tomorrow?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question, outlining your views.

on Resources



eWorksheets Customisable worksheets for this topic (ewbk-13448)
Reflection (ewbk-10629)
Crossword (ewbk-10630)



Interactivity Food security crossword (int-8249)

3.11 Review exercise

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Receive immediate feedback and access sample responses



Access additional questions



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Multiple choice

- Which of the following statements are true about food security?
 - Food security means having a sufficiently healthy and reliable daily diet.
 - The proportion of people who have food security is not distributed evenly around the world.
 - People who do not have food security suffer from illnesses and a shorter life expectancy.
 - All of the above.
- Which of the following is one way that governments can attempt to prevent food shortages?
 - Stockpiling food when production is high
 - Charging people less for food
 - Preventing imports to their country
 - Refusing to accept food aid
- What is the interconnection between urbanisation and food security?
 - As cities expand, more food is produced in their suburbs.
 - As cities expand, they tend to invade surrounding food-producing areas.
 - Smaller cities lead to a larger crop yield.
 - Big cities have wealthy populations who are food secure.
- How might foreign owners benefit from owning farmland in Australia?
 - Financial gain
 - Food production
 - Improved food security
 - All of the above
- Which type of cropland is predicted to be the most changed by a 1-metre rise in sea level in Asia?
 - Groundnut
 - Oilseed
 - Maize
 - Wheat
 - Rice
 - From the options below, select the three countries that will be most at risk of losing cropland.
 - China
 - Bangladesh
 - Vietnam
 - India
 - Myanmar
 - Thailand
 - Indonesia

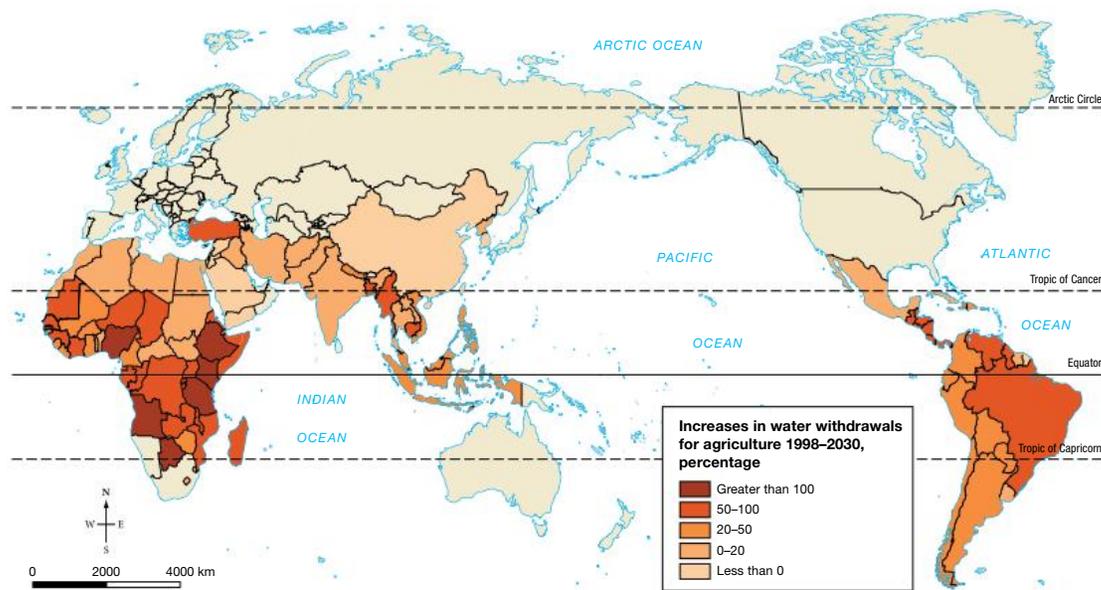
6. Which of the following would be a positive factor affecting the world's ability to produce enough food to feed everyone sustainably by 2050?
- A. There will be a growing population at a world scale and increasing populations in some regions so food supply will not meet demand.
 - B. Transporting crops and food will become difficult and expensive as petrol and transport costs increase.
 - C. Changing climatic conditions will have altered growing regions for some crops.
 - D. Technology will allow previously unusable land to be used for agriculture.
 - E. There may be a shortage of water and the difficulty of irrigation in areas where climate conditions have changed.
 - F. There may be a growing appetite for meat as economies become more developed.
7. Identify the reasons for supplying food aid for Cambodia.
- A. Life expectancy is lower in Cambodia than in Australia.
 - B. It is much warmer in Cambodia and food perishes faster.
 - C. Literacy rates are lower in Cambodia than in Australia.
 - D. Under-5 mortality rates are higher in Cambodia than in Australia.
8. Which three water-stressed places of Australia might be able to sustainably use greenhouse food production?
- A. Places with irregular rainfall such as inland Australia
 - B. Coastal regions not previously opened up to agriculture
 - C. Coastal areas with low rainfall
 - D. Inland areas with salty groundwater
9. a. Which of the following food categories provided the largest average calorie intake (per person per day) across the globe in 2009?
- A. Grains
 - B. Meat
 - C. Vegetables
 - D. Fruits
- b. Which of the following food types is expected to decrease in consumption in developing countries between 1999 and 2030?
- A. Wheat
 - B. Rice
 - C. Vegetable oils
 - D. Sugar
10. Which of the following statements is true?
- A. The yield gap between developed and developing nations is small.
 - B. Developed countries have the best chance of increasing gap yield as opposed to developing nations.
 - C. China could increase the gap yield if they had access to disease-free strains of potatoes.
 - D. None of the above.

Short answer

Communicating

11. Study the information in **FIGURE 1** shown below.

FIGURE 1 Predicted increases in water use for agriculture 1998–2030



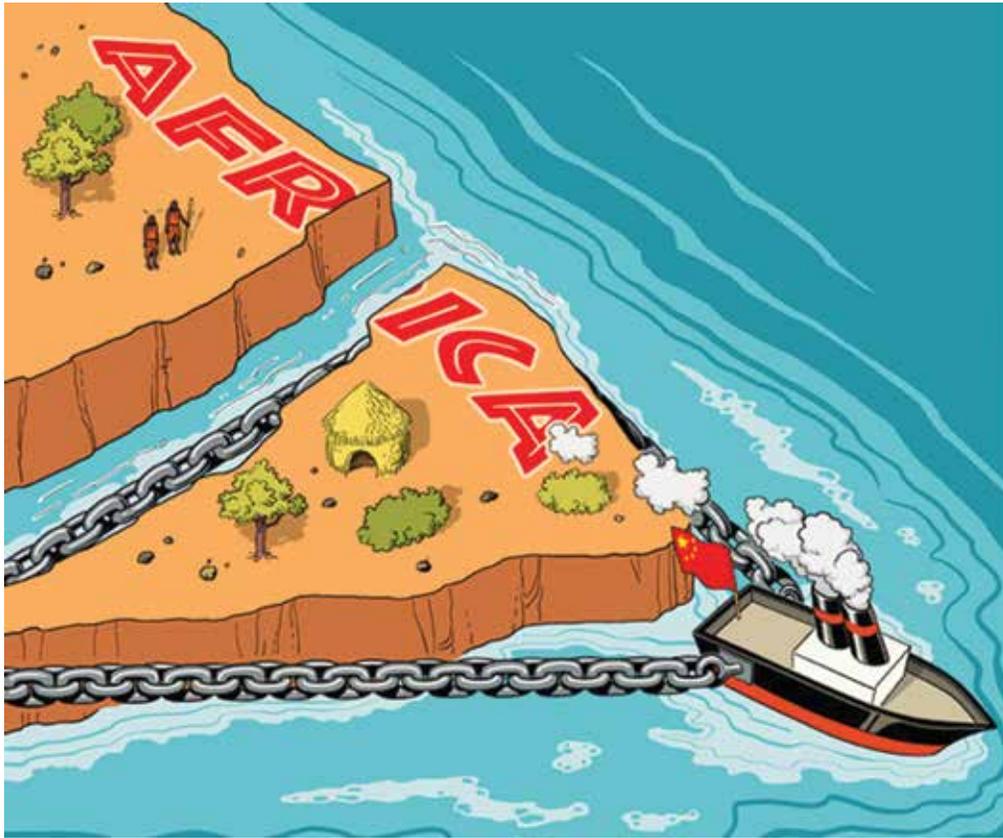
Source: Map drawn by Spatial Vision.

Describe the distribution pattern of countries that are predicted to withdraw over 100 per cent more water in the years to 2030.

Suggest a reason why Australia, the United States and countries in Europe are not in this category.

12. Refer to **FIGURE 4** in section 3.3.1. The original land use for this location was tropical rainforest.
- Why might this area have been cleared?
 - Is this a suitable landscape for such extensive clearing? **Explain** your answer.
13. **Predict** what might happen to some of the 53 000 people living independently in Australia if Meals on Wheels could not deliver meals to them.
14. 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. **Discuss** the advantages and disadvantages of this scheme.

15. What is the cartoon below trying to tell us? **Summarise** the point of view about land grabs that is being expressed in this cartoon.



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4 Connecting with our places

LESSON SEQUENCE

4.1 Overview	159
4.2 How do perceptions of land vary?	160
4.3 How do we access places?	165
4.4 INQUIRY: Designing a sustainable garden	170
4.5 How is Australia connected globally through export and import trade?	171
4.6 How does trade connect us?	175
4.7 What is Australia's contribution to the global trade industry?	184
4.8 Is international trade fair?	193
4.9 How do Australians use technology to communicate and interconnect?	199
4.10 What is a digital divide?	204
4.11 Why is e-waste presenting such significant challenges?	209
4.12 Investigating topographic maps — Norway — the best place on Earth	216
4.13 Review	219



LESSON

4.1 Overview

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Exciting or dull, familiar or strange? How can the same place look and feel different for each person?

4.1.1 Introduction

The way we interact with places is dynamic: we change places and places change us. In a world of eight billion people, we have many different perceptions of what a place is like, how it is used and how it could be improved.

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.

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.

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 technology, some of those places may be imagined. What do our connections look like today, and how will they change tomorrow?

FIGURE 1 Rock art is part of the history and tradition of the place in which it is found. Here Willie Gordon, a Nugal-warra Elder, explains the painting found in Cooktown, Queensland.



perception the process by which people translate sensory input into a view of the world around them

ethnicity cultural factors such as nationality, culture, ancestry, language and beliefs

on Resources



eWorkbook

Customisable worksheets for this topic (ewbk-13450)



Video eLesson

Making connections (eles-1722)

LESSON

4.2 How do perceptions of land vary?

LEARNING INTENTION

By the end of this lesson you should be able to give examples of peoples from around the world who are closely connected to the land and explain why their way of life may be under threat from modern ways of living.

TUNE IN

Different people have different perceptions and, therefore, connections with the land.

FIGURE 1 Inuit hunter



1. Why would this environment be challenging for the people who live in the Arctic region?
2. What type of food sources do you think the Inuit people could access through their connection with the land and the sea?

4.2.1 Why is a connection with the land so important?

Land means different 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 it as an area that can be divided, built upon and sold for a profit.

In today's world there are many First Nations Peoples still very closely connected to the biophysical elements of the land through their nomadic hunting and gathering, or forest gardening. However, modern technology and contact with developed nations' ways of life have had significant impacts on their livelihoods. These people practise what is called traditional subsistence agriculture and may also have access to local markets to buy and exchange food and goods. The practices have minimum impact on the environment and hence are highly sustainable ways of living.

Some of the peoples of the world that are still involved with traditional cultural practices closely connected with the land include the San (or Kalahari Bushmen) in southern Africa; Huli of Papua New Guinea; Maasai in Kenya; Berbers in north Africa; Sami of Scandinavia; Uyghurs in China; Ainu in Japan; Inuit in Greenland and Alaska; and Yanomami in the Amazon Basin.

FIGURE 2 Maasai



FIGURE 3 Sami



FIGURE 4 San peoples, also known as the Kalahari Bushmen



FIGURE 5 Uyghurs



FIGURE 6 Ainu



4.2.2 Hunters and gatherers: the San

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 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.

FIGURE 7 A San tribesman teaches his son how to use a bow and arrow



4.2.3 Nomadic herders: the Bedouin

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.

FIGURE 8 A Bedouin camp in Saudi Arabia



4.2.4 Shifting agriculture: the Huli

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

The Huli people 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; it is the role of the women to tend these gardens. 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.

FIGURE 9 A map showing Huli land, Papua New Guinea



Source: Map drawn by MAP graphics Pty Ltd, Brisbane.

FIGURE 10 Huli tribesman, Papua New Guinea



4.2 SKILL ACTIVITY: Concluding and decision-making, Communicating

1. With your class, make a list of the places or landmarks in your community that you use on a regular basis.
2. Each student should rate the importance of each on a scale of 1 to 3, with 3 being the most important.
3. Collate the data to find out which places are most and least important to your class.
4. **Analyse** whether the results are as you expected.
5. Do they match your own perceptions of how important places are, or do you have a different view from your classmates?
6. **Explain** why there might be similarities or differences.

4.2 Exercise

learnon

4.2 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3

■ LEVEL 2

4, 7, 8

■ LEVEL 3

5, 6, 9, 10

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Check your understanding

1. **Determine** whether the following statements are true or false.
 - a. Extensive agriculture is an example of traditional food production.
 - b. There are no remaining peoples still involved with traditional cultural practices closely connected with the land.
2. The Bedouin people live in the countries of the Arabian Peninsula and the Sahara. These include
 - A. Iraq.
 - B. Syria.
 - C. Jordan.
 - D. All of the above.
3. Factors that may influence our perception of place include
 - A. culture.
 - B. experiences.
 - C. values.
 - D. All of the above.
4. From the list in question 3, **identify** which factor you think is the most influential. Why?
5. **Discuss** what land means to you. Think about where you live or where you come from to help describe the interconnection you have with land.
6. **Discuss** the main responsibilities a community has to protect Country.
7. **Distinguish** which of the following is *not* true about being a custodian of the land.
 - A. A custodian cares for the land without actually owning the land.
 - B. A custodian is an owner of the land.
 - C. The land will exist long after the person has gone.
 - D. First Nations Australians view themselves as custodians of the land.

Apply your understanding

Communicating

8. The establishment of European colonies forced many people off their Country. **Consider** how this changed their relationship with the land.
9. **Discuss** why you think the opening of the federal Parliament is preceded by a 'Welcome to Country' ceremony.

Concluding and decision-making

10.
 - a. In 2019 widening of the Western Highway near Ararat in Victoria was realigned to save two birthing trees. **Elaborate** why this can be seen as an important decision taken by the Major Road Projects Authority.
 - b. In 2020, this decision was reversed. **Suggest** why this may have been the case and **justify** your response to this decision.

LESSON

4.3 How do we access places?

LEARNING INTENTION

By the end of this lesson you should be able to discuss and analyse the ways in which we are globally connected.

TUNE IN

Travelling around an area or region can take many forms, such as on foot, by car, bus, train, ferry or even aeroplane.

1. Why would people in Brisbane use a ferry to travel to a destination?
2. What forms of transport do you know about or have used to connect to places in your local area?

FIGURE 1 The Brisbane river can be travelled by ferries.



4.3.1 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**.

Our changing needs

With any population growth, governments at all levels must consider how they will meet changing transport needs. Technological developments have allowed us to make better decisions for our use of public transport. Many people now use 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 people depend upon public transport to access jobs, services, education and recreation.

Different forms of public transport have different uses

Trains move large numbers of people over long distances at high speed in and out of the central business district (CBD). Greater traveller access is created by routes winding across the city; the fewer stops made by trains and the speed at which they can cover distance increases travellers' ability to connect with places. Ferries serve a similar purpose, in terms of alleviating traffic on roads, taking commuters directly to places that can be accessed more easily by river or sea routes.

In Brisbane, the Brisbane City Council is responsible for sustainably developing Brisbane's transport network to cater for future needs. One of its most recent projects is the Brisbane Metro, which will improve access to the CBD.

infrastructure the facilities, services and installations needed for a society to function, such as transportation and communications systems, water pipes and power lines

FIGURE 2 Map of the Brisbane Metro



Source: Brisbane Metro | Brisbane City Council.

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; they are able to change routes as there is no fixed rail system involved. Buses, and to some extent trams, ferry people to and from train stations, adjusting timetables and reorganising routes to match the train network.

4.3.2 User perception of public transport

Conducted quarterly online, the Transport Opinion Survey gathers the views on public transport of 1000 adult Australians. In September 2021, 24 per cent of those surveyed said public transport was a top priority. Only 17 per cent of those surveyed thought Australia’s transport systems would be better within a year; just 16 per cent felt that local public transport would be improved within a year; and 35 per cent of those surveyed

thought the transport system they were using would be better in five years' time. The perceptions that people have about public transport influence how they use it. Factors that influence this perception include:

- weather conditions
- uncertainty about when the next bus or train will arrive
- 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.

4.3.3 Active travel

Any transport that requires physical activity, such as cycling or walking, is called active travel. In the 2021 Census, of the 9.212 million Australians who commute, only 3.2 per cent participated in **active travel**. This is an area that the states and territories see as an opportunity to not only reduce carbon footprints, but also to improve liveability.

Perth is working to improve its rates of active travel through the design of more user-friendly bike paths (see **FIGURE 3**) that connect places through the city, while also encouraging people through the Department of Transport's Your Move program. Perth's bike paths and trails continue to grow in number, providing increased access to places, including dedicated cycling lanes on roads and extensive river and coastal cycling routes. Laws also changed in 2016 to allow people of all ages to cycle legally on the footpath.

Throughout Australia, there are various different programs that encourage active travel including bicycle and electric scooter (e-scooter) hire schemes. They encourage active travel by connecting central hubs throughout the CBD. The City of Adelaide has provided two e-scooter operators and one bike-share operator to operate within defined areas of the city and North Adelaide. To ride an e-scooter in the city and North Adelaide, you need to be at least 18 years old. Other cities, such as Melbourne and Brisbane, also have a system of e-scooter rentals. The choice to access places by public transport, active travel or vehicle keeps people connected and strengthens interconnection in a community.

active travel making journeys via physically active means, such as cycling or walking

FIGURE 3 Safe Active Street in Mount Hawthorn, Perth



The importance of walkability

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. There is a reduced environmental impact with fewer cars on the road: 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, because 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. All of these factors work together to improve the perception of places and increase the interconnections between people and services.

FIGURE 4 The components of the '20-minute neighbourhood' concept



4.3.4 Walking to connect — the '20-minute neighbourhood'

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.

The concept of the '20-minute neighbourhood' is being implemented in some parts of Australia. For example, the creation of 20-minute neighbourhoods is central to one of the objects in 'Plan Melbourne 2017–2050' — a development plan to manage population growth, sustainability and liveability.

As **FIGURE 4** 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, a medical clinic and primary schools. Factors that make a good neighbourhood walkable are:

- *a centre* — either as a street or public space
- *mixed income and mixed use* — a range of housing types
- *people* — enough people for businesses to be successful and for public transport frequency
- *parks and public space* — for people to gather and to play
- *pedestrian design* — foot access (cars parked off street)
- *complete streets* — suited to bicycles and walking, and allowing easy movement across the place
- *schools and workplaces* — close enough to walk.

on Resources

 **Interactivity** Off the rails (int-3333)

 **Weblink** Your Move — Western Australian Department of Transport

4.3 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

1. **Select** a location on the other side of town or somewhere in your region.
2. Using a rail, ferry, bus or other public transport provider website, or an online mapping site that provides real-time traffic data, 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
 - b. Sunday evening at 6 pm.
3. How much, if any, of each trip is not covered by public transport?
4. **Suggest** how you might practically fill the gaps if you had to make this trip (e.g. walk, cycle, car).
5. What did you notice about the travel times?
 - a. Were they different?
 - b. Why do you think this is?
6. **Create** a map of your journey, using an appropriate key, to show rail, bus and other modes of transport used.

4.3 Exercise

learnon

4.3 Exercise

Learning pathways

■ LEVEL 1
1, 2, 3

■ LEVEL 2
4, 5

■ LEVEL 3
6, 7, 8

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Check your understanding

1. Determine whether the following statements are true or false.
 - a. Public transport is perceived by governments as being very important because it is relatively low-cost and can reduce traffic congestion and pollution.
 - b. The 20-minute neighbourhood is designed to improve traffic flow.
2. Determine whether the following statements are true or false.
 - a. Active travel is any transport that requires physical activity.
 - b. Active transport is used by a high amount of commuters.
3. One of the most significant aspects of public transport is the interconnection between the different forms of transport. The perceptions that people have about public transport influences how they use it. Travellers consider non-vehicle travel time to be more difficult than in-vehicle travel time. Factors that influence this perception include:
 - A. familiarity with the journey.
 - B. weather conditions.
 - C. uncertainty about when the next bus or train will arrive.
 - D. all of the above.
4. **Summarise** how you perceive the quality of your public transport. **Describe** accessibility, timeliness, cleanliness, comfort, ticketing, safety, convenience and information about the service. **Explain** your answer.
5. Do you use public transport? Why or why not?
 - a. **Explain** how interconnected the place in which you live is. **Describe** 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?

Apply your understanding

Communicating

6. **Construct** an isoline map to show the distance of services from the CBD for your local area. Using the map, **describe** the level of interconnection that exists for this area.
7. **Predict** how the development of electric vehicles and Uber travel may change the way people interconnect.
8. In a paragraph response, **propose** ways that the transport interconnections can be improved in your local area and **justify** how they will boost the perception of place and the connection of people to services.

LESSON

4.4 INQUIRY: Designing a sustainable garden

LEARNING INTENTION

By the end of this lesson you should have a comprehensive understanding of environmentally sustainable gardens and spaces and how the needs of the students can be balanced with the needs of the environment.

Background

In this inquiry you have been commissioned by the school council to design a new student leisure area that is an environmentally friendly landscaped garden. The idea is that students will connect with this area and find it a pleasant place to spend recess or lunchtime breaks.

Before you begin

Access the **Inquiry rubric** in the digital documents section of the Resources panel to guide you in completing this task at your level. At the end of the inquiry task you can use this rubric to self-assess.

Inquiry steps

Discuss the following:

1. What do you know about landscape gardening?
2. How can a sustainable landscaped leisure area be developed to suit student needs?

Step 1: Questioning and researching using geographical methods

Write your selected inquiry question based on the focus of this topic.

These inquiry questions are a guide for you to develop your own inquiry question:

- What are the causes and consequences of change in your school landscape and how can this change be managed?
- What are the future implications of changes to your school landscape?
- Why are interconnections and interdependencies important for the future of your school landscape?
- Conduct **research** into the different needs of students in terms of seating and outdoor leisure.
- Provide relevant data in table or graph form.
- Provide annotated images and maps to illustrate different aspects of your student leisure area.

Step 2: Interpreting and analysing geographical data and information

- **Create** a table which summarises the different needs that students have suggested.
- **Identify** any issues related to the concept of sustainability for your planned area.

Step 3: Concluding and decision-making

- **Conclude** your study with potential strategies to help protect and maintain the landscaped student leisure area.

Step 4: Communicating

- **Decide** how you will communicate your findings, whether it be in the form of a written report, multimedia presentation, poster or PowerPoint presentation.

Complete your self-assessment using the **Inquiry rubric** or access the 4.4 exercise set to complete it online.

FIGURE 1 Example of sustainable garden beds



LESSON

4.5 How is Australia connected globally through export and import trade?

LEARNING INTENTION

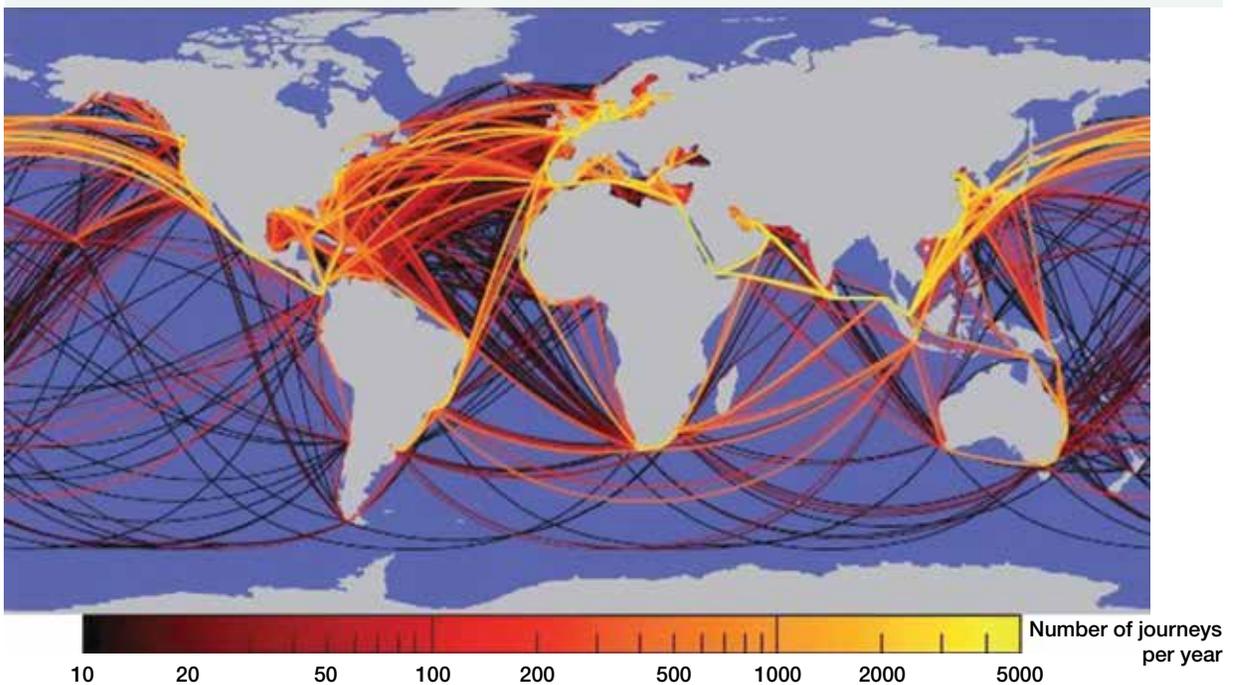
By the end of this lesson, you should be able to comment on and provide examples of interconnections through global trade in goods and services.

TUNE IN

We live in a world that is connected through many different forms of land, water and air transport that move essential goods and services.

1. Can you suggest reasons why the volume of cargo is so great between Europe and America?
2. Have you ever travelled by river or sea to a destination? If so, describe what you liked or disliked about the form of transport and the journey.

FIGURE 1 The density of major global cargo shipping routes



4.5.1 How connected are we?

Since the advent of mass transport, our world has been shrinking. We have the capability to be more connected than ever before thanks to waterways that have drawn distant places together with improved shipping access

and the cheaper, faster flights of the digital age. These developments have made travel far more accessible to more places and for more people than ever before.

4.5.2 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. In March 2021, the Suez Canal was blocked for six days after the grounding of *Ever Given*, a 20 000 TEU container ship. The 400-metre-long vessel was buffeted by strong winds and ended up wedged across the waterway with its bow and stern stuck in the canal banks, blocking all traffic until it could be freed. The obstruction occurred south of the section of the canal that had two channels, so there was no way for other ships to bypass *Ever Given*. As one of the world's busiest trade routes, the canal obstruction had a significant negative impact on trade between Europe, Asia and the Middle East. On 28 March, at least 369 ships were queuing to pass through the canal. This prevented an estimated US\$9.6 billion worth of trade. 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 six months from the United Kingdom, as it once was; with faster, bigger ships, the distance can be covered 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 (see **FIGURE 1**).

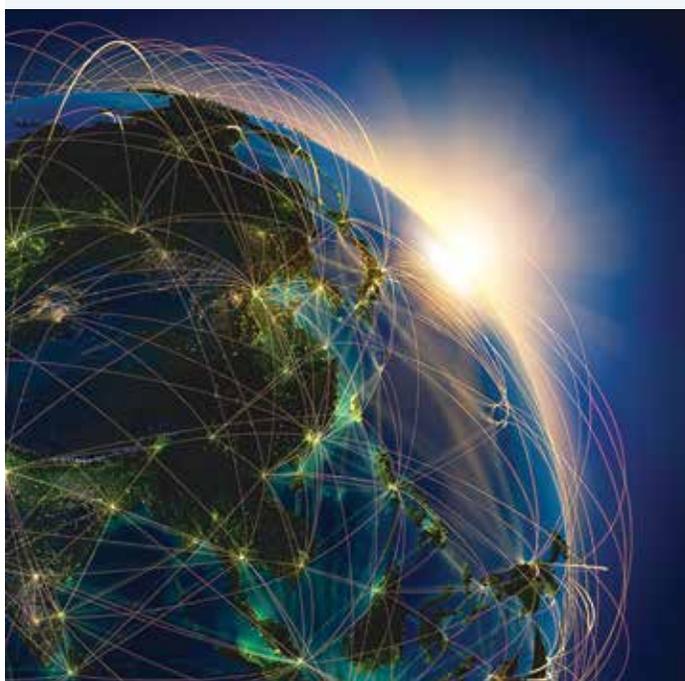
In 2019, cruise ship passenger numbers were around 30 million people, demonstrating the increasing popularity of this mode of travel. Cruise ships offered affordable holidays to a variety of places on each voyage. Cruise ships have grown much larger in size, with more berths and a greater range of on-board activities. These changes meant that access to places had never been easier. In 2020, the COVID-19 pandemic virtually shut down the entire global cruise industry.

4.5.3 How do we connect through the air?

In 2018, 4.3 billion people flew safely on 38.1 million flights for the purposes of business, tourism or reconnection with relatives. **FIGURE 2** 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 needed to access places; the Airbus 380 is able to travel to London from Melbourne in about 22 hours with one stop. Airlines are vying for technologically advanced aircraft such as the Dreamliner, which flies long haul, non-stop to London from Perth, Western Australia, in under 17 hours. Constant monitoring of the success levels of routes sees frequent adjustments to schedules and discounts offered on flights. Australians are able to

FIGURE 2 Flight patterns vary according to the time of day.



access the United States non-stop (Los Angeles, Dallas) with most flights less than A\$1000 each way; these flights are often discounted heavily.

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 website, with the product air-freighted from Hong Kong and delivered in three days!

Technological developments in transport are likely to further increase the interconnection of people around the world, making our connections easier, quicker and more frequent. In 2020, the COVID-19 pandemic significantly restricted air travel for people, but global air transport networks became vital pathways for the transport of goods, with some commercial airlines using their passenger planes to transport cargo.

DISCUSS

How did the COVID-19 pandemic affect the ways the world connected? What were the impacts on how and why people travelled? What were the impacts of cargo and freight transport routes? Did global communication and transport become more or less important? Do you think the pandemic has changed the way people and places connect forever? How can we overcome the difficulties of restricted connectivity?

4.5 SKILL ACTIVITY: Questioning and researching using geographical methods

1. Use the internet to **research** 'World traffic pattern over a 24-hour period' and watch major airlines fly into major cities over the course of one day. Choose at least two major cities to watch.
 - a. Make a list of the data as you watch it. A table format might be useful to collate your data.
 - b. Are there any differences between your cities?
 - c. What do you notice about the places being accessed?
 - d. Does access change between day and night?
 - e. Can you **explain** why international flights leave Australia late at night or early in the morning?

4.5 Exercise

learnon

4.5 Exercise

Learning pathways

■ LEVEL 1
1, 2, 3, 4, 6

■ LEVEL 2
5, 7, 8

■ LEVEL 3
9, 10

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Check your understanding

1. Refer to **FIGURE 1**. The areas where cargo shipping routes are dense are between
 - A. Australia and Asia.
 - B. Australia and the Middle East.
 - C. Africa and Antarctica.
 - D. the United States and Europe.

2. Refer to **FIGURE 1**. Regions with which size of population require greater transfer of goods?
 - A. Smaller
 - B. Similar
 - C. Higher
 - D. Decreasing
3. 'Just-in-time' manufacturing components lets manufacturers purchase and receive components just before they're needed and are an example of fast connections through the air. True or false?
4. **Explain** how the opening of the waterways has improved access to places for cargo ships.
5. Australia is circumnavigated by shipping routes. **Explain** why this might be.
6. **Summarise** the value of air travel for passengers.

Apply your understanding

Communicating

7. a. Will Australia's perceived remoteness be further reduced by 2030? **Consider** how this might be.
 b. **Describe** how a person can connect from Los Angeles, United States, to Kalgoorlie, Western Australia, by air.
8. International conflicts can have an impact on connecting goods for trade. **Analyse** how a dispute in the Pacific Ocean might affect Australian trade.
9. **Discuss** why cruise ship holidays have become so popular.
10. Our world is shrinking. **Discuss** this statement in relation to interconnections.

FIGURE 3 Loading containers for global trade



LESSON

4.6 How does trade connect us?

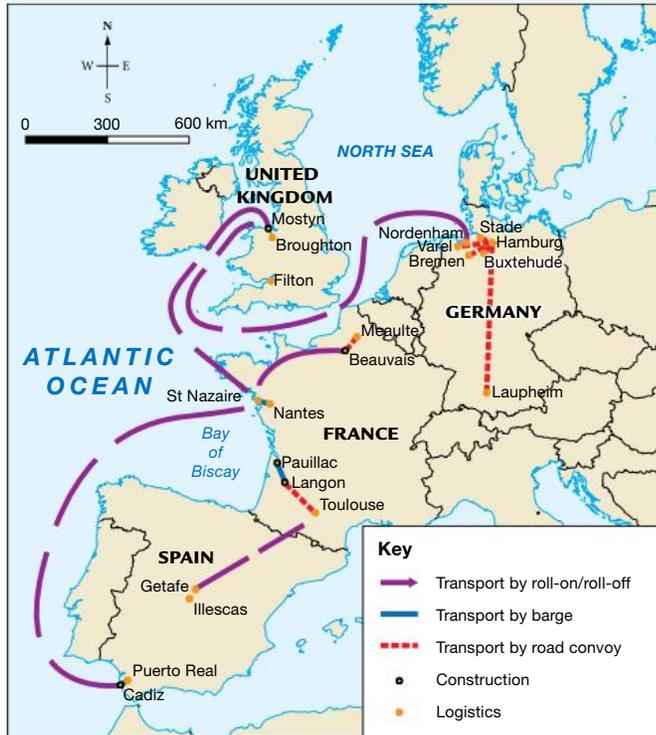
LEARNING INTENTION

By the end of this lesson you should be able to explain and give examples of how trade in goods and services helps to more evenly distribute the Earth's resources, and comment on variation in levels of consumption across the world.

TUNE IN

Modern-day production of goods and services requires connections to multiple locations where specialist resources and expertise may be sourced. These resources may then be brought together via transport systems to assemble the commodities we need for everyday life.

FIGURE 1 Transporting the component parts of the Airbus A380



Source: Data from Wikimedia Commons. Map drawn by Spatial Vision.

1. What forms of transport and, from which countries, are the component parts for the Airbus A380 derived?
2. Think about your household items and find out where they were manufactured by checking labels. What reasons can you suggest for why many of your household items need to come from faraway places?

4.6.1 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 as barter 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.

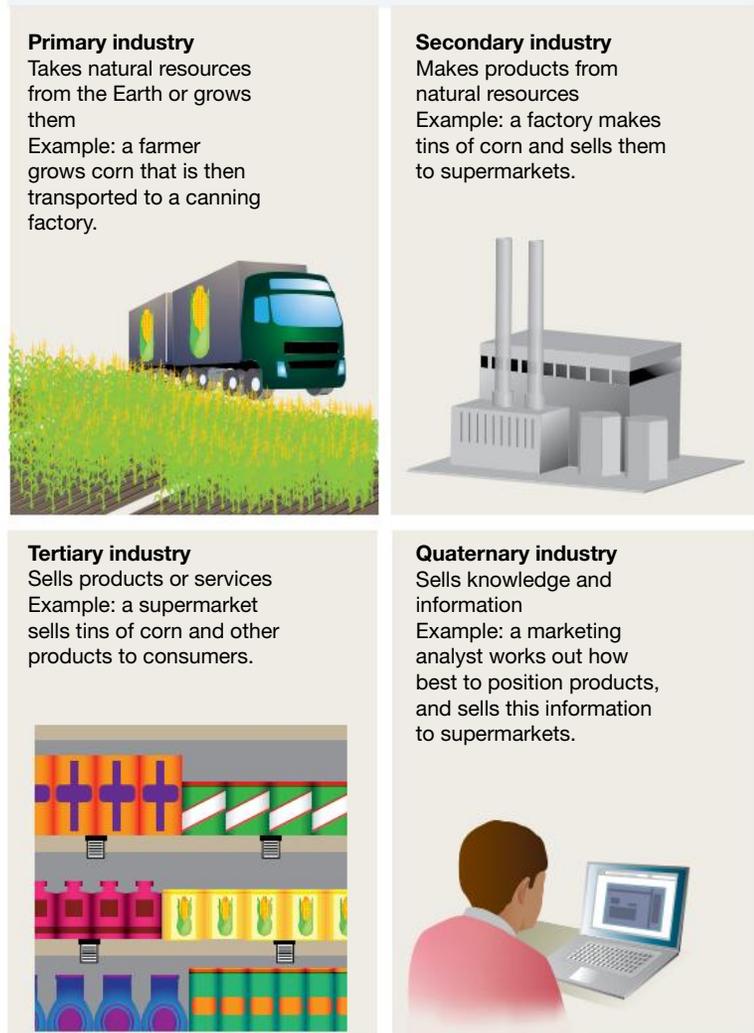
A modern example of the interconnection of trade is the production of the Airbus A380. To construct this plane, component parts must be purchased from different countries and transported over land and sea to reach their final assembly place in Toulouse, France (see **FIGURE 1**).

Goods and services, of which there are many, are generated by either processing the Earth's resources (goods) or people doing things for each other (services).

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 a service 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.

