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JACARANDA

GEOGRAPHY ALIVE 7

AUSTRALIAN CURRICULUM | THIRD EDITION

AUSTRALIAN CURRICULUM v9.0

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The Publishers of this series acknowledge and pay their respects to Aboriginal Peoples and Torres Strait Islander Peoples as the traditional custodians of the land on which this resource was produced.

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.

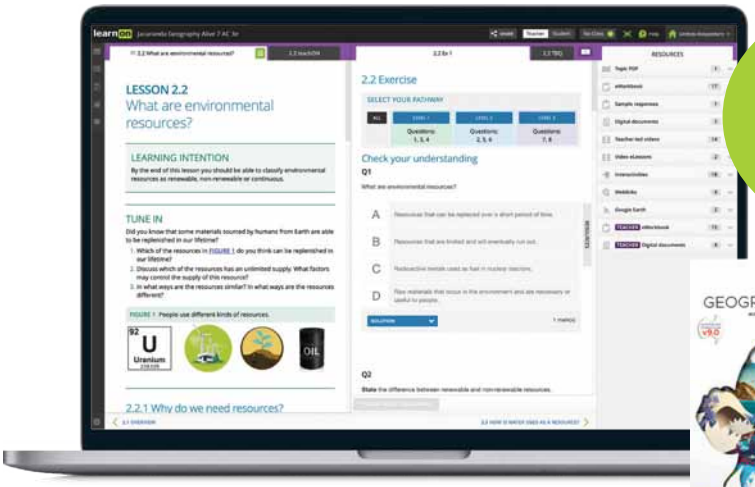
It is strongly recommended that teachers examine resources on topics related to Aboriginal and/or Torres Strait Islander Cultures and Peoples to assess their suitability for their own specific class and school context. It is also recommended that teachers know and follow the guidelines laid down by the 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



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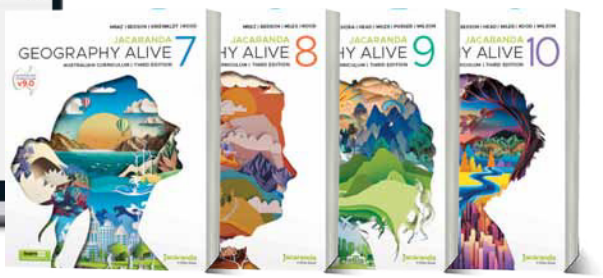

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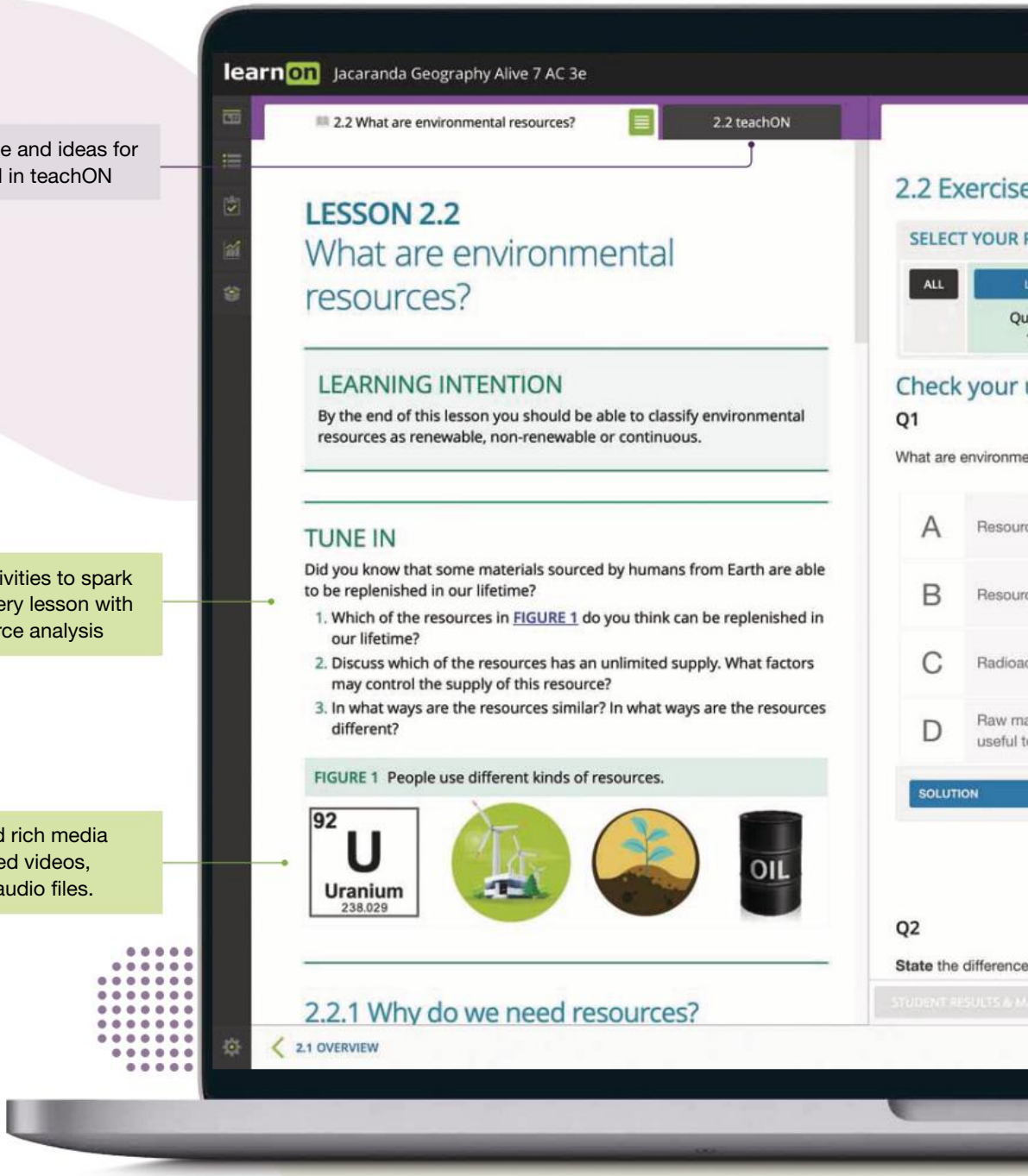
Everything you need for each of your lessons in one simple view

- **Trusted, curriculum-aligned content**
- **Engaging, rich multimedia**
- **All the teaching-support resources you need**
- **Deep insights into progress**
- **Immediate feedback for students**
- **Create custom assignments in just a few clicks.**

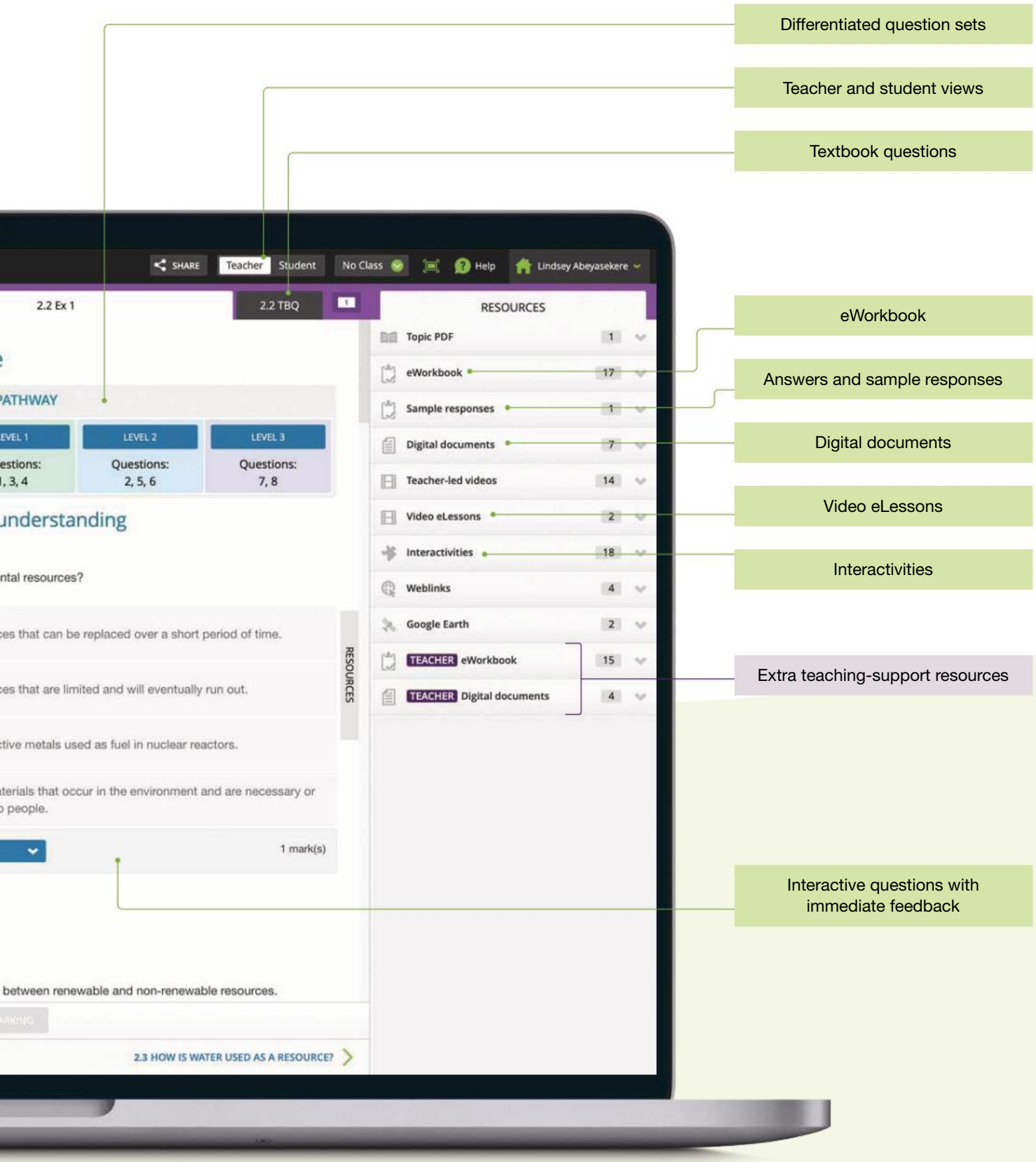
Practical teaching advice and ideas for each lesson provided in teachON

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.