FIGURE 2 Four levels of industry showing supply chain

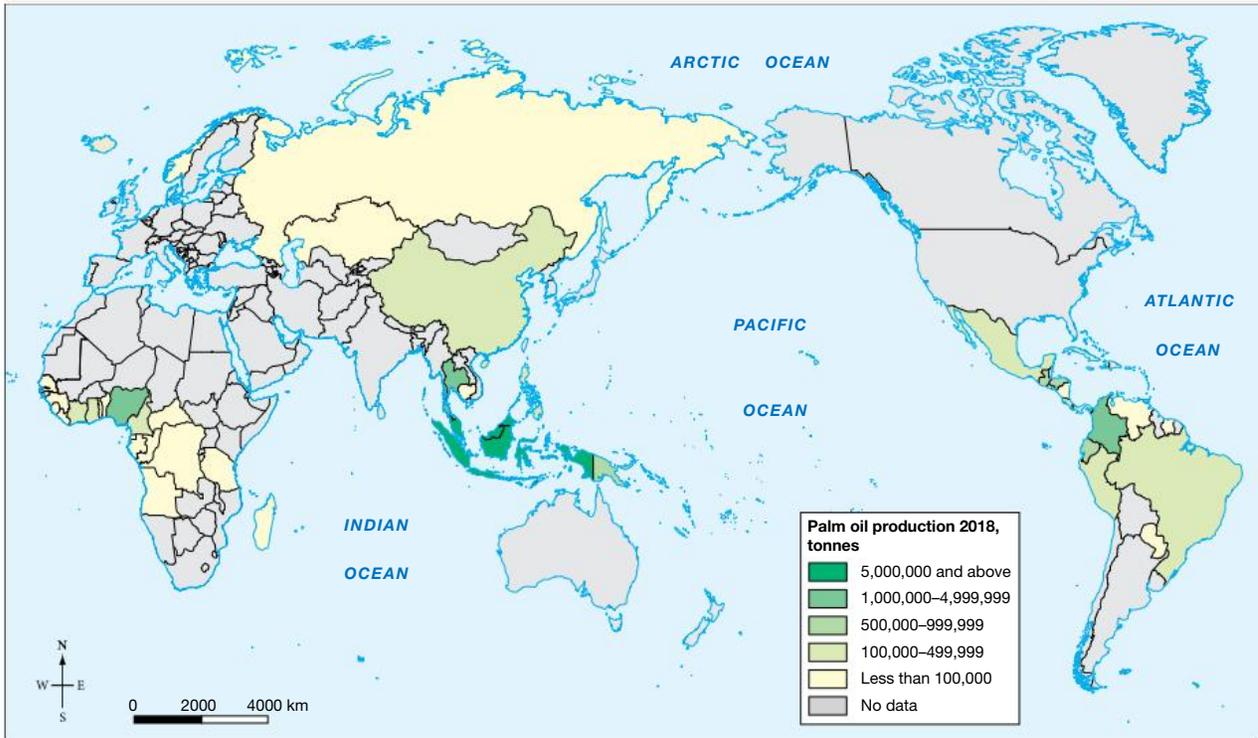


value adding processing a material or product and thereby increasing its market value

4.6.2 CASE STUDY: Palm oil production and consumption

Palm oil is an edible oil derived from the fruit of the oil palm. The oil is used in many applications, from food to cosmetics and even biofuel. Production of palm oil as a commodity has increased rapidly since 1970, when the world was producing only 2 million tonnes. In 2023, 79 million tonnes of palm oil was produced — an increase of nearly 40 per cent. In 2023, palm oil accounted for around 40 per cent of global oils produced from seed oil crops. Palm-oil tree plantations are found mainly in tropical regions relatively close to the equator (see **FIGURE 3**).

FIGURE 3 Palm oil plantations around the world



Source: Based on data from Kongsager, R., & Reenberg, A. (2012). Contemporary land-use transitions: The global oil palm expansion. GLP International Project Office. GLP Report No. 4, Hannah Ritchie and Max Roser (2021) - “Forests and Deforestation” and (c) FAO. FAOSTAT Statistics, <https://www.fao.org/faostat/en/#data/>, date accessed on 3 May 2022. Map redrawn by Spatial Vision.

The increase in global palm oil production has given rise to a need for a more sustainable approach to all elements of the supply chain (see **FIGURE 4**). Supply chain management is important to ensure the production and consumption of palm oil meets sustainable environmental practices. In this sense, sustainability means not being harmful to the environment or depleting natural resources, and thereby supporting a long-term ecological balance for the planet. Environmental impacts from supply chains can include the following:

- toxic waste, water pollution, hazardous greenhouse gas emissions and energy use
- loss of biodiversity, deforestation, long-term damage to ecosystems.

FIGURE 4 A responsible palm oil supply chain

					
No deforestation.	Already degraded land is used to establish certified palm oil plantations.	Best management practices are used to encourage increased yields.	Oils from certified plantations are harvested and refined.	Oil from these certified plantations are shipped to traders. This is called a 'traceable supply', which is audited and transparent.	Traders produce products that contain only certified deforestation-free palm oil.

4.6.3 How are goods and services consumed?

Household final consumption per person

If we tally 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 within a country for a year, then divide this figure by the total population of the country, we obtain what is referred to as the household final consumption per person. This per-person dollar value can provide a general indication of the economic development and prosperity of a country.

The greatest consumers of goods and services on a per-person basis tend to be wealthy, industrialised countries, as shown in **FIGURE 5**. However, countries such as China and India also 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 a significant impact on the environment, particularly in terms of energy use and waste production.

FIGURE 5 Top ten countries for household final consumption, per person. Australia is ranked third in this list for the years 2019–2020.

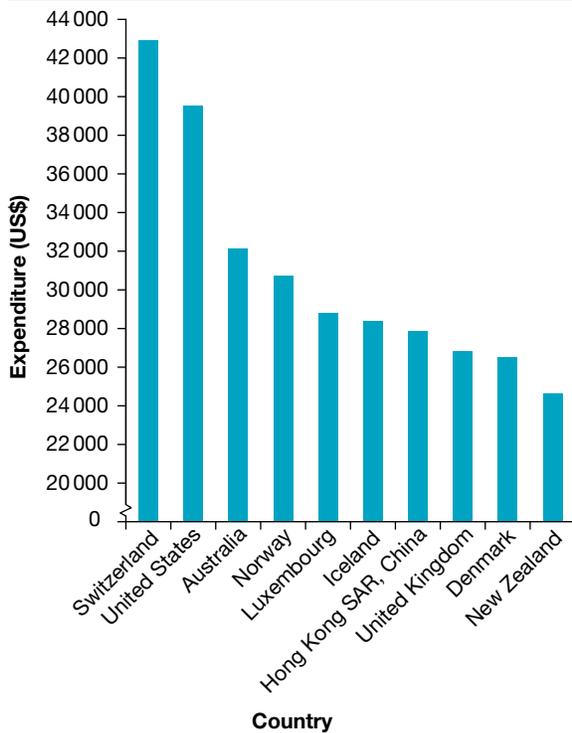
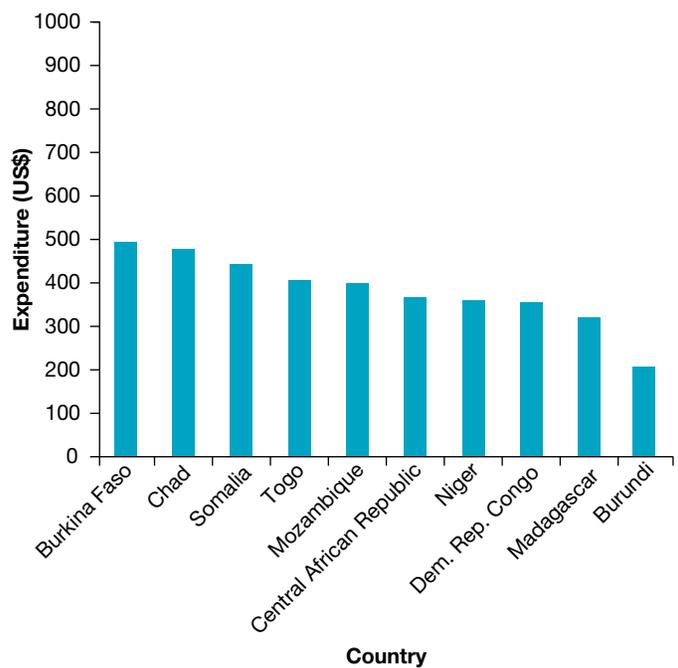


FIGURE 6 Household final consumption expenditure per person for the ten lowest ranked countries in the world for 2019–2020



At the lower end of the scale of household final consumption per person, people in countries such as Madagascar and Burundi spend an average of \$320.07 and \$207.56 respectively per year per person which relates to only 88 and 57 cents per person per day respectively (see **FIGURE 6**). This expenditure is mainly for food.

4.6.4 CASE STUDY: Western rock lobster – connecting Australia to the world

The western rock lobster (see **FIGURE 7**) is Australia's most valuable single species wild captive fishery. The operation brings in approximately \$500 million each year to Australia's export industry. The lobsters are found in southern Australia coastal waters across the Southern Ocean. Western rock lobsters are exported around the world; however, 98 per cent of the 6300 tonnes of lobster caught annually are airfreighted to China. Significant growth in the Chinese market over recent years has led to the development of a live export facility next to Perth's airport to improve transit times, with the journey to China taking less than 20 hours.

The lobster industry does not just provide interconnections on the international scale, it also connects local communities. Regional employment has been boosted, with over 200 commercial vessels operating in the industry. Social interconnections also exist through recreational fishing, with over 60 000 recreational licences issued in 2017.

Unfortunately, the interconnections that make the western rock lobster industry successful also make it vulnerable to global crises. The COVID-19 pandemic in 2020 had a devastating impact on the industry due to the sharp decline in exports to China (see **FIGURE 8**).

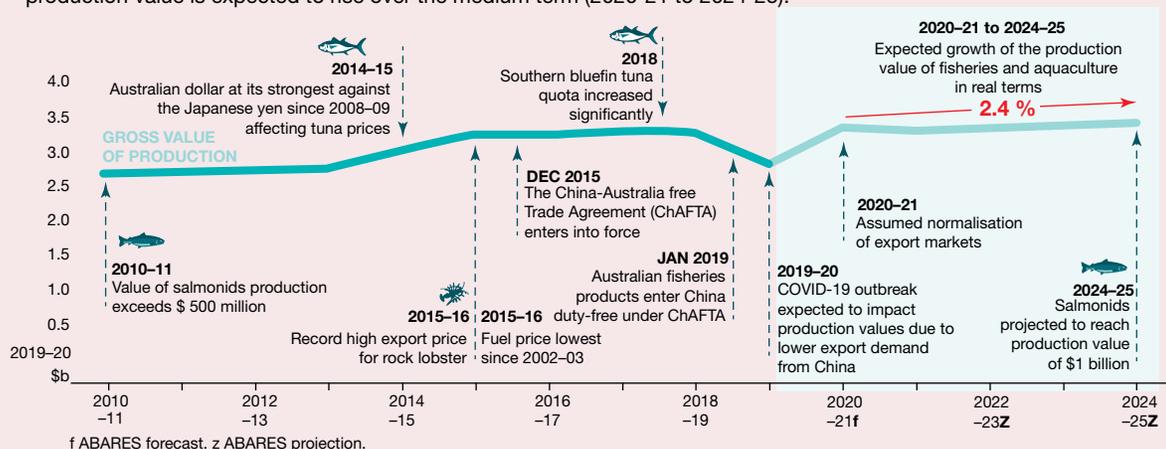
FIGURE 7 Western rock lobster



FIGURE 8 Fisheries and Aquaculture outlook, 2020

Fisheries production value to dip

Fisheries and aquaculture production value is projected to fall in 2019–20, caused largely by reduced export demand from China following the 2019 coronavirus (COVID-19) outbreak. Market conditions are expected to normalise in 2020–21 and production value is expected to rise over the medium term (2020–21 to 2024–25).



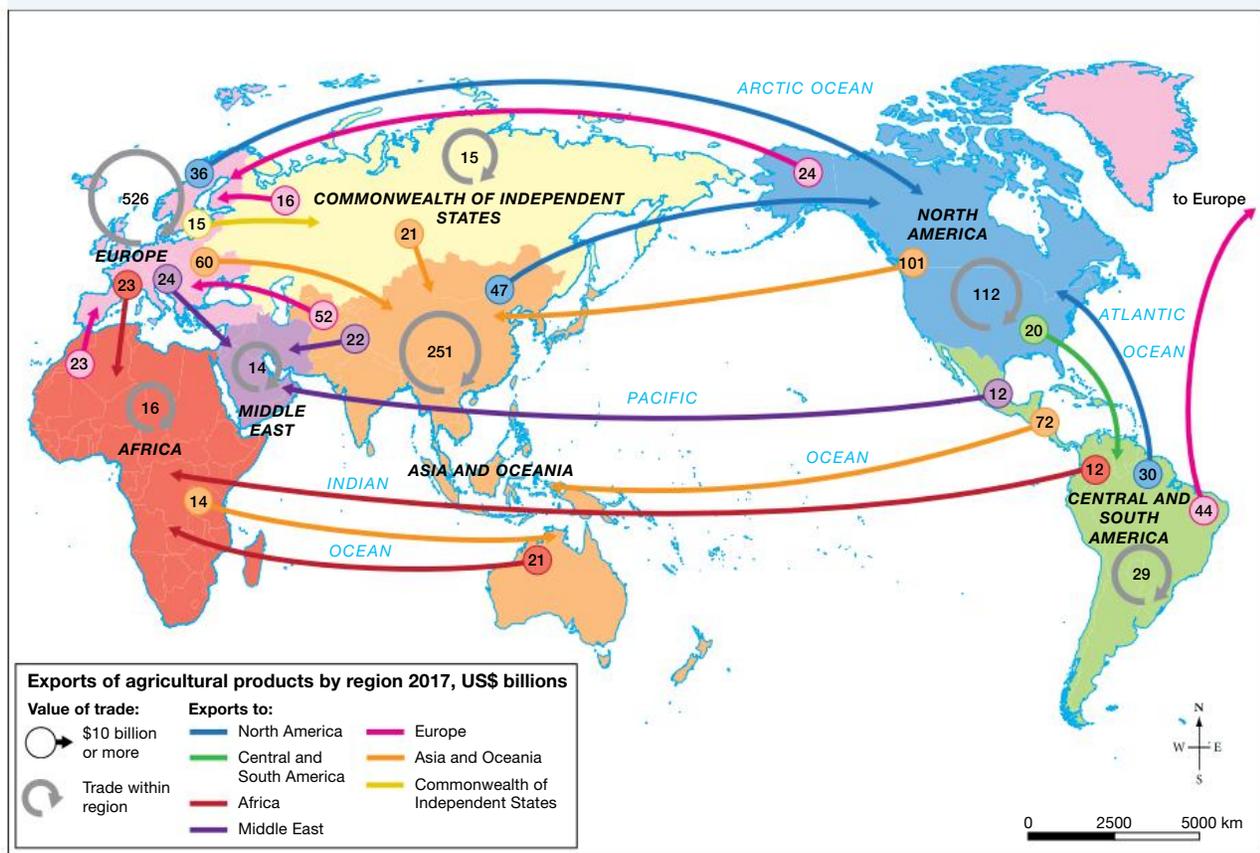
Food trade around the world

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 some 40 per cent (or by some estimates, more) 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 2019–20 farm production was estimated to be worth \$61 billion, with \$50 billion of this in export worth. The gross value for Australian agriculture increased to \$90 billion in 2022–23 and Australia exported \$76 billion worth of agricultural produce in 2021–22.

Food trade is a complicated business, as can be seen in **FIGURE 9**. It is estimated that for **developing countries**, three-quarters of exports are agricultural produce. While developed countries may need to import some 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.

FIGURE 9 World trade flows — exports of agricultural products by region, US\$ billion



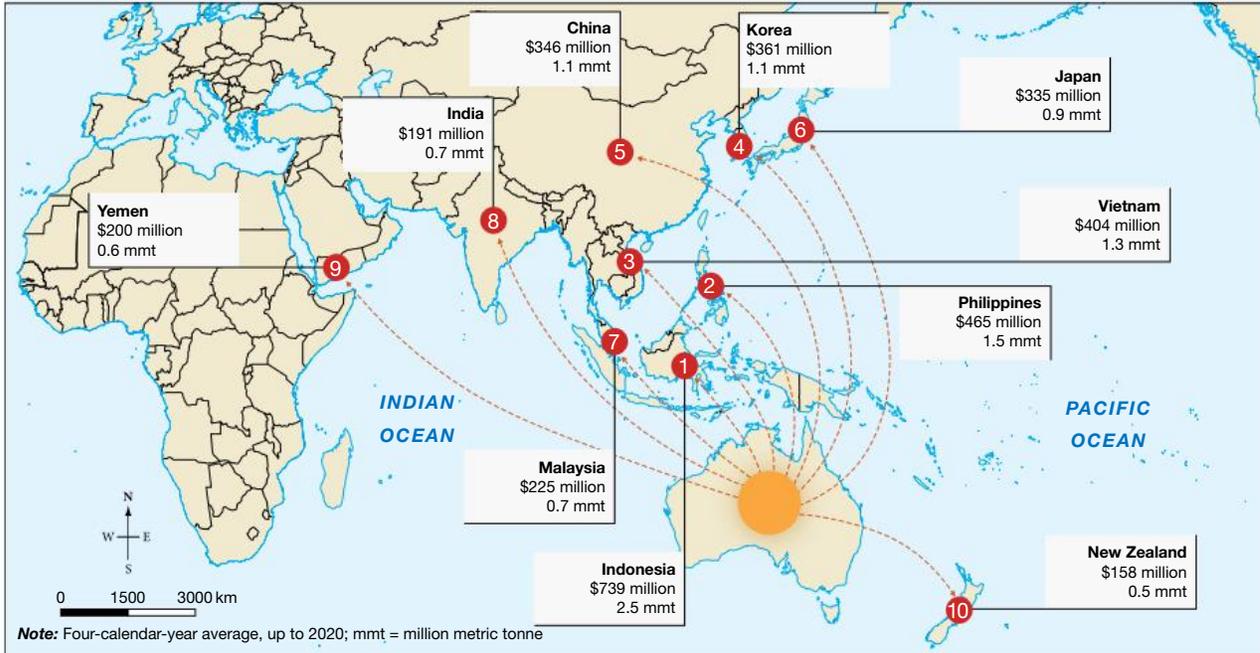
Source: Adapted from WTO. Retrieved from: https://www.wto.org/english/res_e/statis_e/world_commodity_profiles18_e.pdf; Map drawn by Spatial Vision.

Wheat production levels vary from year to year, depending on weather conditions experienced at particular times in the growing season. After a bumper year in 2016–17, when in excess of 34 million tonnes was produced, in 2017–18 Australia produced just over 21 million tonnes of wheat. More than three-quarters of this crop was for sale in overseas markets, worth some \$5 billion in export earnings. **FIGURE 10** shows Australia's top ten wheat export partners, with production quantities and earnings averaged over the four-year period up to 2017.

barter to trade goods in return for other goods or services rather than money

developing countries nations with a low living standard, undeveloped industrial base and low human development index relative to other countries

FIGURE 10 Top ten Australian wheat export destinations



Source: Based on data from Australian wheat | Quality, versatility, and reliability. Australian Export Grains Innovation Centre. Map redrawn by Spatial Vision.

Australia's diverse food trade

In addition to wheat, Australia conducts more than \$5 billion worth of trade annually through a range of other agriculture, forestry and fisheries exports. **TABLE 1** provides information about Australia's top 20 exports in this category and their respective export values for the 2019–20 financial year.

TABLE 1 Australia's top 20 agriculture, forestry and fisheries exports, 2019–20

Rank	Commodity	\$ million	% share
1	Beef	11 258	21.7
2	Meat (excl. beef)	5520	10.6
3	Wheat	3847	7.4
4	Wine	2897	5.6
5	Edible products and preparations	2757	5.3
6	Fruit and nuts	2523	4.9
7	Wool and other animal hair	2516	4.9
8	Live animals (excl. seafood)	2231	4.3
9	Sugars, molasses and honey	1776	3.4
10	Vegetables	1471	2.8
11	Milk, cream, whey and yoghurt	1451	2.8
12	Animal feed	1375	2.7
13	Wood (in chips or particles)	1238	2.4
14	Oil seeds and oleaginous fruits, soft	1188	2.3
15	Barley	1028	2.0
16	Cheese and curd	985	1.9

Rank	Commodity	\$ million	% share
17	Cotton	964	1.9
18	Cereal preparations	925	1.8
19	Crustaceans	803	1.5
20	Wood, rough	592	1.1
Total agriculture, forestry and fisheries exports		51 864	

DISCUSS

Would Australia be failing to respect and tolerate other countries' cultural practices if we were to ban the live export of animals?

on Resources

 **Weblink** Trade

SkillBuilders to support skill development

- 1.15 SkillBuilder: Constructing and describing a flow map

4.6 SKILL ACTIVITY: Communicating

1. Use the **Trade** weblink in your Resources panel to **investigate** Australia's top five trade partnerships.
 - a. Which countries do we trade the most with?
 - b. What is the value of these trade partnerships?
2. **Prepare** a mind map to show the different goods and services traded with these countries.

4.6 Exercise

learnon

4.6 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3, 4, 6

■ LEVEL 2

5, 7, 8

■ LEVEL 3

9, 10

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Check your understanding

1. Refer to **FIGURE 9. Represent** by rank the regions of the world in decreasing order by volume of food trade.
 - A. Asia and Oceania
 - B. Europe
 - C. Central and South America
 - D. Africa
 - E. Middle East
 - F. North America
 - G. Commonwealth of Independent States

2. a. Refer to **FIGURE 9**. **Select** the value of food trade from Oceania to Europe.
 - A. US\$21 billion
 - B. US\$22 billion
 - C. US\$24 billion
 - D. US\$52 billion
 - E. US\$60 billion
- b. **FIGURE 10** shows the values of the top ten Australian wheat export destinations. State the value of wheat export from Australia to Japan.
 - A. \$335 million
 - B. \$361 million
 - C. \$191 million
 - D. \$225 million
3. High levels of consumption can have negative consequences for the natural environment. True or false?
4. **Identify** the reasons why goods and services are traded.
5. **Identify** 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 to **explain** this process.

Apply your understanding

Interpreting and analysing geographical data and information

6. **Suggest** why the United States is one of the largest consumers of goods and services in the world.
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. **Judge** how a growing demand for energy sources in these countries might affect the environment.

Concluding and decision-making

8. a. **Identify** how a change, such as growth in Australia's population from 25 million to 40 million, might affect Australia's trade.
 - b. **Determine** ways in which Australia might overcome the problem of drought, which has significant impacts on wheat production tonnage.
9. **Determine** the reasons that people are able to survive on less than \$300 per person per year in countries such as Niger and the Democratic Republic of the Congo.
10. **Refer to FIGURE 10**.
 - a. **Discuss** why Australia can export such a large quantity of wheat to the world.
 - b. What reasons can you **suggest** for why a country such as Russia might not export wheat to Indonesia and Malaysia.

LESSON

4.7 What is Australia's contribution to the global trade industry?

LEARNING INTENTION

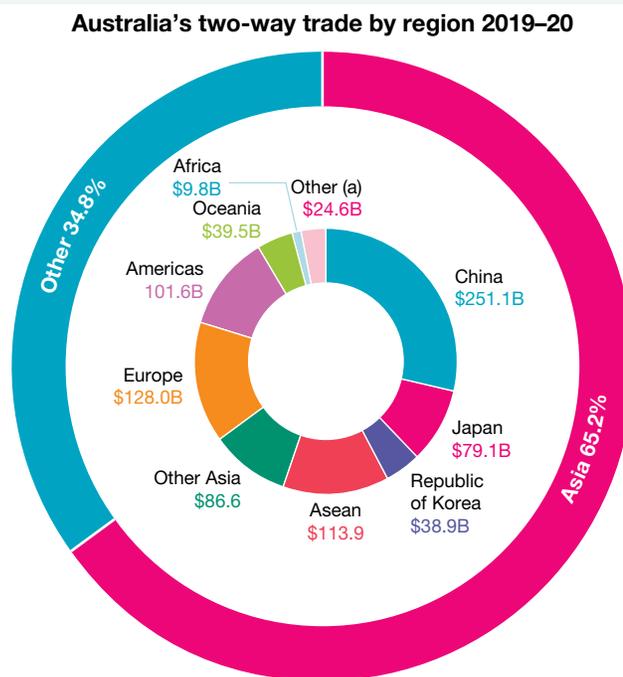
By the end of this lesson you should be able to comment on, and provide examples of, Australia's major types of trade and trading partners and describe the impact of globalisation.

TUNE IN

Australia is a major player in world trade in goods and services, and this trade has allowed Australians to enjoy a high standard of living. In fact, we are in the top ten wealthiest nations of the world based on gross domestic product (GDP) statistics!

Australia is responsible for a large percentage of world trades. As shown in the figure below, Australia has import and export arrangements with a number of large countries which includes a range of goods.

FIGURE 1 Australia's top ten two-way trading partners 2019–20, value of imports and exports (A\$ million)



Source: Data based on Trade and Investment at a glance, p.13., 2021. Department of Foreign Affairs and Trade. www.dfat.gov.au

1. What are Australia's top five two-way trading partners? In which continental regions of the world does Australia have significant two-way trade dealings?
2. Why do you think income to the Australian economy from international students is classified as an 'export service'?

4.7.1 The coordination of trade

Australia is one of the 164 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.

trade barrier

government-imposed restriction (in the form of tariffs, quotas and subsidies) on the free international exchange of goods or services

The 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. Asia continues to dominate Australia's two-way trade flows with 65.2 per cent of the market.

4.7.2 Australia's trading partners

China, the United States and Japan were Australia's top three two-way **trading partners** in 2019–20, accounting for nearly 45 per cent of total trade. **FIGURE 1** shows the value of imports and exports traded between Australia and its top ten trading partners. **TABLE 1** shows the total two-way trade value (imports and exports added together) of all goods and services traded with these ten countries.

trading partner a participant, organisation or government body in a continuing trade relationship

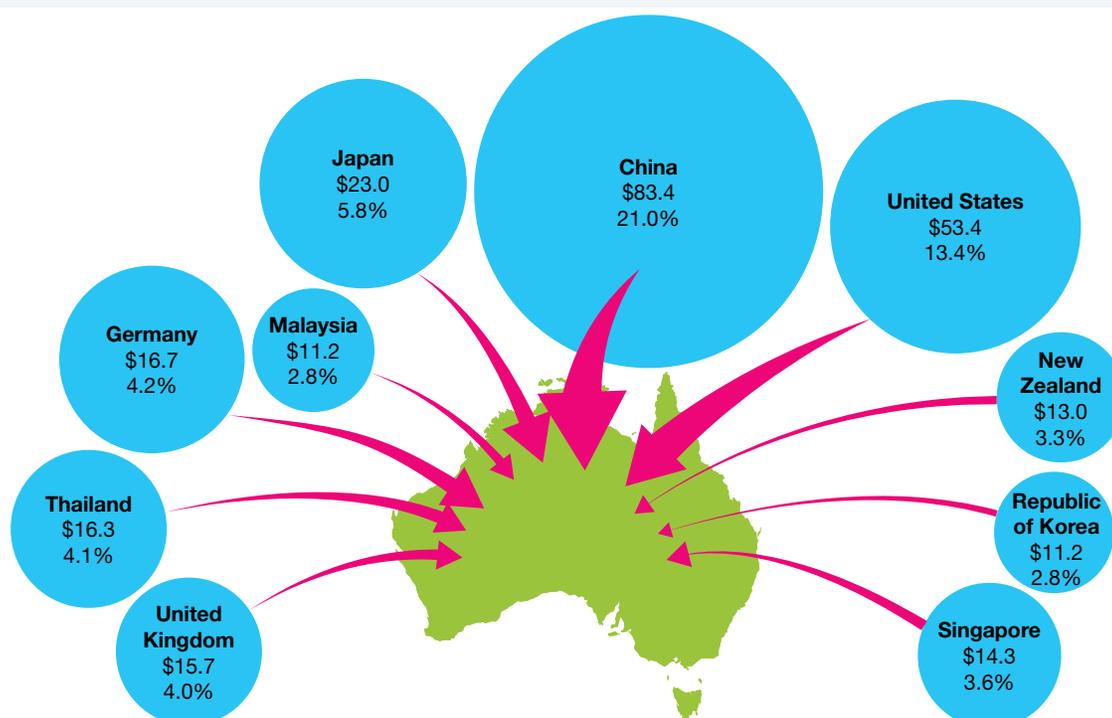
TABLE 1 Australia's top ten two-way trading partners, 2019–20, total two-way trade value (A\$ billion)

Rank		Goods	Services	Total	% share
	Total two-way trade	693.8	179.4	873.1	
1	China	232.4	25.4	251.1	28.8
2	United States	55.4	25.4	80.8	9.2
3	Japan	73.0	6.1	79.1	9.1
4	Republic of Korea	36.5	2.4	38.9	4.5
5	United Kingdom	22.8	13.9	36.7	4.2
6	Singapore	21.7	9.6	31.3	3.6
7	New Zealand	17.6	11.1	28.7	3.3
8	India	15.7	10.6	26.2	3.0
9	Germany	17.3	4.5	21.8	2.5
10	Malaysia	18.2	3.4	21.6	2.5



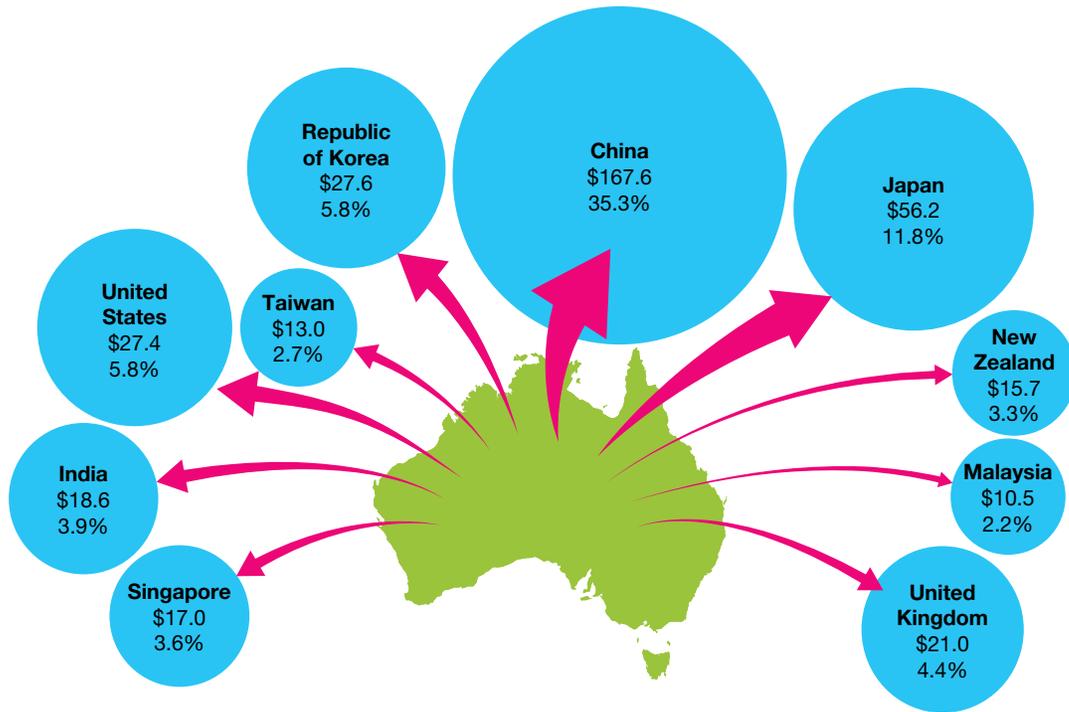
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FIGURE 2 Australia's top ten import markets, 2019–20 (A\$ billion)



Source: Data based on Trade and Investment at a glance, p.40., 2021. Department of Foreign Affairs and Trade. www.dfat.gov.au

FIGURE 3 Australia's top ten export markets, 2019–20 (A\$ billion)



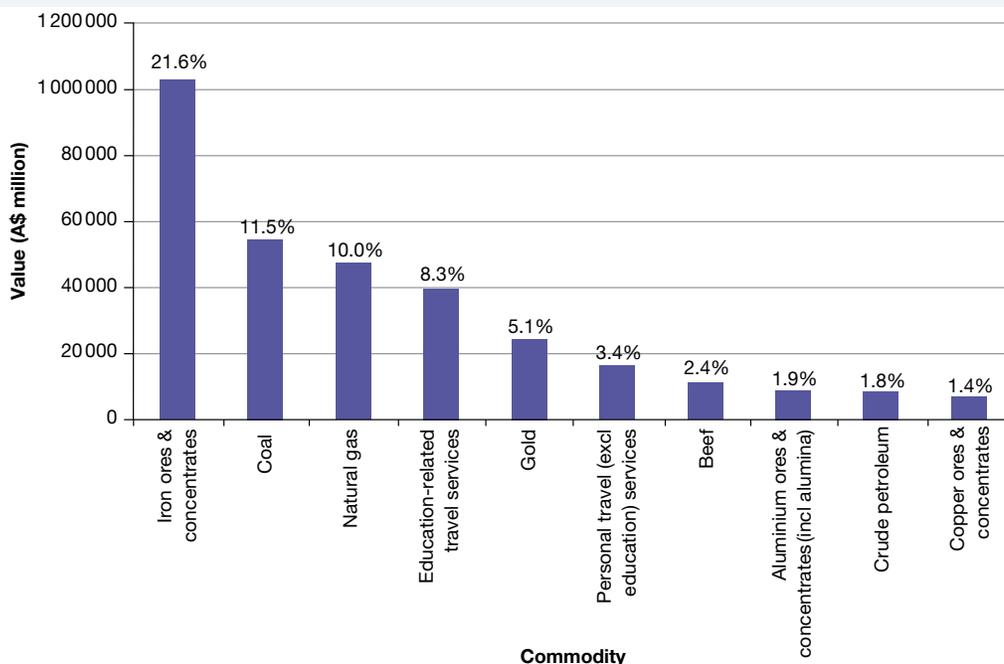
Source: Data based on Trade and Investment at a glance, p.18., 2021. Department of Foreign Affairs and Trade. www.dfat.gov.au

4.7.3 Australia's types of trade

Exports

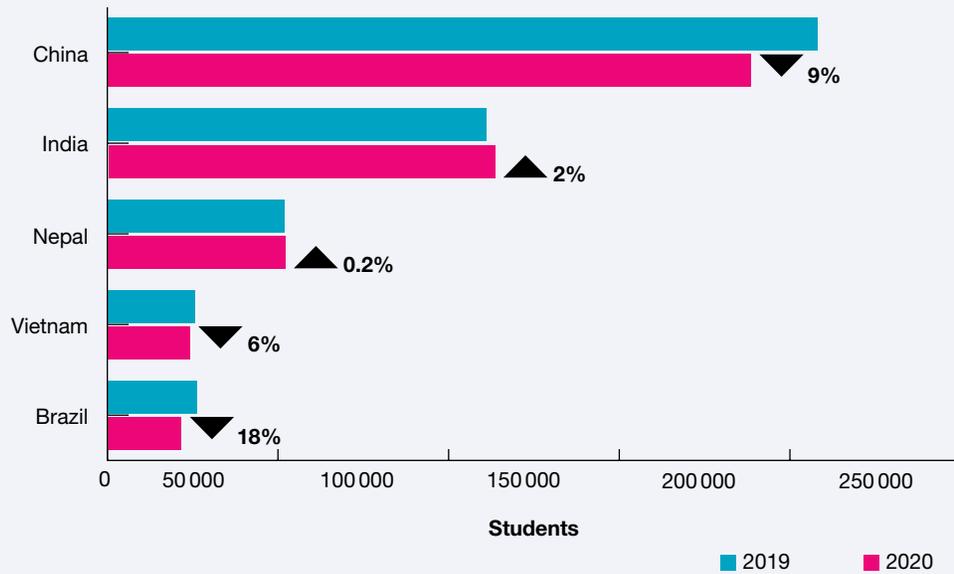
Australia's export trade in 2019–20 was valued at \$382 billion, and was dominated by the mineral products of iron ore and coal. Education-related and personal travel were Australia's leading services exports. See **FIGURE 4** for details of leading exports.

FIGURE 4 Australia's top ten exports of goods and services, 2019–2020



Source: Data based on Trade and Investment at a glance, p.20., 2021. Department of Foreign Affairs and Trade. www.dfat.gov.au

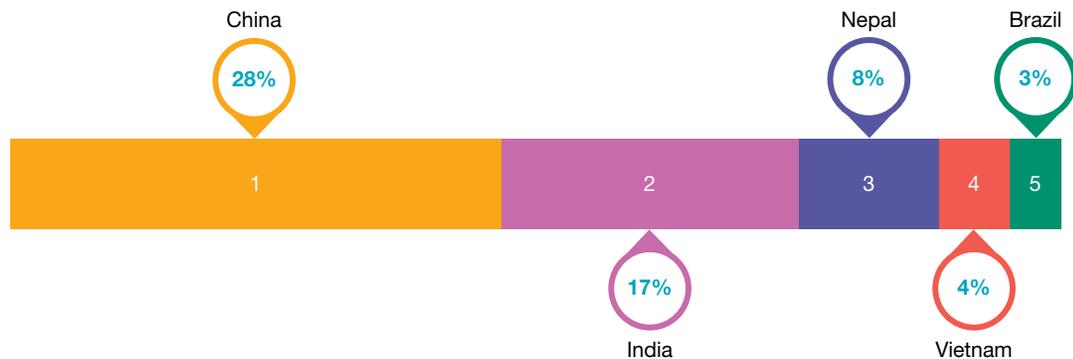
FIGURE 5 COVID-19 led to drop in international student numbers for Australia during 2020.



Top five countries

59%

of international students are from these countries



International students

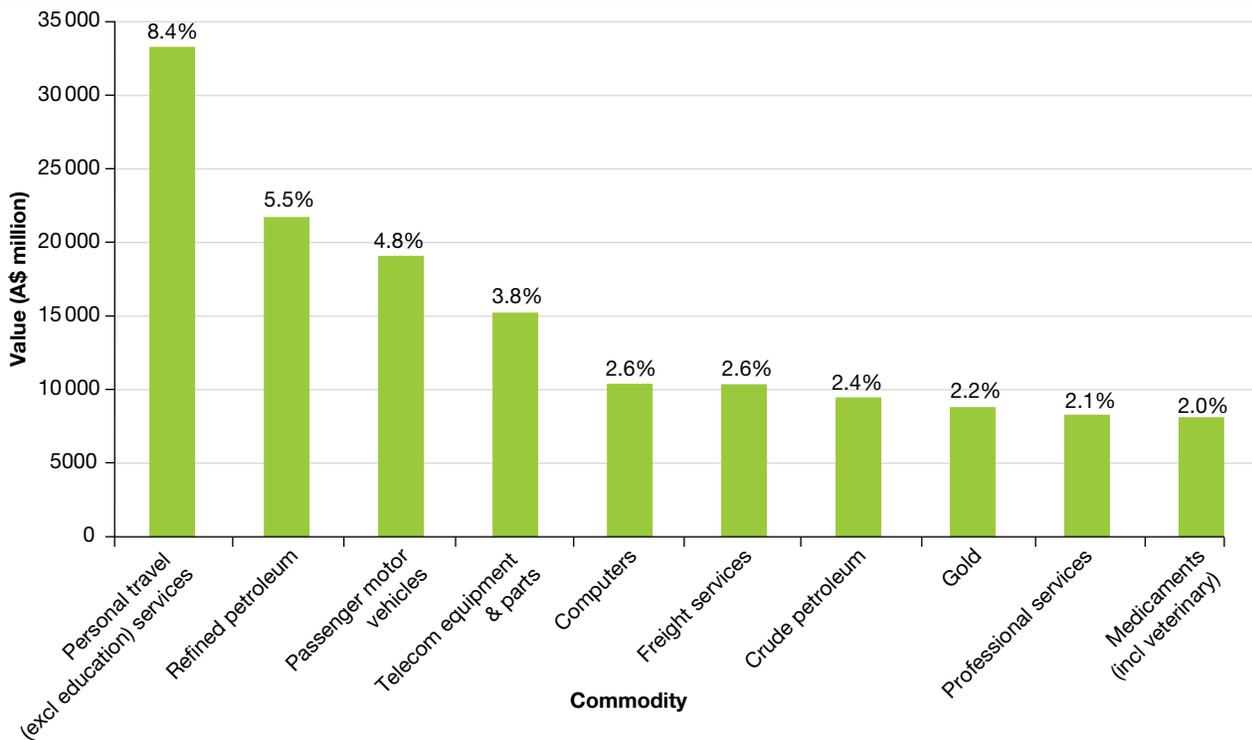
A more recent high-level earner for Australia (ranked as our fourth-highest export in 2019–2020), is the category of ‘education-related travel services’, which was valued at \$40 billion with 693,750 international students from more than 200 countries studying in Australia. In this service industry, students pay for knowledge and skills that they will take back to their home country.