powerful learning tool, learnON

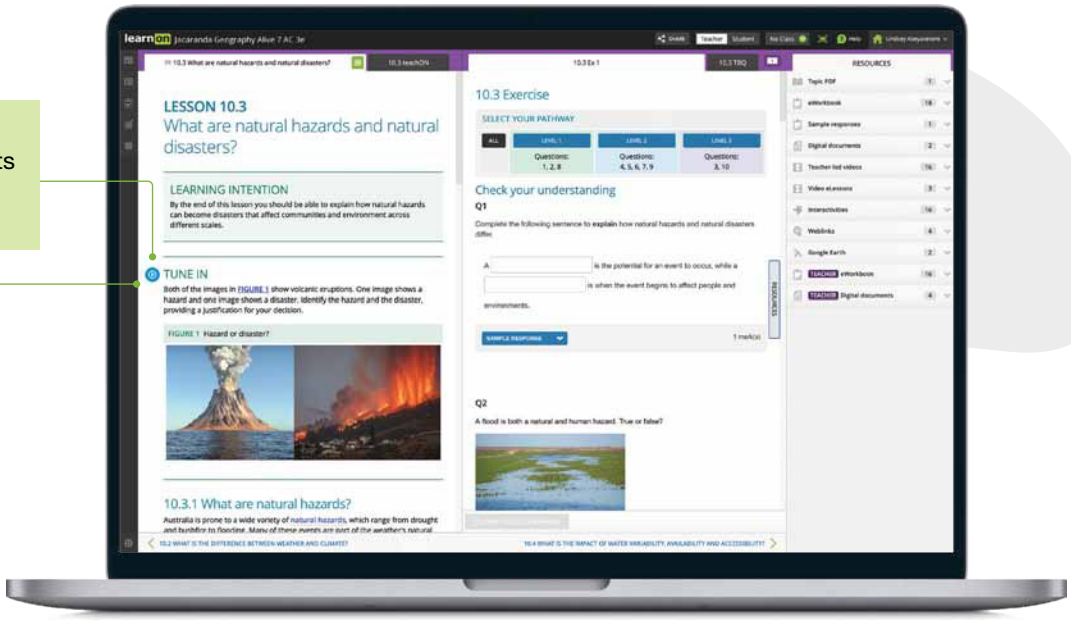


Get the most from your online resources

Online, these new editions are the complete package

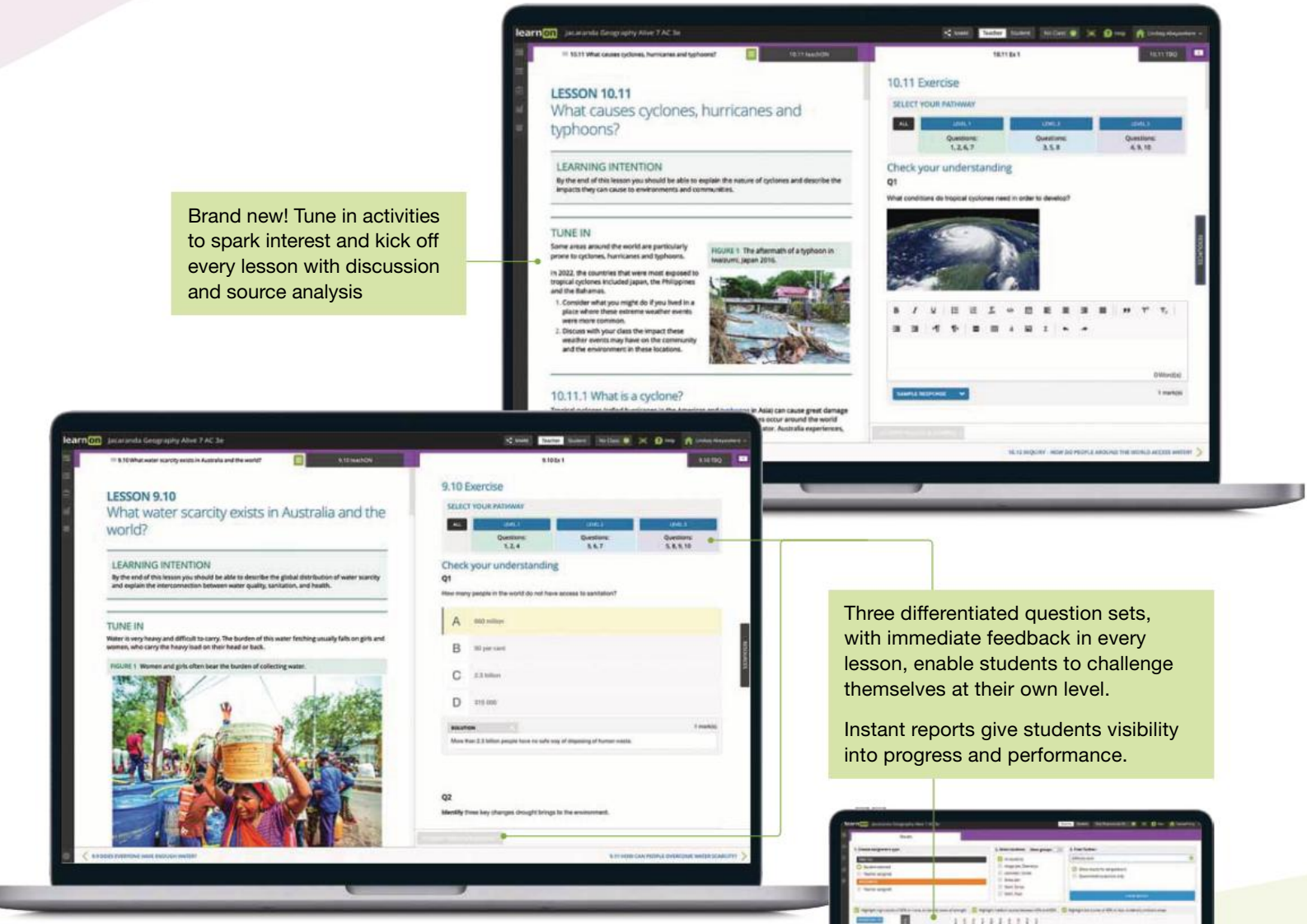
Trusted Jacaranda theory, plus tools to support teaching and make learning more engaging, personalised and visible.

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



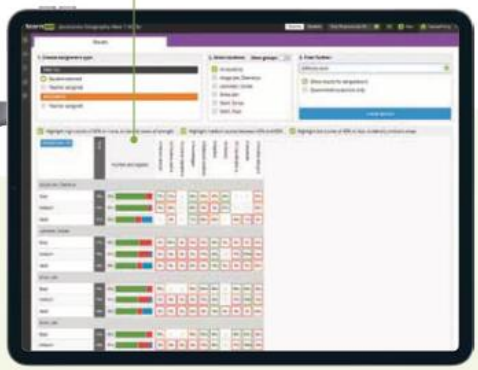
New teaching videos are designed to help students learn concepts by having a ‘teacher at home’, and are flexible enough to be used for pre-and post-learning, flipped classrooms, class discussions, remediation and more.

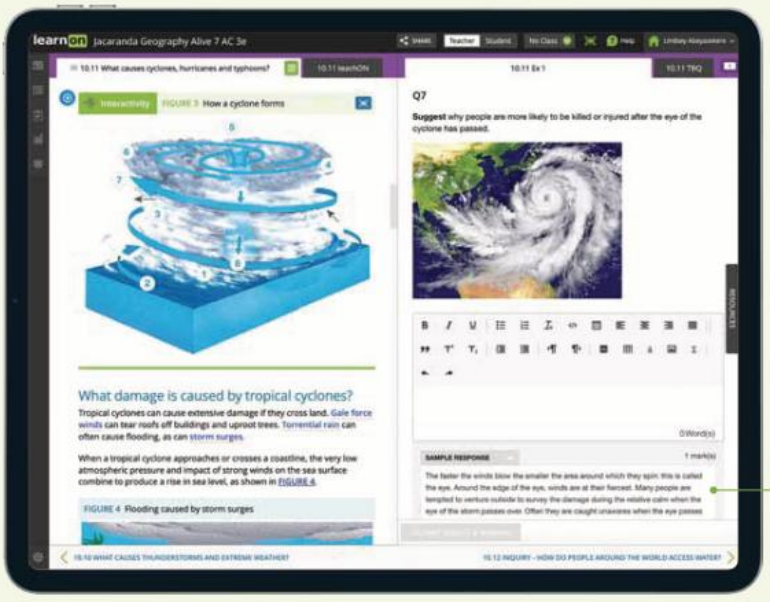
Brand new! Tune in activities to spark interest and kick off every lesson with discussion and source analysis



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.

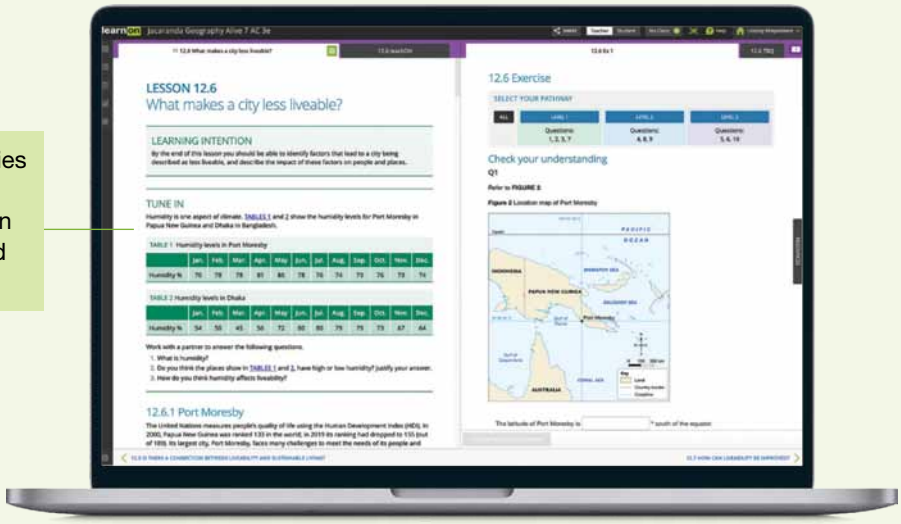




Every question has immediate, feedback to help students overcome misconceptions as they occur and get unstuck as they study independently — in class and at home.

TUNE IN lesson starters

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

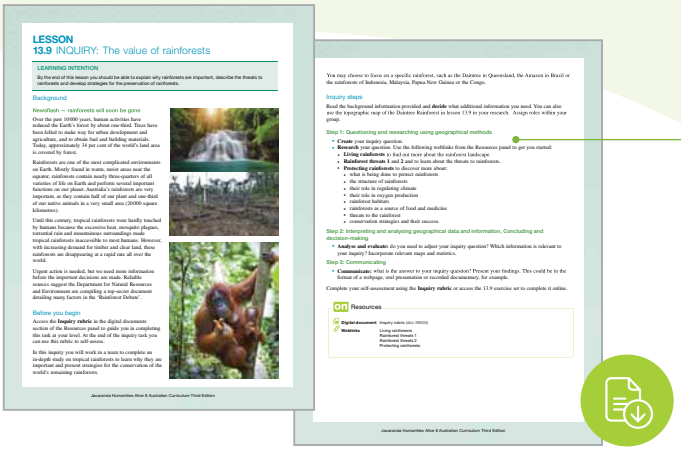


Skill development

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

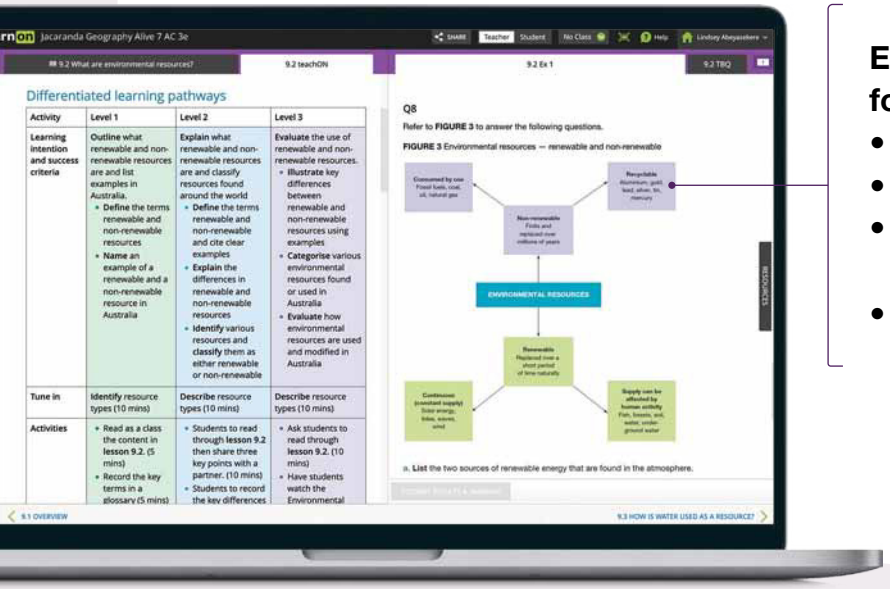
SkillBuilders support and strengthen skill development using our Tell me, Show me, Let me do it approach.

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

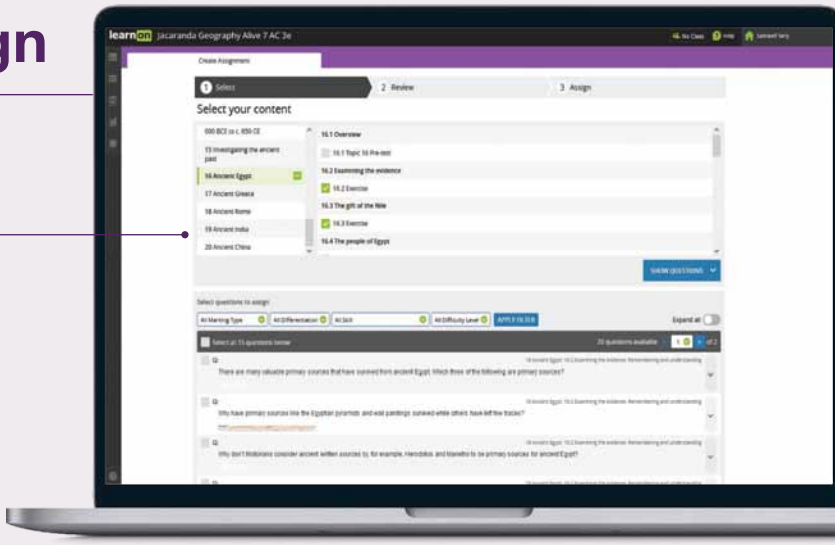


Enhanced teaching-support resources for every lesson, including:

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

Customise and assign

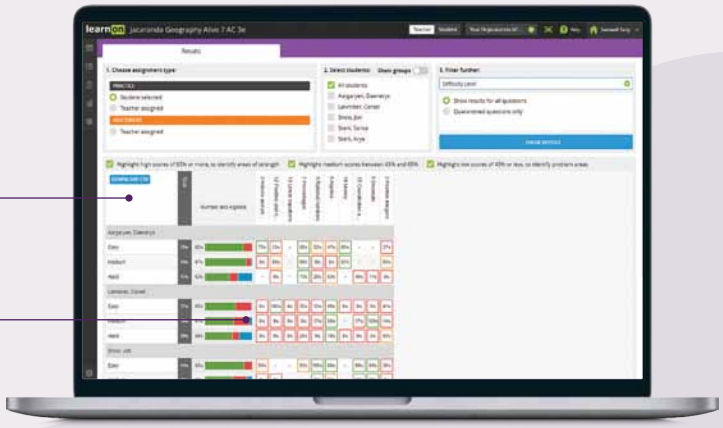
An inbuilt testmaker enables you to create custom assignments and tests from the complete bank of thousands of questions for immediate, spaced and mixed practice.



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 7 and 8.

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. This may involve applying a familiar concept to an unfamiliar situation.
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 in order to develop an idea or opinion.
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 sometimes requires making a decision.
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.
identify	recognising and showing a particular part or feature 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.
select	choosing the most suitable option from a number of alternatives. This might require some consideration of context.

Source: Adapted from the QCAA Cognitive Verbs.

1 Geography concepts and skills

LESSON SEQUENCE

LESSON
1.1 Overview

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1.1.1 What is Geography?

The world around us is made up of a large range of interesting places, people, cultures and environments. Geography is a way of exploring, analysing and understanding this world of ours — especially its people and places. Studying Geography at school allows you to build up your knowledge and understanding of our planet, at different scales: the local area, our nation, our region and our world. In essence, geographers investigate the characteristics of places and the relationships between people and places.

FIGURE 1 Geography helps you explore and understand the amazing world we live in.

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-10539)

Video eLesson Geography concept and skills (eles-6009)

LESSON
1.2 Concepts in Geography

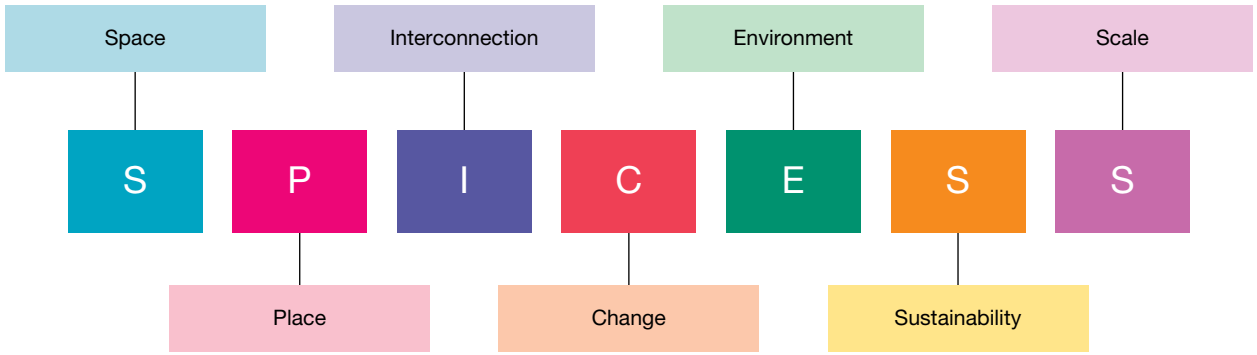
LEARNING INTENTION

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 Geography concepts: SPICESS

Geographical concepts help you to make sense of your world. You can use these concepts to both investigate and understand the world you live in. You can also use them to try to imagine a different world. The concepts help you to think geographically. The seven major concepts are ***space***, ***place***, ***interconnection***, ***change***, ***environment***, ***sustainability*** and ***scale***. You will use the seven concepts to investigate two aspects: water as a resource, and place and liveability.

FIGURE 1 A way to remember these seven 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, and how the space is organised and managed by people.

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 31.95° South latitude and 141.45° 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.

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > **Space**

1.2.3 What is place?

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

Places may be natural (such as an undisturbed wetland) or highly modified (such as a large urban conurbation).

Places provide us with the services and facilities we need in our everyday life. The physical and human characteristics of places, their location and their environmental quality can influence the quality of life and wellbeing of people living there.

You often have mental images and perceptions of places — your city, suburb, town or neighbourhood — and these may be very different from someone else's perceptions of the same places.

FIGURE 2 Mental map of Jayden's local place (a) by Jayden and (b) by Annette, Jayden's mother

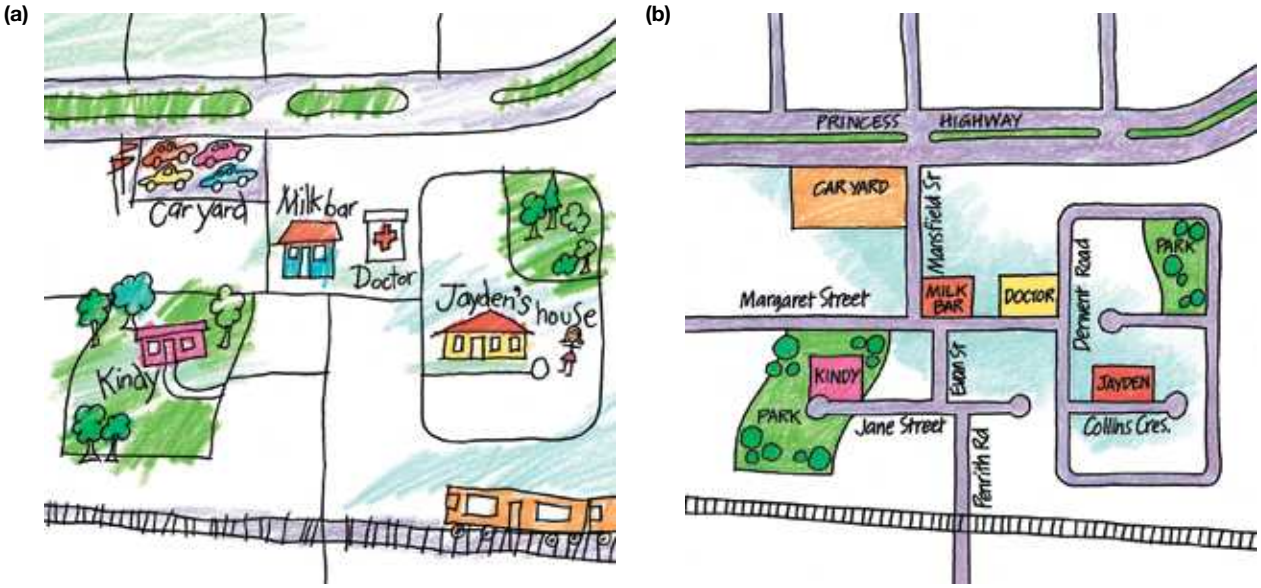
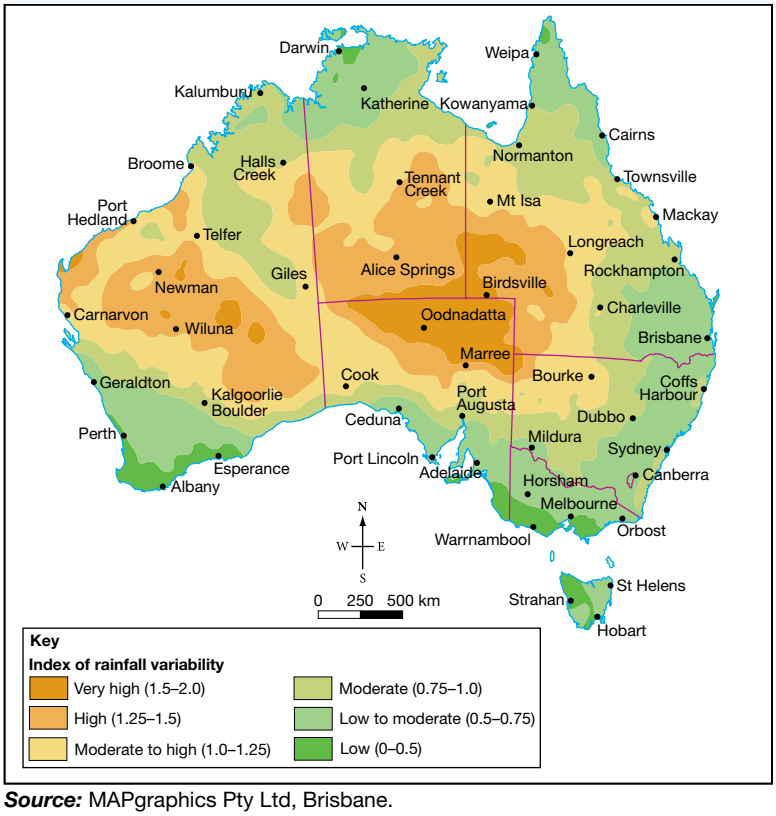
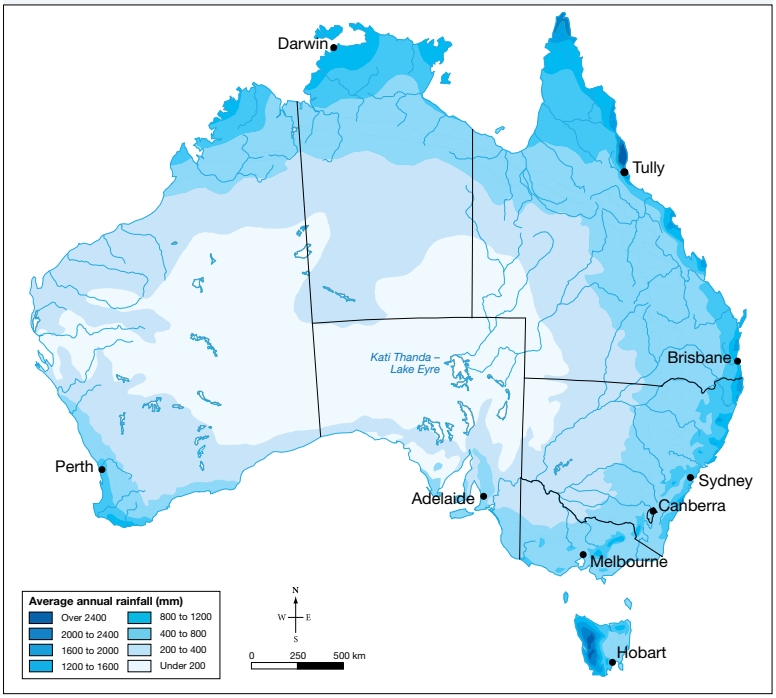


FIGURE 3 Australian annual rainfall variability



Source: MAPgraphics Pty Ltd, Brisbane.

FIGURE 4 The amount of rain that falls in Australia varies from place to place, as this rainfall map shows.



Source: Bureau of Meteorology, 2003

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > **Place**

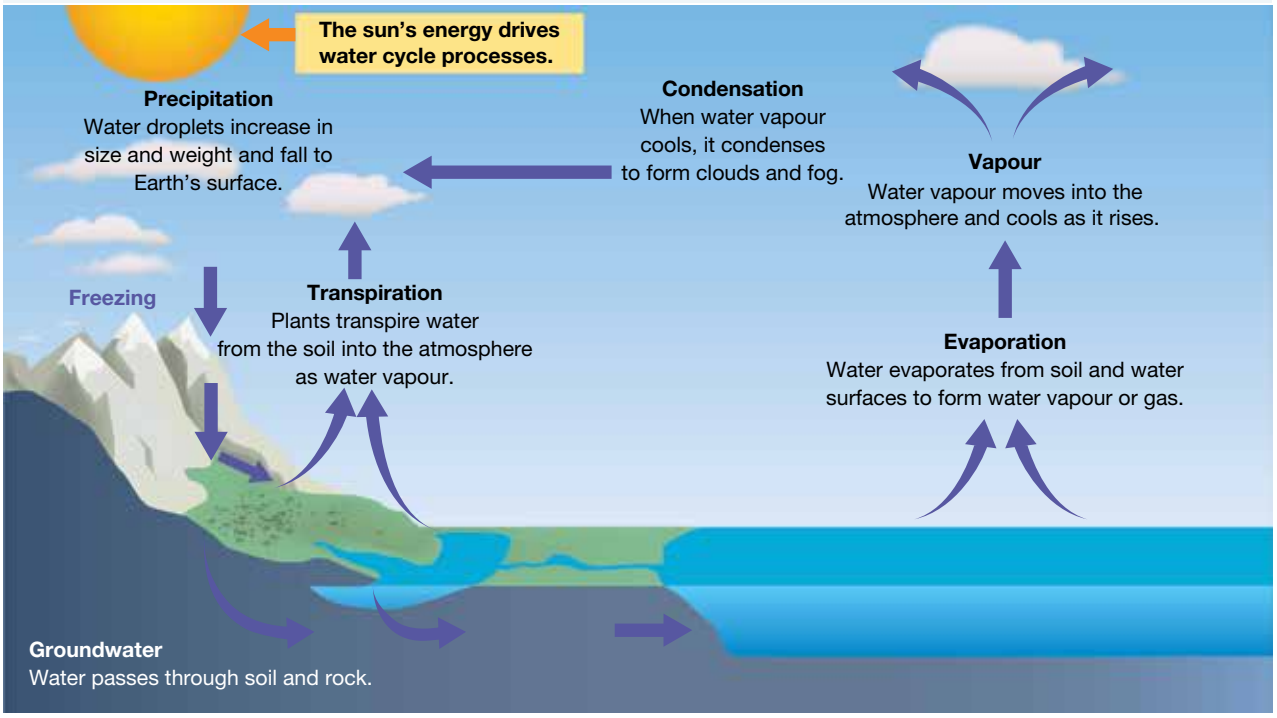
1.2.4 What is interconnection?

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.

An event in one location can lead to change in a place some distance away.

FIGURE 5 Mount Tom Price township and mine in Western Australia, with fly in, fly out (FIFO) worker huts in the left foreground

FIGURE 6 The water cycle shows many interconnections.



Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > **Interconnection**

1.2.5 What is change?

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

The concept of change involves both time and space — change can take place over a period of time, or over an area. The time period for change can be very short (for example, the impact of a flash flood) or over thousands or millions of years (for example, the development of fossil fuel resources).

FIGURE 7 Port Douglas, 60 km north of Cairns, was a busy port in the 1870s, with a population of over 10 000. The mining that had attracted people to this hot, wet area, however, did not last. By the 1960s, the population was only 100. In the 1980s, road and air access to the town improved and tourist numbers to the area grew. The permanent population is now about 3500. During the peak holiday season (May to November), this number increases by four times.

Environmental change can occur over short or long periods of time. The use of technology can result in rapid change — think of the explosions at a mining site that reveal mineral seams.

The degree of change occurring can be used to predict, or plan for, actual or preferred futures.

Explore more with myWorldAtlas

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

- Developing Australian Curriculum concepts > **Change**

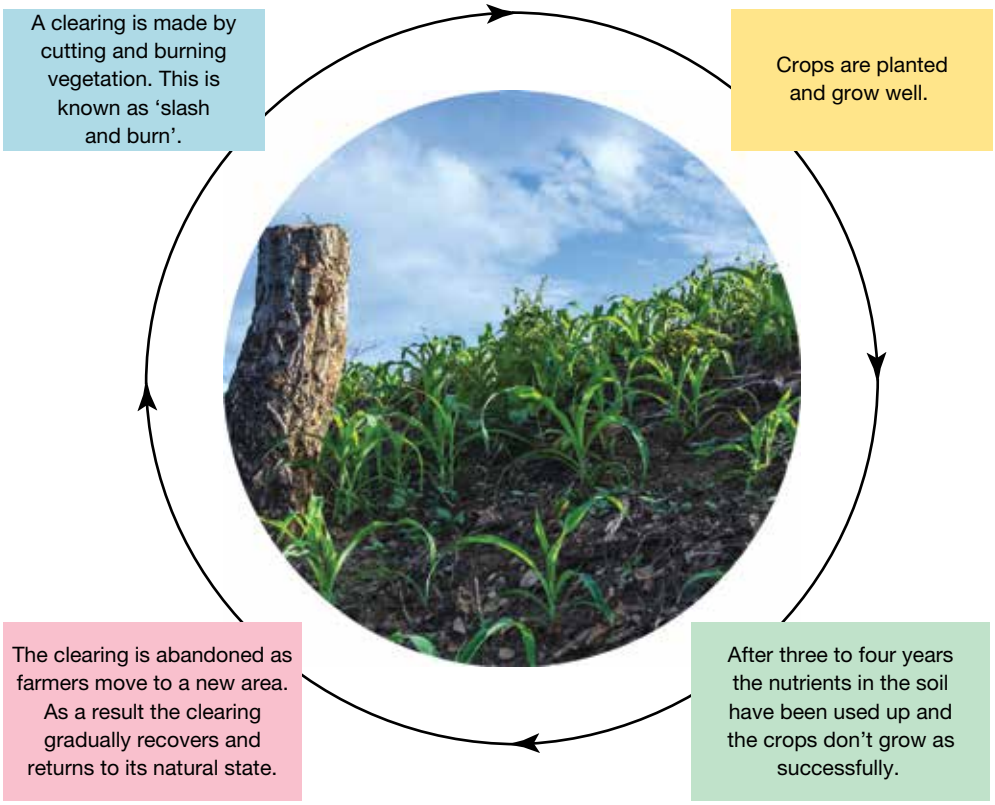
1.2.6 What is environment?