During 2020, COVID-19-related international border restrictions heavily disrupted the operation of this industry as students were not permitted to enter or leave their home countries for a period. Many continued their studies remotely from places outside of Australia. The industry started to rebound in 2023, with many international students returning to study in person.

Imports

Like many countries, Australia is not self-sufficient in all goods and services. In 2019–20, Australia imported goods and services valued at over \$397.9 billion. **FIGURE 6** shows the top ten commodities of this trade.

FIGURE 6 Australia's top ten imports of goods and services, 2019–2020 (A\$ million)



Source: Data based on Trade and Investment at a glance, p.40., 2021. Department of Foreign Affairs and Trade. www.dfat.gov.au

FIGURE 7 Oil and petroleum products make up a significant part of Australia's import trade.



4.7.4 Impacts of globalisation

Today, you might purchase a jacket online that was designed in Milan, but it is woven from New Zealand wool and stitched together in China. The globalised economy that has resulted from technological developments since the 1990s has brought global marketing, encouraging consumers everywhere to buy goods without considering where they come from. Online shopping has revolutionised the business world by making just about anything imaginable available at the simple tap of a finger or click of a mouse.

The car exports market is a significant example of global connections, with 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. Australia once had a thriving car manufacturing industry, but competition from European and Asian manufacturers led to its demise. We now import all our cars from overseas.

The Australian clothing manufacturing industry has produced some recognisable brand names and distinctive products. Today, the industry faces tough international competition, especially from producers in developing countries who can afford to mass-produce clothing far more cheaply than Australian companies can. As a result, Australian clothing manufacturers tend to focus on high-end, high-quality products rather than attempting to compete with lower-cost producers.

It is not just the clothing industry that has felt the impact of an increasingly globalised economy. Many multinational companies have 'offshored' various production and service divisions to developing countries, such as India, China, Malaysia and the Philippines, due to these countries' lower labour costs. A range of other economically appealing factors, such as a lack of labour unions and incentives offered by those governments including tax breaks and low import duties, have also fueled this trend.

Foreign companies in China

As an example of the growth in global business operations, in 1979, there were 100 foreign-owned enterprises in China. In 1998, there were 280 000, and by the end of 2015, there were more than 835 000 companies with foreign direct investment registered in mainland China. Since 2007, foreign companies have employed more than 25 million people in China. These companies include Coca-Cola, Pepsi, Nike, Citibank, General Motors, Philips, Ikea, Microsoft and Samsung. China's economy is growing rapidly; the country is destined to remain an engine for global growth for some years to come.

4.7.5 Sweatshops — a negative side of global trade

If you buy well-known global brands, 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 often use dangerous machinery in cramped conditions and can even be exposed to toxic substances. In the worst cases, child labour may be used. Sweatshop workers' wages are generally insufficient to sustain reasonable living conditions; many workers live in poverty. Most are young women aged 17 to 24.

FIGURE 8 This symbol signifies that a product has been manufactured in Australia by an Australian-owned company.

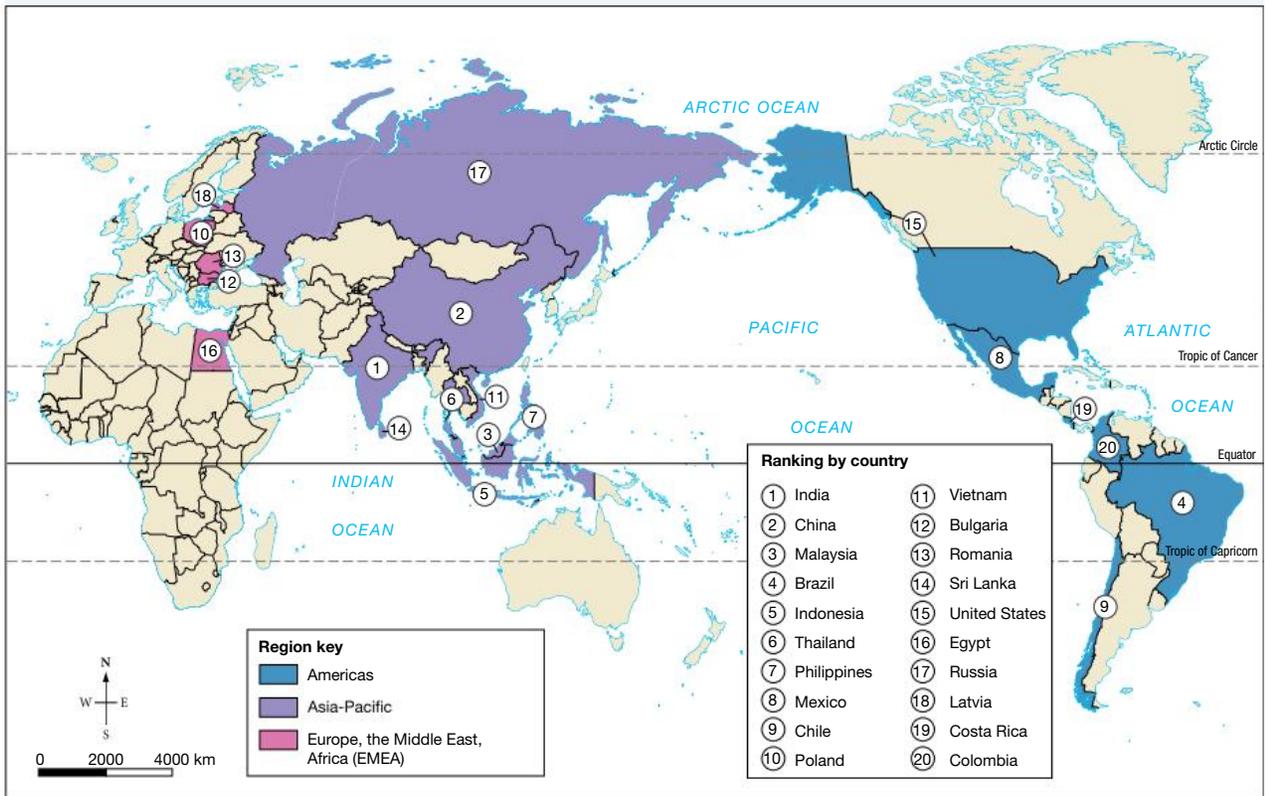


offshore to relocate part of a company's processes or services overseas in order to decrease costs

In our globalised world, the question of ethical trade is increasingly important. Socially responsible companies are taking steps to ensure that profits gained from offshoring production and services to less developed countries do not come at the expense of the wellbeing of the people within those countries.

int-9081

FIGURE 9 Top 20 locations for offshore companies, by region



Source: Data from Statista. Map drawn by Spatial Vision.

FIGURE 10 A sweatshop in Bangladesh



4.7 SKILL ACTIVITY: Questioning and researching using geographical methods

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.

Research which Australian-made garments you can purchase to support fair working conditions.

- Which companies in Australia carry the ECA label?
- How does ECA support fair working conditions?
- What do they do differently to other companies?

4.7 Exercise

learnon

4.7 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3, 7

■ LEVEL 2

4, 5, 9

■ LEVEL 3

6, 8, 10, 11, 12

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Check your understanding

- State** the interconnection between the World Trade Organization and Australia's trade.
 - Australia's Department of Foreign Affairs and Trade governs the WTO.
 - Australia is one of the member states of the WTO.
 - Australia is one of the few countries whose trade is not connected with the WTO.
 - The WTO governs Australia's Department of Foreign Affairs and Trade.
- Select** Australia's three most important exports.
 - Gold
 - Passenger motor vehicles
 - Natural gas
 - Iron ores and concentrates
 - Wheat
 - Refined petroleum
 - Coal
 - Education-related travel services
 - Beef
- Identify** Australia's three most important imports.
 - Iron ores and concentrates
 - Computers
 - Beef
 - Education-related travel services
 - Personal travel services
 - Refined petroleum
 - Crude petroleum
 - Passenger motor vehicles
 - Coal
- What reasons can you **suggest** for Australia's significant two-way trade with Asian nations?
- Identify** three reasons why many multinational companies have 'offshored' various production and service divisions.
- Discuss** what is meant by the term sweatshops.

Apply your understanding

Communicating

7. Despite having a relatively small population, Australia has many goods and services to trade. **Identify** reasons why this might be so.
8. **Consider** Australia's exports (see **FIGURE 4**).
 - a. What evidence is there in this lesson to confirm Australia's reputation as being mostly a primary industry exporter?
 - b. Are there any figures for export trade that **contradict** this statement?

Concluding and decision-making

9. **Examine** why Australia has become such an important exporter of education services?
10. Look at **FIGURE 9**. **Suggest** reasons why so many offshore manufacturing companies are located in the Asia-Pacific region.
11. **Discuss** whether sweatshops are ethical and/or sustainable. **Explain** your answer.
12. Online ordering of goods is a feature of the internet age. **Discuss** the advantages and disadvantages of online ordering for workers in the Australian retail industry.

LESSON

4.8 Is international trade fair?

LEARNING INTENTION

By the end of this lesson you should be able to identify the uneven benefits of international trade and comment on how fair trade and aid programs help to balance this.

TUNE IN

Many children in Australia, once they are over the age of 14, work in part-time jobs. Some younger children help out in their family businesses. However, there are strict rules around the employment of children under the age of 16.

FIGURE 1 Fair trade organisations promote fair labour practices such as preventing and eliminating child labour.



1. What is the physical condition of the child shown in the photograph? How would this child compare to an average Australian child of similar age?
2. Why do you think it is common for children in developing countries such as Bangladesh and Nepal to work at such a young age?

4.8.1 Problems of trade

The benefits of international trade are not evenly shared around the world, and trade often favours developed countries rather than developing countries. It is the role of governments, organisations and agencies to regulate this trade so that the economic benefits are more evenly distributed.

Developed countries, like Australia, also implement measures such as aid programs that help to support economic development in the areas of need.

Australians benefit economically, culturally and politically from international trade, but **social justice** problems can arise through this trade. For example, if we import 'blood diamonds' from Africa, clothing manufactured in sweatshops in Bangladesh, or carpets from Nepal produced by child labour, we are supporting unethical industries.

social justice a principle applied so that a society is based on equality, the appreciation of the value of human rights and the recognition of the dignity of every human being

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.

4.8.2 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. There are over 1.9 million farmers and workers across 71 countries participating in Fairtrade International.

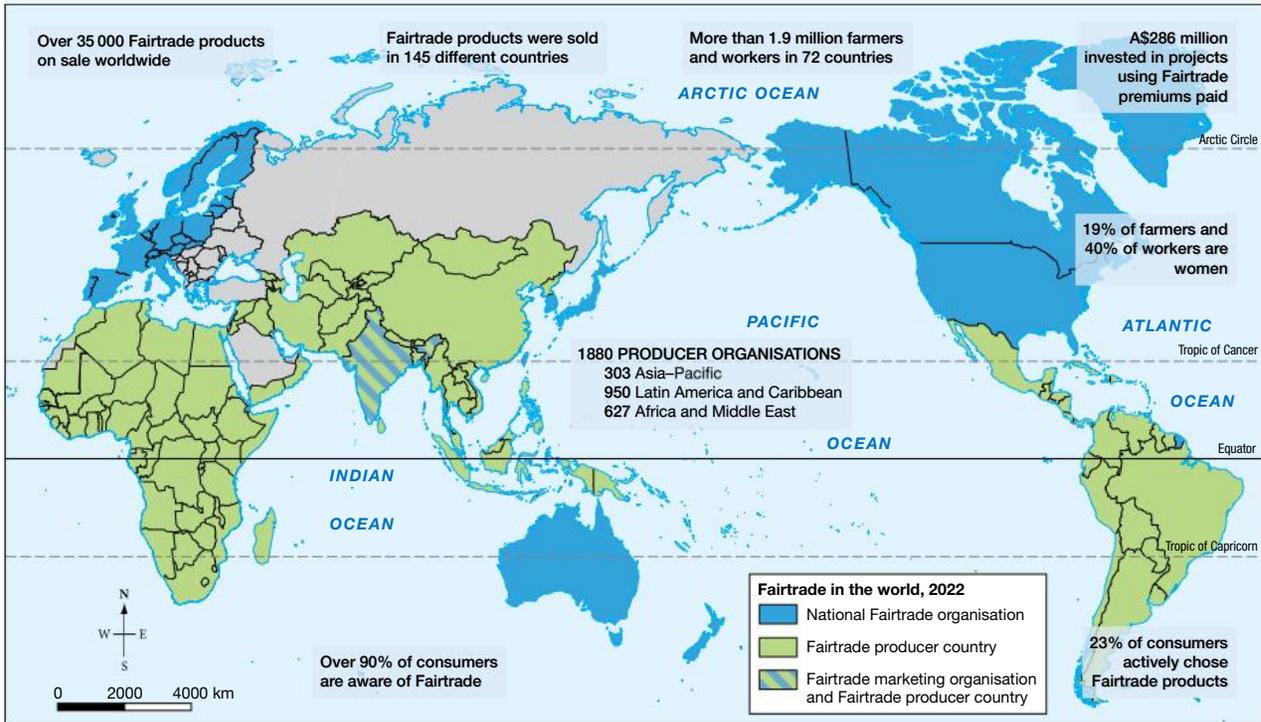
The fair trade labelling system is operated by Fairtrade International, of which Australia is a participating member. This system works to ensure that income from the sale of products goes back directly to the farmers, artisans and their communities (see **FIGURE 3**).

In 2020–21, Australia and New Zealand had a combined retail sales total of A\$316 million in Fairtrade-certified products, with three in five New Zealanders and two in five Australians purchasing Fairtrade offerings. This included 4 million kilograms of coffee, 20.3 million blocks of chocolate and 36.6 million tea bags. On a global scale, Fairtrade’s 1.9 million farmers and their families have benefited from Fairtrade premium-funded infrastructure and community development projects with a value of over A\$262 million.

FIGURE 2 Goods produced by workers for the World Fair Trade Organization mission



FIGURE 3 Fairtrade in the world, 2022



Source: Based on data from Fairtrade International, <https://www.fairtrade.net/>. Map redrawn by Spatial Vision.

4.8.3 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 poorer developing countries keep their agricultural markets open.

DISCUSS

In small groups, consider the following questions:

- Why is there a need for organisations such as Fairtrade International?
- Should stores be allowed to sell items that are not sourced from Fairtrade producers?

4.8.4 Global connections through Australian Aid

Overseas aid is the transfer of money, food and services from developed countries such as Australia to less-developed countries in order to help people overcome poverty, resolve humanitarian issues and generally help with their development. Over one billion people in the world live in poverty and do not have easy access to education and healthcare. 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.

non-government organisation (NGO) a group or business that is organised to serve a particular social purpose at local, national or international level, and operates independently of government

extremism extreme political or religious views or extreme actions taken on the basis of those views

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** as it may also help promote stability and prosperity in the region. In addition, it improves our status throughout the world and creates political and economic interconnections with our Asia–Pacific neighbours. Australia’s Official Development Assistance (ODA) program is known as Australian Aid.

4.8.5 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 those in need, 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. In 2022–23, Australia’s ODA budget was \$4 billion, with the majority of this being earmarked for the Indo–Pacific region, of which Australia is a part (see **FIGURE 4**).

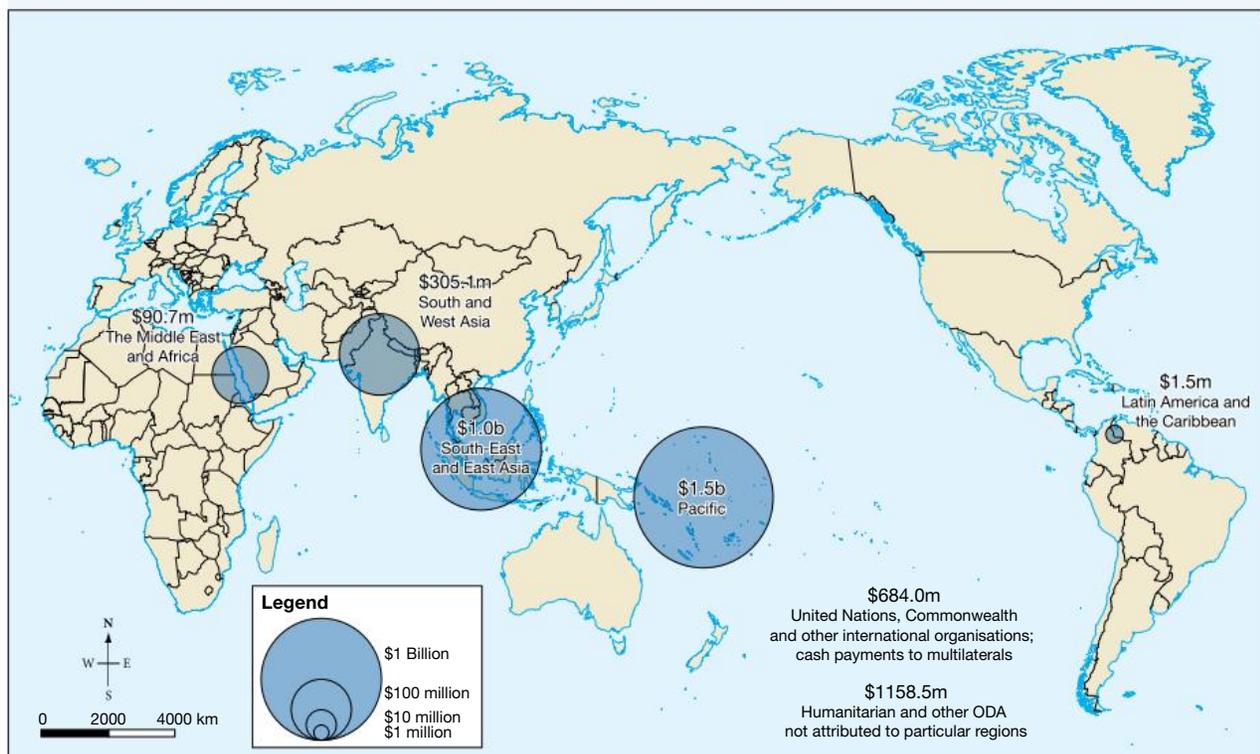
There are various investment priorities within Australia’s ODA budget (see **FIGURE 5**). Within these priorities, many programs that target specific areas of need or interest are covered. These include:

- aid to governments for post-conflict reconstruction, as in Afghanistan
- 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
- programs by non-government organisations to reduce child labour in developing countries
- funding for education programs
- funding for programs to promote gender equality and improve women’s economic and social participation
- support for Australian volunteers working overseas.

humanitarian principles the principles governing our response to those in need, with the main aim being to save lives and alleviate suffering

national security the protection of a nation’s citizens, natural resources, economy, money, environment, military, government and energy

FIGURE 4 Australia’s aid 2022-23, by region



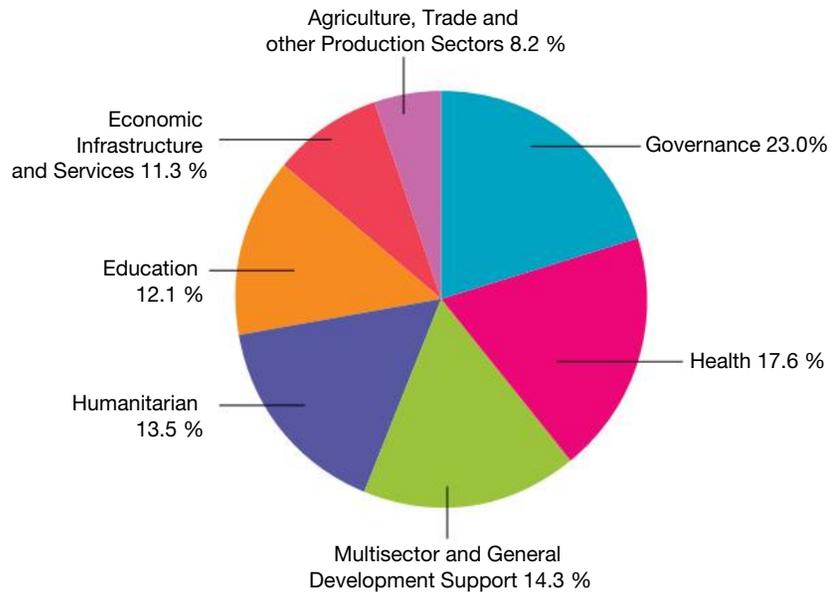
Source: Based on data from Department of Foreign Affairs and Trade website – www.dfat.gov.au, Australian Official Development Assistance budget summary 2022–23. Map redrawn by Spatial Vision.

DISCUSS

Australia should help its less developed neighbours, not just because it benefits Australia but because it is the right thing to do. Discuss this statement as a class, considering the types of help we should provide and potential limits (if any) that should apply.

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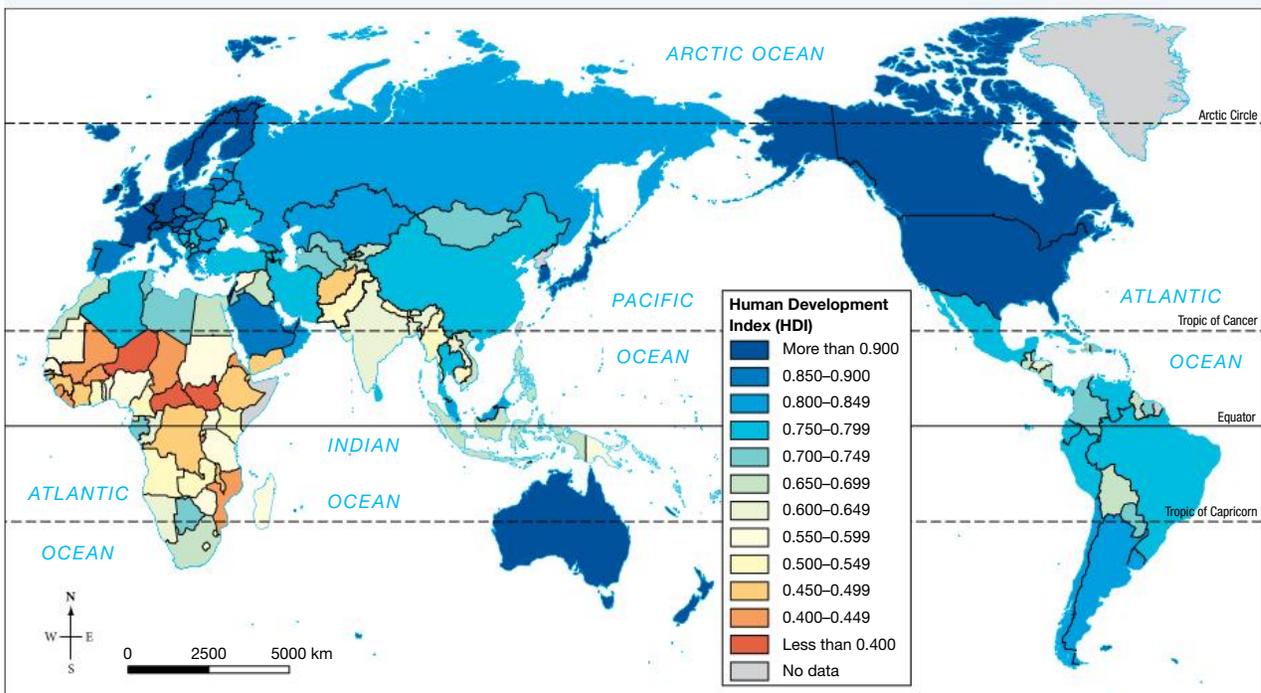
FIGURE 5 Distribution of Australia's Official Development Assistance (ODA) budget by investment priority, 2023–24



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FIGURE 6 The Human Development Index, 2017

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Source: Data from UNDP Human Development Reports. Map drawn by Spatial Vision.

The Australian Aid program supports the United Nations Sustainable Development Goals (SDGs). In addition, countries with a low Human Development Index (HDI) score are the target for development assistance. The HDI ranks countries according to life expectancy, education and per capita income. The highest possible score

for a country is 1.0; countries with low HDI ranking score below 0.55 (see **FIGURE 6**). Australian ODA aims to improve the lives of people in such countries through programs and initiatives that seek to build social and economic resilience.

4.8 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

1. Visit your local supermarket and find as many products as you can that carry the Fairtrade symbol.
2. Take pictures of these products and create an annotated world map or collate in a table to show each of the products and where it is produced.

4.8 Exercise

learnon

4.8 Exercise

Learning pathways

■ LEVEL 1
1, 2, 4, 6

■ LEVEL 2
3, 4, 6, 7, 9

■ LEVEL 3
5, 8, 10, 11

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Check your understanding

1. **Select** which of the following is *not* one of the different focus areas across which Australia's ODA budget is distributed.
 - A. General development support
 - B. Health
 - C. Education
 - D. Law enforcement
 - E. Infrastructure and trade
2. **State** which of the following options best describes the spatial distribution of low-HDI countries.
 - A. Predominantly above the Tropic of Cancer
 - B. Predominantly in Europe and North and South America
 - C. Predominantly in Africa and South Asia
 - D. Predominantly in South-East Asia
3. **a. State** which regions of the world receive most of Australia's aid funding.
 - A. Pacific; South and West Asia
 - B. South-East and East Asia; South and West Asia
 - C. Pacific; South-East and East Asia
 - D. Pacific; Humanitarian and other ODA not attributed to particular regions

b. Explain why you think this is so.
4. **Identify** the role of NGOs such as Oxfam in relation to trade.
5. **Justify** why trade can be unfavourable to poorer countries.

Apply your understanding

Communicating

6. **Analyse** and report on the distribution of Fairtrade producer countries.
7. **Identify** the parts of the world in which National Fairtrade organisation countries can be found.
8. **Infer** how awareness of the work of Fairtrade could be increased.
9. **Discuss** how consumers in developed countries may unwittingly support unethical enterprises.
10. **Discuss** the prospect of Australian overseas aid being stopped. What two changes would this have on Australia's reputation in the international community?

Concluding and decision-making

11. **Determine** which elements of the Australian aid program you think will have the greatest impact on the lives of people in the Pacific region. Give reasons for your selection.

LESSON

4.9 How do Australians use technology to communicate and interconnect?

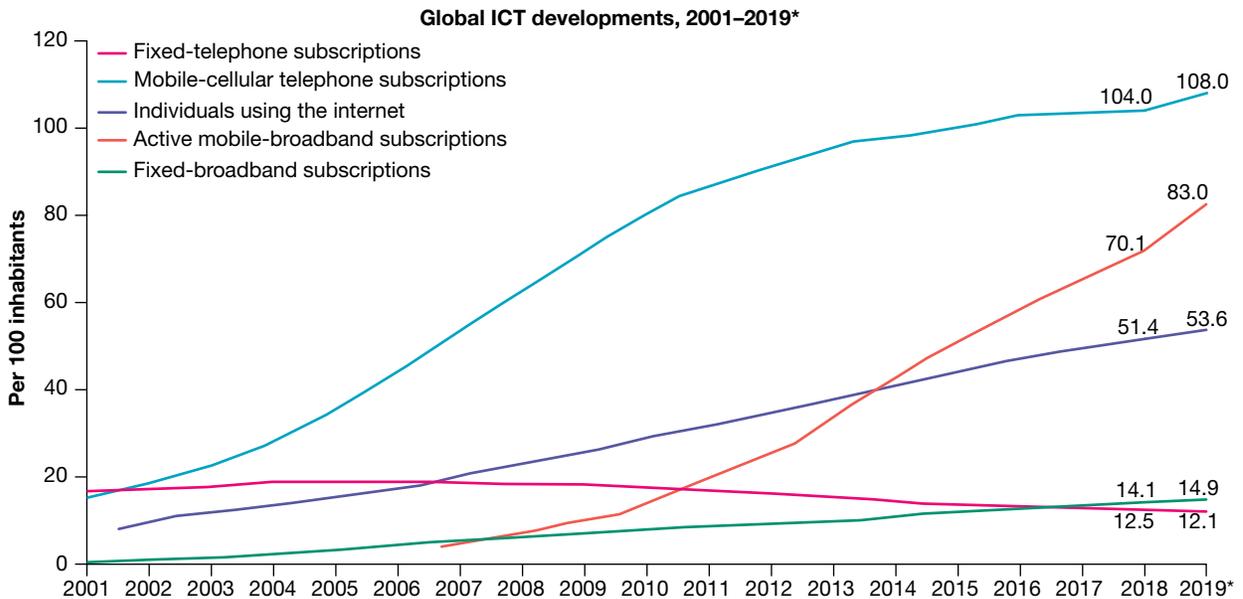
LEARNING INTENTION

By the end of this lesson you should be able to explain the different ways we communicate and interconnect and describe and give examples of how reliant we are on information and communication technologies (ICT). You should also be able to analyse the impact of fast-paced technological change.

TUNE IN

Most likely every household in Australia has at least one computer with connections to the world wide web. Think of all of the advantages computing technology brings to your family and the types of online activities you and your family engage in.

FIGURE 1 The change in our use of technology



Note: *Estimate

Source: ITU World Telecommunication/ICT Indicators database.

1. Explain what the graph shows you about fixed-telephone subscriptions and the other ICT developments. Why do you think these trends of ICT use have occurred?
2. What forms of ICT do you and your family use? Also consider what ICT you use at school in your answer.

4.9.1 Changing communications technology

The information and communications technology (ICT) sector is a rapidly evolving aspect of our lives. Change is ongoing, with new technologies constantly emerging. At the same time, some technologies have been superseded. **FIGURE 1** shows the surge in use of mobile phones and in particular the active (used within last 30 days) use of mobile broadband, compared to the decline of the fixed telephone line.

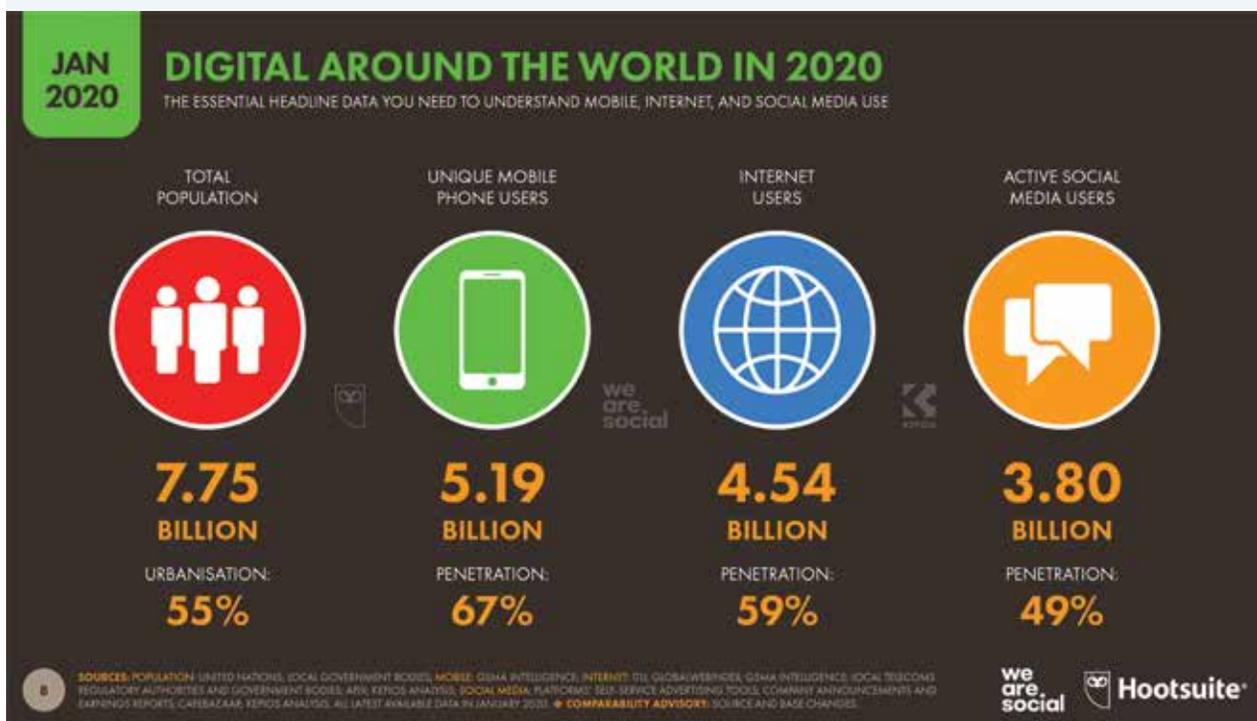
The **world wide web** was developed as a way of accessing and spreading information. It was once simply a means of collaboration and exchanging ideas online. Today it is an enabler that makes our lives connected to almost everything through the internet.

world wide web the global resources and information exchange available to internet users through the use of the Hypertext Transfer Protocol (HTTP)

The first mobile phones in the 1980s were used solely for conversation. Today mobile phones have evolved with a global demand for smartphones — technology that can map travel routes, take photos and videos, act as a diary or notebook, do shopping and banking, participate in gaming, record music, print documents wirelessly, allow face-to-face talking, share documents via the cloud and much, much more. Applications (apps) are being developed at a high rate for the interpretation and use of everything from human health matters, to bird calls, to alerts for disaster management, and so on. Virtual reality is taking us places we have never been.

Although there are more than 750 million adults in the world who lack basic literacy skills, youth culture worldwide has adopted ICT as a mainstream part of life. It has become a fundamental element in the way many of us connect to services and information, and to people in other places. Today, globally, there are more people using the internet on their mobile phones than those using the internet from a stand-alone computer (see **FIGURE 2**).

FIGURE 2 Global users of digital communications, 2020



Source: Hootsuite and We Are Social, 'Digital 2020 Global Digital Overview', 2020, retrieved from <https://wearesocial.com/digital-2020>.

4.9.2 Global internet connections

Internet **connectivity**, whether via a computer or a mobile phone, is available across the world, but its distribution is not even across regions or within countries. From **TABLE 1** it is clear that the regions with a very high level of **human development**, for example Europe and North America, also have a high level of internet users. The countries of Middle and Eastern Africa with a lower level of human development have fewer people using the internet. Just like internet access, the distribution of mobile phones across the

connectivity the ability to access the internet

human development measures such as life expectancy, education and economic wellbeing that provide an overall indication of a place's level of development and the standard of living of its inhabitants

world is not even. **TABLE 1** shows the **digital divide** between countries and regions, with the top ten countries and the bottom ten countries measured per capita of population using the internet.

digital divide a type of inequality between groups in their access to and knowledge of information and communication technology

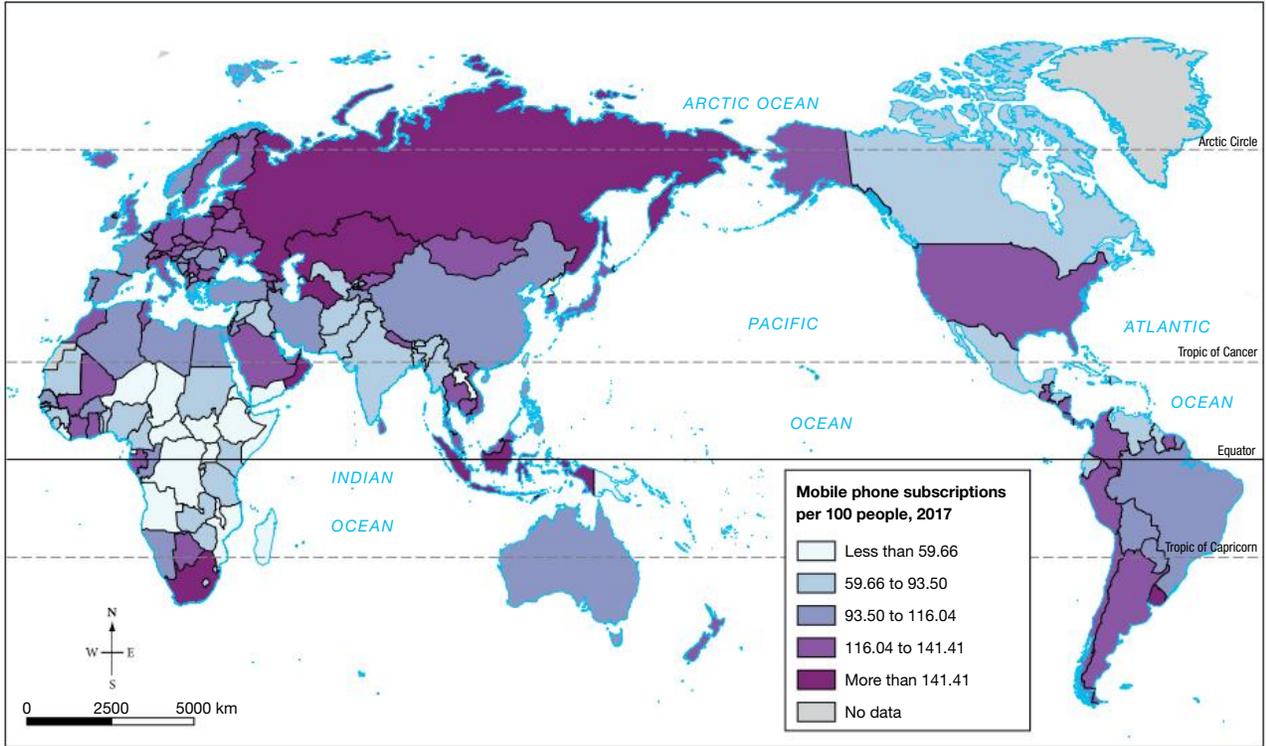
TABLE 1 Countries with the highest and lowest population proportion using the internet, 2020. Note that the top ten countries listed all ranked at #1 in the survey.

Rank	Country	Proportion of population	Number of users
Top ten			
1	Bahrain	99%	1 757 245
1	Denmark	99%	5 771 237
1	Iceland	99%	341 440
1	Ireland	99%	4 960 744
1	Kuwait	99%	4 323 655
1	Liechtenstein	99%	37 972
1	Luxembourg	99%	634 066
1	Norway	99%	5 444 901
1	Qatar	99%	2 937 815
1	United Arab Emirates	99%	9 958 440
Bottom ten			
232	North Korea	<0.1%	Data not available
231	Eritrea	8%	291 756
230	Comoros	8.5%	76 724
229	Central African Republic	10.4%	519 202
228	South Sudan	11.4%	1 318 014
227	Somalia	14.1%	2 352 190
226	Niger	14.8%	3 834 599
225	Burundi	15.1%	1 890 007
224	Democratic Republic of the Congo	17.9%	16 888 629
223	Malawi	19.8%	3 969 332

Source: Hootsuite & We Are Social 2022, “Digital 2022 April Global Statshot Report,” retrieved from <https://wearesocial.com/au/blog/2022/04/more-than-5-billion-people-now-use-the-internet/>

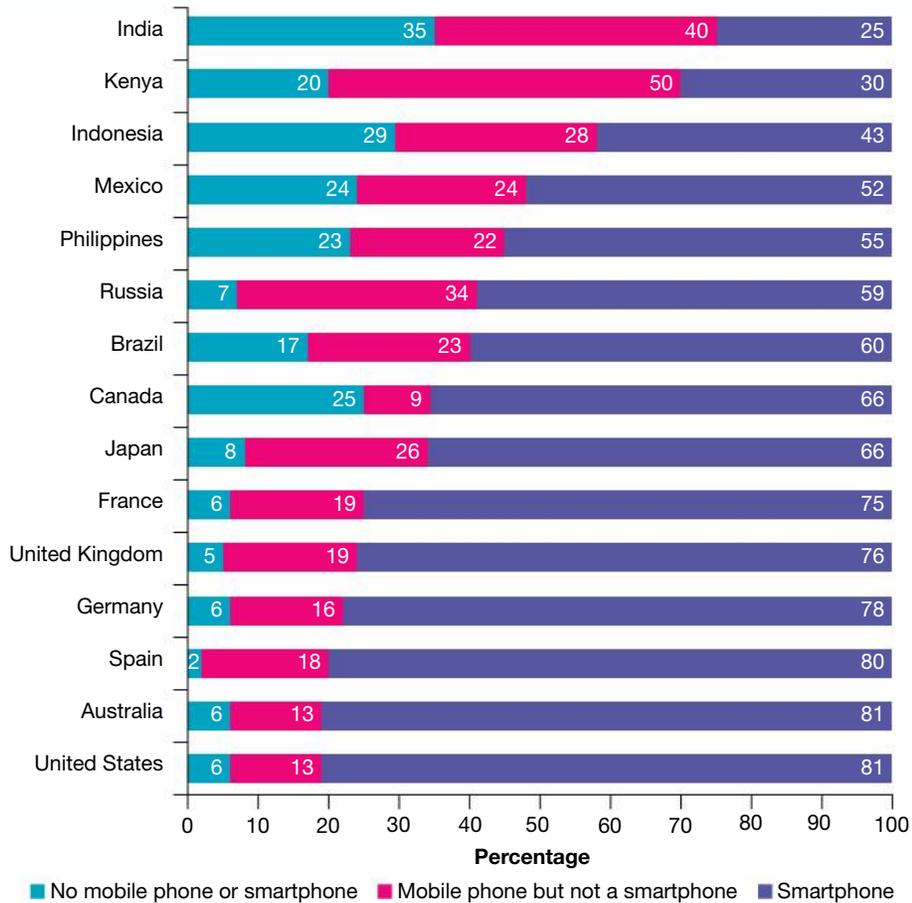
In countries with a very high level of economic development there has been a shift to smartphones. In the countries with a lower level of economic development the adoption of the latest technology is not as evident. **FIGURE 4** shows the adoption of mobile phones and smartphones in a few selected countries.

FIGURE 3 The distribution of mobile subscriptions per 100 people, 2017



Source: Based on information from JUMIA (2018)

FIGURE 4 The adoption of mobile phones by adults in selected countries, 2018



4.9 SKILL ACTIVITY: Questioning and researching using geographical methods, Interpreting and analysing geographical data and information

Using a world map, find the countries listed in **TABLE 1**.

1. In which parts of the world is the highest proportion of internet use found? **Suggest** a reason for this occurrence.
2. In which parts of the world is the lowest proportion of internet use found? **Suggest** reasons for this occurrence.

4.9 Exercise

learn**on**

4.9 Exercise

Learning pathways

■ LEVEL 1

1, 2, 4, 6

■ LEVEL 2

5, 7, 8, 9

■ LEVEL 3

3, 9, 10, 11

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Check your understanding

1. The country with the lowest number of people using the internet is:
 - A. North Korea.
 - B. Chad.
 - C. Madagascar.
 - D. Niger.
2. **Determine** whether the following statements are true or false.
 - a. The world wide web is an 'enabler'.
 - b. Internet connectivity is available globally, but its distribution is not even.
 - c. Referring to **FIGURE 2**, it can be said that 4.54 billion people worldwide are active social media users.
3. Is everyone across the world connected to the internet? **Justify** your response with data.
4. **Explain** the initial purpose of the world wide web.
5. **Identify** the parts of the world where the adoption of smartphones been greatest.

Apply your understanding

Interpreting and analysing geographical data and information

6. Using **FIGURE 1**, **describe** the change over time from 2001 to 2019 of the technologies shown.

Communicating

7. **Decide** why it is young people who have adopted technology so readily into their lives.
8. **Predict** if computers will become extinct for communications in the future. **Explain** your view.

Interpreting and analysing geographical data and information

9. Using statistics from **FIGURE 4** to support your answer, **analyse** and then **describe** the level of mobile phone use in:
 - a. India
 - b. Kenya
 - c. Australia.
10. Choose one European country, one African country and one Asian country included in **FIGURE 4** and **hypothesise** the changes to mobile phone adoption that might occur in those countries by 2030.
11. **Discuss** three reasons for the uneven distribution of mobile phones across the world.

LESSON

4.10 What is a digital divide?

LEARNING INTENTION

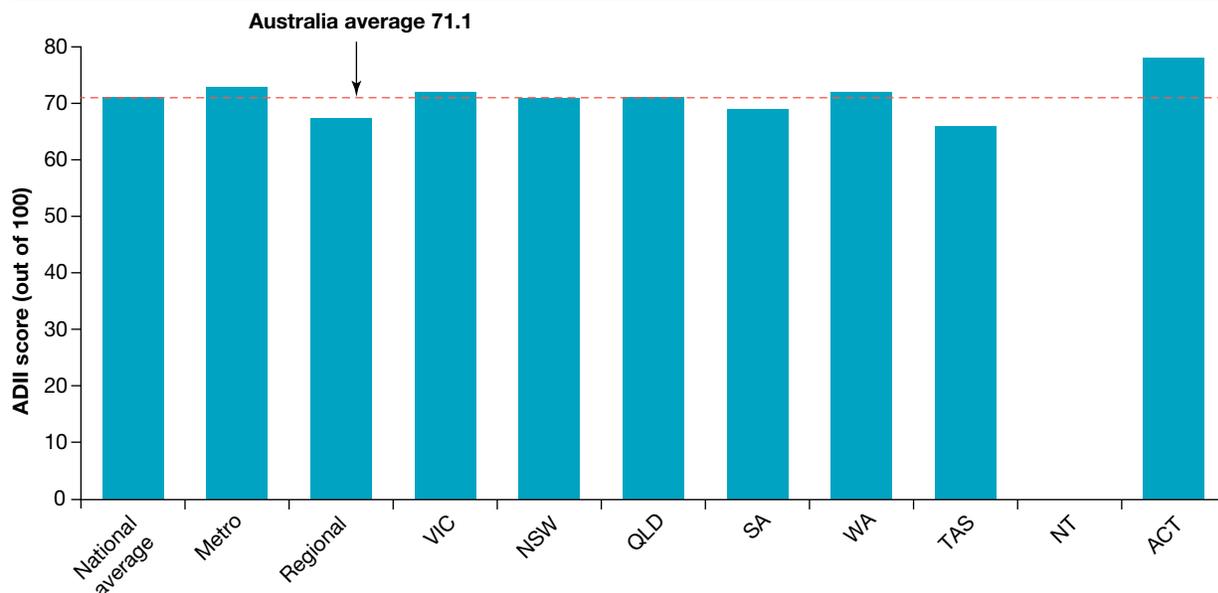
By the end of this lesson you should be able to explain what a digital divide is, and comment on the use of technology in India.

TUNE IN

Do you realise there is a digital divide across the world? Some countries have very poor access to ICT facilities. Consider the notion of digital inclusion across Australia and where your state stands.

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FIGURE 1 Australian Digital Inclusion Index by state, 2021



Source: Thomas, J., Barraket, J., Parkinson, S., Wilson, C., Holcombe-James, I., Brydon, A., Kennedy, J. (2021). Australian Digital Inclusion Index: 2021, Dashboard Dataset Release 1. Melbourne: RMIT and Swinburne University of Technology, and Telstra.

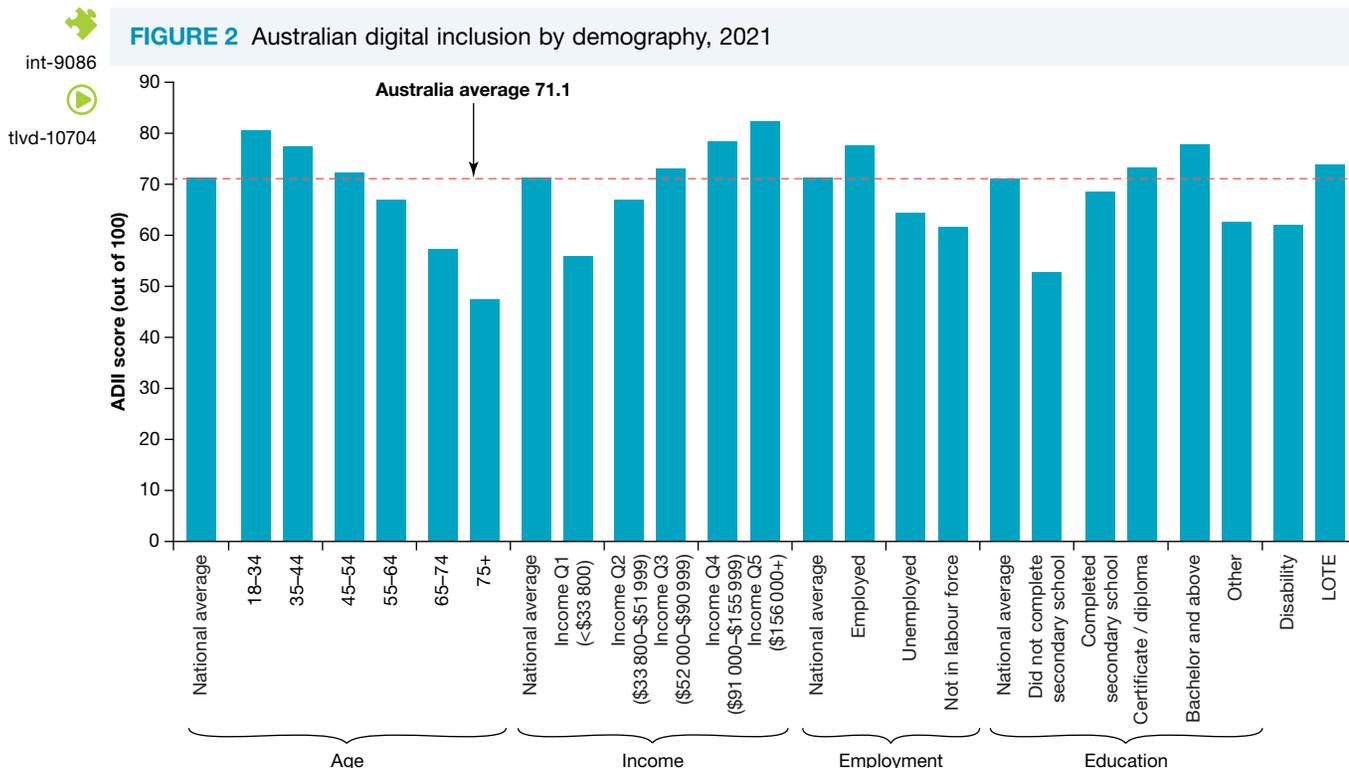
1. Why do you think rural Australia has a lower access rating than capital cities as shown in the graph?
2. Investigate what is meant by the phrase 'the tyranny of distance' and indicate how this can apply to the roll-out of digital technology across Australia.

4.10.1 Australia's digital divide

Australia is an economically developed country. We consider access to the internet a necessity. Australians also expect the technology to be affordable as a proportion of their income. Our ability to adapt to the rapidly changing environment and our high skill levels are such that Australians make good use of their connectivity. However, not everyone in Australia has equal access to the internet. There is a digital divide, whereby some areas experience greater levels of digital inclusion than others. This is particularly so with respect to remote communities when compared to capital cities and regional centres. Nevertheless, in 2021 Australia rated 71.1 out of a maximum of 100 on the Australian Digital Inclusion Index (ADII) (see **FIGURE 1**).

4.10.2 Some Australians are less well connected

In addition to disparities in connectedness based on geographical location, there are also particular groups within Australian society that are more digitally disadvantaged. **FIGURE 2** shows that people with lower incomes, those with no income, those older than 50 years and especially those over 65 and the disabled have a digital inclusion index lower than the Australian average.



Source: Thomas, J., Barraket, J., Parkinson, S., Wilson, C., Holcombe-James, I., Brydon, A., Kennedy, J. (2021). Australian Digital Inclusion Index: 2021, Dashboard Dataset Release 1. Melbourne: RMIT and Swinburne University of Technology, and Telstra.

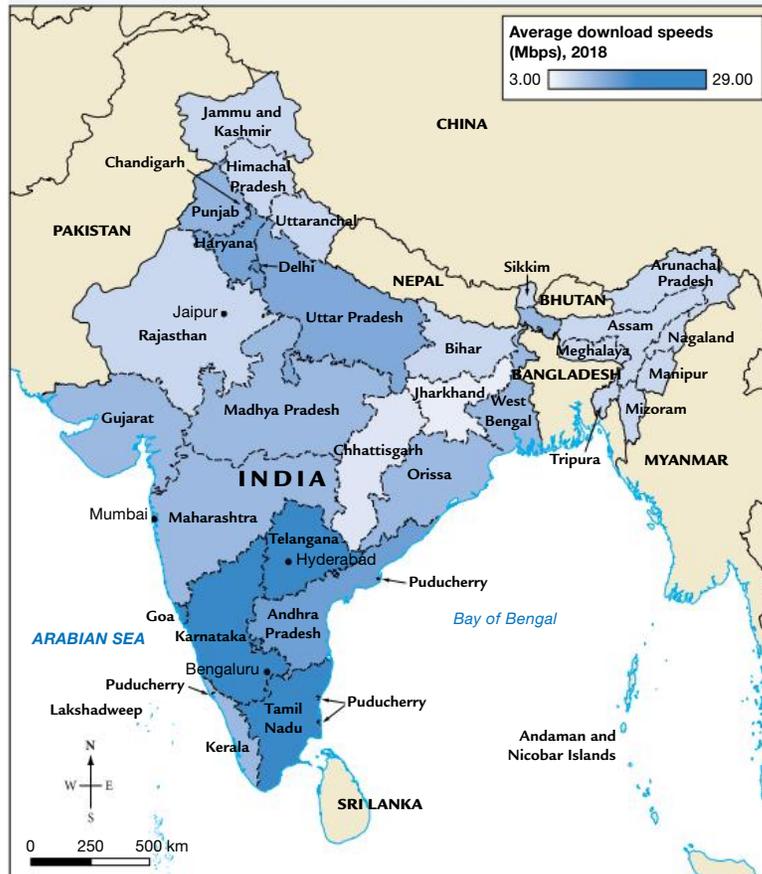
4.10.3 The digital divide in India

India is a medium-level-development country with varying levels of prosperity among its people. In 2017, Indian gross national product (GNP) was relatively low, at US\$6353 per person, and 21.2 per cent of the population earned less than US\$1.90 per day. However, mobile phone subscriptions are high (85.2 per cent in 2017, with an increase of 39.4 per cent between 2010 and 2016), providing greater connection within India and to the world. Conversely, internet users comprise a much smaller percentage of the population (only 29.5 per cent in 2017). Despite this, ICT is a boom industry in places like Bengaluru and Hyderabad, where many international companies have set up their service industries providing the world with call centres, and conducting research and development within the ICT sector.

4.10.4 ICT in India

Among Asian countries, India is a leader in internet affordability and is ranked third in its readiness for the internet, but poor mobile speed and uneven availability mean that a digital divide does exist within the country. **FIGURE 3** shows the uneven average download speeds across India. The ICT hubs are within the highest-rated areas, although this rate of connection is lower than can be expected in Melbourne, where the average download speed is over 40 Mbps.

FIGURE 3 Broadband speeds across India, 2018



Source: Speedtest® by Ookla®. Analysis by Ookla of Speedtest Intelligence data February 2018.

4.10.5 Bengaluru — a dynamic city

Bengaluru began its role in the ICT world back in the 1980s when two Indian tech companies — Infosys and Wipro — moved their head offices there. Other tech companies followed, growing their businesses around the two firms. This included foreign companies looking to cut costs by employing cheap local ICT developers. The ICT outsourcing model had begun.

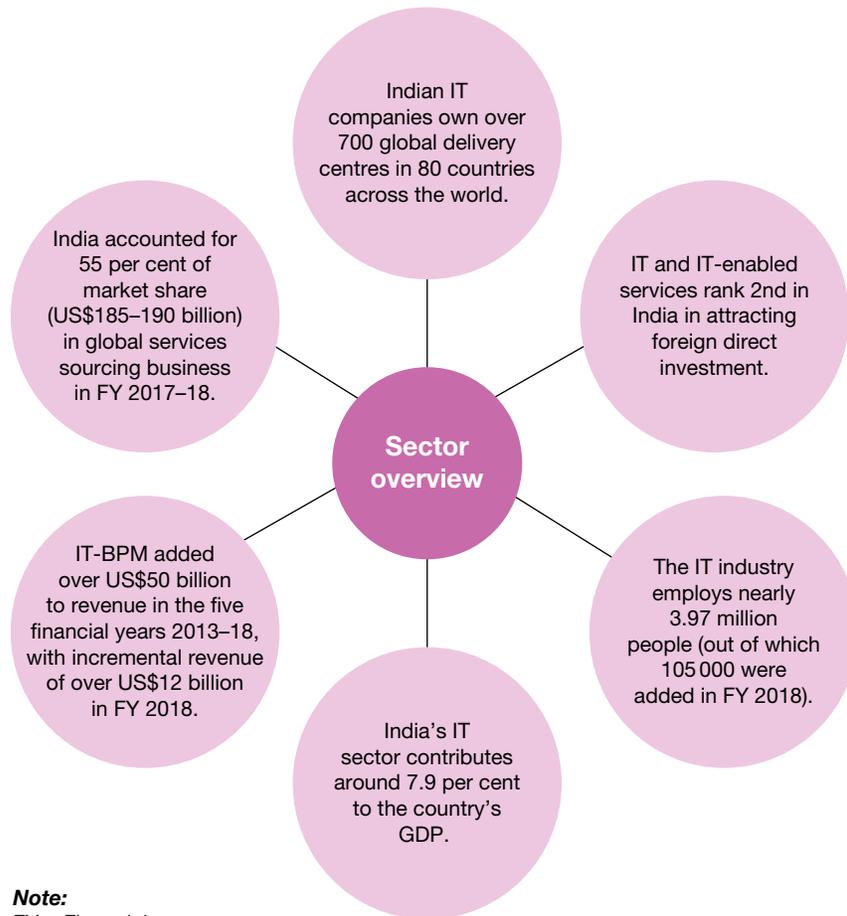
Bengaluru is now a modern city. These new jobs raised living standards and attracted educated Indians from across the country, as well as expatriates from across the world. Academic institutions set up alongside the innovative ICT businesses. Indians working elsewhere in the world are bringing their knowledge and skills home. More and more international companies are outsourcing to India because labour costs are lower and skill shortages occur across the world. India also has a large and able English-speaking

FIGURE 4 Modern Bengaluru



workforce (there are more than 80 million English-speakers in India). In 2019, Australia’s Telstra launched its Telstra Innovation and Capability Centre in Bengaluru to overcome the skill shortage in Australia. Bengaluru has grown into a major international hub for ICT companies. Since 2018, Bengaluru and Hyderabad (part of India’s Silicon Valley) have shared top billing as the world’s most dynamic cities, according to a ranking devised by the investment management firm Jones Lang LaSalle.

FIGURE 5 The strength of India's IT sector



Note:
 FY = Financial year
 IT = Information technology
 BPM = Business process management

FIGURE 6 Modern city Hyderabad is part of India's Silicon Valley.



4.10 SKILL ACTIVITY: Interpreting and analysing geographical data and information

The digital divide in Australia occurs across different sectors of our society. Use **FIGURE 2** to **assess** the following:

- Which sector of Australia's population is furthest from the average Australian inclusion index?
- Which is more of a hindrance to achieving digital connection: lack of employment or lower level of education?
- For the disabled group, how accessible, affordable and digitally skilled is their digital connection?

4.10 Exercise

learnon

4.10 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3, 4

■ LEVEL 2

5, 6, 7

■ LEVEL 3

5, 8, 9, 10

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Check your understanding

- It is important for the Indian population to speak English. True or false?
- Name** the state or territory that has the highest level of digital inclusion.
- What percentage of the Indian population earns less than US\$1.90 per day?
 - 21.2 per cent
 - 29.5 per cent
 - 39.4 per cent
 - 85.2 per cent
- Identify** the Indian cities in which the IT industry is developing rapidly.
- Define** the term *digital divide* in your own words.

Apply your understanding

Interpreting and analysing geographical data and information

- With reference to **FIGURE 1**, **examine** how close each of Australia's states and territories is to the average ADII.
- Look at **FIGURE 3**. **Describe** the broadband speeds across India.
- Consider** what impact India's broadband speeds would have on the establishment of technological companies across the country.

Communicating

- In what ways does the ICT sector help the economic development of India within the country?
- In what ways does the ICT sector help the economic development of India with its connection to the world?

LESSON

4.11 Why is e-waste presenting such significant challenges?

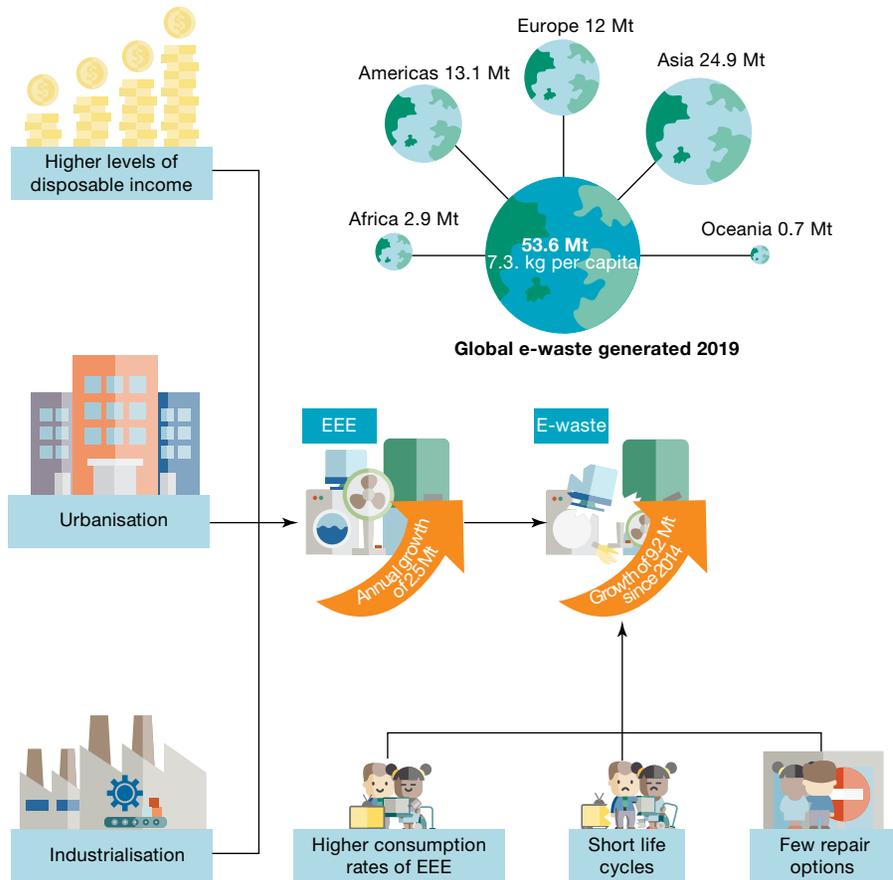
LEARNING INTENTION

By the end of this lesson you should be able to describe the growing level of e-waste that comes with our growing use of ICT and discuss the significant challenges this presents in terms of sustainable disposal and recycling methods that do not pose risks to the health of people and the planet.

TUNE IN

In this modern ICT-oriented world, devices wear out, reach the end of their usable life or are superseded by new forms of technology. The fast rate at which appliances become obsolescent means there is a growing 'mountain' of e-waste around the world.

FIGURE 1 Continents generating the most electronic waste, 2017



Note: Includes discarded products with a battery or plug including mobile phones, laptops, televisions, refrigerators, electrical toys and other electronic equipment

Source: Adapted from Forti V., et al., The Global E-waste Monitor 2020: Quantities, flows and the circular economy potential. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR) – co-hosted SCYCLE Programme, International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam.

1. Which nations are the biggest producers of e-waste and how do you think this e-waste is managed around the world?
2. What items in your home have become e-waste over the last few years and how did you manage that e-waste?

4.11.1 Production and consumption

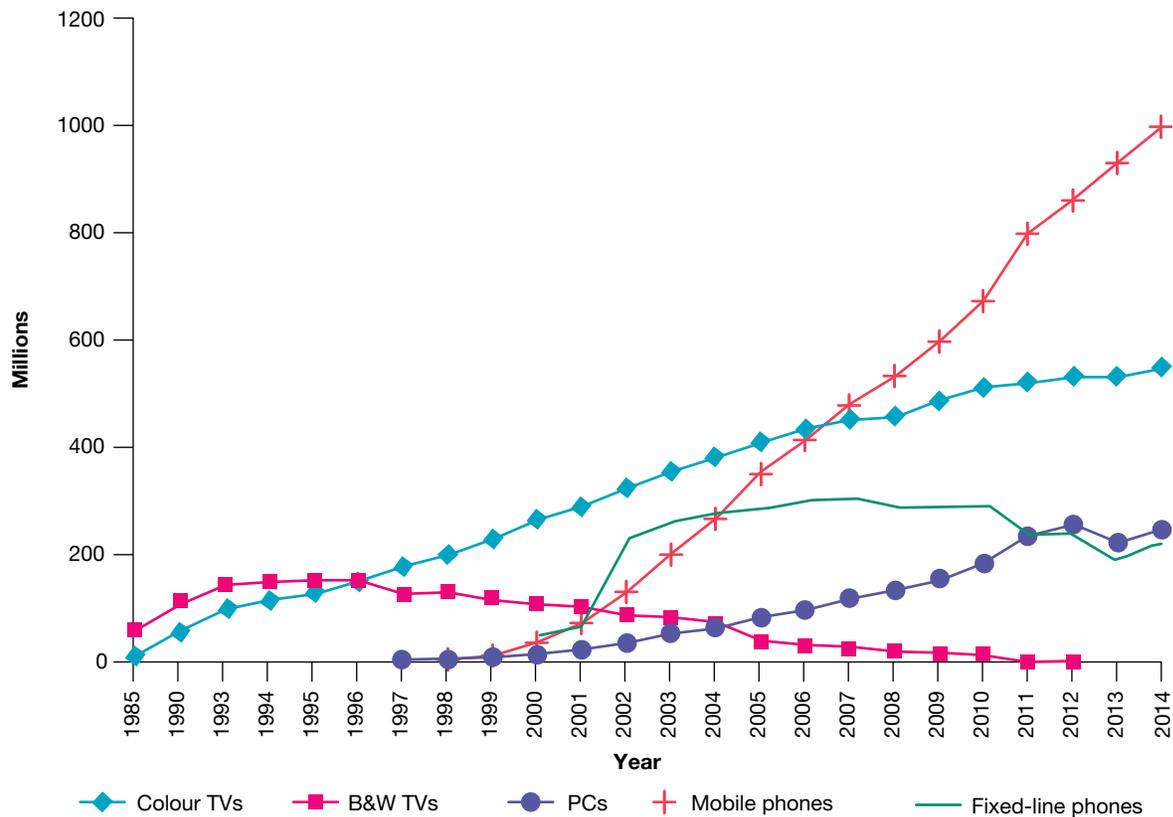
China is one of the largest producers and consumers of electronics. With the short lifespan of some products — the Chinese buy a new mobile phone on average every 18 months — and with advances in technology, there is a growing amount of e-waste, produced both within China and by overseas countries (see **FIGURE 1**). Globally, 59.4 million metric tonnes of e-waste were produced in 2022; it is expected this figure will reach 74.7 million metric tonnes by 2030. For a long time, places like China, India and Ghana have accepted and processed the world’s e-waste to enhance their economic development.

4.11.2 The impact of e-waste on people in China

Growth in China’s national economy has seen a change in the sale of ICT appliances as its middle class has grown. China generates the highest quantity of e-waste in Asia and in the world — over 70 per cent of all global e-waste is recorded in China. **FIGURES 2** and **3** (a) and (b) show the changes in ICT device ownership and disposal of devices in China over a 30-year period of significant change in China and ICT development around the world.

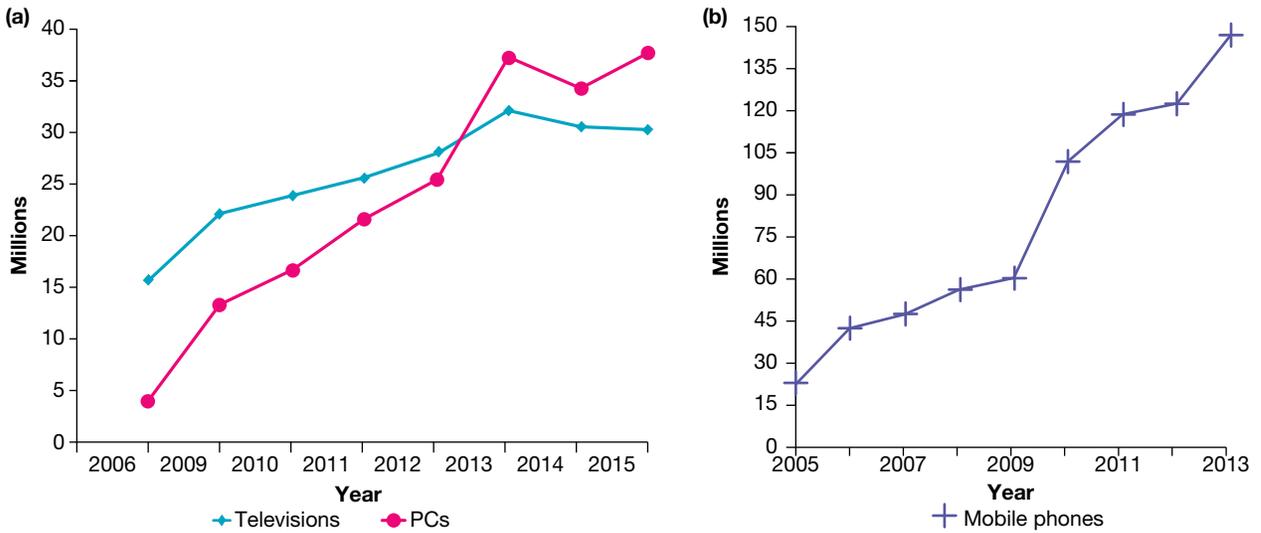
In the domestic market, informal collectors travel door-to-door collecting technological appliances for cash. It is estimated that this mode of collection recovers most e-waste (86 per cent in 2015). Formal collectors are tax-paying businesses or waste stations that buy back old appliances. But the Chinese consumers prefer the informal collectors who offer a higher price and a more convenient service.

FIGURE 2 The change in number and types of ICT devices owned in China over a 30-year period



Source: China Household Electric Appliance Research Institute (CHEARI), White Paper on WEEE Recycling Industry in China, 2015.

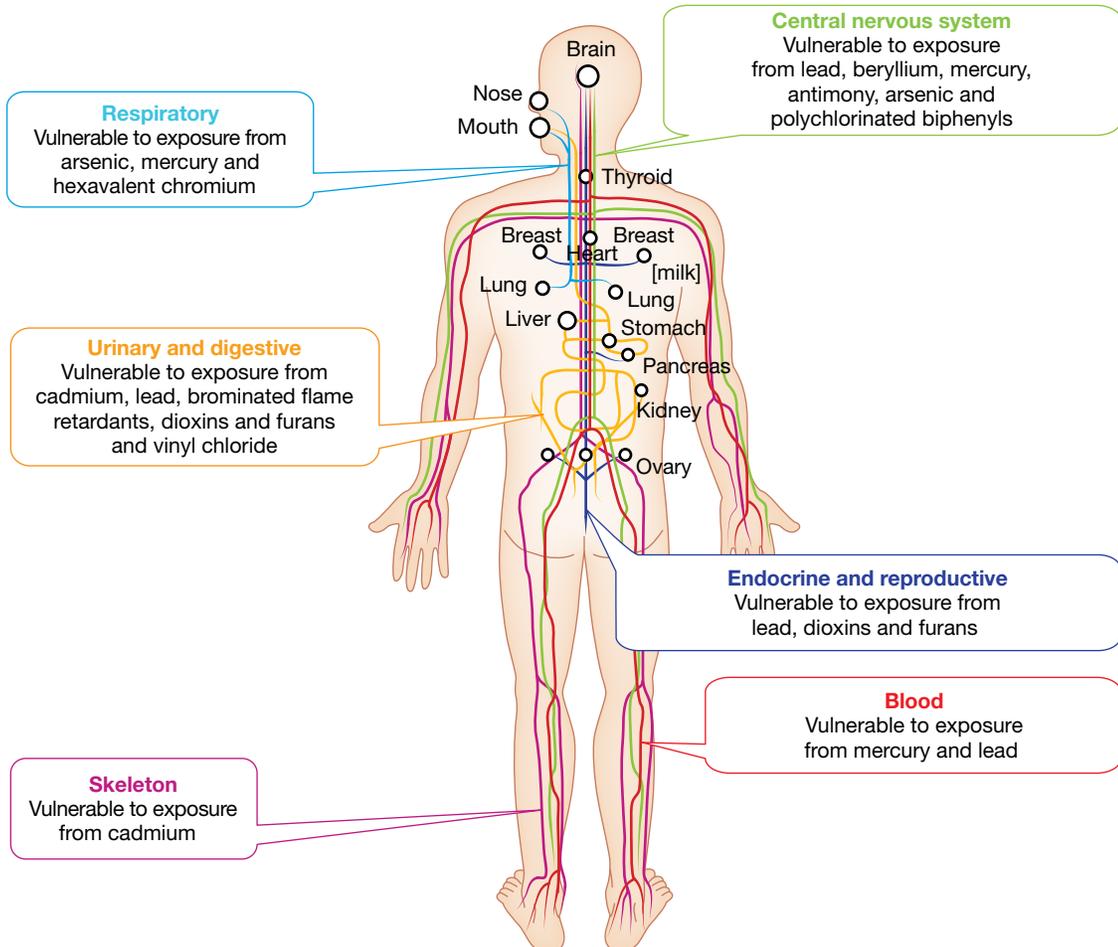
FIGURE 3 Trends in the number of devices discarded annually in China (a) televisions and PCs and (b) mobile phones



Source: (a) Based on data from China Household Electric Appliance Research Institute (CHEARI), White Paper on WEEE Recycling Industry in China 2015. (b) Based on data from Zeng. X. Li, J., Liu, L. 2015. Solving spent lithium-ion battery problems in China: Opportunities and challenges. Renewable and Sustainable Energy Reviews Volume 52, December 2015, 1759–1767

int-9087

FIGURE 4 Health impacts of e-waste on waste workers and people who live near landfills or incinerators



The informal collectors' method of handling the e-waste is a major concern for their wellbeing. In backyards and laneways families sift through the e-waste, exposing themselves to many toxic components. **FIGURE 4** shows the various human body systems and the e-waste components that can affect them. Major exposure to the toxic elements occurs when the e-waste component parts are melted down over open fires to extract gold, copper and silver (**FIGURE 5**). Recent studies have shown that exposure to such toxic components reduces intelligence and has a negative impact on the development of the central nervous system of children.

For many years Guiyu, in Guangdong province, China, was known as the centre for reclaiming e-waste. The livelihood of its residents depended on this business. The air was polluted by an acidic smell, waste water as a by-product flowed into waterways, and soils were contaminated. Local agricultural produce was contaminated by the toxic water used for irrigation. Vegetables further absorbed toxins through their leaf systems, and people ate these vegetables.

Today Guiyu has a number of modern formal recycling plants. The informal collectors have been forced into operating in and through these plants. However, it has not been easy to change people's ways, so regulation and law enforcement have not always been adequate to bring about change.

FIGURE 5 Collectors sort and burn e-waste.



FIGURE 6 Animals graze among e-waste in Guiyu.



4.11.3 The future for e-waste

Since 2014, legislation regarding the management of e-waste has been developed and, to varying degrees, adopted across the globe (see **TABLE 1**). The coverage by legislation has risen from 44 per cent to 66 per cent of the world's population (in 67 countries). India, as a major generator of e-waste, has been leading the way with the adoption of legislation; most African countries, conversely, have done little to address the issue.

4.11.4 Legislation

The existence of policies or legislation does not necessarily imply successful enforcement or the existence of sufficient e-waste management systems. **TABLE 1** lists some of the more significant attempts at e-waste management around the world.

Only 41 countries in the world collect statistics. Measuring e-waste is an important step towards addressing the e-waste challenge. Statistics help to evaluate developments over time, set and assess targets, and identify best practices of policies. Better e-waste data will help to minimise its generation, prevent illegal dumping and emissions, promote recycling and create jobs.

In 2011, the Australian government commenced the National Television and Computer Recycling Scheme (NTCRS). The NTCRS website directs people to places to dispose of e-waste, such as MobileMuster and Planet Ark.

Laws regarding the disposal of e-waste vary between Australian states and territories. On 1 July 2019, Victoria banned the inclusion of e-waste in general garbage collections and curbside collections, preventing e-waste from going to landfill.

South Australia has prohibited the dumping of e-waste in landfill since 2011, and the ACT since 2010. Western Australia has recently reviewed its regulations on e-waste such that it can no longer go to landfill, but rather must be responsibly processed by recycling depots.

FIGURE 7 Increasing mobile phone usage contributes significantly to e-waste.



TABLE 1 E-waste legislation around the world

Policy/legislation	Specific actions
Basel Convention 1994	<ul style="list-style-type: none"> • Keep the production of hazardous waste as low as possible. • Make suitable disposal facilities available. • Reduce and manage international flow of hazardous waste. • Ensure management of waste is controlled in an environmentally friendly way. • Block and punish illegal movement of hazardous waste.
Buy-back policies	Many countries have tried buy-back schemes, with varying degrees of success.
China's e-waste ban, 2002	Although an official ban was placed on e-waste being shipped into China, it continued to be smuggled in or came across the borders by land. In 2017 China strengthened its ban on e-waste.
International Telecommunication Union	Connect 2030 has taken on board the Sustainable Development Goals, especially Goals 3, 7, 11, 12 and 13, where ICT can be applied.
Kenya e-waste Act	Initiated in 2013 but stalled in parliament, this Act has been replaced by a National E-Waste Management Strategy to cover the period 2019–20 to 2023–24. Its purpose is to prescribe ways to minimise negative impacts of e-waste on the environment and human health.
Global e-waste Statistics Partnership 2017	The International Telecommunication Union, the United Nations University, and the International Solid Waste Association have joined together to improve the collection, analysis and publication of worldwide e-waste statistics, with a view to increasing the awareness of the need for further development in the e-waste industry.
India 2018	Rules were first established in 2011 using the concept of Extended Producer Responsibility whereby the manufacturer is responsible for safe disposal of electronic goods. In 2018 the emphasis was on regulating the dismantlers and recyclers and providing revised collection targets into the future.

on Resources

-  **Interactivity** e-wasted (int-3343)
-  **Weblink** Survey Monkey

4.11 SKILL ACTIVITY: Communicating

1. Find a selection of five images online to **create** a photo essay showing the lives and work of informal e-waste collectors.
2. **Annotate** each image stating where it is from and what the people are doing. Make sure to include its source details.