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

The environment, defined as the physical and biological world around us, 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.

FIGURE 8 Pacific Islanders use traditional methods to fish sustainably.

FIGURE 9 The process of shifting cultivation



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.

Sustainability considers the interconnection between the human and natural world and who gets which resources and where, in relation to conservation of these resources and prevention of environmental damage.

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.

Scale can be applied from personal and local levels to regional, national or global levels. Looking at things at a range of scales allows a deeper understanding of geographical issues.

Different factors can be involved in explaining phenomena at different scales. Local events can have global outcomes; for example, removing areas of forest at a local scale can have an impact on climate at a global scale. A policy at a national scale, such as forest protection, can have an impact at a local scale, such as the protection of an endangered species.

FIGURE 10 Railway route and main settlements between Sydney and Perth

Source: 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

LEARNING INTENTION

By the end of this lesson you should be able to write a class definition of Geography, explain what geographers do, and identify different types of maps and their purpose.

1.3.1 Geography is . . . about our wonderful world

Have you ever visited a place other than the one you live in? If so, you probably noticed that some of the features and characteristics are similar and some are different. Geographers aim to understand these characteristics as well as the relationship between people and the different environments around us.

As a geographer, you answer questions ranging from the local to the global, in the past, present and future. Along the way, you will develop skills and inquiry methods to answer these questions for yourself.

1.3.2 Geography is . . . something you do

One of the best parts of studying Geography is the opportunity to visit places outside the classroom. Going on a field trip allows you to collect data and information for yourself and to work collaboratively with other members of your class.

FIGURE 1 Using maps to work out locations and to plot data

Geographers use what is called an 'inquiry' approach. This means that you will investigate geographical questions by collecting, analysing, and interpreting information and data in order to develop your own understanding and draw your own conclusions.

This helps you develop proposals for what should happen and what action should be taken in the future.

Studying Geography develops a wide range of skills that you can apply in your everyday life, in your future life and possibly in your career!

FIGURE 2 Conducting a survey in the field

FIGURE 3 Collecting your own data and information

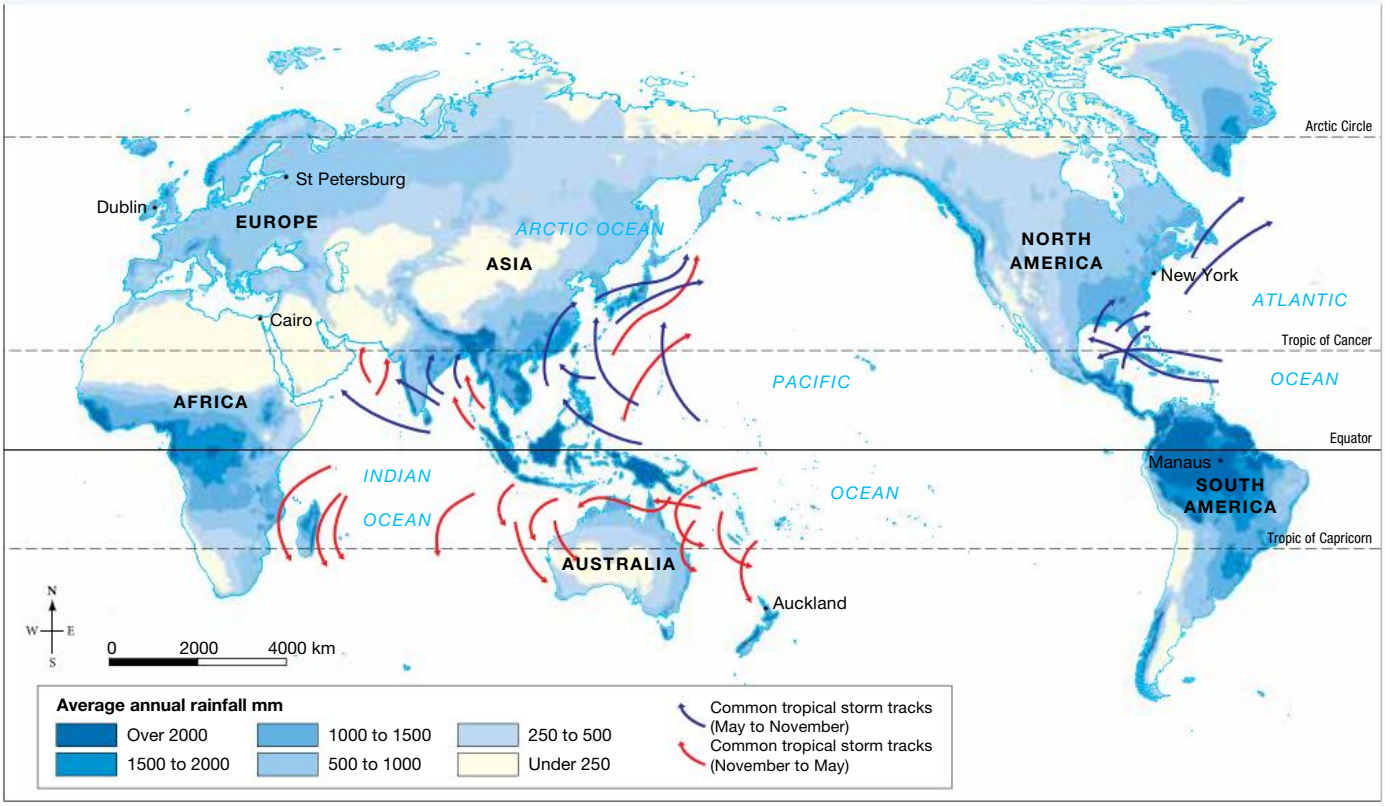
1.3.3 Geography is … a way of thinking

Geography is a way of thinking and a way of looking at the world. One of the key tools geographers use is a map. If you look really carefully at them, maps (such as the ones shown in **FIGURES 4** and **5**) contain a lot of information. As a student, you will often use a variety of different types of maps produced by someone else (for example, from this textbook, atlases and online). However, as a geographer, you will produce your own maps and spatial information, by hand or digitally. Using and interpreting maps are important skills you will develop. It is also important to identify major patterns and trends in maps in order to unlock information they contain.

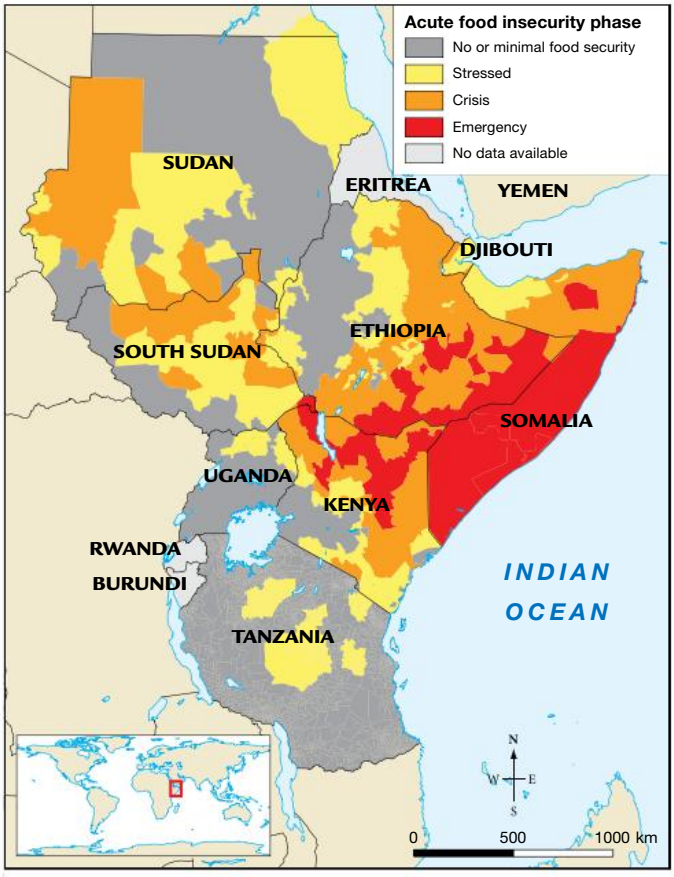
As a geographer, you will use a set of seven geographical concepts to help you not only think geographically but also investigate and understand the world (refer to lesson 1.2).

As a geographer, you should also ask yourself, 'What can I do and contribute as an informed and responsible citizen to make this world a better place?'

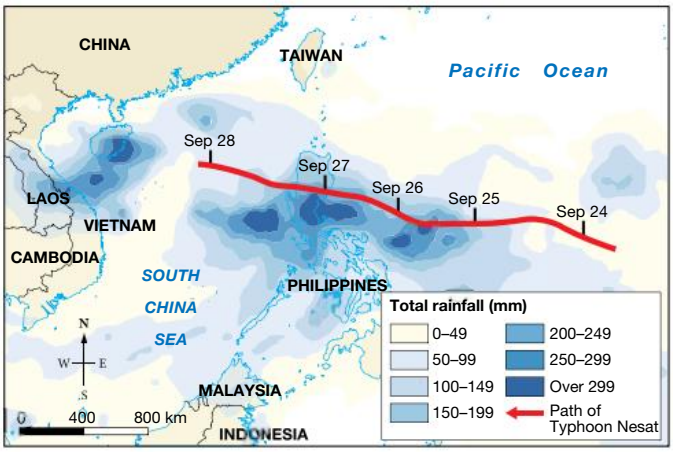
FIGURE 4 Maps: a key tool for the geographer



Source: WorldClim.

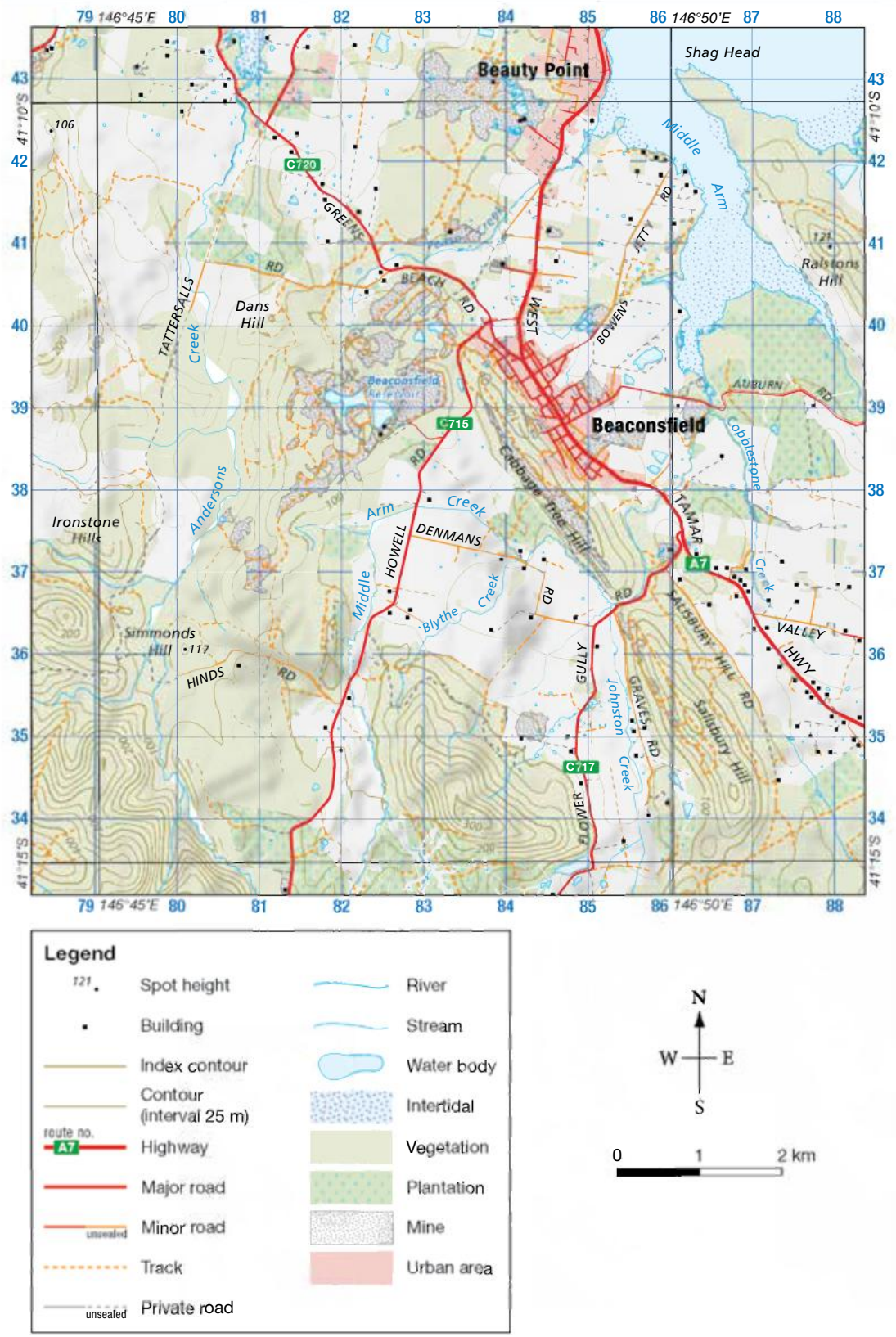


Source: USAID. FEWS NET 2011.