4.11 Exercise

learnon

4.11 Exercise

Learning pathways

■ **LEVEL 1**
1, 2, 4

■ **LEVEL 2**
3, 6, 7, 8

■ **LEVEL 3**
5, 7, 9, 10

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Check your understanding

1. **Identify** the correct definition of the term 'e-waste'.
 - A. A wasted version of the web
 - B. All waste
 - C. Any old electrical equipment, such as computers, toasters, mobile phones and iPads, that no longer works or is no longer required
 - D. Websites that are no longer valid.

2. **Identify** the two countries that produce the greatest amount of e-waste.
 - A. Japan
 - B. United States
 - C. China
 - D. Australia
3. What proportion of the world's countries has legislation in place regarding e-waste management?
 - A. 15 per cent
 - B. 25 per cent
 - C. 50 per cent
 - D. 66 per cent
4. **Recall** the key actions identified in the Basel Convention.
5. **Explain** the importance of statistics in addressing the issue of e-waste management.

Apply your understanding

Interpreting and analysing geographical data and information

6. Has the production of e-waste reflected the consumption of ICT products in China since 2006?
Explain your answer.
7. China might produce the most e-waste, but its per capita level is low. India also has a low per capita level, although it produces far less e-waste. Try to **explain** this situation.

Communicating

8. **Propose** a set of regulations that might assist the city of Guiyu to replace the culture of informal collection of e-waste in the city. **Suggest** how each regulation might be introduced so that the program is a success.

Concluding and decision-making

9. **Consider** reasons for Kenya's inability to bring into law an e-waste Act.
10. **Generalise** what is meant by the 'need for a global solution to the transboundary issue of e-waste'.



LESSON

4.12 Investigating topographic maps – Norway – the best place on Earth

LEARNING INTENTION

By the end of this lesson you should be able to provide examples of why Norway is well ranked on the Human Development Index and identify specific features on a topographic map of part of the country.

4.12.1 Norway's HDI ranking

Norway has consistently held the number one position in the Human Development Index (HDI) rankings for 16 of the past 18 years. This is largely because of its high levels of development in health, education and the economy. Norway makes up the western part of Scandinavia and shares borders with Sweden, Finland and Russia (see **FIGURE 1**).



Source: Spatial Vision.

Much of Norway's wealth is derived from its location on the North Sea and its proximity to oil. In 2019 Norway ranked fifteenth in the world in oil production, producing almost two million barrels per day. The value to the economy is around A\$88 billion, which is 46 per cent of their exports.

Norway has around 40 accredited higher education institutions and several private ones. With the exception of some private university colleges, all higher education institutions are state-run and in general, tuition fees are not required.

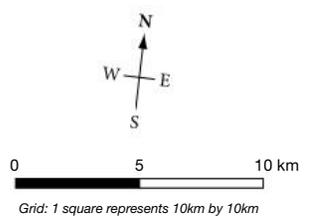
Norway spends just under US\$10 000 per person per year on health care, the highest in the world. Health care is free for children aged 16 or younger, and for pregnant and/or nursing women. Everyone else must pay a fee, which is currently on average US\$325 a year. This entitles them to coverage of all immediate healthcare costs in the event of having to be admitted to a hospital's emergency department.

FIGURE 2 Topographic map of Ulvik



Legend

1410	Spot Height	route no. 7	Highway		River
.	Building		Major road		Water body
	Hut		Minor road		Forest
	Helipad		Track		Swamp
	Index contour		Private road		Glacier
	Contour (interval: 100 m)		Ferry route		Park or reserve
	Kommune boundary		Railway, station		



Source: Map data based on N1000 Map Data, Norwegian Mapping Authority (2021); elevation data sourced from USGS. Map drawn by Spatial Vision.

on Resources

-  **eWorkbook** Investigating topographic maps — The best place on Earth — Norway (ewbk-11576)
-  **Digital document** Topographic map of Ulvik (doc-36371)
-  **Video eLesson** Investigating topographic maps — The best place on Earth — Norway — Key concepts (eles-6126)
-  **Interactivity** Investigating topographic maps — The best place on Earth — Norway (int-8700)
-  **Google Earth** Ulvik, Norway

4.12 Exercise

learnon

4.12 Exercise

Learning pathways

■ LEVEL 1

1, 2

■ LEVEL 2

3, 6

■ LEVEL 3

4, 5

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Check your understanding

1. Refer to **FIGURE 1**. **Identify** the capital cities of three Scandinavian countries.
2. **Describe** the location of Norway.
3. **Outline** some of the key features of the Norwegian government's income and expenditure.

Apply your understanding

Interpreting and analysing geographical data and information

4. Refer to **FIGURE 2**.
 - a. Which quadrant has the highest elevation?
 - b. What is the aspect of the slope at Brimnes?
 - c. **Estimate** the area of the Hardanger Glacier (Hardangerjøkulen) on the eastern side of the map.
 - d. What is the gradient between the highest point of the Hardanger Glacier and the spot height 1306 metres just south of Brimnes?
 - e. What is the local relief between the highest point of the glacier and the spot height 1306 metres just south of Brimnes?
5. Norway scores highly in a number of other categories as well as those on the HDI. Construct an argument to convince a person to emigrate to Norway.
6. If you were moving to Norway, where would you prefer to live? Provide information about the location you chose from **FIGURES 1** and **2** to help explain your decision.

LESSON

4.13 Review

Hey students! Now that it's time to revise this topic, go online to:



Review your results



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4.13.1 Key knowledge summary

Use this dot point summary to review the content covered in this topic.

4.2 How do perceptions of land vary?

- Land means different things to different people.
- People with traditional cultural ways of living often have strong connections to the land through their agricultural practices.
- Our understanding of land is not always the same as that in agriculture-based societies.

4.3 How do we access places?

- Public transport plays a vital role in connecting people and places.
- Active travel, such as cycling or walking, has become a mainstream mode of transport in modern life.
- The '20-minute neighbourhood' concept in urban planning aims to achieve living spaces in which people can walk to access all the key requirements of daily life.

4.4 INQUIRY: Designing a sustainable garden

- What does it mean to be sustainable?
- What is sustainable gardening?
- How can sustainable gardening be implemented in a school environment?
- How can a sustainable landscaped leisure area be developed to suit student needs?

4.5 How is Australia connected globally through export and import trade?

- Technological developments have seen the reduction in time taken to connect with distant places.
- Cruise ship travel has become increasingly popular.
- Air travel has become faster, more frequent and cheaper, making it an increasingly accessible way for people to connect with faraway places and people.

4.6 How does trade connect us?

- Countries of the world are interconnected through trade in goods and services.
- Different countries, because of their level of economic development, have varying levels of consumption of goods and services.

4.7 What is Australia's contribution to the global trade industry?

- Australia is a member nation of the major organisations that control world trade, such as the World Trade Organization (WTO).
- The production of goods can have significant impacts on the environment, requiring careful management of water and soil resources to achieve sustainability.
- Globalisation has led to a change in manufacturing such that goods are now more likely to be produced in developing countries where labour costs are low.

4.8 Is international trade fair?

- The fair trade movement aims to improve the lives of small producers in developing nations by paying a fair price to artisans and farmers who export goods
- The fair trade labelling system is operated by Fairtrade International. The system works to ensure that income from the sale of products goes directly to farmers, artisans and their communities.
- NGOs such as Oxfam and World Vision also support fair trade and oppose socially unjust trade agreements.

4.9 How do Australians use technology to communicate and interconnect?

- The world of ICT is constantly developing and changing.
- The internet is not evenly accessible across the world.
- There is a clear link between access to the internet and mobile phones.

4.10 What is a digital divide?

- Not all Australians have equal access to digital technology.
- Mobile phone subscriptions are high in India, but the internet has less penetration.
- Regional and rural areas in both Australia and India have less access to technology.

4.11 Why is e-waste presenting such significant challenges?

- China is one of the largest producers and consumers of ICT appliances.
- E-waste disposal has had an impact on the environment, which has in turn affected people.
- E-waste legislation is unevenly implemented across the world but does not always work.

4.12 Investigating topographic maps – Norway – the best place on Earth

- Due to high levels of development in health, education and the economy, Norway has consistently held the top position in the Human Development Index.
- Many factors are considered when ranking a country 'the best in the world'.

4.13.2 Key terms

active travel making journeys via physically active means, such as cycling or walking

barter to trade goods in return for other goods or services rather than money

connectivity the ability to access the internet

ethnicity cultural factors such as nationality, culture, ancestry, language and beliefs

digital divide a type of inequality between groups in their access to and knowledge of information and communication technology

developing countries nations with a low living standard, undeveloped industrial base and low human development index relative to other countries

infrastructure the facilities, services and installations needed for a society to function, such as transportation and communications systems, water pipes and power lines

extremism extreme political or religious views or extreme actions taken on the basis of those views

human development measures such as life expectancy, education and economic wellbeing that provide an overall indication of a place's level of development and the standard of living of its inhabitants

humanitarian principles the principles governing our response to those in need, with the main aim being to save lives and alleviate suffering

national security the protection of a nation's citizens, natural resources, economy, money, environment, military, government and energy

non-government organisation (NGO) a group or business that is organised to serve a particular social purpose at local, national or international level, and operates independently of government

offshore to relocate part of a company's processes or services overseas in order to decrease costs

perception the process by which people translate sensory input into a view of the world around them

social justice a principle applied so that a society is based on equality, the appreciation of the value of human rights and the recognition of the dignity of every human being

trade barrier government-imposed restriction (in the form of tariffs, quotas and subsidies) on the free international exchange of goods or services

trading partner a participant, organisation or government body in a continuing trade relationship

value adding processing a material or product and thereby increasing its market value

world wide web the global resources and information exchange available to internet users through the use of the Hypertext Transfer Protocol (HTTP)

4.13.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

Exciting or dull, familiar or strange? How can the same place look and feel different for each person?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question, outlining your views.

Resources



eWorkbook Customisable worksheets for this topic (ewbk-13450)
Reflection (ewbk-10647)
Crossword (ewbk-10648)



Interactivity Connecting with our places crossword (int-7649)

4.13 Review exercise

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Multiple choice

- What factors might influence your understanding of a place?
 - You might hold cultural beliefs that influence your connection to land.
 - You might not understand a place very well and find it unfamiliar or strange.
 - Your religious beliefs might set rules about how you should treat a specific place.
 - All of the above
- What is *not* one of the benefits of air freight?
 - It is quicker than shipping.
 - It allows for easier trade in perishable items over long distances.
 - It facilitates 'just in time' manufacturing.
 - It is more cost-effective than shipping by sea.
- How is household final consumption per person calculated?
 - Multiplying the amount spent on all goods and services within a country for a year, divided by the total population of the country
 - Adding the amount spent on all goods and services within a country for a year, divided by the total population of the country
 - Adding the amount spent on all goods and services within a country for a year, divided by the number of households in the country
 - Adding the amount spent on all goods and services within a country for a month, divided by the total population of the country
- What does the term *value adding* mean?
 - Inflating the price of goods or services for specific customers
 - Absorbing the environmental costs of a product to minimise its impact
 - Increasing a product's market value by processing or changing it
 - Charging an additional fee to import products
- Why did the COVID-19 pandemic affect the international rock lobster market?
 - Rock lobsters caught the disease and died.
 - A significant number of lobster fishermen were quarantined.
 - Local markets closed down.
 - Export to China decreased significantly.
- Which of these countries was *not* one of Australia's top ten trading partners in 2019–20?
 - China
 - India
 - Canada
 - Germany



7. What was Australia's largest export commodity in 2019–20?
 - A. Education-related travel
 - B. Gold
 - C. Iron ore and concentrates
 - D. Beef
8. Which government body manages Australia's overseas aid program?
 - A. The United Nations
 - B. The Department of Trade
 - C. The Department of Homeland Security
 - D. The Department of Foreign Affairs and Trade
9. What proportion of Australia's aid budget was spent on education in 2019–20?
 - A. 16 per cent
 - B. 19 per cent
 - C. 20 per cent
 - D. 37 per cent
10. Higher levels of smartphone adoption tend to occur in:
 - A. countries with low levels of human development.
 - B. countries with high levels of human development.
 - C. countries with limited internet access.
 - D. countries with small populations.

Short answer

Communicating

11. How can stereotypes affect how we 'see' a place?
12. What are the benefits for a community that can walk to satisfy its daily needs?
13. a. **Describe** the types of disabilities that would make it most difficult to travel on public transport.
b. Choose one of these types of disability and explain why it would make using a specific type of public transport difficult (e.g. train, bus, tram, ferry).
14. Come up with a plan for improving transport in your region.
 - a. **Explain** what kind of services your community needs.
 - b. **List** the stakeholders who would need to be involved in order to make your dream a reality.
15. a. **Identify** one way that people living in remote places in Australia can be connected to the world through the use of technology.
b. **List** how this interconnection might benefit people living in remote communities.
16. **Explain** why providing international aid might be in the interests of Australia's national security.
17. **Identify** and **describe** one trend in the spatial distribution of internet users around the world.

Concluding and decision-making

18. **Consider** the factors affecting access to the internet in Australia. In your view, which of these factors would be most difficult for an individual to overcome? **Present** an argument to **justify** your decision.
19. **Propose** and **explain** one strategy that might be put in place to ensure that e-waste in your community is recycled.
20. Land means different things to different people. What factors influence the way you feel and think about the place you live? You could answer this question on a local, national or international scale.

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5 Connecting people and place

LESSON SEQUENCE

5.1 Overview	225
5.2 How is tourism important?	226
5.3 What is global tourism?	233
5.4 Is Australian tourism growing?	241
5.5 What are the impacts of tourism?	246
5.6 How can we manage the environmental impacts of tourism?	251
5.7 What is cultural tourism?	256
5.8 How are tourism and sport connected?	263
5.9 INQUIRY: Cruising sustainably	268
5.10 Investigating topographic maps: Nature-driven tourism at Victoria Falls	270
5.11 Review	273



LESSON

5.1 Overview

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Can the tourism choices we make today be managed sustainably, to have a positive impact on economy, society and the environment?

5.1.1 Introduction

For Australians in the 1950s and 1960s, overseas travel was an exotic, time-consuming and expensive adventure that for many was simply beyond their reach. Fast forward to 2020 and nearly 60 per cent of the Australian population owns a passport. Whether at home or abroad, travel is an important part of modern life.

The World Tourism Organization estimates that by 2030, five million people will travel each day. Where will these people go and what will influence their choices? What impact will these choices have on the places they visit? Spending time in a new location helps us to feel that we know and understand the place, people and culture, but what kinds of other connections do travelling and tourism create?

FIGURE 1 People move to and from different places for many reasons



on Resources



eWorkbook

Customisable worksheets for this topic (ewbk-13452)



Video eLesson

Moving around (eles-6001)

LESSON

5.2 How is tourism important?

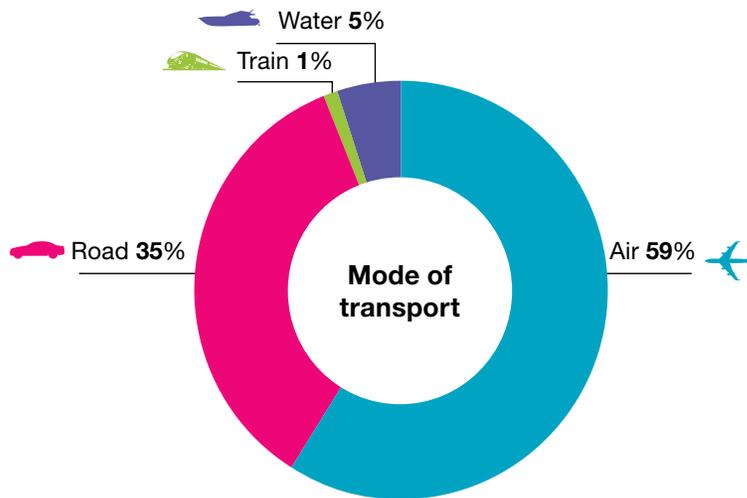
LEARNING INTENTION

By the end of this lesson you should be able to define what is meant by tourism and explain factors that shape the growth and changing trends in tourism.

TUNE IN

The COVID-19 pandemic had a dramatic impact on the ability of people to travel. Now that borders have re-opened, the tourism industry is rebounding. **FIGURE 1** shows the main methods people use to reach their destination.

FIGURE 1 How did people reach their destination in 2019?



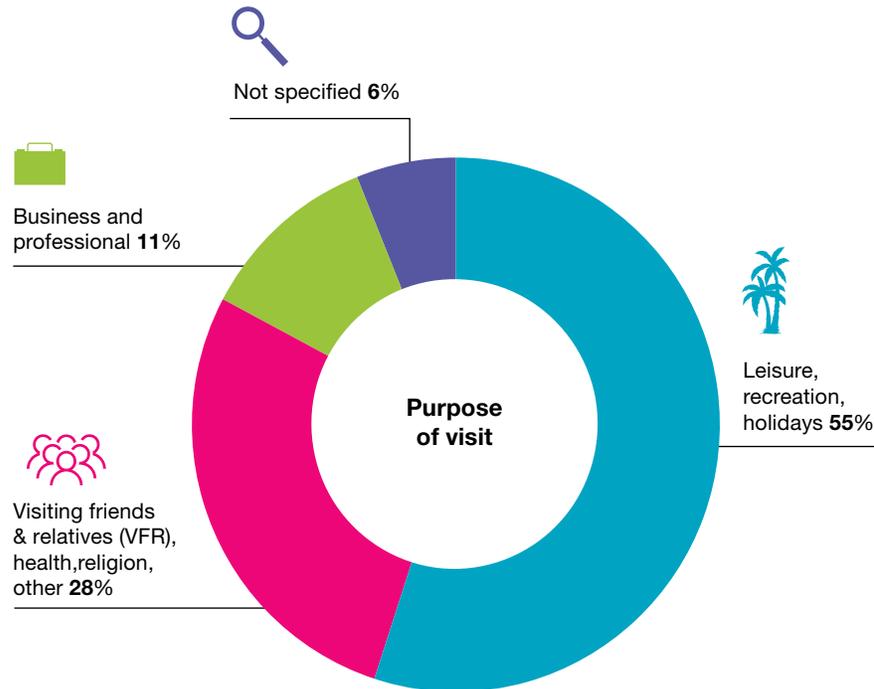
Source: World Tourism Organization (2021), International Tourism Highlights, 2020 Edition, UNWTO, Madrid, p. 9, 15 DOI.

1. Survey your class and record the answers in an Excel spreadsheet.
 - a. When was the last time you travelled and where did you go?
 - b. What was the purpose of this travel?
 - c. How did you reach your destination?
 - d. What did you do while you were away?
2. Create pie graphs using your statistics from questions 1b and c.
3. Compare your graph for question 1c to **FIGURE 1**.
 - a. Highlight any similarities or differences.
 - b. Why do you think the graphs are similar or different?

5.2.1 Defining tourism

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 2**), and it involves a stay of more than 24 hours but less than one year.

FIGURE 2 Purpose of people's travel, 2019



Source: World Tourism Organization (2020), UNWTO International Tourism Highlights, 2020 Edition, UNWTO, Madrid, p. 9, DOI: <https://www.e-unwto.org/doi/epdf/10.18111/9789284422456>.

5.2.2 Types of tourist

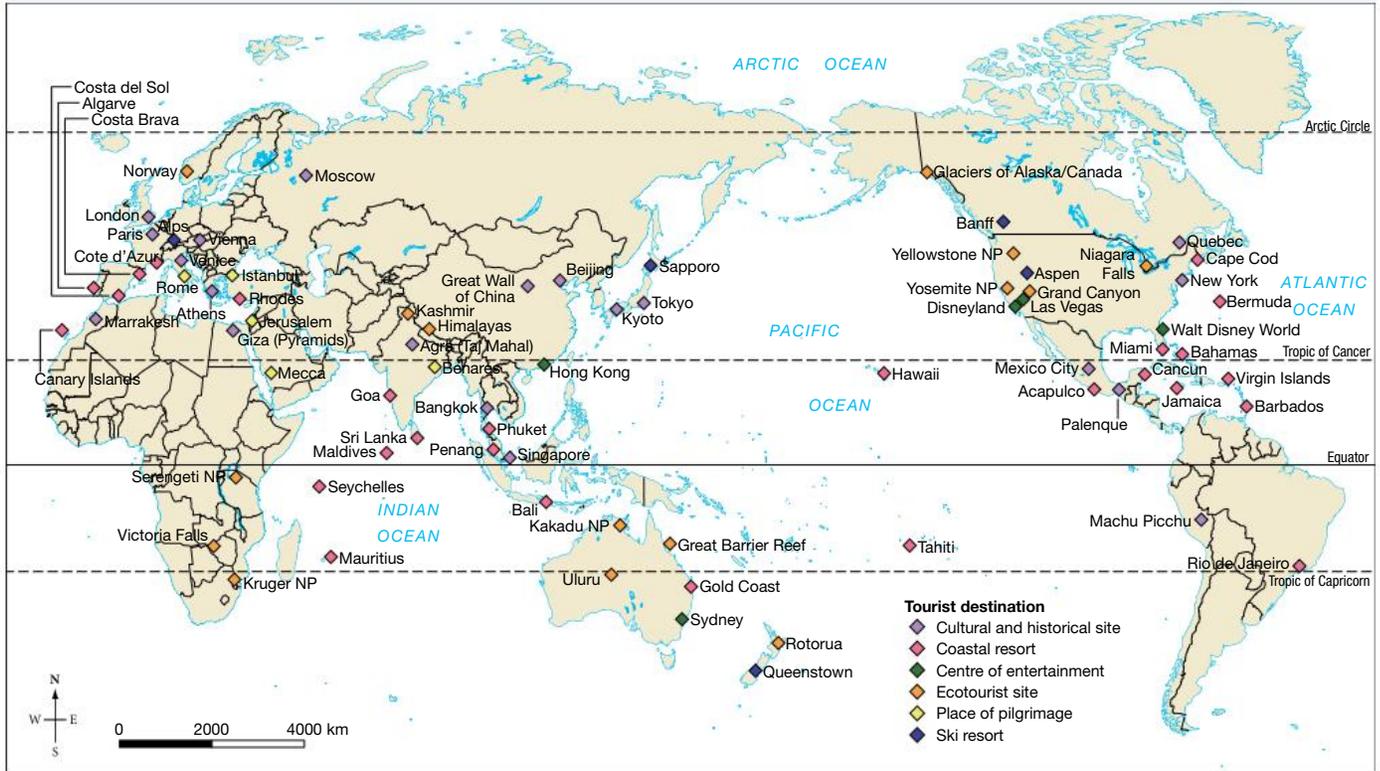
People travelling for leisure have different interests, reasons for travel and preferred ways of approaching the travel experience. **FIGURE 3** identifies some of the key characteristics of different types of tourists and how they like to travel, and **FIGURE 4** illustrates the location of some of the different types of popular tourist destinations.

FIGURE 3 Four kinds of tourist

Organised mass tourist	Individual mass tourist
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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 explorer	The drifter
<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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



FIGURE 4 Types of tourist destinations



Source: Map drawn by Spatial Vision.

Trends in tourism: medical procedures

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 the increased demand for elective surgery are turning medical tourism into a multi-billion-dollar industry. In 2020, the global medical tourism market was valued at US\$54.4 billion and, with an annual growth rate of approximately 25 per cent, is expected to rise to more than US\$200 billion by 2027.

FIGURE 5 A medical tourist has heart surgery in Bangkok International Hospital while one of the world's leading heart surgeons supervises.



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 fertility treatments, complex heart surgery and orthopaedic procedures, such as knee and hip replacements.

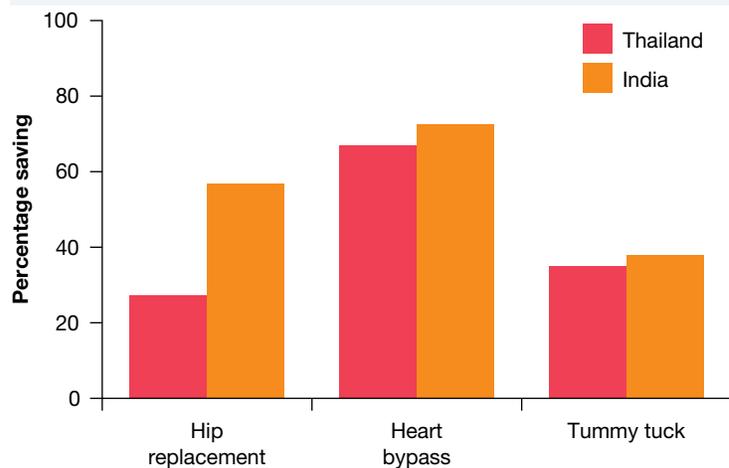
Countries all over the world are attracting patients for a variety of reasons. In some instances, it is the high standard of medical care or the outstanding reputation of a particular facility that attracts people, while for others it is the savings to be made and the opportunity to include a holiday and luxury accommodation as part of the package.

Asia is the market leader in the medical tourism industry, with Thailand being the most popular destination, offering savings of up to 70 per cent over having the same procedure in Australia. The savings allow medical tourists to afford the best private hospitals Thailand has to offer and luxury accommodation for after-care. India is now the third most favoured destination in Asia and has the added attraction of offering a medical tourist visa that allows a spouse or other relative to stay with the patient. Hospitals in both countries are staffed by doctors trained in western countries or Singapore.

Medical tourists are prepared to pay more and have their procedure performed in Thailand as more services are available and the overall tourism experience is considered better. **FIGURE 6** illustrates the savings to be made by having selected medical procedures carried out in Asia rather than in Australia.

Singapore is now the second ranked destination for medical tourism, due to the high standard of care and new innovative ‘stem cell’ treatments being offered. Tourists choosing this destination are looking for the best medical treatment available rather than cost savings. **FIGURE 7** shows the savings when a variety of medical treatments are undertaken in Malaysia, when compared to the United States, Thailand or Singapore. With medical tourism expected to add millions to Asian economies per year, it is not surprising that there has been a dramatic increase in the number of facilities delivering these services, as well as medical tourism travel companies to plan every aspect of the would-be traveller’s itinerary.

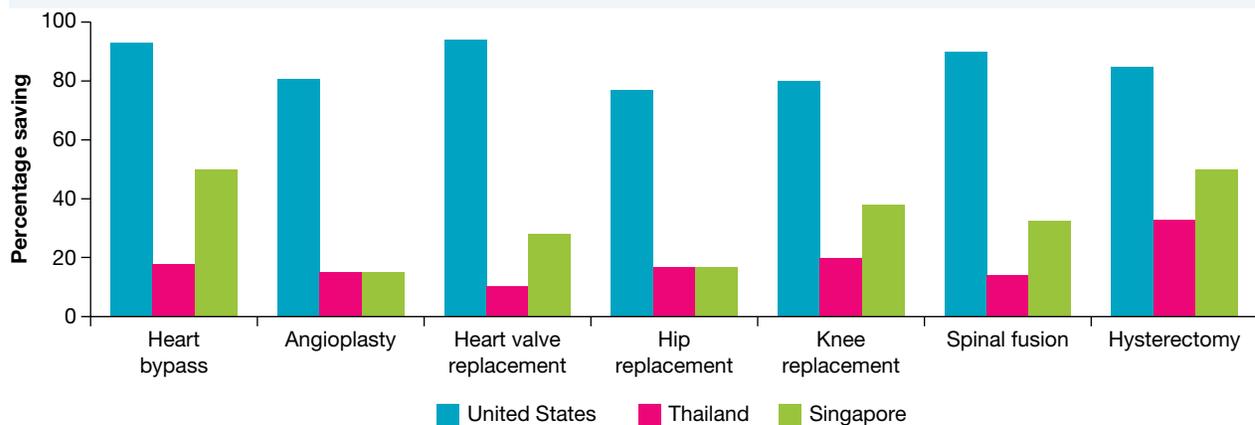
FIGURE 6 Cost savings that can be made by having medical treatment in Asia versus Australia



Source: Adapted from Cosmetic Surgeon India and Rowena Ryan/News.com.au.

int-9066

FIGURE 7 Cost savings that can be made by having medical procedures carried out in Malaysia versus the United States, Thailand and Singapore



Source: Adapted from Cosmetic Surgeon India and Rowena Ryan/News.com.au

5.2.3 The economic importance of tourism

Tourism is one of the world’s largest industries and, as such, an important component in world economies. One in 11 jobs worldwide is linked either directly or indirectly to the tourism industry and in 2019 tourists added US\$9.2 trillion to the global economy.

Globally about 10 per cent of **gross domestic product (GDP)** is directly linked to the tourism industry; for many developing countries it is the primary source of income. The flow-on benefits in the development of infrastructure and the cultural exchange are enormous.

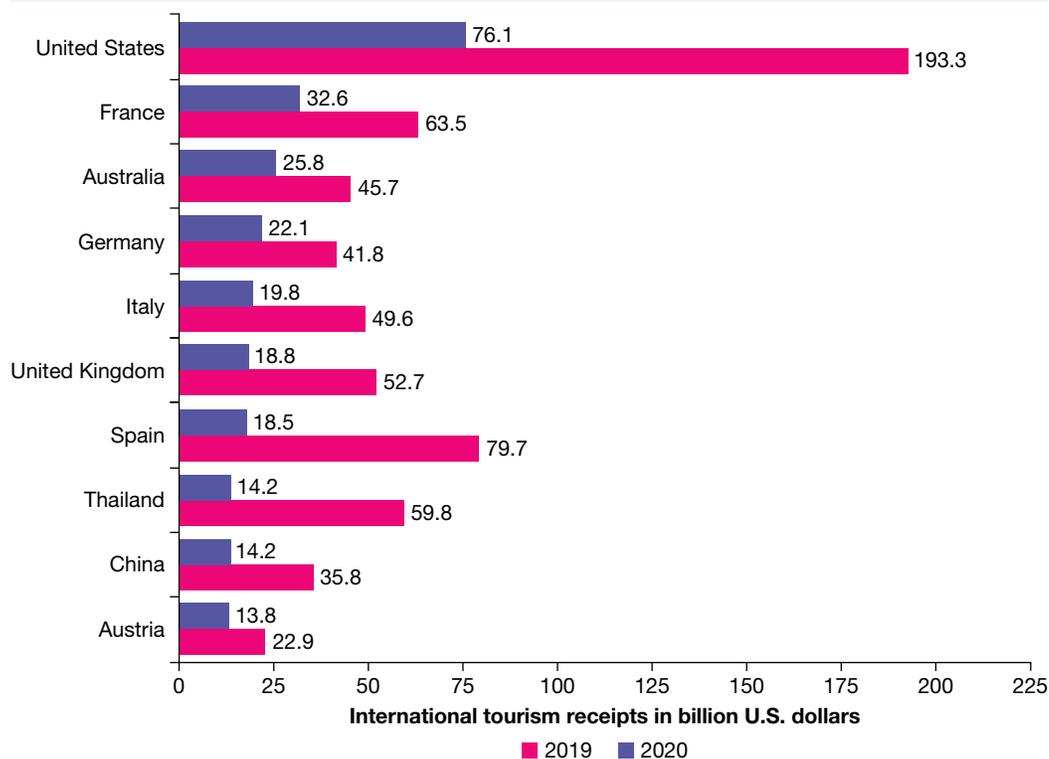
Along came COVID-19

Even when global economies are experiencing a downturn, people still travel. After natural disasters, countries rely on the tourism to rebound and the tourist dollar to help stimulate their economies. One significant exception to the general rule that people travel even during a downturn is when travel is restricted because of passenger safety. Such was the case during 2020 during the COVID-19 pandemic.

Before COVID-19, global tourism was thriving; however, the onset of a global pandemic and border closures saw a dramatic decline in tourism numbers. This is illustrated in **FIGURE 8**, which shows the sharp decline in tourism revenue from 2019 (pre-pandemic) to 2020.

gross domestic product (GDP) the value of all the goods and services produced within a country in a given period of time (usually a year). It is often used as an indicator of a country’s wealth.

FIGURE 8 Tourism earnings 2019 and 2020



Source: Based on data from Countries and regions with the highest inbound tourism receipts worldwide 2019–2021, Statista 2022, International tourism, receipts (current US\$) — United States, The World Bank, World Tourism Baometer, Statistical Annex, Volume 19, Issue 3, May 2021, World Tourism Organization (UNWTO).

Global tourism earnings slumped to US\$4.7 trillion in 2020, slightly more than half of pre-pandemic figures, along with a loss of 62 million jobs. In 2019, 334 million people owed their employment to the tourism

industry; however, in 2020 this figure dropped to 272 million. Job losses would have been greater if not for the government retention schemes and reduced hours, aimed at ensuring the industry would be able to bounce back. It is predicted that it will take global tourism six months to rebound once international tourism markets are fully re-opened and without restrictions.

In June 2020, the Australian Bureau of Statistics estimated that the number of overseas travellers arriving in Australia in April 2020 represented a 98.8 per cent decrease from the same month in 2019. This included an estimated 99.5 per cent decrease in arrivals from China, 99 per cent decrease from the UK and 98.5 per cent decrease from New Zealand. (Refer to the **ABS — COVID-19 statistical insights** weblink in your Resources panel for more data.) The COVID-19 shutdown is an interesting case study to examine in terms of what it demonstrates about the impacts of tourism. You will return to this case study throughout this topic, but you will also examine the typical patterns and trends in travel prior to the pandemic.

FIGURE 9 Grounded aircraft in 2020



on Resources

 **Weblink** [ABS — COVID-19 statistical insights](#)

5.2 SKILL ACTIVITY: Concluding and decision-making, Communicating

Using your atlas as a primary source of information, select three places from different categories shown on the map in **FIGURE 4** that you might like to visit. Show each location on a map and **annotate** your map with two or three sentences that give an overview of each place.

- Plan** how you might travel to each place from your nearest capital city. Add this to your map.
- Calculate** the distance you will travel from your nearest capital city to your first destination, then on to your second and third destinations and finally home.
- Work out how long your round trip will take.
- Describe** each location, using geographic concepts such as latitude and longitude, direction and scale.
- Explain** why you chose each place and what you expect to see and do in each place.
- Select** an appropriate method of conveying your information to others; for example a PowerPoint or a travel documentary.
- Share your work with other members of the class.

5.2 Exercise

Learning pathways

■ LEVEL 1

1, 2, 5

■ LEVEL 2

3, 4, 7, 8

■ LEVEL 3

6, 9, 10

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- Receive immediate feedback
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Check your understanding

- Identify** the sentence that best **describes** a tourist.
 - A person who leaves the place where they normally live and goes to live in another location permanently
 - A person who has never left the place where they were born
 - A person who leaves the place where they normally work or live and goes to another location for more than 24 hours
 - A person who buys imported products
- Identify** the two most common purposes of people's travel.
 - Leisure, including recreation and holidays
 - Attending funerals
 - Scuba-diving
 - Space travel
 - Visiting friends and relatives or for health and religious reasons
- Describe** the key characteristics of two tourist types.
- Identify** the main reasons people travel to Asia for medical tourism.
 - There are better doctors in Asia.
 - Procedures are more affordable in Asia.
 - The hospitable food is tastier in Asia.
 - People want to combine a holiday with having the procedure.
- Identify** the country that had the highest tourism earnings in 2019.
 - Thailand
 - Spain
 - France
 - United States
 - United Kingdom

Apply your understanding

Communicating

- Is a person who flies interstate to watch their football team a tourist? **Justify** your answer.
- Tourism contributes both directly and indirectly to the creation of jobs. With the use of examples, **explain** the difference between direct and indirect contributions.
- Explain** the term 'gross domestic product (GDP)' and why tourism is an important component of GDP.
- Explain** two reasons for the growth in medical tourism.

Interpreting and analysing geographical data and information

- 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. **Justify** your response.
 - Using these figures and the information in section 5.2.3 as a guide, **predict** how many years it might take for the Australian tourism industry to get back to the same levels as before the COVID-19 pandemic.
 - Explain** how you came to this conclusion and **outline** the different factors that will influence how quickly the industry will recover.

LESSON

5.3 What is global tourism?

LEARNING INTENTION

By the end of this lesson you should be able to identify and explain global tourism trends and identify and explain factors shaping the future of tourism.

TUNE IN

Did you know that in October 2021 William Shatner, who played Captain Kirk in the original *Star Trek* series, fulfilled a lifelong dream when he jetted into space onboard a Blue Origin spacecraft?

1. Take a class poll on the favourite holiday destinations of the people in your class.
2. Take a second poll of the place members of your class most want to visit and why.
3. Create a bar graph to show the results of your survey.
4. Would you like to be a space tourist? Give reasons for your answer.

FIGURE 1 Captain Kirk heads for the stars



5.3.1 Who is travelling?

Over time, travel has become faster, easier, cheaper and safer. Economic growth in many parts of the world has ensured that more people can afford to travel. Annual leave entitlements also provide people with time to travel. For example, in addition to the four weeks annual leave that is a standard condition for full-time employees in Australia, many Australians accumulate long-service leave, which is often spent on an extended overseas trip. More young people are also spending time seeing the world during a ‘gap year’ after finishing school or university.

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.

FIGURE 2 Backpackers tend to travel further and stay longer than other tourists.



At the other end of the scale, there has also been a dramatic growth in **mature-aged** tourist movements, such as ‘grey nomads’ who spend their retirement on the road, living in a caravan or campervan. The number of older people in **developed** countries is growing. Some of these travellers have savings, access to superannuation funds, and the opportunity to retire early; thus, they have both the time and the money to travel.

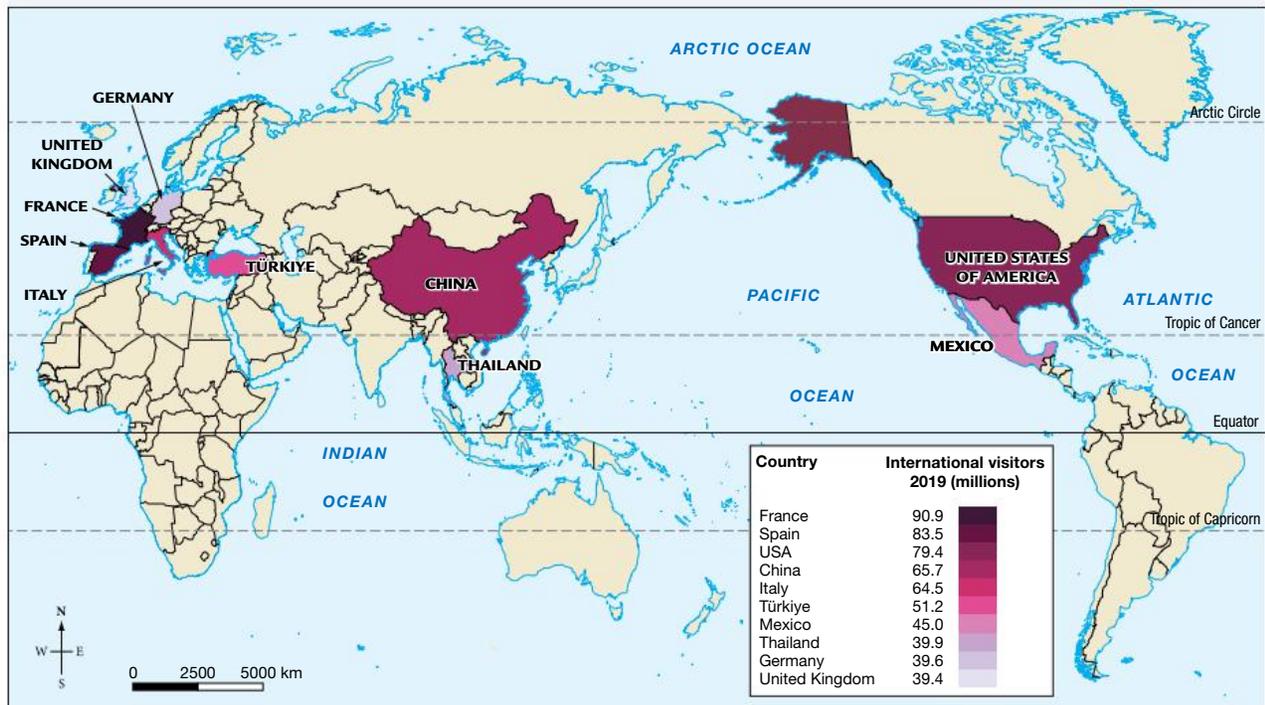
mature-aged describes individuals aged over 55
developed describes countries with a highly developed industrial sector, a high standard of living, and a large proportion of people living in urban areas

5.3.2 Where do people go?

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. **FIGURE 3** shows the ten most popular tourist destination countries for 2019. Forty per cent of all tourists visited one of the countries ranked in the top ten.

int-9067

FIGURE 3 World’s top ten tourist destinations, 2019



Source: Based on data from World Tourism Organization (2021), International Tourism Highlights, 2020 Edition, UNWTO, Madrid, p. 8 DOI: <https://doi.org/10.18111/9789284422456>. Map drawn by Spatial Vision.