Source: NASA Earth Observatory.

FIGURE 5 Topographic map extract, Tamar Valley, Tasmania, 2021



Source: Address Points, Coastline, Contours, Hydrographic Areas, Hydrographic Lines, Spot Heights, Tasmania 25m DEM, TASVEG 3.0, Transport Nodes, Transport Segments from www.theLIST.tas.gov.au © State of Tasmania.

1.3.4 Skills used in studying Geography

You will learn, practise and master a range of essential practical skills as you study Geography. The SkillBuilder lessons found throughout this title will tell you about the skill, show you the skill and let you apply the skill to the topics covered.

Investigating using geographical methods

Investigating 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 fieldwork should involve gathering information from both primary sources (for example, information you observe and record) and a range of secondary sources (for example, information obtained from maps, atlases and textbooks), and then 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.

The SkillBuilders related to this skill that you'll use at Year 7 level are:

- Interpreting diagrams

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 (for example, a range of different types of maps, tables, graphs and charts). In Year 7 Geography, this may include looking at the link between mountain ranges and rainfall patterns, or links between wealth and liveability.

The SkillBuilders related to this skill that you'll use at Year 7 level are:

- How to read a map
- Interpreting topographic maps
- Using alphanumeric grid references
- Cardinal points — wind roses
- Understanding satellite images
- Constructing a pie graph
- Reading a weather map
- Creating a simple bar or column graph
- Drawing a line graph
- Interpreting topological maps

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 what makes a liveable community or city. The significance of water in the world will be analysed and you will be expected to make conclusions about how best to manage this precious resource.

The SkillBuilders related to this skill that you'll use at Year 7 level are:

- Drawing a climate graph
- Creating and analysing overlay maps

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 seek to express your thoughts and ideas on a wide range of concepts and issues. When communicating in Geography you need to ensure that you consider your audience, acknowledge your sources and choose appropriate methods of communication to ensure your message is clear and well-conceived. In Year 7 you will be expected to explore new ways of presenting information, take risks and develop new presentation skills.

The SkillBuilders related to this skill that you'll use at Year 7 level are:

- Annotating a photograph
- Creating a concept diagram

LESSON
1.4 SkillBuilder: Constructing a pie graph

online only

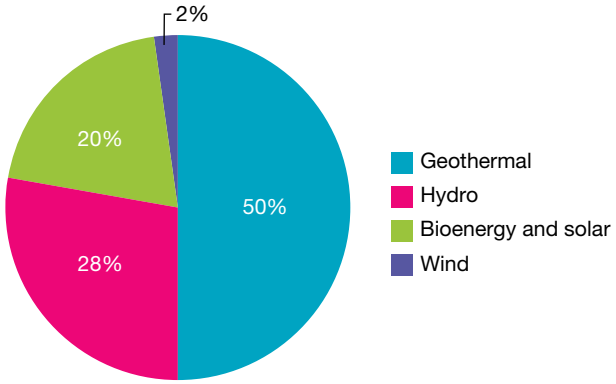
What is a pie graph?

A pie graph, or pie chart, is a graph in which slices or segments represent the size of different parts that make up the whole. The circle of 360 degrees represents the total, or 100 per cent of whatever is being examined. The size of the segments is easily seen. Presenting the parts in order, from largest to smallest, makes it easier to interpret.

Go online 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).

Percentage of electricity generated from renewables in New Zealand



on Resources

Video eLesson Constructing a pie graph (eles-1632)
Interactivity Constructing a pie graph (int-3128)

LESSON
1.5 SkillBuilder: How to read a map

online only

What are maps and why are they useful?

Maps represent parts of the world as if you were looking down from above. The mapmaker, or cartographer, simplifies the plan view from a vertical aerial photograph or satellite image. Cartographers use colours and symbols on the map to show how features such as roads, rivers and towns are organised spatially. Maps are useful to show features so that we have a deeper understanding of places. When travelling, maps are essential to navigate unfamiliar places.

BOLTSS

- B **Border** — a box around the map to clearly show its extent
- O **Orientation** — a compass direction
- L **Legend** — a key to what the symbols and colours on the map stand for
- T **Title** — a clear indication of what the map is about or its theme
- S **Scale** — indicates distances on the map compared with the actual area being shown
- S **Source** — where possible, the information used to make the map should be sourced

Go online 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 How to read a map (eles-1634)
Interactivity How to read a map (int-3130)

LESSON
1.6 SkillBuilder: Reading a weather map

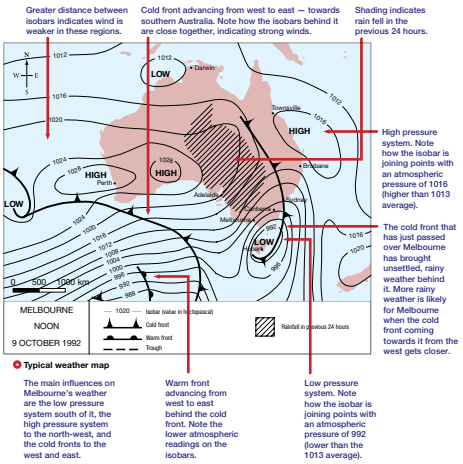
online only

What are weather maps?

Weather maps, or synoptic charts, show weather conditions over a larger area at any given time. They appear every day in newspapers and on television news. Being able to read a weather map is a useful skill because weather affects our everyday life.

Go online 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

- **Video eLesson** Reading a weather map (eles-1637)
- **Interactivity** How to read a weather map (int-3133)

LESSON
1.7 SkillBuilder: Creating a simple column or bar graph

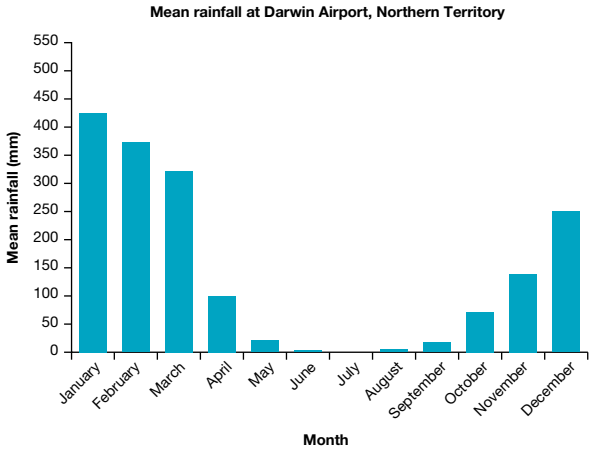
online only

What are column or bar graphs?

Column graphs show information or data in vertical columns. In a bar graph, the data is shown in bars that are drawn horizontally. Column and bar graphs can be drawn by hand, or constructed using a computer spreadsheet.

Go online 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

- **Video eLesson** Constructing a simple column or bar graph (eles-1639)
- **Interactivity** Creating a simple column or bar graph (int-3135)

LESSON
1.8 SkillBuilder: Using topographic maps

online only

What are topographic maps?

Topographic maps are more than just colour maps showing the height and shape of the land. They also show features of the natural environment, such as forests and lakes, and features of human environments, such as roads and settlements (places where a community of people live).

Go online 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 extract — Mt Gambier (doc-17951)
Video eLesson	Using topographic maps (eles-1641)
Interactivity	Using topographic maps (int-3137)
Google Earth	Mount Gambier

LESSON
1.9 SkillBuilder: Using alphanumeric grid references

online only

What are alphanumeric grid references?

Alphanumeric grid references are a combination of letters and numbers that help us locate specific positions on a map. They are linked to the lines that form a grid over certain kinds of maps. The letters and numbers are placed alongside the gridlines, just outside the map. The grid, letters and numbers allow you to pinpoint a place or feature by stating its alphanumeric grid reference.

Source: Russell Tate / Getty Images Australia

Go online 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	Using alphanumeric grid references (eles-1642)
Interactivity	Using alphanumeric grid references (int-3138)

LESSON
1.10 SkillBuilder: Drawing a climate graph

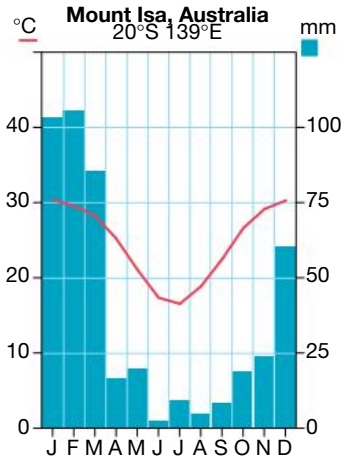
online only

What are climate graphs?

Climate graphs, or climographs, are graphs that show climate data for a particular place over a 12-month period. They combine a column graph and a line graph. The line graph shows average monthly temperature, and the column graph shows average monthly precipitation (rainfall).

Go online 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 Drawing a climate graph (eles-1644)
Interactivity Drawing a climate graph (int-3140)

LESSON
1.11 SkillBuilder: Creating and analysing overlay maps

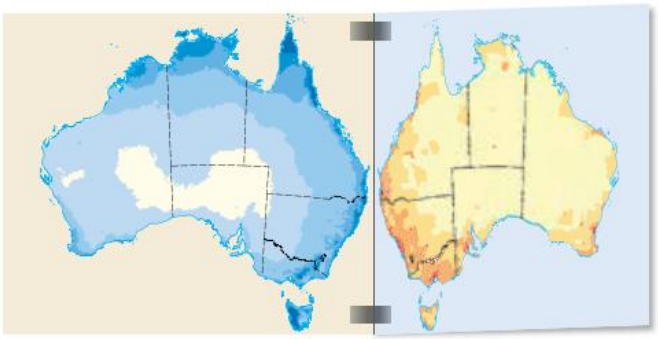
online only

What are overlay maps?

An overlay map usually consists of two or more maps of the same area. A base map is overlaid with a transparent overlay, showing different information. Overlay maps allow users to see the relationships between the information on two or more maps.

Go online 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 Creating and analysing overlay maps (eles-1645)
Interactivity Creating and analysing overlay maps (int-3141)

LESSON
1.12 SkillBuilder: Annotating a photograph

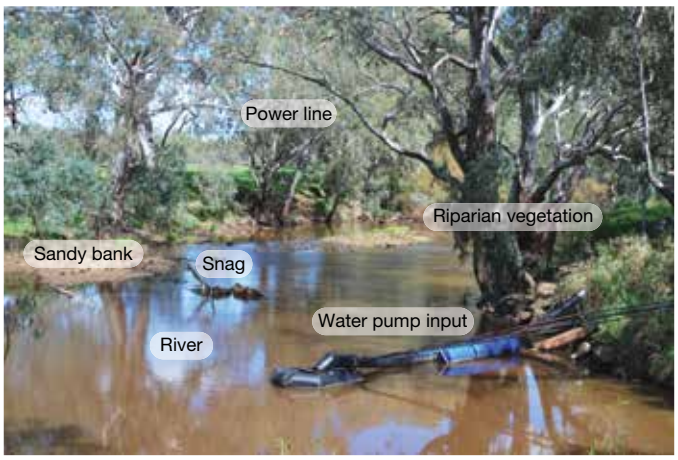
online only

What are annotated photographs?

Photographs are used to show aspects of a place. Annotations are added to photographs to draw the reader's attention to what can be seen and deduced.

Go online 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 Annotating a photograph (eles-1633)
Interactivity Annotating a photograph (int-3129)

LESSON
1.13 SkillBuilder: Drawing a line graph

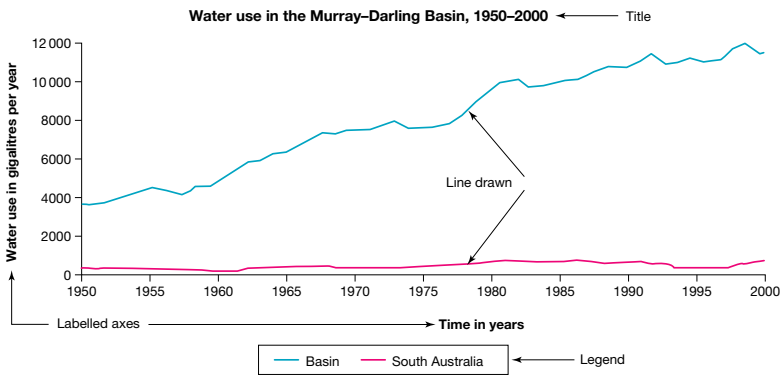
online only

What is a line graph?

A line graph displays information as a series of points on a graph that are joined to form a line. A line graph can be drawn by hand or by using a spreadsheet program such as Excel.

Go online 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: © Department of Environment, Water and Natural Resources, South Australia Government

on Resources

Video eLesson Drawing a line graph (eles-1635)
Interactivity Drawing a line graph (int-3131)

LESSON
1.14 SkillBuilder: Interpreting diagrams

online only

What are diagrams?

A diagram is a graphic representation of something. In Geography, it is often a simple way of showing the arrangement of elements in a landscape and the relationships between those elements. Diagrams also have annotations: labels that explain aspects of the illustration.

Go online 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 Interpreting diagrams (eles-1636)

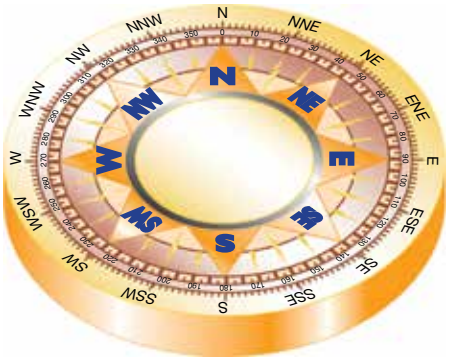
Interactivity Interpreting diagrams (int-3132)

LESSON
1.15 SkillBuilder: Cardinal points — wind roses

online only

What are wind roses?