Where do people stay?

Today, in addition to traditional accommodation such as hotels and backpacker hostels, tourists have a wide range of accommodation options, and their preferences will vary depending on a multitude of personal and economic factors. The rise of operators such as Airbnb means people can now choose to stay independently in an apartment or house, or perhaps in a guest room within someone else’s own home. Staying with locals in their homes in cities, towns and villages across the globe provides an opportunity to experience the local culture in a more ‘up close and personal’ way. For many however, an established resort or hotel remains the preferred choice of accommodation.

When travelling overseas, most tourists give little thought to who owns the hotel or resort in which they are staying. **TABLE 1** lists the locations of various hotel chain headquarters, and shows that the corporate owners of many hotels are based in a country that is often not the one a tourist is visiting.

TABLE 1 World's top 10 hotel groups in 2020

Company	Headquarters (country)	Total hotels	Number of countries
Wyndham Hotels & Resorts	USA	9300	75
Marriott International	USA	7500	131
Choice Hotels International	USA	7100	41
Hilton Worldwide	USA	6200	118
InterContinental Hotel Group	UK	5700	100
Jin Jiang International	China	5600	120
Accor	France	4800	100
Best Western Hotels	USA	4700	90
Hauzhu (Home Inns)	China	4500	16
G6 Hospitality	USA	1500	2

5.3.3 Who spends the most?

FIGURE 3 shows the countries that attract the most tourists, but which countries do these tourists come from, and how much do they spend? **FIGURE 4** shows the top ten countries in terms of the money they spend on international tourism, and offers an idea of the huge input into the economies of destination countries that the tourist dollar provides.

5.3.4 The growing future of tourism

Until 2020, levels of global tourism increased year after year. Advances in transport technology reduced travel times and cost, making travel increasingly accessible to more and more people.

- Commercial airlines fly from Australia to Europe in about 20 hours from the east coast, or under 17 hours flying nonstop from Perth. A similar journey by boat in the late 1940s took six weeks or more.
- Cut-price deals and an increased number of operators competing for the tourist dollar means that travel becomes more affordable.
- Improvements in transport and technology increased awareness and knowledge of the world and 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.

FIGURE 4 World's top ten tourist spenders, 2019

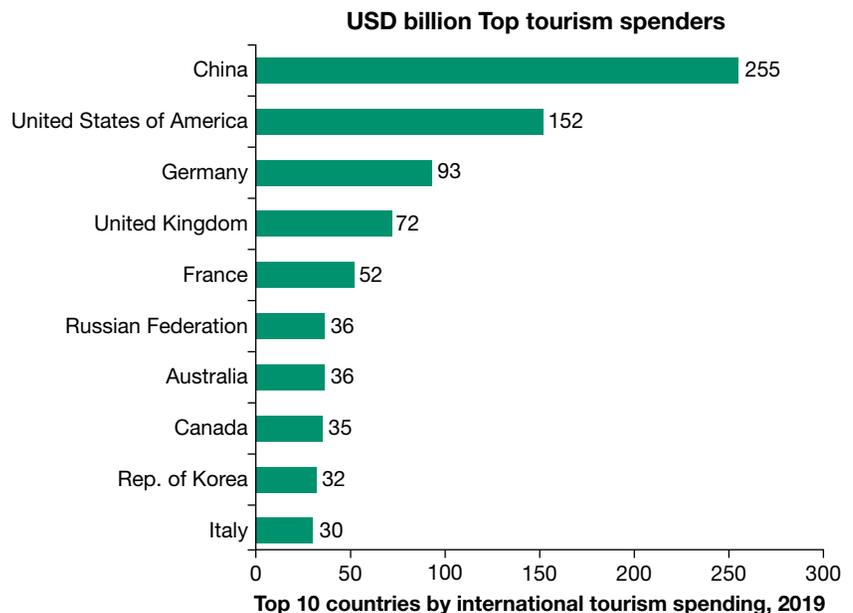
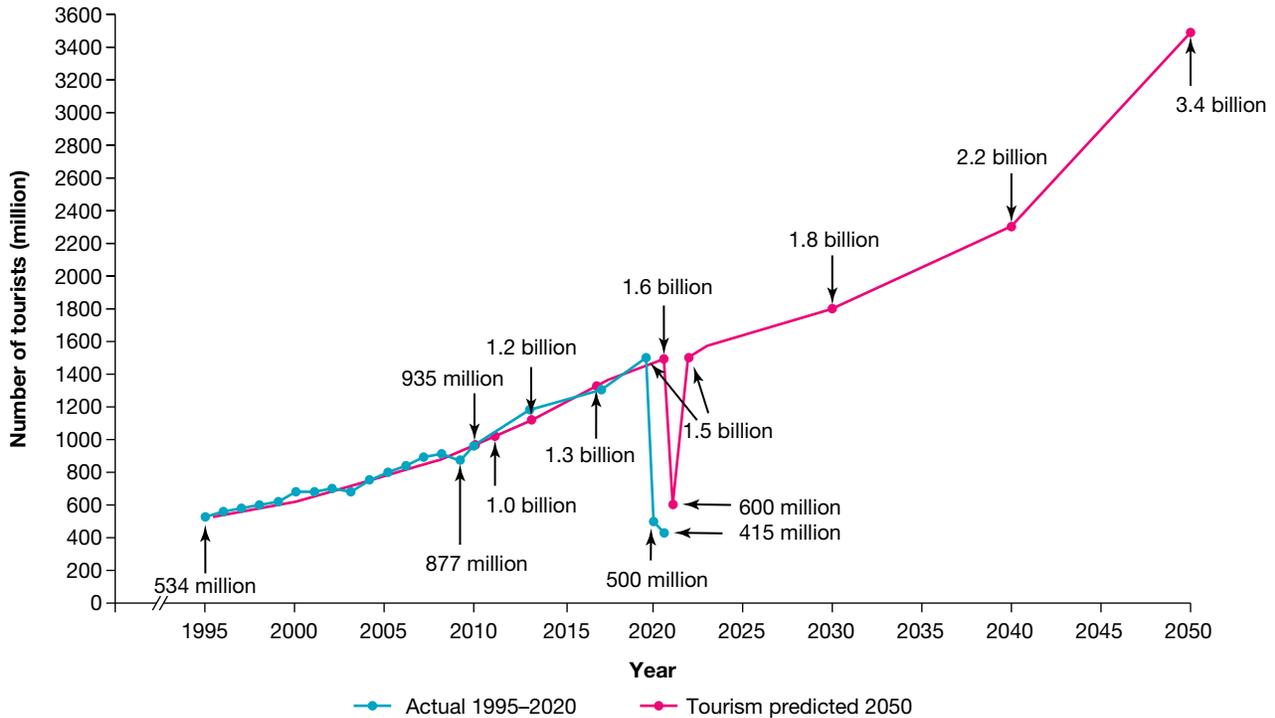


FIGURE 5 shows the growth in tourist numbers from 1995 to 2020 and the decline due to the COVID-19 pandemic. Predictions for 2022 to 2025 are based on market estimates of a steady recovery followed by strong growth after 2025. Observable dips in the upward tourism trend can also be seen in 2003–04 during the SARS outbreak and in 2008 following the Global Financial Crisis.

tlvd-10705

FIGURE 5 Projected future growth in world tourism



The evolving tourist

Improved living standards, increased leisure time and greater disposable incomes have all created opportunities for people to travel and experience new places and cultures. These factors are also shaping the tourist of the future (see **FIGURE 6**). Established and emerging tourist destinations will need to ensure that they meet the evolving needs of the tourist market, in order to continue to attract and benefit from the tourist dollar.

According to the United Nations World Tourism Organization (UNWTO), 2020 was the worst year on record for global tourism. 2019, on the other hand, marked the tenth year of strong tourism growth. How do the two years compare?

- One billion fewer tourist arrivals
- A decline of 74 per cent
- 62 million jobs lost, around 50 per cent of what had been forecast due to job retention schemes designed to allow the industry to recover quickly.

FIGURE 6 Characteristics of the future tourist



Within Australia, domestic travel resumed much earlier than international travel, but the industry still suffered significant losses from the almost immediate and complete shutdown of the industry.

Growth areas for tourism

How quickly the tourism industry recovers is dependent on many factors, such as borders opening and remaining open, vaccination rates, and travel requirements and restrictions in destinations, such as COVID-19 testing and quarantine requirements.

It is expected that the first areas of tourism to recover will be those associated with open-air and nature-based tourism.

Predictions suggest that Africa and the Asia–Pacific region will be particular growth areas, attracting more and more tourists in the years to come. In Africa, for instance, countries such as Kenya and Tanzania offer a different type of tourist experience.

Kenya offers:

- relative safety
- beaches and a tropical climate
- safari parks and encounters with lions and elephants
- a unique cultural experience with the **Masai** people.

The 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 can be put towards projects such as improved water quality and **infrastructure** such as water pipes, roads and airports.

Masai an ethnic group of semi-nomadic people living in Kenya and Tanzania

national parks parks or reserves set aside for conservation purposes

infrastructure the facilities, services and installations needed for a society to function, such as transportation and communications systems, water pipes and power lines

FIGURE 7 Tourists can see many wild animals such as giraffes at the Amboseli National Park in southern Kenya.



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.

Such challenges, of course, are not unique to Kenya. Wherever in the world there is an increase in tourist numbers, there is a need for a sustainable approach, to ensure that the economic benefits of tourism do not come at the cost of a region’s people and environment.

Reaching for the stars

Ever since Dennis Tito became the first space tourist in 2001, when he spent eight days on the International Space Station, the idea of holidaying in space has gained more and more interest. Dennis Tito paid US\$20 million for his space adventure, meaning that it is not yet commercially viable for the average citizen.

Since this ground-breaking flight, others have also paid huge sums of money to jet into space, some to visit the space station and others to orbit the Earth before returning home.

At present, opportunities are limited to the rich, but the same was true of international travel in its early days.

FIGURE 8 shows a futuristic city on the moon and **FIGURE 9** shows the cost of space tourism; perhaps in years to come, space travel will be a part of people’s ‘bucket list’.

Those who have ventured into space have had a unique view of planet Earth, and some have said they gained a new insight into the need to protect the Earth and its resources. Critics have referred to the impact of space tourism on our carbon footprint and the harm we are doing to the planet in our quest for the stars.

FIGURE 8 Is this the future of tourism?



FIGURE 9 The astronomical cost of space tourism.

10-minute flights to the edge of space with Blue Origin	An 8- to 10-day stay on the International Space Station
\$28 million	\$55 million
A package visit to the International Space Station, plus involvement in experiments in space	90-minute flights in sub-orbital space, including experiencing zero gravity
\$35 000 per day	\$450 000

on Resources

-  **Weblink** United Nations World Tourism Organization
-  **Google Earth** Kenya

5.3 SKILL ACTIVITY: Questioning and researching using geographical methods, Interpreting and analysing geographical data and information

Access the **United Nations World Tourism Organization** (UNWTO) weblink in the Resources panel.

- Examine** the reports into global responses to the COVID-19 pandemic and the International Tourism Dashboard.
 - Choose or allocate a specific country for each member of the class.
 - Collect** data about your country from the website.
 - Create** an annotated visual display that shows the impact of COVID-19 on your country.
- As a class, **discuss** the different ways the pandemic affected tourism and the wider economy.
- Compare** the results for major regions identified in the UNWTO data:
 - Europe
 - Asia and the Pacific
 - The Americas
 - Africa
 - The Middle East

5.3 Exercise

learn on

5.3 Exercise

Learning pathways

LEVEL 1

1, 3, 7, 9

LEVEL 2

4, 6, 8

LEVEL 3

2, 5, 10

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Check your understanding

- Carefully study **FIGURES 3** and **4** and answer the following questions.
 - Identify** the three continents where the top 10 tourist destinations are located.
 - Europe
 - Australia
 - Africa
 - Asia
 - North America
 - The top tourist spenders come from Asia, North America and Europe. True or false?
 - Describe** the interconnection between destinations and tourism spending.
- Compare** the needs of a mature-age tourist and a backpacker. **Create** a Venn diagram to demonstrate your understanding of the similarities and differences in the needs of these two groups of tourists.
- Identify** four reasons that help **explain** why tourism is more accessible to the broader community today than it was 100 years ago.
 - People have more leisure time.
 - People have less disposable income.
 - Shorter travel times
 - Longer travel times

- E. Travel costs have increased.
 - F. Travel costs have decreased.
 - G. Larger variety of package deals available
 - H. Less awareness about the world
4. **Explain** what national parks are and why they were established.
 5. **Consider** the data predicting tourist numbers show in **FIGURE 5**.
 - a. **Identify** the predicted number of international tourists travelling in 2020.
 - b. **Identify** the actual number of tourists that travelled internationally in 2020 and 2021. **Explain** the difference between these figures.
 - c. **Propose** and **explain** a strategy that would help the tourism industry recover from the downturn in 2020 and 2021.

Apply your understanding

Interpreting and analysing geographical data and information

6. **Examine** the **FIGURE 5** graph.
 - a. How many global tourists are there predicted to be in 2050?
 - b. **Identify** the places you think will be the most popular.
 - c. **Explain** the potential impact these increases might have on the environment.
 - d. **Clarify** whether increased tourism numbers will result in small-scale or large-scale impact on the environment.
 - e. In your opinion, are these increases sustainable? **Justify** your opinion.

Communicating

7. With rapid growth in tourism, there is a need to ensure sustainability.
 - a. **Explain** what you understand by the term 'sustainable tourism'.
 - b. **Describe** an example of tourism that can be considered sustainable.
 - c. **Describe** an example of tourism that might not be considered sustainable. **Propose** changes that might be needed to make it sustainable.
8. Asia and Africa are future growth areas for tourism; however, they are also home to many of the world's developing nations. Study **TABLE 1**, which shows hotel ownership. **Describe** the impact this ownership might have on the countries in which the hotel chains are located.
9. **Consider** the characteristics of the future tourist shown in **FIGURE 6**. **Predict** the ways in which each of these characteristics might impact on the tourism choices they make. As part of your response, **identify** places and experiences that might be more attractive to this traveller.
10. 'Tourists should be able to go where they like and do what they like without any restrictions.' **Discuss** this statement by presenting one argument for and one argument against.

LESSON

5.4 Is Australian tourism growing?

LEARNING INTENTION

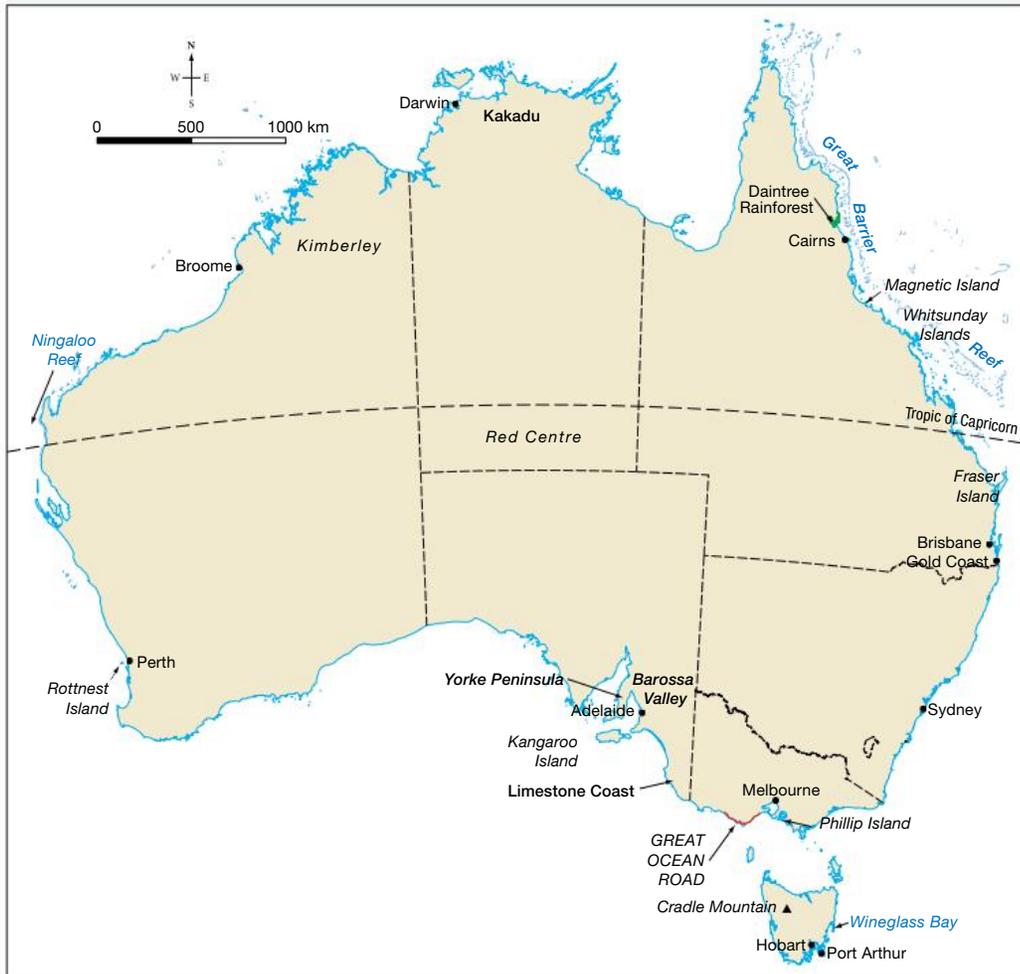
By the end of this lesson you should be able to explain the importance of the tourism industry to Australia and suggest reasons for the growth in the Australian tourism industry.

TUNE IN

Tourism can be a lucrative industry and Australia is a popular place for many tourists to visit and explore.

1. Why is tourism important to Australia?
2. What do you think is the most popular destination for people visiting Australia?
3. Compare your choice with other members of your class and the places shown on **FIGURE 1**.
 - a. How many are shown on the map?
 - b. What aspects of Australia do you think should be used to attract tourists to Australia?
4. What country do think is:
 - a. most visited by Australians?
 - b. the source of most visitors to Australia?

FIGURE 1 Australia's most popular tourist destinations



Source: Data © Commonwealth of Australia (Geoscience Australia) 2013 & © State of Queensland (Department of Agriculture, Fisheries and Forestry) 2013.

5.4.1 Australian travel trends

In 2019, 11.3 million Australians travelled abroad, almost twice as many as ten years ago. Of these, some 1.43 million people travelled to New Zealand, making it our most popular tourist destination.

The buying power of the Australian dollar compared to other currencies means that a wide range of international destinations are more affordable than holidaying at home. Competition between airlines, choice of flights and package deals that include combinations of flights, accommodation, tours and meals are largely fuelling the international travel market. The option of children staying for free also makes overseas travel more attractive for families. While over a million people elect to holiday in Australia, for many their tourism dollar has greater buying power in destinations such as Indonesia and Thailand, where the cost of living is much lower than it is at home.

FIGURE 2 New Zealand's stunning scenery makes it a popular destination.



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. This visa, which is available in more than 35 countries around the world, allows people aged between 18 and 30 to live and work in a country for up to 12 months. At any one time about one million Australians are living and working overseas.

While the most popular tourist destination for Australians travelling abroad is New Zealand, the fastest expanding markets for Australian travellers are Indonesia and the United States.

5.4.2 Visitors to Australia

In 2019, 9.4 million tourists came to Australia at a rate of around 1000 per hour. They spent more than 274 million nights in the country and added \$60.8 billion to the Australian economy. The states most visited by international tourists in 2019 were New South Wales, Queensland and Victoria. The greatest international tourism growth was recorded in Tasmania with a 12.9 per cent increase over 2018 visitor numbers, followed by Western Australia with a 6.4 per cent increase. In contrast the largest decline in tourist arrivals was in the Northern Territory with a 21.4 per cent decrease over 2018. In Australia more than 850 000 jobs were attributed either directly or indirectly to the tourism industry, representing about 8 per cent of the workforce.

FIGURE 3 illustrates the reasons why people chose to come to Australia in 2018, with holidays being the most popular. **FIGURE 4** shows the countries of origin of those who visit, and where in the world Australians are travelling on their overseas journeys. **FIGURE 5** highlights the importance of tourism to the Australian economy.

The COVID-19 pandemic in 2020 resulted in the number of tourism arrivals falling by 98.8 per cent to just 8820, before increasing to 77 000 in 2021. The reasons for people visiting are also significantly different in 2021, with more than 60 per cent of arrivals visiting relatives and friends, followed by employment (9.3 per cent) and holidaying (8.7 per cent). By September 2022, the tourism industry was showing significant signs of recovery with visitor arrivals increasing to 2.1 million, 24 per cent of pre-COVID-19 levels. Tourism spending added \$8.8 billion to the Australian economy (28 per cent of pre-COVID-19 levels).

Australia is a land of contrasts, having a wide variety of both human and natural environments. The most popular tourist destinations are shown in **FIGURE 1**.

FIGURE 3 Reasons for visiting Australia, 2019

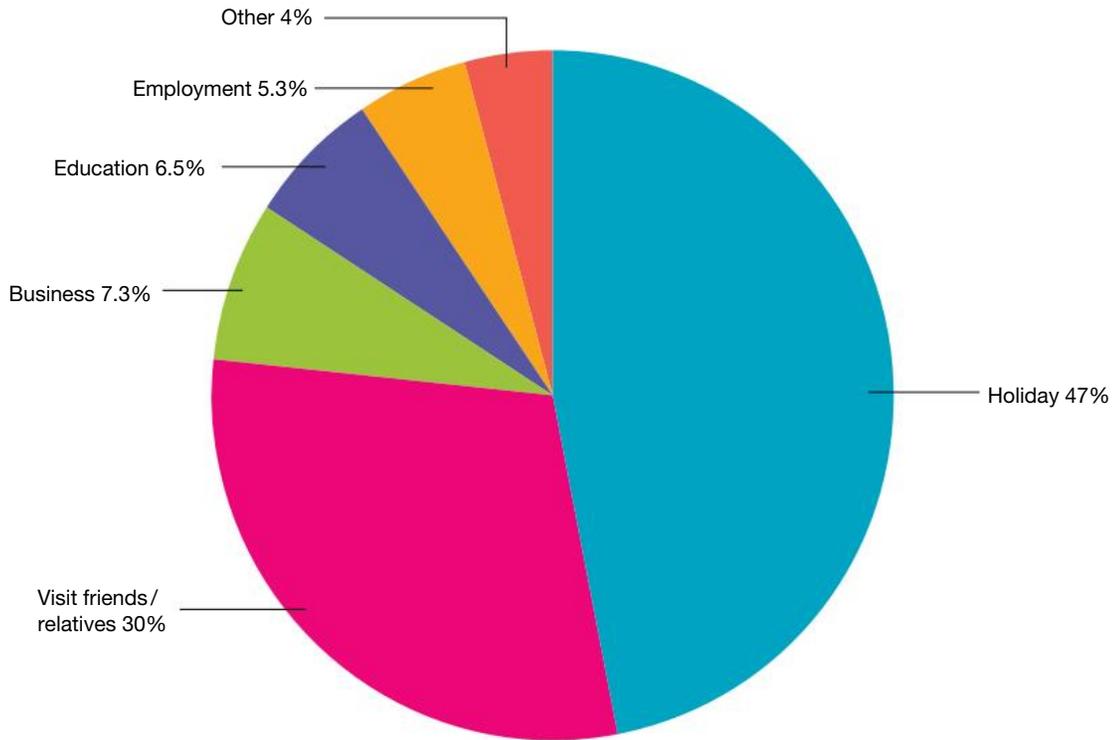
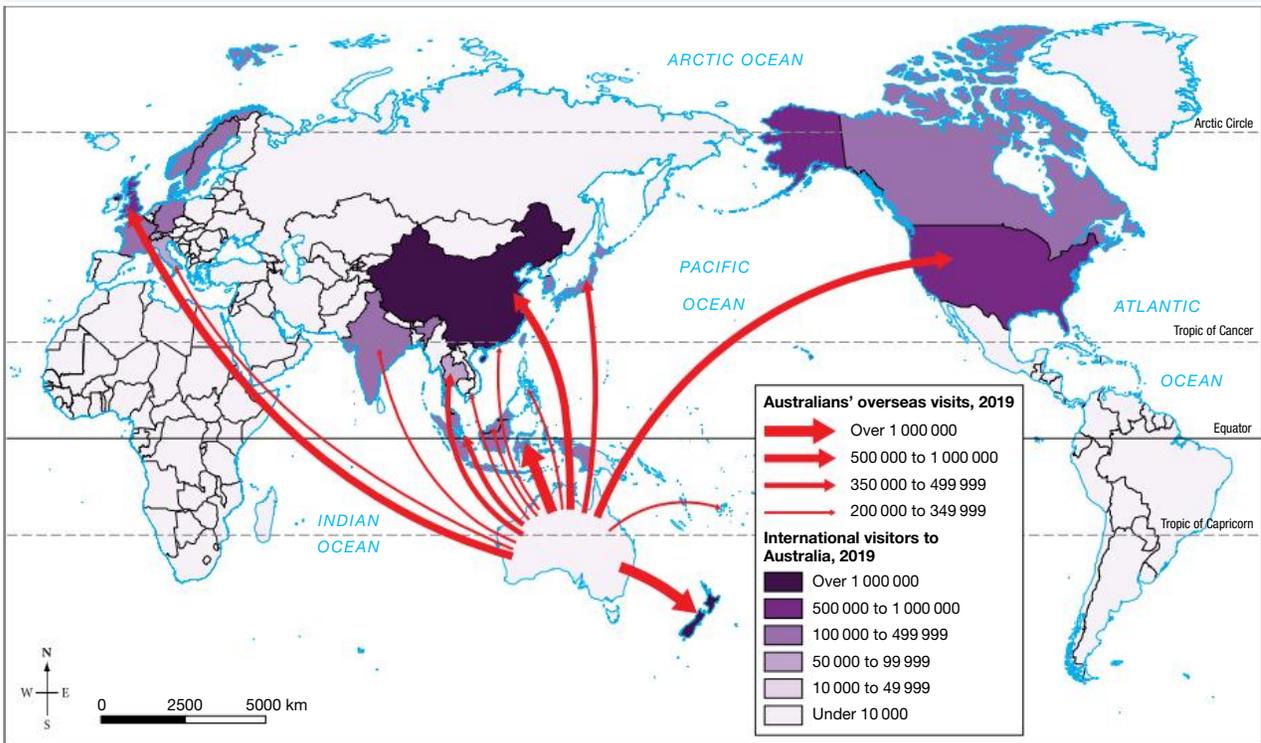


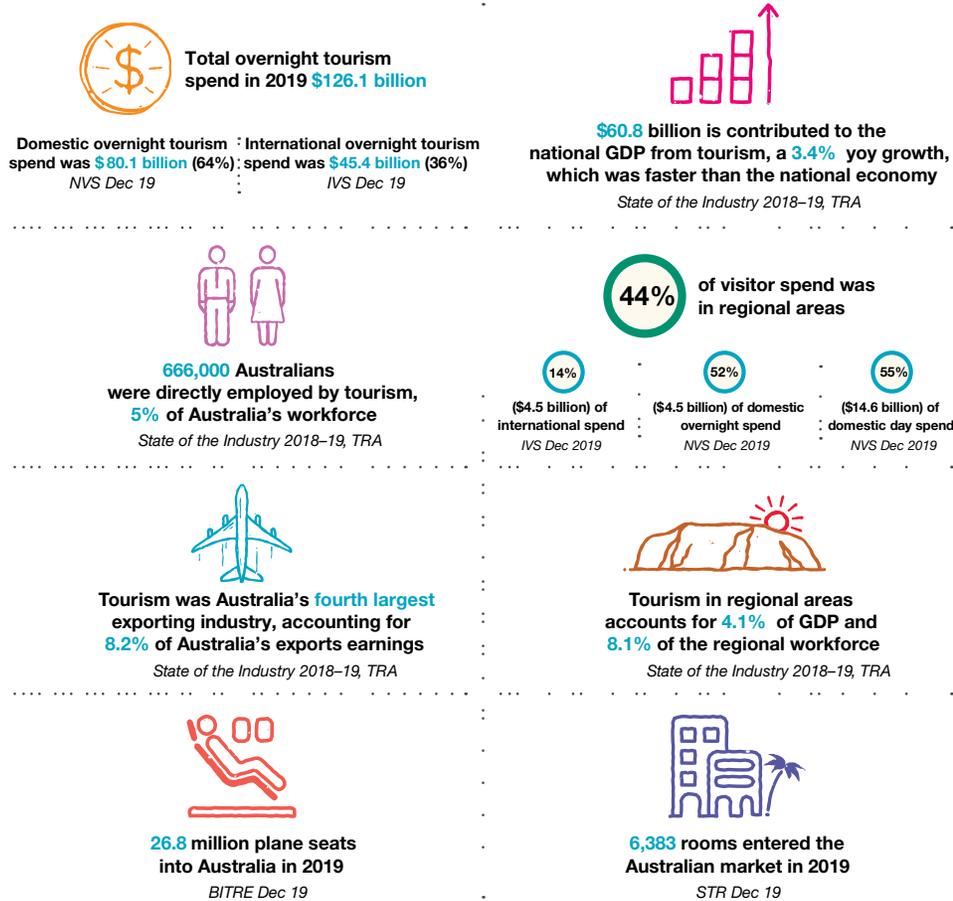
FIGURE 4 Country of origin for tourists visiting Australia, and destinations for Australian tourists

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Source: Austrade / Tourism Research Australia: National Visitors Survey. Licensed under CC BY 4.0

FIGURE 5 The value of tourism



SkillBuilders to support skill development

- 1.11 SkillBuilder: Creating a survey

5.4 SKILL ACTIVITY: Questioning and researching using geographical methods, Interpreting and analysing geographical data and information

Investigate people's favourite places.

1. Survey the members of your class to find out what overseas places they would most like to visit and why.
2. Each class member should also ask their parents or guardians which three overseas places they would most like to visit and why.
3. Compile your class data and **identify** the most popular places selected by students and adults. Make sure you also collate the data showing the reasons for their choices.
4. On an outline map of Australia, show the results of your survey — as a class **decide** how many places you will show.
 - a. **Create** a colour key so you can **distinguish** between places chosen by adults and students.
 - b. **Select** an additional colour to show places that were on both lists.
5. **Annotate** your map with the reasons given for the choices.
6. Remember to make sure your map has **BOLTSS**.
7. Is there an interconnection between places chosen by adults and students? **Suggest** reasons for your observations.

5.4 Exercise

5.4 Exercise

Learning pathways

■ **LEVEL 1**

1, 2, 3, 6

■ **LEVEL 2**

4, 5, 9

■ **LEVEL 3**

7, 8, 10

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Check your understanding

- 1. Explain** why more Australians choose to holiday overseas rather than in Australia.
- 2. Identify** the four countries that were the source of most tourist visits to Australia in 2019.
 - A. Japan, United Kingdom, Canada, Bangladesh
 - B. China, Chile, Indonesia, New Zealand
 - C. Indonesia, Canada, United States of America, India
 - D. China, United Kingdom, United States of America, New Zealand
- 3. Select** two statements below that describe the contribution of tourism to the Australian economy in 2019.
 - A. Added \$60.8 billion to the economy
 - B. Provided approximately 1.5 million jobs
 - C. Provided approximately 900 000 jobs
 - D. Added \$60.8 million to the economy
- 4. a. Explain** the impact of COVID-19 on Australian tourism in terms of both numbers and the reason for tourists visiting Australia.
 - b. Explain** how COVID-19 led to this change.
- Select the sentence that best describes a 'day tripper'.
 - A. A person who makes a trip and spends one night away from home
 - B. A person who makes a trip or journey for pleasure and returns home the same day
 - C. A person who travels for business
 - D. A person who attends a family function

Apply your understanding

Communicating

- Study **FIGURE 1**.
 - a. Identify** the top tourist destinations in Western Australia, South Australia and Victoria.
 - b. Suggest** another place in Australia that you think should be on the top of every tourist's itinerary. **Justify** your choice.
- 7. Predict** the impact on Australian tourism if the Australian dollar was to suddenly lose value in relation to international currencies.
- 8. Predict** the impact on Australian tourism if the Australian dollar was to suddenly increase in value and achieve parity with the US dollar.
- 9. Identify** your favourite tourist destination. **Explain** the appeal of this place for you.
- 10. Propose** a strategy to encourage more Australians to holiday at home and entice more international visitors to Australia.

LESSON

5.5 What are the impacts of tourism?

LEARNING INTENTION

By the end of this lesson you should be able to outline the positive and negative impacts of tourism.

TUNE IN

Tourism can have both positive and negative impacts on the tourists, locals, environment etc. Consider some of the potential impacts and create a brainstorm including positives and negatives.

FIGURE 1 Tourism can have both positive and negative impacts on people and the environment.



1. Classify these impacts as affecting people or the environment.
2. Study **FIGURE 1**.
 - a. Describe what you can see.
 - b. Explain whether you think the activities shown will have a positive or negative impact on people and the environment.

5.5.1 Do the benefits outweigh the costs?

In some ways, tourism seems like the perfect industry. It can encourage greater understanding between people and bring prosperity to communities; however, tourism development can also destroy people's culture and the places in which they live.

There is sometimes a fine line between exploitation and sustainable tourism.

FIGURES 3 and **4** outline some of the key positive and negative impacts of tourism.

FIGURE 2 Tourism provides opportunities to learn about other cultures, such as this welcome ceremony for tourists at the Waitangi Treaty Grounds in New Zealand.



FIGURE 3 The positive impacts of tourism

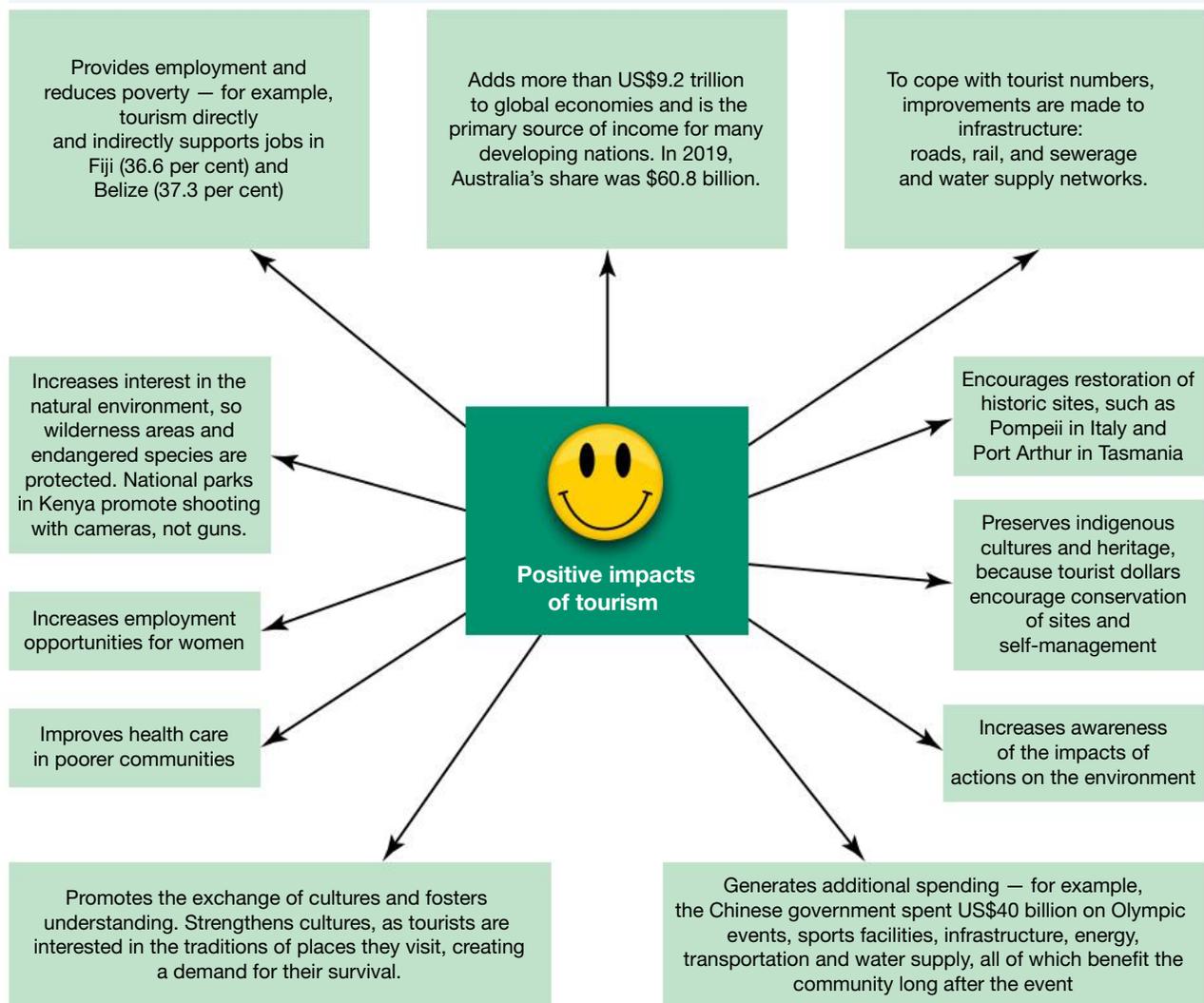
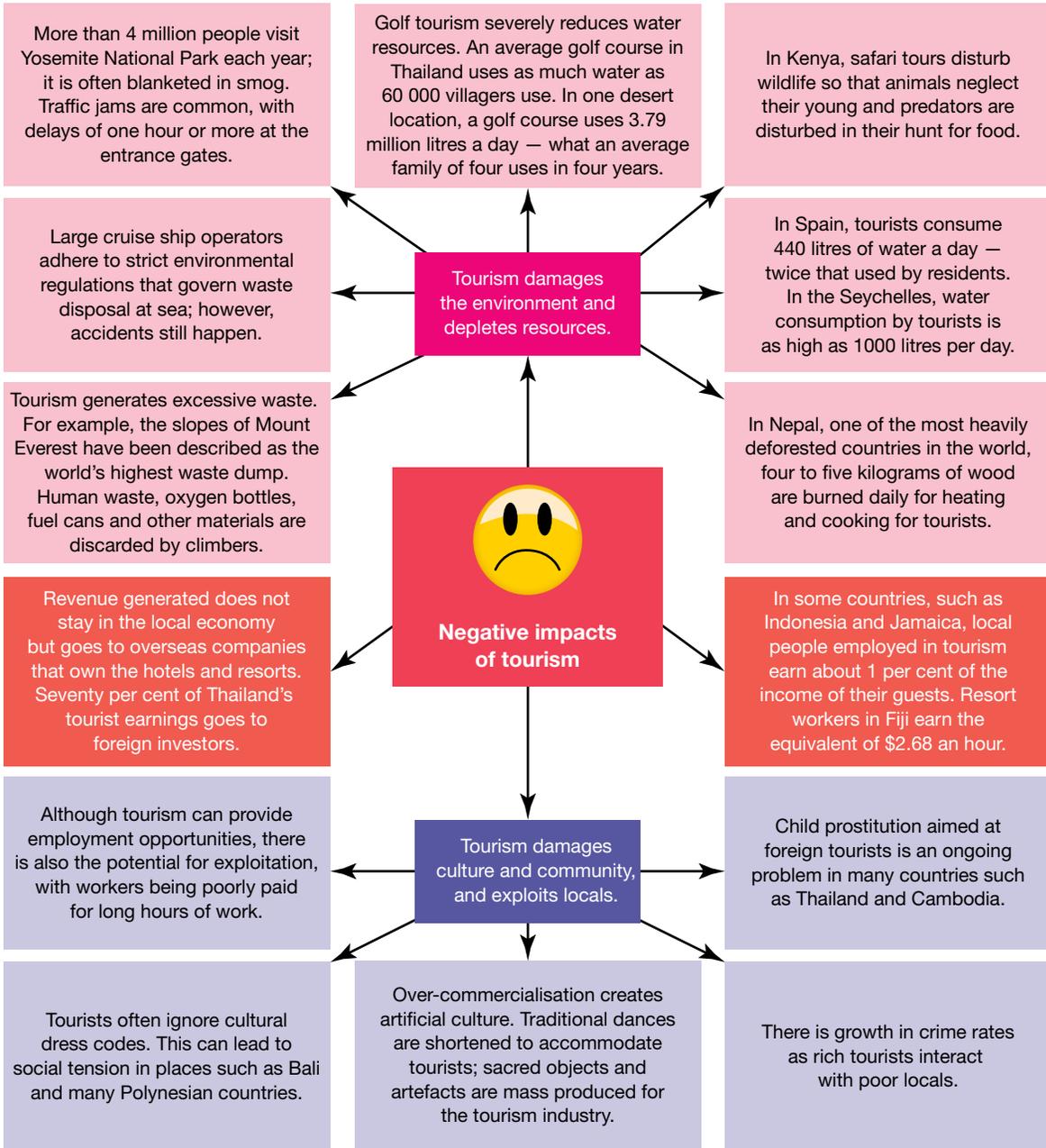


FIGURE 4 The negative impacts of tourism



on Resources

 **Interactivity** Tourism trauma (int-3335)

5.5 SKILL ACTIVITY: Concluding and decision-making

Natural disasters and other global events make people who travel overseas vulnerable. The government publishes information, advice and alerts for travellers on its Smartraveller website. Citizens are sometimes faced with a dilemma: should I stay or make my way home now? While some will head home at the first hint of trouble, others will adopt a wait-and-see approach.