A wind rose is a diagram that shows the main wind features of a place; in particular, wind direction, speed and frequency. Wind directions can be divided into 8 or 16 compass directions.



Go online 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 Cardinal points: wind rose (eles-1638)

Interactivity Cardinal points: wind rose (int-3134)

LESSON
1.16 SkillBuilder: Creating a concept diagram

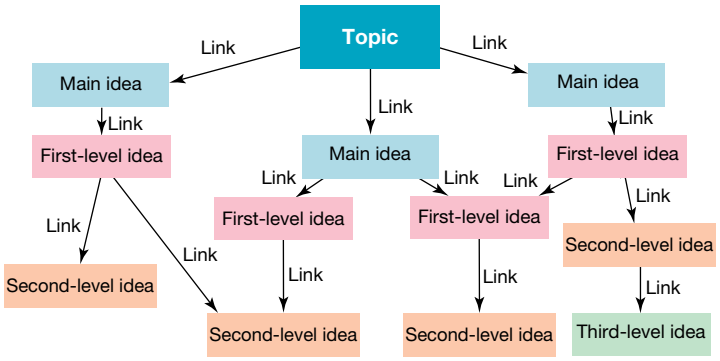
online only

What is a concept diagram?

A concept diagram, sometimes mistakenly called a concept map, is a graphical tool that shows links between ideas or concepts. Concept diagrams organise links into different levels. Concept diagrams enable you to organise your ideas and communicate them to others.

Go online 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 Creating a concept diagram (eles-1640)
Interactivity Creating a concept diagram (int-3136)

LESSON
1.17 SkillBuilder: Interpreting topological maps

online only

What are topological maps?

Topological maps are very simple maps, with only the most vital information included. These maps generally use pictures to identify places, are not drawn to scale and give no sense of distance. However, everything is correct in its interconnection to other points.

Go online to access:

- 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 Interpreting topological maps (eles-1736)
Interactivity Interpreting topological maps (int-3354)

LESSON
1.18 SkillBuilder: Understanding satellite images

online only

What are satellite images?

Satellite images show parts of our planet from space. They are taken from satellites and transmitted to stations on Earth. Satellites can collect a variety of data, including standard photographic imagery, colour infrared and radar data. They can show Earth in close-up or from far away.

Go online 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 Understanding satellite images (eles-1643)
Interactivity Understanding satellite images (int-3139)

LESSON
1.19 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

Find all this and MORE in jacPLUS

1.19.1 Key knowledge summary

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 in Geography

- Geography is a way of exploring, analysing and understanding this world of ours, its people and places.
- Geographers use what is called an 'inquiry' approach. This means that you will investigate questions by collecting, analysing, and interpreting information and data in order to develop your own understanding and draw your own conclusions.
- Geography is a way of thinking and a way of looking at the world. One of the key tools geographers use is a map.
- Maps contain a lot of information about people and places. As a geographer, you will produce your own maps and spatial information, by hand or digitally.
- You will learn, practise and master a range of essential practical skills, including:
  - investigating using geographical methods
  - interpreting and analysing geographical data and information
  - concluding and decision-making
  - communicating.

on Resources

eWorkbooks Customisable worksheets for this topic (ewbk-10539)
Reflection (ewbk-10540)

Interactivity Geography concepts and skills crossword (int-7698)

Hey teachers! Create custom assignments for this topic

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LESSON
1.4 SkillBuilder: Constructing a pie graph

LEARNING INTENTION

By the end of this SkillBuilder you should be able to construct a pie graph.

1.4.1 Tell me

What is a pie graph?

A pie graph, or pie chart, is a graph in which slices or segments represent the size of different parts that make up the whole. The circle of 360 degrees represents the total, or 100 per cent of whatever is being examined. The size of the segments is easily seen. Presenting the parts in order, from largest to smallest, makes it easier to interpret.

A pie graph can be drawn by hand or by using a spreadsheet program.

How are pie graphs useful?

Pie graphs give us an overall impression of data. They are useful for comparing proportions of categories. However, if more than eight segments are needed, the graph becomes difficult to read and it is better to use a bar graph. Unlike line graphs, pie graphs are not useful for showing a trend over time.

A good pie graph:

- has a clear and accurate title that explains the purpose of the graph
- has segments that are either labelled directly or indicated by means of a colour key
- includes percentages or raw figures
- has segments drawn clockwise from largest to smallest, starting at 12 o'clock with the largest and finishing at 12 o'clock with the smallest, unless there is a segment for 'other', which is always last
- includes the source of the data.

1.4.2 Show me

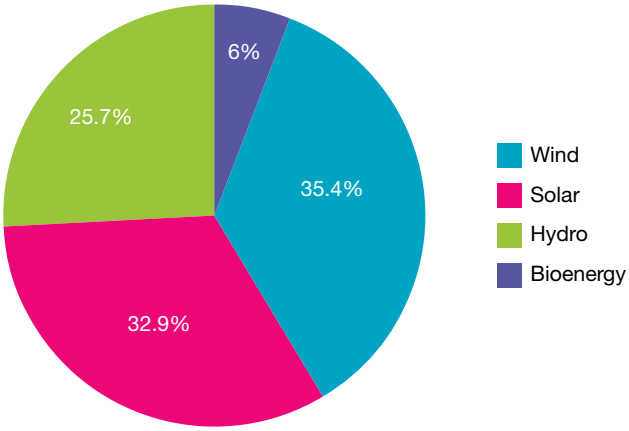
How to complete a pie graph

You will need:

- paper
- a pencil
- a protractor
- a ruler
- coloured pencils
- a data set — in this case, energy generated from renewables in New Zealand (see **TABLE 1**).

Model

FIGURE 1 Percentage of electricity generated from renewables in Australia by energy source (2019)



Source: Based on Clean Energy Australia Report 2020. Clean Energy Council (2020). Retrieved from https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2020.pdf [Online Resource]

Note: 24% of total energy consumption in Australia is from renewable sources.

TABLE 1 Percentage of electricity generated from renewables in New Zealand by energy source (2010)

Renewable energy	Percentage (%)
Hydro	28
Bioenergy and solar	20
Wind	2
Geothermal	50

Note: In 2019, 84% of all electricity generated in New Zealand came from renewable resources.

Source: New Zealand Energy Data File 2012

Procedure

Step 1

Order the statistics from largest to smallest. If there is an 'other' category, put it last.

Step 2

If you have not been given percentages, you will need to calculate them. Add all of the categories together to give you your total figure. Divide each individual category by the total figure and then multiply by 100. This will give you a percentage.

Step 3

Convert the percentage to degrees of a circle by multiplying by 3.6. (100 per cent of the circle = 360 degrees, so 1 per cent of the circle = 3.6 degrees.)

TABLE 2 Converting percentages to degrees in circle

Renewable energy	Percentage (%)	Degrees in circle (percentage × 3.6)
Hydro	28	100.8
Bioenergy and solar	20	72
Wind	2	7.2
Geothermal	50	180

Step 4

Draw a straight line from the centre of the circle to 12 o'clock.

Step 5

Use the protractor to mark the first and largest segment, working clockwise. To do this, place the 0 degrees line on the protractor along the line you have just drawn. Now mark in the second largest group. Use the protractor to mark each of the other segments in descending size, marking the 'other' category last (if needed).

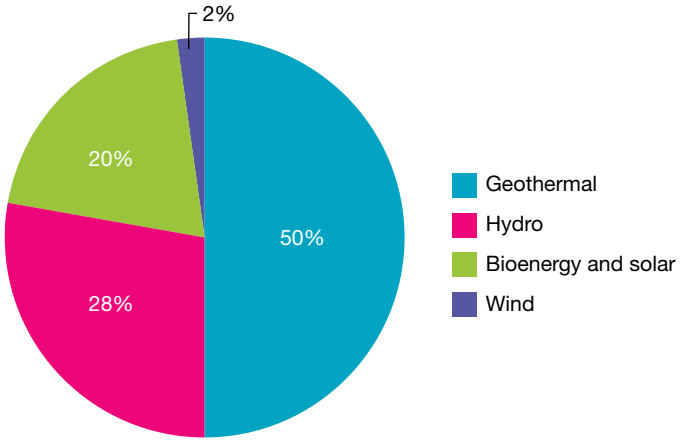
Step 6

Label and colour each segment, making sure you include the percentage label.

Step 7

Provide a clear title and source.

FIGURE 2 Percentage of electricity generated from renewables in New Zealand by energy source (2010)



Source: New Zealand Energy Data File 2012

Resources

Video eLesson Constructing a pie graph (eles-1632)
Interactivity Constructing a pie graph (int-3128)

1.4.3 Let me do it

Complete the following activities to practise this skill.

1.4 ACTIVITIES

1. Use the data in **TABLE 3** to **create** a pie graph. Use the checklist provided to make sure you cover all aspects of the task.

TABLE 3 Source of electricity worldwide, 2017

Source of electricity	Percentage (%)
Coal	38
Oil	3
Natural gas	23
Nuclear	10
Hydro	16
Other	9

Source: Based on IEA data from the IEA (2017). World gross electricity production, by source, 2017. https://www.iea.org/data-and-statistics/charts/world-gross-electricity-production-by-source-2017. All rights reserved.

2. Once you have created your pie graph, apply the skills you have developed in this SkillBuilder to answer the following questions.
   a. What is the most common source when producing electricity?
   b. Are renewables or non-renewables the main source of electricity?
   c. Name a renewable that is part of the 'other' category.

d. In Iceland, 70 per cent of all electricity is produced from hydro power and 30 per cent is produced from geothermal power. Is this similar to or different from the world trend?

e. Research the sources of energy production for another country. Compare your results to Australia and Iceland.

Checklist

I have:

- provided a clear title and source
- plotted the data accurately and labelled each segment
- included the percentages
- shown largest to smallest clockwise from 12 o'clock, with 'other' last.

LESSON
1.5 SkillBuilder: How to read a map

LEARNING INTENTION

By the end of this SkillBuilder you should be able to read a map.

1.5.1 Tell me

What are maps and why are they useful?

Maps represent parts of the world as if you were looking down from above. The mapmaker, or cartographer, simplifies the plan view from a vertical aerial photograph or satellite image. Cartographers use colours and symbols on the map to show how features such as roads, rivers and towns are organised spatially. Six features should be included on all maps. To help us remember these, we use the acronym BOLTSS (see **FIGURE 1**). Maps are useful to show features so that we have a deeper understanding of places. When travelling, maps are essential to navigate unfamiliar places.

FIGURE 1 Essential map features

BOLTSS

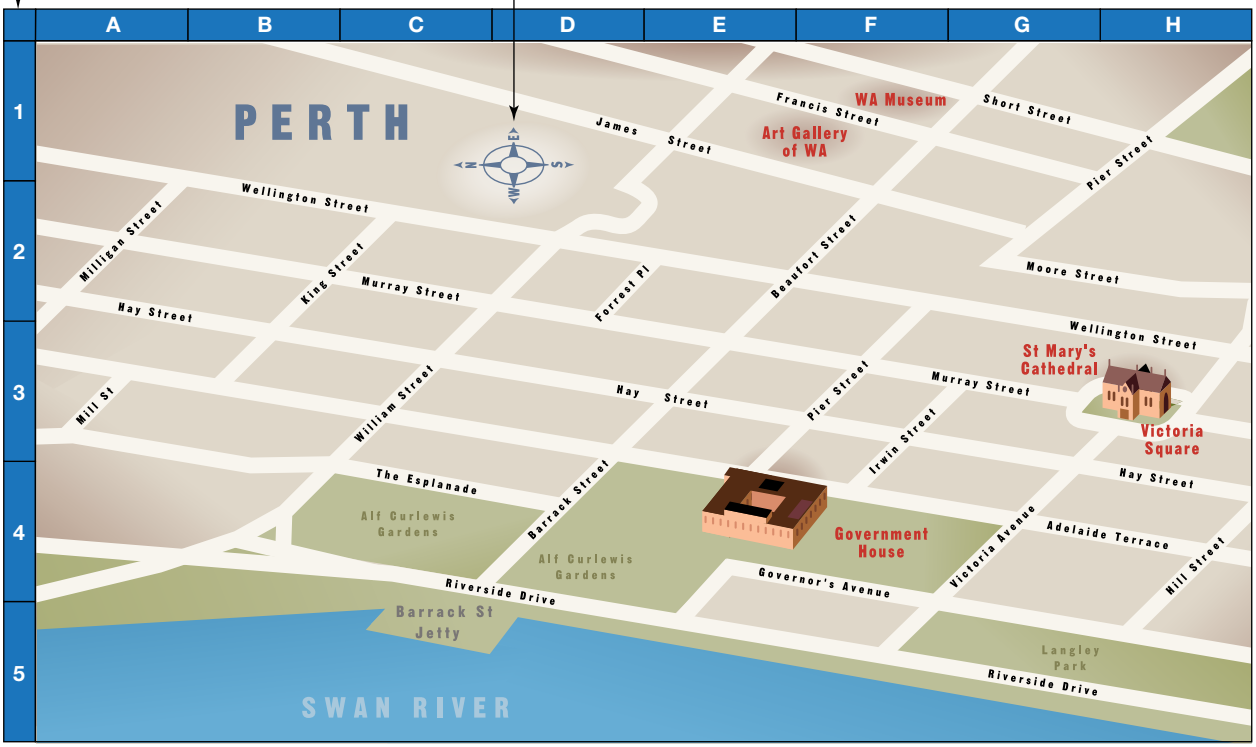
- B — **Border** — a box around the map to clearly show its extent
- O — **Orientation** — a compass direction
- L — **Legend** — a key to what the symbols and colours on the map stand for
- T — **Title** — a clear indication of what the map is about or its theme
- S — **Scale** — indicates distances on the map compared with the actual area being shown
- S — **Source** — where possible, the information used to make the map should be sourced

Understanding map legends

When you look at a map, you no doubt immediately notice the various colours and symbols used on the map. The legend, or key, lists and explains these. The legend is usually found next to or in a corner of the map, or it may be located in a special reference section.

Cartographers overcome the difficult task of showing all features of an area on a map by using symbols and colour to show point symbols (for example, a church), line symbols (a road) and area symbols (a forest). Many maps use the same symbols to help the reader instantly recognise features; for example, blue lines to represent rivers. These conventional symbols are usually drawn to look like the objects they represent. The many symbols used in atlases and other maps are small. It is important that you keep symbols small when making your own maps.

FIGURE 2 A section of the Perth CBD



Source: Russell Tate / Getty Images Australia

Source

Maps often show features that can be seen from an aeroplane but they also show features that are not visible from the air.

As mentioned, a good map has BOLTSS:

- Border — to show the boundaries of the map
- Orientation — to show direction on the map
- Legend — to explain the symbols and colours used
- Title — to describe what the map is
- Scale — to indicate distances on the map
- Source — to explain the source of the information for the map

Importantly, the map must also be accurate and neat.

1.5.2 Show me

How to read a map

You will need:

- a map of the region being considered (see **FIGURE 3**).

Procedure

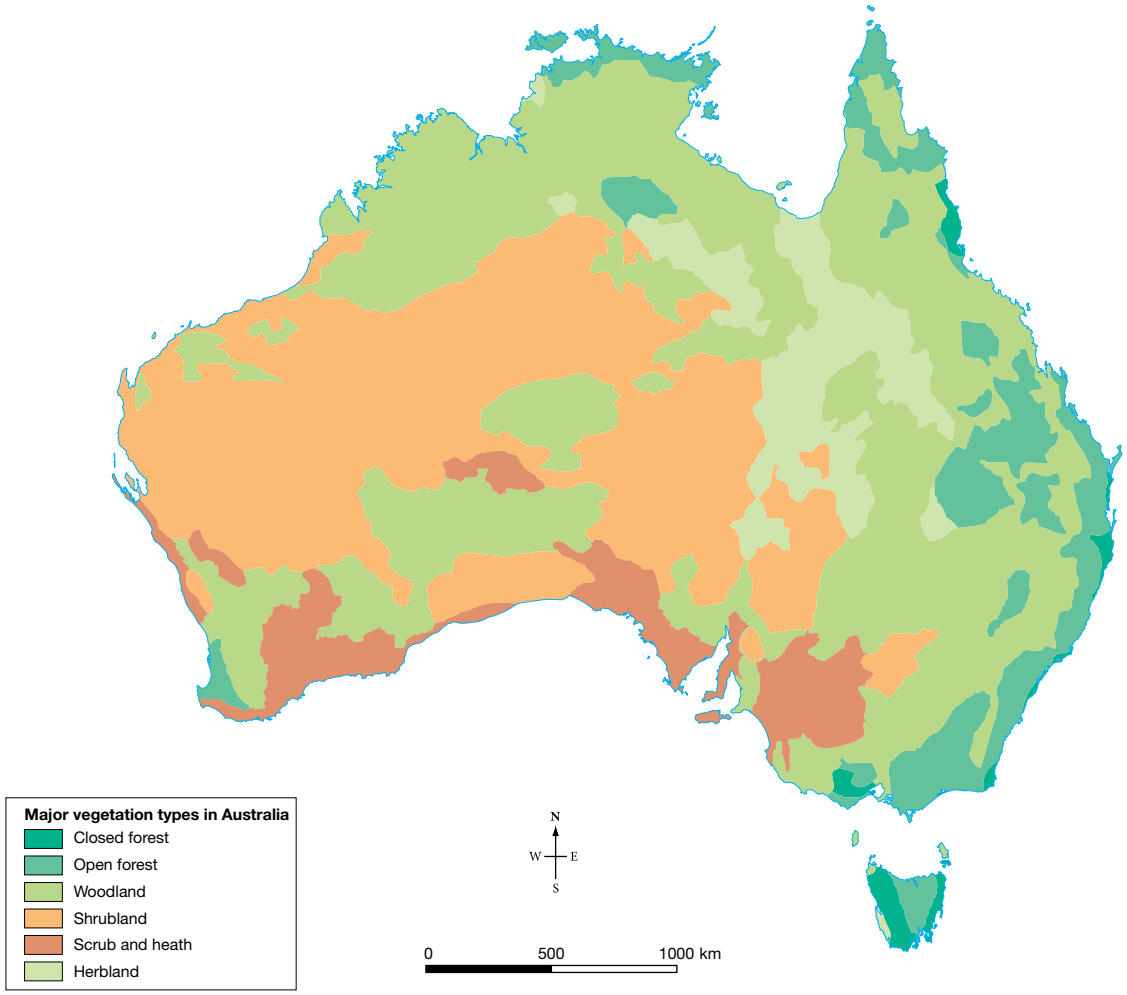
Step 1

Identify and carefully read the title of the map because it will provide you with an understanding of the information you can expect to see on the map. Sometimes the title tells you the date of the information that has been mapped. The map shown in **FIGURE 3** has a title that tells us it is a map of Australia showing major vegetation types. The colours in the key help us to understand the distribution of vegetation.

Step 2

Next, examine the key. We notice that closed forest is found in about half the area of Tasmania, small linear coastal tracts along parts of the east coast of mainland Australia and in the Otway region of Victoria. We could make a similar detailed description of open forest. Looking at the pattern of forests overall, we conclude that only a small area of Australia is forested — less than 10 per cent.

FIGURE 3 Major vegetation types in Australia



Source: Map taken from http://www.anbg.gov.au/aust-veg/veg-map.html. Reproduced with permission from Sydney University Press

on Resources

Video eLesson How to read a map (eles-1634)
Interactivity How to read a map (int-3130)

1.5.3 Let me do it

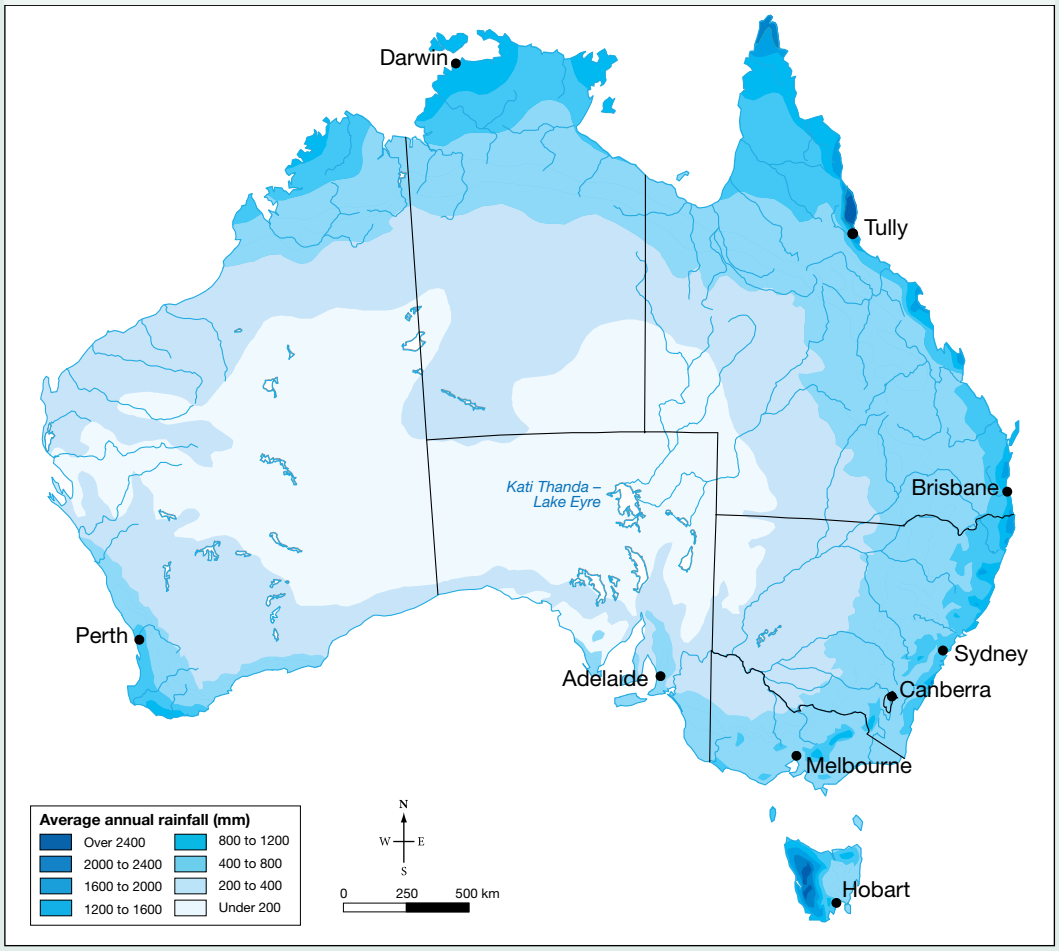
Complete the following activity to practise this skill.

1.5 ACTIVITY

Apply your skills to answer the following questions. Use the checklist provided to make sure you have covered all aspects of the task.

1. Refer to **FIGURE 4**. **Describe** the map of Australia's average annual rainfall.
   a. What is the average annual rainfall of Cairns?
   b. What is the average annual rainfall of Australia's state capital cities?
   c. **Describe** the area of Australia that receives less than 200 mm of annual rainfall.
   d. **Describe** the distribution of the wettest areas in Australia.

FIGURE 4 Average annual rainfall



Source: Bureau of Meteorology, 2003

LESSON
1.6 SkillBuilder: Reading a weather map

LEARNING INTENTION

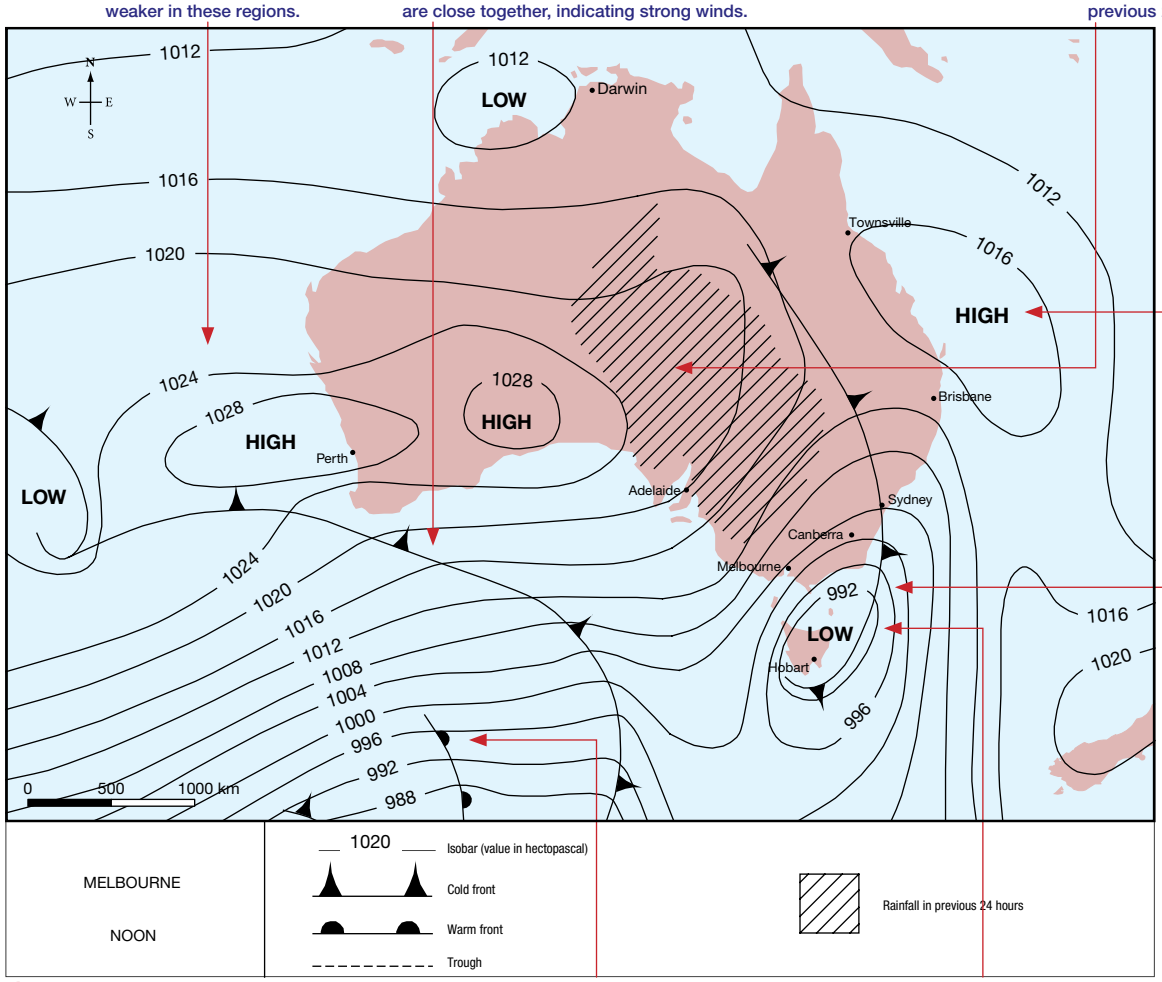
By the end of this SkillBuilder you should be able to read a weather map.

1.6.1 Tell me

What are weather maps?

Weather maps or synoptic charts appear every day in newspapers and during the television news. They may look complex but, just as you learned to read letters and words, you can learn to read the symbols on weather maps. Weather maps use lines and symbols to show areas of low and high pressure, and weather events such as warm and cold fronts. The lines are called isobars. They join places with the same atmospheric pressure.

FIGURE 1 A typical weather map



Typical weather map

The main influences on Melbourne's weather are the low pressure system south of it, the high pressure system to the north-west, and the cold fronts to the west and east.