When COVID-19 struck, many Australians were living, travelling or studying overseas and found themselves stranded with no money or opportunity to fly home. Similarly, many international tourists were stranded in Australia.

This raised questions about the role of the government:

- Should government resources be used to help get people home and support them?
- If flights are grounded because of a natural disaster or global crisis, should a country be responsible for getting their citizens home?
- If international citizens are stranded in Australia because of a natural disaster or global crisis, should our government provide them with financial assistance or support until they can get home?

1. In small groups, **discuss** the following question and **propose** and **justify** a possible solution.

'If Australian citizens are stranded overseas because of a natural disaster or global crisis, who — if anyone — should provide them with support and assistance?'

2. Select one representative to share the opinion of each group.

5.5 Exercise

learn on

5.5 Exercise

Learning pathways

■ LEVEL 1

1, 2, 5

■ LEVEL 2

3, 4, 7, 8

■ LEVEL 3

6, 9, 10

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Check your understanding

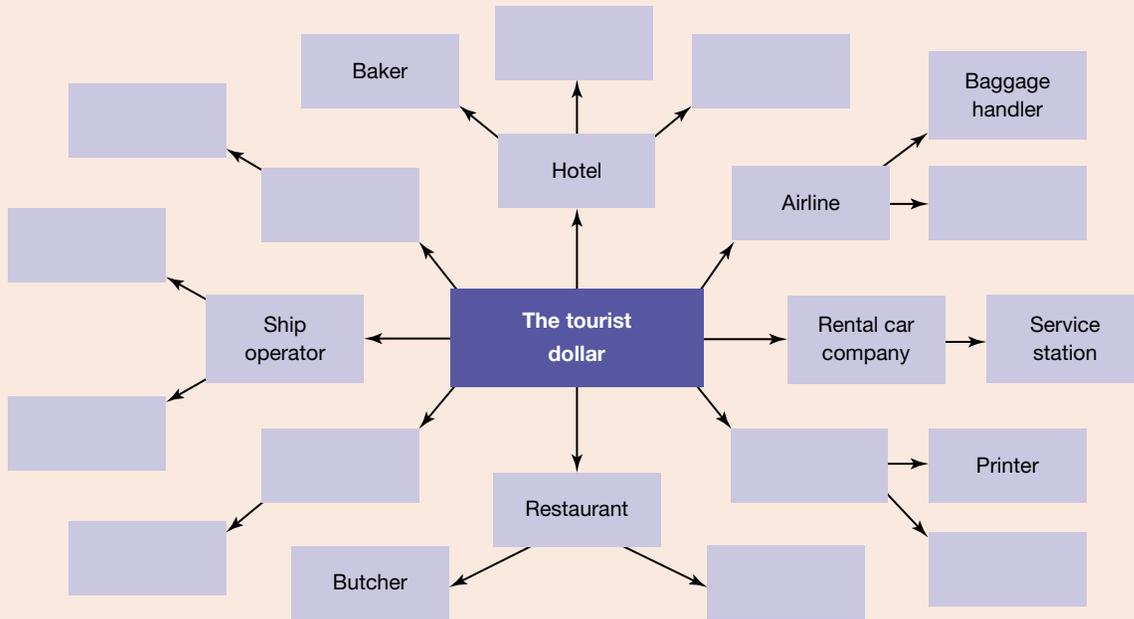
1. One criticism of tourism is that it is 'over-commercialised'. **Select** the two statements that best describe this term.
 - A. There is too much emphasis on making money.
 - B. There is too much emphasis on supporting local projects.
 - C. Items are mass produced for the tourism market.
 - D. Goods are hand-made and sold in local villages.
2. Tourism provides both direct and indirect employment. From the list below, **identify** all the examples of direct employment provided by tourism.
 - A. Mechanic
 - B. Taxi driver
 - C. Food supplier
 - D. Hotel receptionist
 - E. Waiter
 - F. Resort masseuse
3. **Explain** how tourism can improve the living conditions for individuals living in developing nations.
4. **Explain** how tourism may lead to an increase in the crime rate in a popular tourist destination.
5. Tourism has only positive effects on culture, community and the environment. True or false?

Apply your understanding

Communicating

- Explain** how tourism can lead to the preservation and conservation of ancient ruins and the creation of nature reserves.
- One popular tourist destination is the Inca Trail in Peru. **Describe** the negative impacts of tourism in this region and suggest possible strategies for sustainable tourism.
- The figure below 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. Recreate the diagram and insert the extra jobs listed below.

Shops	Retail staff	Manufacturer	Tour operator
Security staff	Pilot	Housekeeping	Waitress
Entertainers	Maintenance	Cabin staff	Clothing



- Discuss** the type of interconnection shown between industries, which is sometimes called the 'multiplier effect'. **Explain** what 'multiplier effect' means.
- Which of the following would be the best to develop as a tourist resource in your region: an art gallery, a museum, a cinema complex or a sports stadium? **Justify** your answer.

LESSON

5.6 How can we manage the environmental impacts of tourism?

LEARNING INTENTION

By the end of this lesson you should be able to explain the concept of ecotourism and classify activities as eco-friendly or not eco-friendly and justify your point of view.

TUNE IN

Did you know that Melbourne Zoo is a popular destination for both domestic and international tourists? Like many zoos around the world, it has undergone a transformation in an endeavour to recreate natural habitats and focus on educational and conservation programs.

1. Brainstorm the meaning of the term 'eco-friendly'.
2. Observe **FIGURE 1** and describe the differences between image a and image b.
3. Does either image match your idea of eco-friendly? Explain.
4. Why do you think tourists like to visit zoos?

FIGURE 1 Zoos of the past and present



5.6.1 Ecotourism

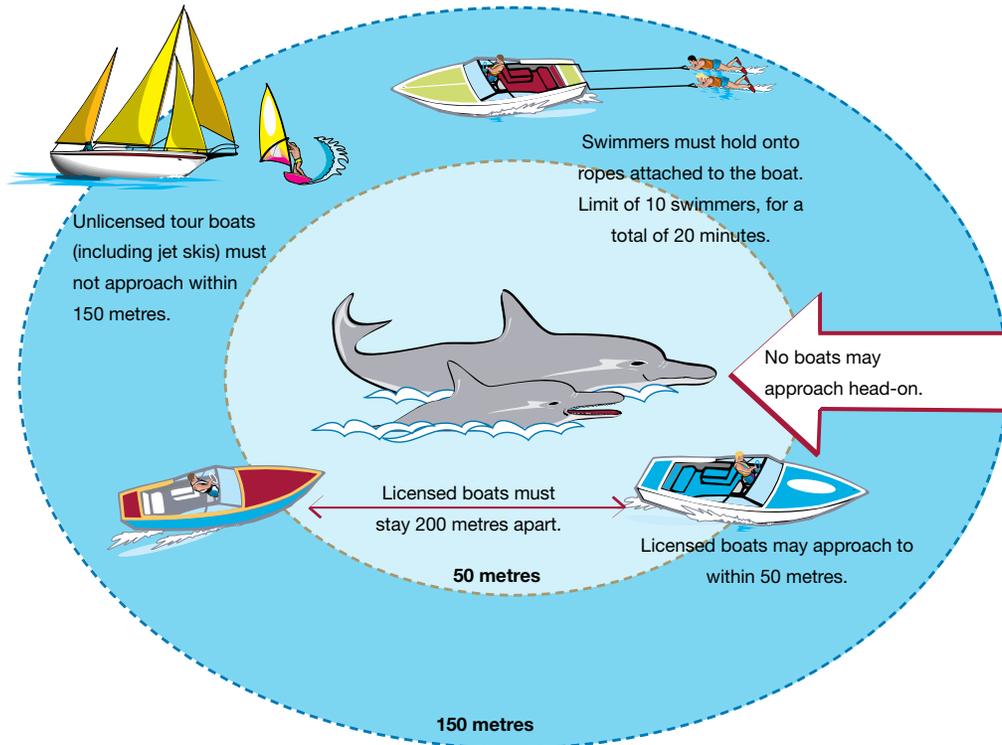
Tourism has the capacity to benefit environments and cultures or destroy them. **Ecotourism** has developed in response to this issue. The aim is to manage tourism in a sustainable way. This might be through educational programs related to the environment or cultural heritage, or through controlling the types and locations of tourist activities or the number of tourists visiting an area. Ecotourism is the fastest growing sector in the tourism industry, increasing by about 10 to 15 per cent per year.

Ecotourism (see **FIGURE 3**) 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 tourism that interprets the natural and cultural environment for visitors, and manages the environment in a way that is ecologically sustainable

FIGURE 2 Regulations for contact with dolphins



One of the most famous examples of wildlife-based ecotourism in Australia is Monkey Mia in Western Australia. Here the wild dolphins come in to shore and tourists are able to feed, swim with and touch them. **FIGURE 2** shows some of the regulations in place to manage this experience for the mutual benefit of tourists and the marine wildlife.

5.6.2 Zoos and marine parks

Traditionally, a zoo was simply a place where animals were held in captivity and 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, now called menageries.

In recent years, people have become more aware of the plight of animals that are kept in captivity. The design of zoos has undergone a major transformation in many parts of the world. 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 cold habitats for animals such as polar bears and heated enclosures with regulated humidity for species from tropical areas. Zoos also engage in wider conservation strategies; for example, captive breeding programs to ensure the survival of rare or endangered species and providing community education.

FIGURE 3 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, greywater 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 water that would need to be used and the pesticides it would require.
- G** Low-impact, non-polluting transport, such as bicycles, is 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.

The Helmeted Honeyeater, for example, is part of a captive breeding program at Healesville Wildlife Sanctuary. Should the small wild population be wiped out due to a natural disaster such as a bushfire destroying its last remaining habitat, this is the only viable population that could be used to re-populate their range.

While zoos and marine parks primarily promote themselves as acting in the best interests of the wildlife they keep, sometimes this is not necessarily the case. The scenario outlined in **FIGURE 4** provides one example of a situation where the best interests of the animal were not taken into account.

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 (EAZA) — 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 / Science Writer, originally published by Scientific American

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, with many offering not just the opportunity to view marine animals but also to watch them perform.

While most marine parks promote the fact that they only house animals born in captivity or rescued from the wild, this has not always been the case. Adult orcas, for example, have sometimes been killed so that their young could be taken into captivity. Orcas were often housed in pools that were inadequate in size; the collapsed dorsal fins of many of these animals indicated inadequate standards and perhaps even boredom. In addition, the lifespan of captive orcas is halved compared to the species living in the wild.

As tourists boycotted facilities in protest against the treatment of orcas and the visitor numbers fell, marine parks such as Sea World in San Diego, California (see **FIGURE 5**) revamped their shows to improve the conditions of the animals and emphasise the natural environment. Some marine parks now also promote themselves as theme parks — for example, Sea World on the Gold Coast.

In contrast, China’s ocean theme parks have recently experienced a tourist boom. It is thought that across China, 872 marine mammals are held, including bottlenose dolphins, beluga whales, orcas and sea lions, all taken directly from the wild and sold on the black market at prices ranging from US\$50 000 to US\$1 000 000.

In their natural Arctic and sub-Arctic environment, beluga whales are social animals that live in pods varying in size from a few to a couple of hundred individuals. 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 Sea World in California is home to orcas.



5.6 SKILL ACTIVITY: Concluding and decision-making, Communicating

Visitors to ecotourism resorts are often attracted by brochures that emphasise the resort's environmental policies. These brochures also set out guidelines to follow to minimise visitor impact.

- Design** and **create** a brochure for the ecotourism resort illustrated in **FIGURE 3**. Use ICT tools and techniques to maximise the brochure's impact.
- Add another eco-friendly activity to the island and **devise** strategies to educate tourists and minimise their impact on the environment.

5.6 Exercise

learnon

5.6 Exercise

Learning pathways

■ **LEVEL 1**
1, 3, 5, 9

■ **LEVEL 2**
4, 7, 8

■ **LEVEL 3**
2, 6, 10

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Check your understanding

- Identify** the statement that demonstrates how an ecotourism resort differs from a traditional tourist resort.
 - It provides opportunities for tourists to learn about the natural and cultural environment.
 - It aims to limit the impact of both tourists and the facilities they use on the environment.
 - Tourist numbers are often limited to minimise their impact on the environment.
 - Recycling and waste management and minimisation strategies are actively employed.
 - All of the above
- One of the most famous examples of wildlife-based ecotourism in Australia is Monkey Mia in Western Australia. Here the wild dolphins come in to shore and tourists can feed, swim with, and touch them.
 - Predict** some potential problems that might occur between dolphins and tourists.
 - Suggest an example of sustainable ecotourism. **Justify** your answer.
- Identify** the modern concept of a zoo.
 - Zoos are places where animals are held in captivity and are put on display for people to view.
 - Zoos mimic the natural environments of the enclosed animals.
 - Zoos take part in captive breeding programs as a part of a wider conservation strategy.
 - All of the above
- Outline** the different types of zoos and the positive and negative impacts they may have on wildlife.
- Identify** the main aim of a captive breeding program.
 - To create zoos
 - To increase the numbers of endangered animals in the wild
 - To make wild animals more accessible to ordinary people
 - To train animal handlers
 - To create stock for shooting parties

Apply your understanding

Communicating

- Study the ecotourism resort in **FIGURE 3**.
 - Outline** one strategy that could be used to make this ecotourism resort even more environmentally friendly.
 - Justify** the change that you have suggested.
- Discuss** the extent to which you think zoos are an ethical form of tourism.
- Explain** the role zoos play in conservation programs.
- Communicate** the difference between marine and theme parks.
- There is a thriving black-market trade in marine animals. **Propose** one strategy for reducing the illegal trade in wildlife.

LESSON

5.7 What is cultural tourism?

LEARNING INTENTION

By the end of this lesson you should be able to explain the different forms cultural tourism can take and explain why cultural tourism is a growth area.

TUNE IN

The United Nations World Tourism Organization (UNWTO) has provided the following definition of cultural tourism.



aud-0550

FIGURE 1 The UNWTO definition of cultural tourism

Cultural tourism is a type of tourism activity in which the visitor's essential motivation is to learn, discover, experience and consume the tangible and intangible cultural attractions/products in a tourism destination. These attractions/products relate to a set of distinctive material, intellectual, spiritual and emotional features of a society that encompasses arts and architecture, historical and cultural heritage, culinary heritage, literature, music, creative industries and the living cultures with their lifestyles, value systems, beliefs and traditions.

This definition appears to be quite complex.

1. Work with a partner to break down this definition and create a simplified explanation of cultural tourism.
2. Brainstorm a list of activities or events that you think could be considered cultural tourism.
3. Share your ideas with the rest of your class.
4. How difficult was it to define cultural tourism? Justify your opinion.

5.7.1 Defining cultural tourism

Cultural tourism is not a new thing — it has long been a factor in many people's reasons for travel. Visits to places like Port Arthur in Tasmania, Sovereign Hill in Ballarat, the Colosseum in Rome or the Pyramids in Egypt can be considered cultural tourism, as people endeavour to learn about and connect with the past. This type of tourism prompts us to preserve and protect our heritage.

Visiting art galleries, such as the Louvre in Paris (**FIGURE 2**), attending

music and theatre performances, or even undertaking a cooking course in another place are also examples of cultural tourism activities that broaden our knowledge and understanding of our world and its people.

According to the UNWTO, cultural tourism is expanding rapidly. In 2019, 50 per cent of global tourist travel plans were influenced by cultural or heritage-based tourism. Within the Australian market, more than two-thirds of international visitors included either a cultural or heritage event in their itinerary. In the last four years, cultural tourism has grown by 7.5 per cent and heritage tourism by 11.2 per cent annually. Both domestic and international visitors are keen to experience the splendour of the world's oldest continuous culture. Cultural tourists tend to stay longer, on average 45 nights, compared with 31 nights for other types of tourists.

FIGURE 2 The Louvre in Paris is one of the most popular and famous cultural tourism destinations for international travellers.



Cultural tourism has the added benefits of:

- boosting a country's pride in its living heritage
- providing a valuable economic boost to local communities
- maintaining and preserving indigenous cultures and traditions.

However, despite the growing popularity of the Australian market, Australia did not rank in the top ten destinations in 2019. Northern hemisphere travellers are impacted by the long distances and cost of flying to Australia, with much cheaper options available in the Asian market.

Globally, cultural tourism is on the rise as people return home, undertake a pilgrimage, or simply want to experience a significant cultural event in another place. Examples include the following.

- The Day of the Dead — originating in Mexico, the festival celebrates the dead, who have awakened to celebrate with loved ones before continuing their spiritual journey (see **FIGURE 3**). The festivities span three days, and the public holiday encourages people to remember and pray for family and friends who have passed away. The custom has now spread to other places such as the United States and other countries in Latin America.
- The ancient religious festival of Holi, marking the arrival of spring, celebrates the start of a plentiful spring harvest. Originating in the predominantly Hindu nations of India and Nepal, it is also referred to as the Festival of Colours, because of the traditional practice of throwing colours at the Emperor. It has now also spread to other parts of Asia, the Caribbean, North America and South Africa.
- The Hajj pilgrimage to the sacred city of Mecca, located in Saudi Arabia, is a practice dating back to the ancient prophets. With the expectation that it will be made at least once in every Muslim person's lifetime, the Hajj is an enormous gathering, attracting 3 to 5 million people each year (see **FIGURE 4**). It occurs over 5 or 6 days in the last month of the Islamic calendar.
- In many cultures where Christianity is the predominant religion, people come together to celebrate Christmas, commemorating the birth of Christ, and Easter, to remember his resurrection.

Whatever the reason, the mass movement of people associated with these events has a significant impact on both people and places.

FIGURE 3 Thousands gather to attend the Day of the Dead parade in Mexico City each year.



FIGURE 4 Muslims from all over the world make the Hajj pilgrimage to Mecca, Saudi Arabia.



5.7.2 Thanksgiving

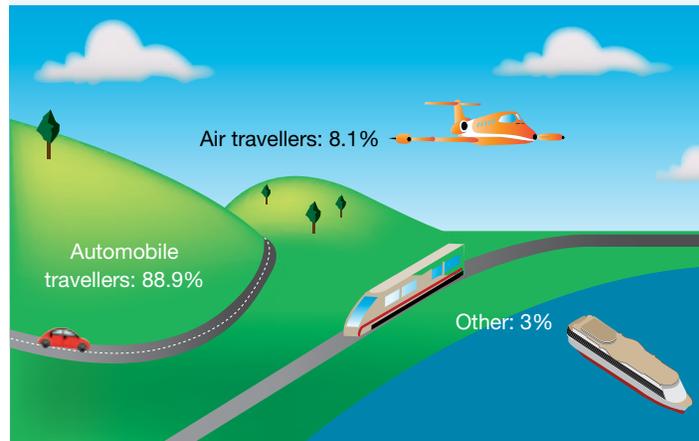
Thanksgiving is held each year in the United States on the fourth Thursday in November. It dates back to the seventeenth-century celebration of the harvest. Today it is a time for families to get together and give thanks for what they have.

The Thanksgiving holiday period runs from Wednesday to Sunday. As millions of people travel across the United States, transport systems are stretched to their limits, creating traffic congestion and delays.

Because the holiday season is so close to the start of winter, the weather can further complicate people's travel plans, especially for those who live in the colder northern states. Early winter storms can bring ice and snow, resulting in airport closures and impassable roads.

The average American will spend around 21 per cent of their Thanksgiving budget on travelling to their destination, whether by car, air or other means (see **FIGURE 5**). In 2019, 55.3 million adults travelled during the four-day Thanksgiving period to spend time with family and friends. During COVID-19, the number of travellers decreased to 50.6 million in 2020 but rebounded to 53.4 million in 2021.

FIGURE 5 Modes of transport used for Thanksgiving travel



5.7.3 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 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.

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 6**). The changing nature of this holiday has meant that many governments have to shift working days to accommodate the event.

In China, 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, delays in delivery are to be expected during this period.

FIGURE 6 For prosperity and good fortune, dragons and lion dances feature in Chinese New Year celebrations.



new moon the phase of the moon when it is closest to the sun and is not normally visible
winter solstice the shortest day of the year, when the sun reaches its lowest point in relation to the equator

The logistics of moving millions

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 — a total of 400 million people on the move in just five days!

Although incomes have risen for middle-class citizens in China, most people elect to travel by road as they do not want to stand in long queues for hours or even days to purchase bus or rail tickets. In 2019, over the 40-day Spring Festival period that encompasses Chinese New Year, 2.46 billion trips were made by road, 4.3 million trips were made by train (an increase of 8.3 per cent over 2018) and 76 million trips were made by air.

Airlines scheduled 532 000 flights, 10 per cent more than in 2018 and ten airports remained open around the clock to cope with the demand. It is not uncommon for commuters to add hundreds, or even thousands of kilometres to their journey; one airline passenger flew from Beijing to Kunming in Southern China via Bangkok in Thailand because there were no direct flights. Weather conditions and the impact of additional flights competing for the same amount of air space make delays inevitable.

Weather conditions can also impede rail and car travel. In 2017 a cold snap saw highways in central China covered in ice; this was further complicated by heavy fog making road travel close to impossible. 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 (see **FIGURE 7**). Almost 4000 police and security guards were called in to keep order.

Late in 2018, ten new railways were added to the rail network to expand the length of China's high-speed railway — the second-largest in the world behind the United States. At its peak, the online rail booking system had to cope with 1000 bookings per minute. To ease congestion, facial-recognition software and ticketless travel were installed. High demand also leads to high prices, and scalpers were quick to cash in, charging double or even triple the usual ticket cost.

For many, motorbike travel is the cheapest way to return home, with some making journeys in excess of 400 kilometres. Motorbikes offer not only a cost saving, but also a time saving. Although China boasts one of the world's largest road networks, with almost 98 000 kilometres of motorway, when 2.4 billion people take to the roads, congestion is inevitable. Drivers with electric cars are able to recharge at one of the 7400 charging stations that have been installed. To ensure safety and improve traffic flow, 170 000 additional police in an extra 60 000 police vehicles are mobilised.

With such challenges to moving around China during this period, it is no wonder that a growing trend favoured by more than 7 million Chinese is to celebrate the New Year by travelling abroad, to 90 different countries. Others are now electing not to travel at all, instead choosing to work through the holiday period to take advantage of increased pay rates on offer. In response to an increasing trend in takeaway food orders during the festivities, some employers in the hospitality industry are offering delivery drivers triple pay to work on Chinese New Year.

FIGURE 7 Travel chaos as crowds swell outside Guangzhou station after bad weather causes long delays



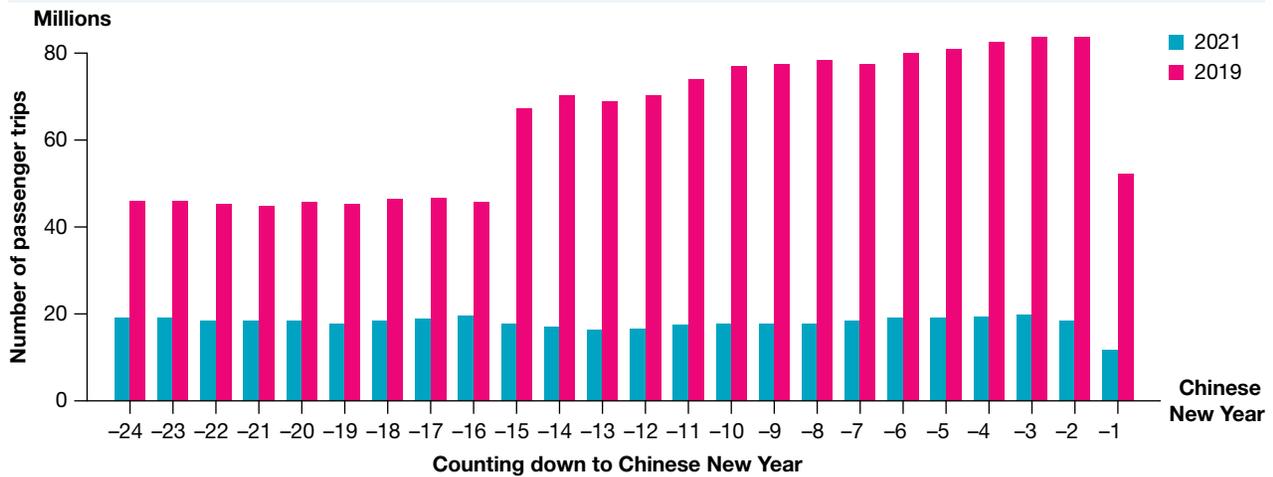
In 2020, COVID-19 had a significant impact on the number of people travelling home for the Lunar New Year, as the holiday coincided with dramatic increases in cases. Three Chinese cities were in complete lockdown as the New Year holiday began, but many other cities had imposed strict travel restrictions. In addition, the impact of the illness and its potential for spread meant many people chose not to travel rather than risk infection.

To help prevent the virus spreading, the Chinese government discouraged travel and extended the holiday for a further three days to help reduce large gatherings of people.

China's Ministry of Transport data shows that travel was steady but much in much lower levels in 2021, compared with the mass movement of 2019 (FIGURE 8). Seventy per cent fewer trips were made in the lead-up to Chinese New Year due to the pandemic.

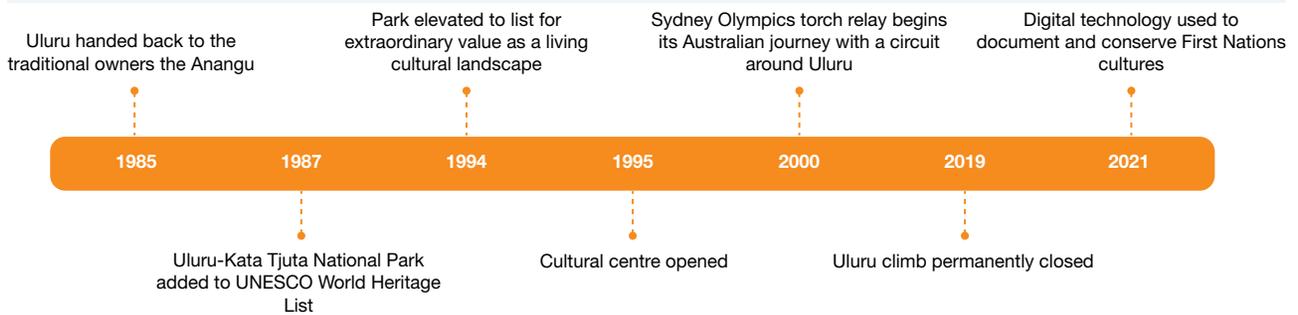
int-9069

FIGURE 8 Comparing the domestic movement of people in China before and during COVID-19



5.7.4 The power of science in preserving Australia's cultural heritage

FIGURE 9 Uluru-Kata Tjuta is a living museum



A state-of-the-art digital system is being used to preserve the cultures of First Nations Peoples from the Kimberley Region to Port Augusta.

The project began as a joint venture between the Anangu Peoples, the traditional owners of Uluru-Kata Tjuta National Park and Parks Australia. It was designed to document and conserve the 80 rock arts sites which were under threat from visitors, invasive species such as wasps, water damage and dust.

FIGURE 10 First Nations Australian rock art is recorded in a database



A multimedia interactive database is being used to record the rich heritage that has been passed down through the generations in song, dance, stories and relationships. The system uses icons and graphics to help overcome problems associated with language and reading difficulties.

Three levels of information have been created — men’s sites, women’s sites and public sites. Access is controlled by passwords so that sensitive information is not available to the public.

Digital soundtracks, video clips, site plans, photographs, cultural sites and traditional land management strategies handed down through the 60 000 years of Anangu history and memories of first contact with white settlers have been captured for future generations.

5.7 SKILL ACTIVITY: Questioning and researching using geographical methods, Concluding and decision-making

How does Australia celebrate its culture?

1. **Brainstorm** a list of cultural events that are celebrated in Australia. (You might like to do this as a class.)
Identify the events on your list that are unique to Australia; for example, Moomba, National Sorry Day.
2. **Select** one of these events to **investigate** in more detail. **Devise** your own research questions to find out about the history of the event and when it is held.
What statistics can you find in relation to this event?
Include how this event may have been impacted by COVID-19.
3. **Create** an annotated visual display to present your findings.

-  **Weblinks** Thanksgiving 1
 Thanksgiving 2
 COVID-19 impact on Chinese New Year travel and tourism
 Chinese New Year COVID-19 advice — WHO

5.7 Exercise

5.7 Exercise

Learning pathways

■ **LEVEL 1**

1, 4, 5, 6

■ **LEVEL 2**

2, 3, 10

■ **LEVEL 3**

7, 8, 9

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Check your understanding

- Identify** the focus of cultural tourism.
 - The natural environment
 - People travelling to overseas destinations for medical care and procedures
 - The way of life of people in a geographical region
 - Managing tourism in a sustainable way
- Explain** why Thanksgiving and Chinese New Year are regarded as cultural events.
- Explain** why Chinese New Year leads to industries shutting down for 15 days.
- Select** the sentence that best defines the purpose of a pilgrimage.
 - A trip to an overseas family wedding
 - A journey usually made by an individual, typically with a spiritual significance
 - A package holiday to Thailand
 - A wine tour of France

Apply your understanding

Communicating

- Using the content in lesson 5.7, **identify** the correct answer for each question relating to the celebrations of Thanksgiving and Chinese New Year.
 - Thanksgiving
 - Number of trips taken
 - Most common form of transport
 - Length of holiday period
 - Purpose of trip/activities
 - Chinese New Year
 - Number of trips taken
 - Most common form of transport
 - Length of holiday period
 - Purpose of trip/activities
- Write a paragraph **explaining** how cultural events can *change* people, *places* and the *environment*.
- Describe** the impact the weather might have on a cultural event.
- Write a paragraph **describing** a traditional cultural event that you and your family celebrate. Is it an example of cultural tourism? **Justify** reasons for your answer.
- Explain** the impact Chinese New Year might have on a clothing import business in Australia. In your answer, **explain** what business owners might need to do to ensure their business is not affected by this event.
- Some cultural events, such as Thanksgiving, occur at approximately the same time each year, whereas others such as Chinese New Year vary more in their timeframe. **Explain** why this is so.

LESSON

5.8 How are tourism and sport connected?

LEARNING INTENTION

By the end of this lesson you should be able to discuss the increasing popularity of sport tourism and identify both positive and negative impacts of sport tourism.

TUNE IN

Did you know that cities sell the Olympics to their own citizens by quoting that there will be substantial flow-on to tourism? However, this is not always the case.

TABLE 1 Tourism statistics from various Olympic Games.

Olympics	Year	Impact on tourism
London (summer)	2012	Hotels, restaurants and cultural sites in London recorded a 40 per cent fall in tourism activity during the games.
Sochi (winter)	2014	Saw an increase in domestic tourism following the games but no impact on international arrivals.
Rio (summer)	2016	A tourist boom, with a 30 per cent increase in tourist arrivals than for the same time 12 months earlier.

1. Why do you think the Olympics has a hit-or-miss impact on tourism?
2. Do you want to go to the Olympics? Give reasons for your answer.
3. Share your ideas with the rest of the class.

5.8.1 How are tourism and sport connected?

Sport tourism involves people travelling to view or participate in a sporting event or sporting pursuits. Tourism in which someone travels to either actively participate in or watch a competitive sport as the main reason for their travel is known as **hard sport tourism**. Tourism in which someone participates in recreational and leisure activities, such as skiing, fishing and hiking, as part of their travel is known as **soft sport tourism**. A common trait in all sports tourists is their passion for the sport and a willingness to spend money to indulge this passion.

Sport tourism is an expanding sector of the tourism industry, estimated to add \$800 billion to global economies each year. It is estimated that between 12 million and 15 million international trips are made to view sporting events. Sport tourism is currently growing growing at a rate of 16.1 per cent each year. It is expected that by 2039 this industry will be valued at \$1.8 trillion. But what impact does this have on people and places?

FIGURE 1 On the trail — soft sport tourism



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

soft sport tourism tourism in which someone participates in recreational and leisure activities, such as skiing, fishing and hiking, as part of their travel

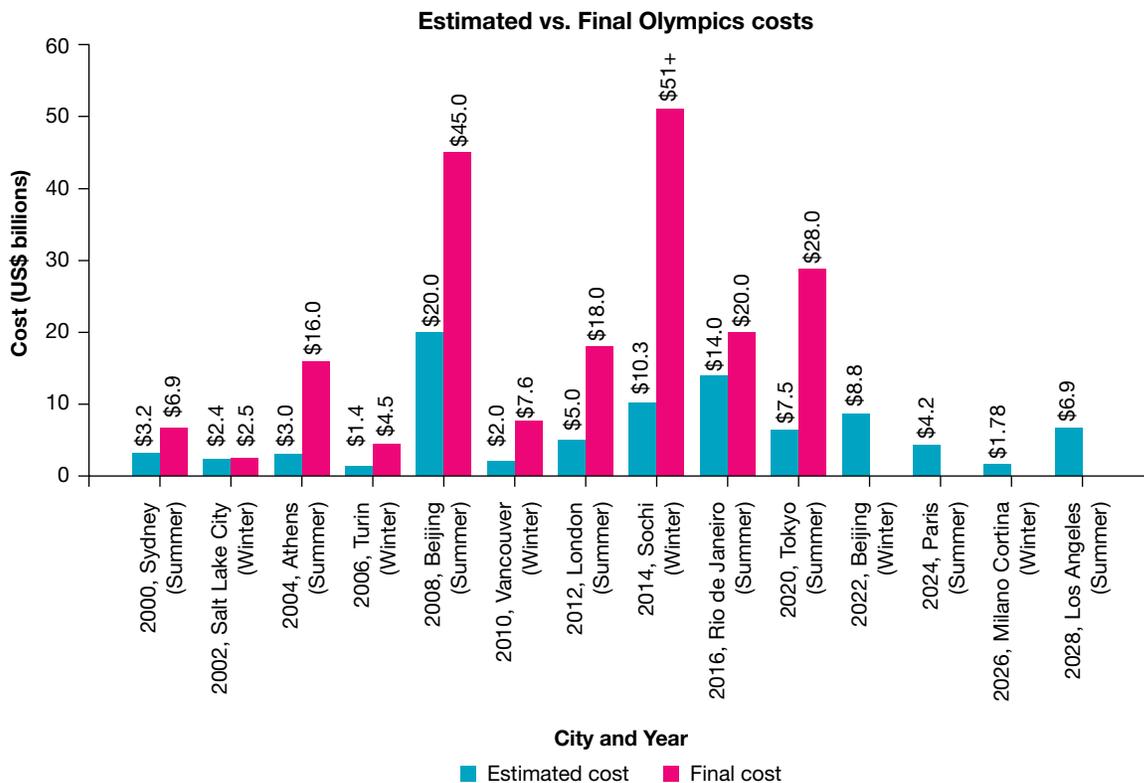
Governments spend millions of dollars to attract people to sporting events such as the Olympics, the cricket, the FIFA World Cup and motor racing events, to name just a few. These events also trigger:

- 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.

5.8.2 The Olympics

Major sporting events such as the Olympic Games translate into improved infrastructure, and provide the host city with considerable international exposure, but this comes at a substantial cost (see **FIGURE 2**). Does this bring in more tourists and justify the capital outlay?

FIGURE 2 Olympics expenditure (summer and winter), including infrastructure



The general consensus among economists is that the costs associated with hosting a one-off major event, such as the FIFA World Cup or the Olympic Games, generally exceed the value of any anticipated long-term benefits. Every Olympics since 1960 has run over budget by an average of 172 per cent and has generally run at a loss. For instance the Beijing Olympics cost \$40 billion and only generated \$3.6 billion in revenue, while the London Olympics cost \$18 billion and generated \$5.2 billion in revenue.

The 2016 Rio Olympic Games were plagued by political and economic controversy. As the cost of hosting the Games blew out to \$20 billion, Brazil was plunged into recession. Issues such as the Zika virus epidemic, a Russian doping scandal and high levels of pollution also threatened to derail the games. On the plus side, upgrades to the public transport network and sewerage system, cleaning up the pollution at Guanabara Bay, and the construction of nine new permanent venues and seven temporary venues delivered a boost to the construction industry. However, now that the Games are long past, Rio has a surplus of venues that it no longer needs. Plans to sell them off failed due to a lack of buyer interest, resulting in many venues, such as the Olympic pool and Maracanã Stadium (site of the opening and closing ceremonies) falling into a state of

disrepair. The athletes' village, which housed 10 000 athletes in 3604 apartments, is largely empty, with only 7 per cent of the apartments sold.

Purpose-built stadiums impose additional costs on host cities, well into the future; Beijing's 'Bird's Nest' stadium was built at a cost of \$460 million, costs \$10 million annually to maintain and is rarely used. The Athens's Olympics helped plunge Greece into a debt crisis and many of its stadiums are now in ruins.

In the United Kingdom during the 2012 Olympics year, statistics for August showed 5 per cent *fewer* visitors than in the previous year. Tourism spending, however, went up by 9 per cent, in part because of spending on Olympics 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 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, or renovate their existing dwellings. In the lead-up to the Beijing Olympics, 1.5 million Chinese people were forced out of their homes to make way for Olympic venues.

Once the event is over, many of the stadiums are underused, and it can take years to recover from the cost of staging the event. For instance, the city of Montreal in Canada, which hosted the games in 1976, took 30 years to pay back the equivalent of US\$6 billion (in today's money) in Olympic spending.



COVID-19 and the Tokyo Olympics

COVID-19 saw the Tokyo Olympic Games postponed until 2021. It is the first time that stadiums were largely empty rather than packed with spectators. Measures put in place to add additional safeguards for athletes and officials added more to the cost of staging these games. Tokyo has been left with a \$15 billion debt because of empty stadiums, even though the International Olympic Committee (IOC) raked in billions of dollars through the sale of broadcasting rights. The IOC traditionally keeps half of the television revenue generated.

5.8.3 Other sports events

It has generally been accepted that regular sporting events can have financial benefits for the host location. Many international tourists visiting the United Kingdom, for instance, 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. Overall, sports tourists stay longer and are not deterred by the weather. Sporting fans also tend to spend more than the rest of the tourist population.

The popularity of football is also evident in Australia, where three separate codes (AFL, soccer and rugby league) attract huge crowds every week, and many fans are prepared to travel interstate to watch their teams play.

But it is not just football that attracts the crowds. The English cricket team, for example, is followed around the world by its unofficial cheer squad — the Barmy Army. Many Australian fans participate in a range of organised sporting tours each year, taking in some of the biggest events both at home and abroad involving, in addition to cricket, sports such as tennis, rugby and golf.

FIGURE 4 The Barmy Army are English cricket fans who travel the world to cheer on the English cricket team.



5.8 SKILL ACTIVITY: Concluding and decision-making

Phillip Island is located 100 kilometres south-west of Melbourne, Victoria, and is linked to the mainland by a bridge. The island is only 102 km² and has a population of around 10 000. The area is popular for its beaches and wildlife, but is also home to a Grand Prix racing circuit that stages a variety of motor sports throughout the year. Collectively more than \$140 million is generated annually from the circuit's car and bike activities. Three events — the Moto GP, V8 Supercars and Superbikes — bring in around \$80 million. Each of these events attracts more than 90 000 people to the island.

- Identify** the facilities needed to cater for such a large influx of people.
- The mind map shown in the 5.5 Exercise shows some ideas for how the tourist dollar can flow from one job to the next. Complete a diagram like this for the Phillip Island Grand Prix Circuit.
- Summarise** the negative consequences that might result from having a Grand Prix Circuit on Phillip Island. Make sure you consider the impact of people and the environment, as well as the scale of such effects.
- Write a paragraph, **explaining** the interconnection between the location of sporting facilities and their impact on people and places.
- Do you think this is an example of sustainable tourism? **Justify** your point of view.

5.8 Exercise

Learning pathways

■ LEVEL 1

1, 2, 3

■ LEVEL 2

5, 6, 7, 8

■ LEVEL 3

4, 9, 10

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Check your understanding

- Define** 'hard sport tourism'.
 - Tourism in which someone travels to either actively participate in or watch a competitive sport as the secondary reason for their travel
 - Tourism in which someone travels to either actively participate in or watch a competitive sport as the main reason for their travel
 - Tourism in which someone travels to either actively participate in or watch a fashion show as the main reason for their travel
 - Tourism in which someone goes to a sporting event while already on a trip
- Define** 'soft sport tourism'.
 - Tourism in which someone competes in a fishing event as part of their travel
 - Tourism in which someone participates competitively in activities such as skiing, fishing and hiking as part of their travel
 - Tourism in which someone participates in recreational and leisure activities, such as skiing, fishing and hiking, as part of their travel
 - Tourism in which someone participates competitively in activities such as football as part of their travel
- Identify** a reason some of the stadiums built for the Rio de Janeiro Olympic Games were temporary, rather than permanent.
 - They would not be needed after the Games and could easily be dismantled.
 - The people did not want new stadiums.
 - The stadiums were too ugly to keep.
 - It was not possible to build permanent structures in time for the Games.
- Create** a table that classifies the impacts of tourism as positive or negative.
- Select** two positive and two negative impacts of sports tourism. For each impact, **explain** how it affects people and places.

Apply your understanding

Concluding and decision-making

- Explain** why the Olympics often result in a nation being heavily in debt.
- Explain** how hosting a major international sporting event can lead to improvements in infrastructure.
- Identify** a financial benefit of hosting a major sporting event. In your opinion, does the benefit outweigh the cost? **Justify** your answer.
- Queensland has recently been awarded the 2032 Olympic Games. Considering the pros and cons of hosting such a major event, **propose** advice for the Queensland Government.
- A leading economist recently said, 'Major events such as the Olympics should be hosted by developed countries; the cost to developing nations is too great.' **To what extent** do you agree with this statement? **Justify** your view.

LESSON

5.9 INQUIRY: Cruising sustainably

LEARNING INTENTION

By the end of this lesson you should have a comprehensive understanding of how cruising can be sustainable and how it can have a positive impact on the economy, society and the environment.

Background

In this inquiry, you investigate how a cruise can be managed sustainably and have a positive impact on economy, society and the environment.

Mystic Cruises is about to add a new cruise ship to its fleet. As a member of the company's cruise-development team, you need to design a seven-day cruise, including exotic ports of call and shore excursions that allow cruise guests to take in the sights and culture of the places they visit. If your itinerary is accepted, you will also have the honour of naming the ship.

FIGURE 1 Which ports will your cruise visit?



Before you begin

Access the **Inquiry rubric** in the digital documents section of the Resources panel to guide you in completing this task at your level. At the end of the inquiry task you can use this rubric to self-assess.

Discuss the following:

1. The pillars of sustainability, economy, society and environment.
2. The places that people in different age groups or life stages might want to visit.
3. The different types of experiences that might be eco-friendly.
4. The different types of experiences that might be considered culturally based.

Inquiry steps

Step 1: Questioning and researching using geographical methods

In this inquiry you are required to plan a seven-day cruise for a new cruise line. You can choose where the cruise ship will operate (for example, Australia and the Pacific, the Caribbean, the Mediterranean).

Select your ports (at least four) and write your inquiry question — remember you need to cater for a variety of people and offer a variety of experiences.

Investigate seven-day cruises to give you an idea of where you might travel in seven days.

Conduct research into your four ports of call.

Collect your information in table format.

Identify places of interest in each location (more than you might need for your final presentation) that support eco-friendly activities, provide the opportunity for a cultural experience and will appeal to different ages and life stages.

Use the **Carnival Cruises**, **CruiseCo**, **P&O Cruises** and **Royal Caribbean** weblinks in the Resources panel to get you started.

Step 2: Interpreting and analysing geographical data and information

Create a master table that will pull your research together.

Categorise each of your activities as eco-friendly, cultural or contributing to the economy, and indicate your target audience. An example is shown below.

Eco-friendly	Cultural	Appeals to	Economy
	Fire walking and traditional feast	All ages and life stages	Employment for local people Tour operator may be international

Step 3: Concluding and decision-making

Reflect on your table and select your four ports of call. Make sure you can realistically visit these ports within the timeframe of your cruise.

For each port of call, **develop** three shore excursions that will allow people to take in the sights and culture of the places they visit.

Decide which information you will use in your presentation to attract tourists.

- Port information and excursions
- Eco-friendly/cultural
- Appeals to
- Economy

Step 4: Communicating

Create your presentation — you might choose to use PowerPoint or Prezi or make a video.

Remember to include a map that shows the cruise journey and ports of call.

Remember to include your shore activities and make your cruise appeal to a wide range of travellers.

Give your ship a name and include this in your presentation.

Use visuals to make your presentation more appealing.

Complete your self-assessment using the **Inquiry rubric** or access the 5.9 exercise set to complete it online.

FIGURE 2 What cultures will your passengers discover?



on Resources

 **Digital document:** Inquiry rubric (doc-39693)

 **Weblinks**
 Carnival Cruises
 CruiseCo
 P&O Cruises
 Royal Caribbean

LESSON

5.10 Investigating topographic maps: Nature-driven tourism at Victoria Falls

LEARNING INTENTION

By the end of this lesson you should be able to identify features on a topographic map and examine their impacts on tourism at a specific location.

5.10.1 Tourist mecca

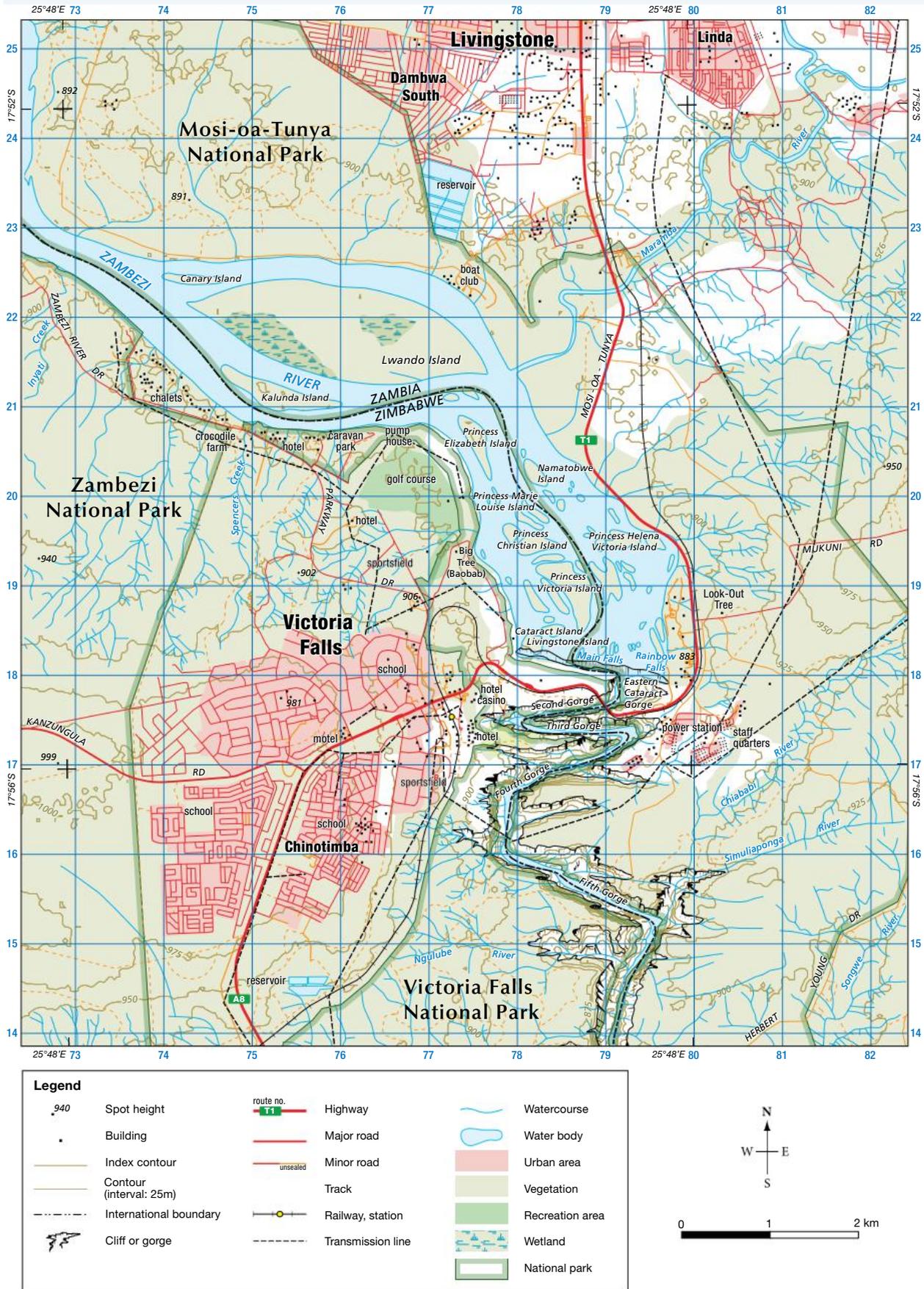
Victoria Falls, or Mosi-oa-Tunya, has been recognised as a World Heritage site due to its spectacular waterfalls. The falls attract several hundred thousand visitors from around the world each year, which has led to the development of numerous tourist businesses to cater to them.

UNESCO has deemed Victoria Falls to be a site of exceptional natural beauty and geological importance. The main falls, located on the Zimbabwe side of the border with Zambia, drop in excess of 100 metres. Due to the outstanding universal value posed by this collection of waterfalls, a significant tourism industry has sprung up on both sides of the border. Victoria Falls covers an area of 6860 hectares. The region is used for a variety of tourist activities including rafting, helicopter flights, walking with lions, abseiling and bungee jumping, bush walks, mountain biking, jet boats, horseback and elephant-back safaris, as well as fly fishing.

FIGURE 1 Oblique aerial photo of Victoria Falls



FIGURE 2 Topographic map extract of Victoria Falls, Zambia and Zimbabwe, 2021



Source: © OpenStreetMap contributors, <https://openstreetmap.org>, Data is available under the Open Database Licence, <https://opendatacommons.org/licenses/odbl/>; Spatial Vision.

on Resources

-  **eWorkbook:** Investigating topographic maps — Nature-driven tourism at Victoria Falls (ewbk-10651)
-  **Digital document:** Topographic map of Victoria Falls, Zambia and Zimbabwe (doc-39317)
-  **Video eLesson:** Investigating topographic maps — Nature-driven tourism at Victoria Falls — Key concepts (eles-6002)
-  **Interactivity** Investigating topographic maps — Nature-driven tourism at Victoria Falls (int-8562)
-  **Google Earth:** Victoria Falls

5.10 Exercise

learnon

5.10 Exercise

Learning pathways

■ LEVEL 1
2, 4

■ LEVEL 2
1, 3

■ LEVEL 3
5, 6

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Check your understanding

- Which of the following physical features forms a natural boundary between Zambia and Zimbabwe?
 - A gorge
 - A perennial lake
 - A dam
 - A highway
- Give the area reference for Canary Island.
- What is found at GR765202?
- Describe** how people staying in Livingstone, Zambia, get to Victoria Falls.

Apply your understanding

Communicating

- Evaluate** the impacts (positive and negative) of tourism to this area.
- Suggest** how the COVID-19 pandemic might have affected tourism in this region.

LESSON

5.11 Review

Hey students! Now that it's time to revise this topic, go online to:



Review your results



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5.11.1 Key knowledge summary

Use this dot point summary to review the content covered in this topic.

5.2 How is tourism important?

- Tourism is, generally speaking, one of the world's fastest-growing industries.
- A combination of factors such as increased leisure time, improved standard of living and advances in technology have ensured that tourism is no longer only for the rich.
- New forms of tourism, such as medical tourism and opportunities to travel and work overseas, are contributing to the expansion of the tourism industry.

5.3 What is global tourism?

- Tourism is accessible to a wider demographic.
- With people living longer, there are more opportunities for mature-aged tourists and cheap travel options for the 18- to 25-year-old market.
- North America, China and Western Europe are not only popular destinations, but also among the top ten in tourism spending.
- Most hotel chains are owned and operated by companies based in the United States.

5.4 Is Australian tourism growing?

- More Australians are choosing to travel abroad rather than holiday at home; this is mostly due to increased choice and competition within the tourism industry.
- While New South Wales continues to attract the most international visitors, Western Australia has also recorded strong growth.
- Tourism is important to the Australian economy; global events such as a pandemic can have a dramatic impact on our tourism industry.

5.5 What are the impacts of tourism?

- Tourism has both positive and negative impacts, and these impacts can be interconnected.
- While tourist spending can boost the economy, this is not always of benefit to the local community if people are being exploited, or if revenue is going to major corporations and locals are being underpaid.
- The infrastructure that is needed to support the tourism industry can also benefit local communities.

5.6 How can we manage the environmental impacts of tourism?

- Eco-tourism aims to be sustainable, to limit the impact of tourism and to educate the public.
- Zoos and aquariums perform an important role in the education of the public and conservation of endangered species.
- Many zoos and aquariums have undergone a transformation to make them more eco-friendly, but this is not the case everywhere.

5.7 What is cultural tourism?

- Cultural tourism results in the mass movement of people over a short period of time so that they can come together to celebrate their shared history, religion or traditions.
- Examples of cultural tourism include Chinese New Year and Thanksgiving.
- While it is traditional for people to spend holidays with their extended family, there is a growing trend of travelling abroad to avoid the holiday overcrowding.

5.8 How are tourism and sport connected?

- It is becoming more common for people to combine a sporting event with their travels, either as an active participant or a passive observer.
- Major sporting events such as the Olympics are often touted as being a financial windfall for the host nation; however, while there might be a peak in employment in the lead-up and during the event, nations can also be left with significant debt.
- Some travel companies focus primarily on putting together sporting itineraries.

5.9 INQUIRY: Cruising sustainably

- Students complete an investigation into the cruising industry.
- Students develop a 7-day cruise itinerary that will have a positive impact on economy, society and the environment.

5.10 Investigating topographic maps: Nature-driven tourism at Victoria Falls

- Victoria Falls is a UNESCO site of exceptional natural beauty and geological importance.
- Tourism forms a vital part of the economy in this region.

5.11.2 Key terms

developed describes countries with a highly developed industrial sector, a high standard of living, and a large proportion of people living in urban areas

ecotourism tourism that interprets the natural and cultural environment for visitors, and manages the environment in a way that is ecologically sustainable

gross domestic product (GDP) the value of all the goods and services produced within a country in a given period of time (usually a year). It is often used as an indicator of a country's wealth.

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

infrastructure the facilities, services and installations needed for a society to function, such as transportation and communications systems, water pipes and power lines

Masai an ethnic group of semi-nomadic people living in Kenya and Tanzania

mature-aged describes individuals aged over 55

national parks parks or reserves set aside for conservation purposes

new moon the phase of the moon when it is closest to the sun and is not normally visible

soft sport tourism tourism in which someone participates in recreational and leisure activities, such as skiing, fishing and hiking, as part of their travel

winter solstice the shortest day of the year, when the sun reaches its lowest point in relation to the equator

5.11.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

Can the tourism choices we make today be managed sustainably, to have a positive impact on economy, society and the environment?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question, outlining your views.

Resources

-  **eWorkbook** Customisable worksheets for this topic (ewbk-13452)
Reflection (ewbk-10652)
Crossword (ewbk-10653)
-  **Interactivity** Tourists on the move crossword (int-7650)

5.11 Review exercise

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Multiple choice

- Which of the following people would not be considered a tourist?
 - Bec moves to London permanently to work as a teacher.
 - Callum spends a weekend with friends camping in a nearby national park.
 - Hyun spends two weeks of the summer holidays with relatives in Sydney.
 - Charlie spends three days at a yoga retreat in the country.
- Which of the following countries was not in the top ten destinations for tourist earnings in 2019?
 - United States
 - France
 - Australia
 - Mexico
- Identify the typical features of a backpacker's travel plans. Select all that apply.
 - Tight budget but willing to work
 - Flexibility
 - Uses superannuation to fund travel
 - All of the above
- Which of the following countries was not in the top ten destinations for tourists in 2019?
 - United States
 - France
 - Australia
 - Mexico
- Identify a potential new growth area for tourism.
 - Sports tourism
 - Cultural tourism
 - Space tourism
 - All of the above
- Why has international travel become more common? Select all reasons that apply.
 - Faster travel times across long distances
 - Fewer airlines on major tourist routes
 - Lower prices for flights and tours
 - More leg room in commercial plane cabins
- Which of the following are challenges faced by developing economies with growing tourist numbers? Select all that apply.
 - Enforcing environmental protections
 - Balancing local and tourist needs
 - Keeping the profits in the local community
 - All of the above

8. Which country is the most common international destination for Australian tourists?
 - A. New Zealand
 - B. China
 - C. Indonesia
 - D. England
9. What is the most common reason that tourists visit Australia?
 - A. Business
 - B. To visit family
 - C. Holiday
 - D. Education
10. Identify the hard sport tourism activities from this list.
 - A. Travelling to the UK to watch the World Netball Cup finals
 - B. Travelling to Aspen in the USA for a skiing holiday
 - C. A rock-climbing holiday in the Grampians National Park in Victoria
 - D. Hiring a mountain bike for a day of trail riding

Short answer

Communicating

11. If tourism does not significantly harm or change natural or cultural environments, does this mean it is environmentally sustainable? **Justify** your answer.
12. Consider this scenario.
A proposal has been put forward to rezone about 1155 hectares of land at Cape Leveque on the Dampier Peninsula, in order to expand tourism accommodation and facilities. The plans include a sealed road from Broome, a new airstrip and the development of 4- and 5-star resort-style accommodation. The resort will contain a large bistro/restaurant, self-contained accommodation, hotel accommodation and cabins.
Describe a possible positive change and a possible negative change this may have on the environment.
13. **Describe** one example of why it can be difficult to balance the needs of tourists and protect the environment.
14. **Discuss** the reasons why someone might travel to Thailand for dental surgery.
15. Which of the four types of tourist would be most likely to take a cruise-ship holiday? **Justify** your answer.

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GLOSSARY

- active travel** making journeys via physically active means, such as cycling or walking
- agribusiness** business set up to support, process and distribute agricultural products
- anthropogenic** resulting from human activity (man-made)
- aquaculture** the farming of aquatic plants and aquatic animals such as fish, crustaceans and molluscs
- 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
- 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
- change** is about using time to better understand a place, an environment, a spatial pattern or a geographical problem. The concept of change involves both time and space — change can take place over a period of time, or over an area.
- clear-felling** the removal of all trees in an area
- connectivity** the ability to access the internet
- 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
- 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
- ecotourism** tourism that interprets the natural and cultural environment for visitors, and manages the environment in a way that is ecologically sustainable
- endemic** describes species that occur naturally in only one region
- environment** the physical and biological world around us, which supports and enriches human and other life by providing raw materials and food, absorbing and recycling wastes, and being a source of enjoyment and inspiration to people
- 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
- ethnicity** cultural factors such as nationality, culture, ancestry, language and beliefs
- 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
- genetically modified** describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques
- greenhouse gases** any of the gases that absorb solar radiation and are responsible for the greenhouse effect. These include water vapour, carbon dioxide, methane, nitrous oxide and various fluorinated gases.

gross domestic product (GDP) the value of all the goods and services produced within a country in a given period of time (usually a year). 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

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

human development measures such as life expectancy, education and economic wellbeing that provide an overall indication of a place's level of development and the standard of living of its inhabitants

humanitarian principles the principles governing our response to those in need, with 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

indicators things that provide 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

interconnection the fact that people and things are connected to other people and things in their own and other places around the world

irrigation the supply of water by artificial means to agricultural areas

jatropha any plant of the genus *Jatropha*, but especially *Jatropha curcas*, which is used as a biofuel

leeward describes the area behind a mountain range, away from the moist prevailing winds

logging large-scale cutting down, processing and removal of trees from an area

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

national parks parks or reserves set aside for conservation purposes

national security the protection of a nation's citizens, natural resources, economy, money, environment, military, government and energy

new moon the phase of the moon when it is closest to the sun and is not normally visible

non-government organisation (NGO) a group or business that is organised to serve a particular social purpose at local, national or international level, and operates independently of government

offshore to relocate part of a company's processes or services overseas in order to decrease costs

organic matter decomposing remains of plant or animal matter

per capita per person

perception the process by which people translate sensory input into a view of the world around them

place an area on the Earth's surface which is identified and has meaning for people

plantation an area in which trees or other large crops have been planted for commercial purposes

pneumatophores exposed root system of mangroves, which enables them to take in air when the tide is in

potable drinkable; safe to drink

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

rain shadow the dry area on the leeward side of a mountain range

salinity the presence of salt on the surface of the land, in soil or rocks, or dissolved in rivers and groundwater

scale the way that geographical phenomena and processes can be examined at different spatial levels. Scale can be applied from personal and local levels to regional, national or global levels.

social justice a principle applied so that a society is based on equality, the appreciation of the value of human rights and the recognition of 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 part of their travel

space where things are located and distributed on the surface of the Earth

sustainability refers to maintaining the capacity of the environment to support our lives and those of other living creatures now and into the future

sustainable describes the use by people of the Earth's environmental resources at a rate such that the capacity for renewal is ensured

trade barrier government-imposed restriction (in the form of tariffs, quotas and subsidies) on the free international exchange of goods or services

trading partner a participant, organisation or government body in a continuing trade relationship

treeline the edge of the area 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

waterlogging saturation of the soil with groundwater such that it hinders plant growth

water stress situation that occurs when water demand exceeds the amount available or when poor quality restricts its use

watertable the surface of the groundwater, below which all pores in the soils and rock layers are saturated with water

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

world wide web the global resources and information exchange available to internet users through the use of the Hypertext Transfer Protocol (HTTP)

yield gap the gap between a certain crop's average yield and its maximum potential yield

INDEX

A

active travel 167–8, 220
Africa, land grabs in 117
agribusiness 59
agricultural production 120
agricultural yields 48
agriculture 122
 in Asia 58–65
 in Australia 58–65
 distribution 59
 farming 59–61
 rice 62
 biomes for 53–7
 landscape modification 55–7
 modified climate 53–4
 soil modification 54
 technology for food
 production 53
 biotechnology 64
 land use 59
Ainu 162
Airbus 380 172, 175
air movement and ocean
 currents 32
annotated visual display (AVD) 20
anthropogenic 152
aquaculture 75, 78–9, 99
aquatic biomes 28
aquifers 85, 99, 121
arable 48, 99, 111
Asia
 agriculture in 58–65
 rice production in 62–5
Australia
 biodiversity 92–3
 biomes 35–8
 deserts 37
 factors shaping 35–7
 savanna (grasslands) 36
 seagrass meadows 36–7
 wetlands and rivers 36
 climate classification 35
 cultural heritage 260–1
 digital divide 204
 diverse food trade 181–2
 export and import trade 171–3
 export markets 186
 food wastage in 139
 import trade 188
 salinity in 86
 tourism 241–5
 trade industry 184–91

trading partners 185
types of agriculture in 58–65
types of trade 186–8
 exports 186
 imports 188
 international students 187–8
Australian Aid 195–6
Australian Aid program 196–8
Australian Digital Inclusion Index
 (ADII) 204
Australia's ODA budget 196, 197

B

banana plantation 60
Bangladesh, sweatshops in 190
barrier reefs 44
barter 180, 220
Bedouin 162
Bengaluru 206–8
Binydjarrna (Dalywoi/Daliwuy
 Bay) 94–6
 coastal wetlands at 94
biodiesel 116
biodiversity 37, 99
 Australia 92–3
 decline 90
 loss 90
biofuel 47, 99
biofuel projects 118
biomes 26–9
 for agriculture 53–7
 Australia 35–8
 deserts 37
 factors shaping 35–7
 old-growth forest 37
 savanna (grasslands) 36
 seagrass meadows 36–7
 wetlands and rivers 36
 characterise 30–4
 climate's influence on 31–2
 coastal wetland 94–6
 food production 66–9
 First Nations Australians
 use 142–4
 food production linked to
 climate 46–51
 forests 26–7, 70–4
 global biodiversity
 diminishing 89–93
 humans 39–45
 coastal wetlands 42
 coral reefs 42–3

 grasslands 39–41
 ocean 75–9
 soil role in 32–4
 world's major 26–8
 aquatic 28
 deserts 27
 forests 26–7
 grasslands 27
 tundra 27

biophysical environment 66, 99
biophysical world 66–7
 changing 67–8
Brisbane Metro 166
Budj Bim Cultural Landscape 144

C

cattle mustering 59
cereal crops 127
change 6
China
 e-waste, impact on people in 210
 foreign companies in 189
 land and food footprint 116
 Chinese New Year 258–60, 259
 clear-felling 37, 99
 climate change
 on cereal crops 127
 on food production 126
 for food security 125–9
 projected consequences of 128
 climate's influence on biomes 31–2
 landform 31–2
 latitude 32
 ocean currents and air
 movement 32
 clothing industry 189
 coastal wetland biome 94–6
 coastal wetlands 42
 communications technology
 199–200
 connection
 access places 165–9
 Australia
 contribution to global trade
 industry 184–91
 export and import trade 171–3
 use technology to communicate
 and interconnect 199–203
 digital divide 204–8
 international trade, fairness
 of 193–8
 with land 161

- maritime highways 172
- with public transport 165–6
- significant challenges 209–14
- through air 172–3
- through Australian Aid 195–6
- connectivity 200, 220
- coral polyps 42
- coral reefs 42–3
 - anatomy 43
 - threats to 43–5
- COVID-19 230–1
 - Tokyo Olympics 265
- crop production 55
- cruising sustainably 268–9
- cultural tourism 256–62
 - Chinese New Year 258–60
 - defining 256–7
 - Thanksgiving 257–8
- cumulative line graphs 15

D

- deforestation 27, 70–4, 99
- degradation 82, 99
- Department of Foreign Affairs and Trade (DFAT) 185, 196
- desert biomes 27, 84
- desertification 84, 114
- deserts 27
- developed 234, 274
- developing countries 180, 220
- DFAT. *See* Department of Foreign Affairs and Trade
- digital communications 200
- digital divide 200,
 - 204–8, 220
 - in India 205
- distribution, of agriculture 59
- divergence graphs 13
- dust storms 82

E

- Earth's population 48
- ecosystems 26, 90
- ecotourism 7, 251–2, 274
- endemic 92, 99
- environment 7
- environmental impacts
 - of irrigation 85–8
 - tourism 251–5
 - ecotourism 251–2
 - zoos and marine parks 252–5
- environmental issues 64–5
- environmental refugees 126
- erosion 82, 99
- ethanol 116
- ethnicity 159, 220

- e-waste
 - future 212
 - health impacts of 211
 - impacts on people in
 - China 210–12
 - legislation 212–14
 - production and consumption 210
- export and import trade 171–3
- export markets, in Australia 186
- extensive farms 59, 99
 - intensive farming 60
 - mixed farms 60
 - plantation farming 60–1
 - of sheep or cattle 59
 - wheat farms 60
- extremism 195, 220

F

- fair trade 194
 - non-government organisations and 195
- famine crisis report 145–7
- farming yields 132
- farmland irrigation on land, effects of 84
- fertilisers 54, 55
- fieldwork report 21
- First Nations Australians
 - biomes for food production 142–4
 - farming 143–4
 - and land care 143
 - preserving cultural heritage 260–1
- fish 48
- flood irrigation 53
- flow map 18
- food crisis 117
- food insecurity 110
 - causes 111
 - reasons 111
- food production 48–9
 - biomes and 66–9
 - biophysical world 66–7
 - changes in 91
 - challenges to 131–2
 - climate change on 126
 - and distribution 134–41
 - food yield 134
 - innovative production solutions 135–7
 - quantifying food wastage 137–9
 - factors affecting 131–2
 - rice production 62
 - and security 84
 - strategies for 135
 - technology for 53
- food security 107

- climate change challenges
 - to 125–9
- defining 108
- feeding the future 130–3
- food insecurity 110
- global 108–12
- impacts of land loss on 113
- Lake Victoria 148–50
- measuring 109–10
 - risk to 117–18
 - water supplies impact 120–4
- Food Security Index 109, 110
- food staples 46–7
- food sustainability, in Norway 137
- food trade 179–80
- food wastage
 - in Australia 139
 - quantifying 137–9
 - reducing 139–40
- food yield 134
- foreign companies, in China 189
- forest biome 26–7, 27, 70–4
- forest clearing 73–4
- fringing reefs 44

G

- genetically modified (GM) 134
- genetic engineering 64
- geographical information systems (GIS)
 - table of data for 19
- geographical methods
 - questioning and researching using 10
- Geography 3
 - communicating 11
 - concepts in 4–8
 - SPICESS 4
 - concluding and
 - decision-making 11
 - interpreting and analysing 11
 - skills used in 9–11
- global biodiversity
 - diminishing 89–93
- Global Food Security Index 109
- globalisation
 - impacts of 189
- global population 48
- global tourism 233–9
 - evolving 236–7
 - growing future of 235–9
 - spending 235
 - travelling 233–4
 - where people go 234
- global trade, negative side of 189–91

goods and services 175–7
 consumed 178–82
 imports 188
 grasslands 27, 36, 39–41
 Great Barrier Reef 5, 42
 greenhouse gases 71, 99
 greenhouses 53
 Green Revolution, impact 50
 gross domestic product (GDP)
 230, 274
 groundwater 67, 86
 Guangdong province 212

H
 hard sport tourism 263
 harvesting wheat 60
 horizons, in soil layers 32
 horticulture 54
 household final consumption per
 person 178–9
 Huli people 163–4
 human development 200
 Human Development Index 197
 Norway 216
 humanitarian principles 196, 220
 humus 82
 hunger, prevalence and impacts
 of 131
 hybrids, of plants 50

I
 imports 188
 India
 digital divide in 205
 ICT in 205
 Silicon Valley 207
 indicators 109
 industrialisation
 and energy production 115
 information and communications
 technology (ICT)
 sector 199–200
 in India 205
 infrastructure 165, 220, 237, 274
 innovations 49
 innovative production
 solutions 135–7
 intensive farms 59
 interconnection 5
 international students 187–8
 international trade, fairness of 193–8
 fair trade 194
 problems of trade 193–4
 internet connections 200–3
 interviews 20
 irrigation 53, 63, 67

environmental impacts of 85–8
 salinity 85
 isoline maps 18

J
 jatropha 116

L
 Lake Victoria 148–50
 land
 connection with 161
 perceptions 160–4
 use map 15
 land degradation 82–3, 115
 biophysical causes 83
 causes and effects of 81–8
 competition for 115
 creeping cities 115
 farmland irrigation on 84
 forms of 115
 growing fuel 116
 human causes 83
 impacts 83–4
 landform 31–2
 land grabs 116–17
 in Africa 117
 land loss, on food security
 113–18
 causes 114–17
 creeping cities 115
 land degradation 115
 land grabs 116–17
 land reclamation 55
 landscape modification 55–7
 latitude 32
 leeward 31
 legislation, e-waste 212–14
 logging 37

M
 maize 47
 mallee 60
 malnourished 110
 mangrove wetland 94
 marginal land 116
 marine biomes 28
 marshes 94
 Masai 237, 274
 mature-aged 234, 274
 medical tourism 228
 Milankovich Cycle 32
 mixed farms 60
 MobileMuster 212
 mobile phones 202
 modern irrigation methods 53
 modified climate 53–4
 multiple line graphs 15

N
 national parks 237, 274
 national security 196, 220
 National Television and
 Computer Recycling Scheme
 (NTCRS) 212
 natural filtering system 42
 natural habitats 48
 nature-driven tourism 270–2
 new moon 258, 274
 nomadic herders 162
 non-government organisations
 (NGOs) 195, 220
 Northern Territory 242
 Norway
 food sustainability in 137
 HDI ranking 216
 NTCRS. *See* National Television
 and Computer Recycling
 Scheme

O
 ocean biome 75–9
 ocean currents and air movement 32
 offshored 189, 220
 Ogallala Aquifer 87
 old-growth forest 37
 Olympics 264–5
 online shopping 173
 Ord River Irrigation Scheme 132
 organic matter 41
 overfishing 75–9, 80
 causes and consequences 75–6
 overwatering 85

P
 palm oil
 production 176
 supply chain 177
 Panama Canal 172
 Papua New Guinea 163
 per capita 48
 perceptions 159, 220
 of land vary 160–4
 of public transport 166–7
 permafrost 27
 place 5
 plantation farming 60–1
 plantations 72
 pneumatophores 41, 42
 population
 growth and arable land 114
 potable 122
 power of science 260–1
 precipitation 31
 predators and coral reefs 43

public transport 165–6
active travel 167–8
perception of 166–7

Q

qualitative methods 11
quantitative methods 11

R

rain shadows 31
rain shadows forming 30
rice production 62
in Asia 62–5
climate and topography 62–3
environmental issues 64–5
irrigation 63
potential yield 63
in paddy fields 64
technology 64
Rio Olympic Games 264
rivers and wetlands 36
road construction 72

S

salinity 82
in Australia 86
problems 85–8
San 162
satellite images 14
savanna (grasslands) 36
scale 8
seagrass meadows 36–7
sheep or cattle farming 59
shifting agriculture 163–4
slash-and-burn agriculture 73
social justice 193
soft sport tourism 263
soil erosion 81
evidence 114
soil modification 54
soil role in biomes 32–4
space 4
space tourism 238
spatial relationships, in thematic maps 12
sports events 265–6
staple foods 46–7
Sturt Stony Desert 37
Suez Canal 172
survey 16
sustainability 8, 143
sustainable 49

sustainable garden 170
sweatshops 189–91
in Bangladesh 190

T

technological developments 165
temperature anomalies 125
ternary graphs 16
Thanksgiving 257–8
Tokyo Olympics 265
topography, rice production 62–3
tourism
Australia 241–5
travel trends 242
visitors to 242–4
cultural 256–62
defining 226
destinations 228
economic importance 230–1
environmental impacts 251–5
global 233–9
growth areas 237–8
impacts 246–9
outweigh cost 247–9
important 226–32
negative impacts 248
positive impacts 247
space 238
and sport connected 263–7
trends in 228–9
types 227–9
value 244
trade barriers 184, 221
trade, connecting us 175–82
Australia's diverse food trade 181–2
coordination 184–5
export and import 171–3
food trade 179–80
in goods and services 175–7
problems of 193–4
trade industry 184–91
trading partners 185, 221
traditional subsistence agriculture 161
transect 15
Transport Opinion Survey 166
travelling 233–4
travel trends 242
treeline 27
trends, in tourism 228–9
tundra 27, 28

U

Uluru-Kata Tjuta 260
undernourished 110
undulating 55
UN Food and Agriculture Organization (FAO) 48
uniform crops 90
United Nations World Tourism Organization (UNWTO) 236
unsustainable fishing 75
urbanisation 40
Uyghurs 162

V

value adding 176, 221
vegetation characteristics 33
volcanic eruption 6

W

walkability 168
water insecurity, causes of 121–2
waterlogging 85
water quality 122–3
water scarcity 121
water stress 121
water supplies 120–4
watertable 85
weather conditions 259
Western Australia, visitors to 242
western rock lobster 179
Western-style diet 153
wetlands 36, 42
wheat 47
wheat export destinations 181
wheat farms 60
windward 31
winter solstice 258, 274
World Bank 138
World Fair Trade Organization mission 194
World Tourism Organization 226
world trade flows 6, 180
world wide web 200, 221

Y

yield gap 134
Yunnan Province 63

Z

zoos and marine parks 252–5