Source: MAPgraphics Pty Ltd, Brisbane

Atmospheric pressure is the weight of the air. This varies from place to place, depending on the air temperature. Meteorologists use sensitive instruments called barometers to measure atmospheric pressure.

How are weather maps useful?

Understanding weather is useful because it affects everyone's lives. Being able to read weather maps allows you to better understand what weather is expected (forecast) in the days ahead. Farmers use weather information to plan their work; tourists rely on forecasts to make decisions about travel plans; and emergency services use weather forecasts to broadcast warnings so that people can prepare for adverse conditions.

Today, meteorologists have more accurate ways of predicting weather than those used in the past. They use satellite images, radar-tracking weather balloons, automatic weather stations, ships and aircraft to help them predict the weather.

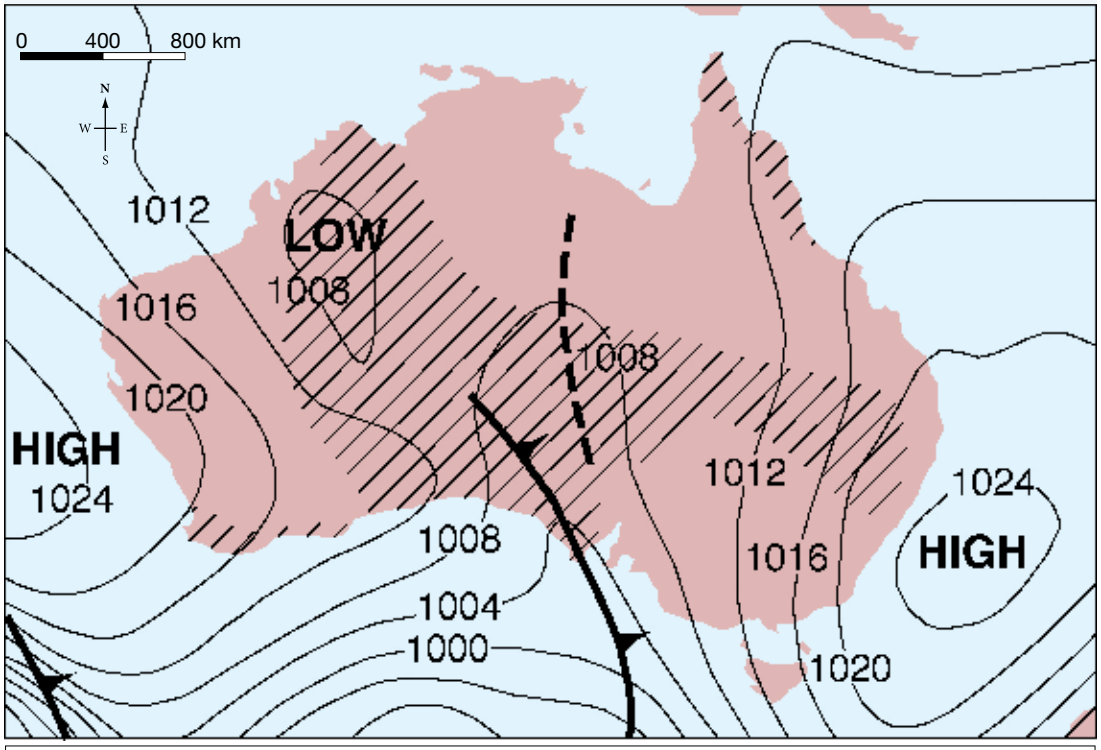
1.6.2 Show me

How to interpret a weather map

You will need:

- a weather map
- a key to interpret the weather map symbols.

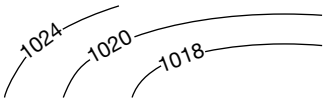
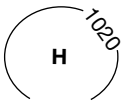
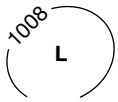
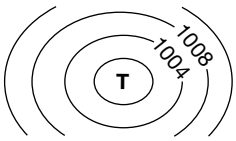
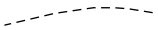
FIGURE 2 Weather map for 10 November



Source: MAPgraphics Pty Ltd, Brisbane

The average weight of air is 1013 hectopascals (hPa). Measurements higher than this (for example, 1020 hPa) indicate areas of high atmospheric pressure, where air is sinking. Measurements lower than this (for example, 985 hPa) indicate areas of low atmospheric pressure, where air is rising. You can use this code to read the weather map in **FIGURE 2**.

TABLE 1 Symbols on weather maps for the southern hemisphere

Symbol	Name	What does it mean?	Comment
	Isobars	Join places with the same air pressure	The closer together these lines, the stronger the wind.
	High pressure area	Sinking air	Generally fine weather. Winds rotate around these areas anticlockwise. 
	Low pressure area	Rising air	Generally cooler weather, rain. Winds rotate around these areas clockwise. 
	Tropical cyclone	Rapidly rising air	Strong winds, torrential rain
	Cold front	The 'line' along which an approaching mass of cold air meets warmer air	Fall in temperature, rain. Front moves in direction of arrowheads.
	Warm front	The 'line' along which an approaching mass of warm air meets colder air	Temperature rise, sometimes light rain. Uncommon in Australia
	Rain	Rain in the last 24 hours	Usually associated with low pressure areas and fronts
	Trough	A dip in isobars	An area associated with unsettled weather and precipitation

Procedure

Step 1

Pressure systems

Examine high-pressure systems (pressure above 1013 hPa) and low-pressure systems (pressure below 1013 hPa). Pressure systems generally move from west to east as they cross Australia and move around the world. In **FIGURE 2**, a high-pressure system is approaching south-west Western Australia, and this system is likely to bring fine weather to the region. The low-pressure system east of Broome brings cooler weather and rain.

Step 2

Air masses and fronts

Examine any air masses and fronts. **FIGURE 2** shows a cold front where cold air meets warmer air. This is likely to cause a fall in temperature and rain in South Australia.

Step 3

Precipitation

Examine precipitation patterns. Precipitation includes snow, hail and dew but the most common form of precipitation is rainfall. In **FIGURE 2**, we can see that more than half of Australia has received rain in the last 24 hours. This chart does not indicate how much rain has fallen.

Step 4

Wind

Wind is not depicted on this weather map. However, the closer together the isobars are, the stronger the winds will be. No significant areas of high wind are shown for Australia on 10 November.

Step 5

Troughs

The weather map in **FIGURE 2** shows a trough in central Australia. The trough line runs north from central South Australia towards the Gulf of Carpentaria. Troughs are usually associated with unsettled weather and precipitation.

on Resources

Video eLesson Reading a weather map (eles-1637)

Interactivity How to read a weather map (int-3133)

1.6.3 Let me do it

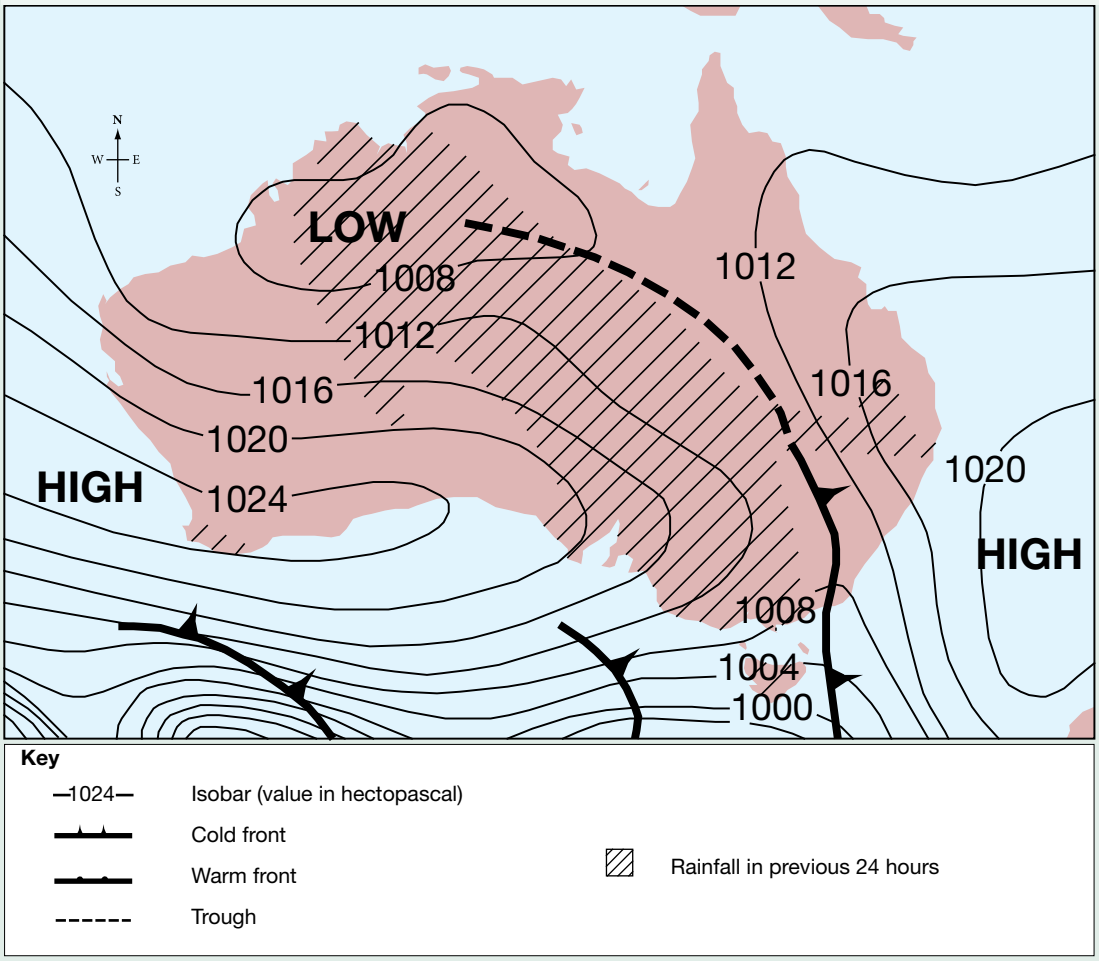
Complete the following activity to practise this skill.

1.6 ACTIVITY

The map in **FIGURE 3**, produced on 11 November, predicts the weather for 12 November. **FIGURE 4** shows what the weather was actually like that day. Based on the skills you have learned in this SkillBuilder, interpret the maps and answer the following questions. Use the checklist provided to make sure you cover all aspects of the task.

1. List what is different in **FIGURE 3** from the map showing actual weather for two days earlier (10 November), shown in **FIGURE 2**.
2. **Compare** the actual weather conditions in **FIGURE 4** with those predicted 24 hours earlier in **FIGURE 3**.
   a. How accurate was the predicted weather map?
   b. How was it different?
3. Using **FIGURE 4**, **describe** Melbourne's weather on 12 November.

FIGURE 3 Weather map showing predicted weather for 12 November



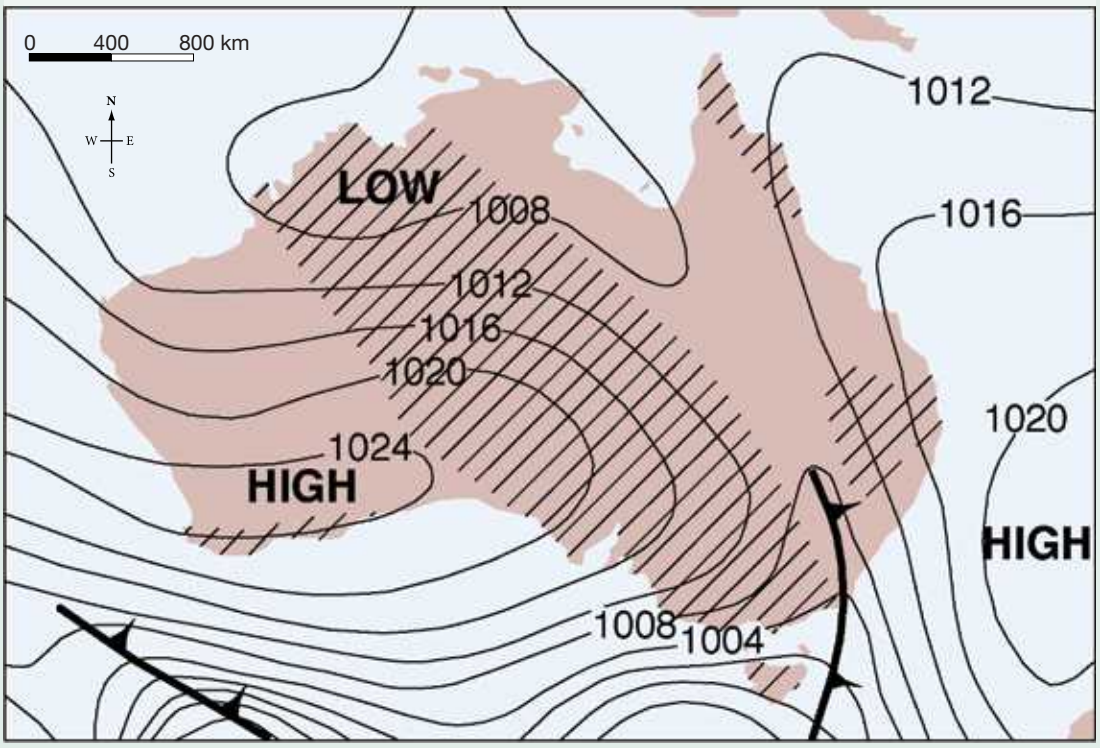
Source: MAPgraphics Pty Ltd, Brisbane

Checklist

I have:

- **interpreted** pressure systems, air masses and fronts, precipitation, wind and troughs
- written a detailed description.

FIGURE 4 Map showing actual weather for 12 November



Key

—1024— Isobar (value in hectopascal)

Cold front

Warm front

Trough

Rainfall in previous 24 hours

Source: MAPgraphics Pty Ltd, Brisbane

LESSON
1.7 SkillBuilder: Creating a simple column or bar graph

LEARNING INTENTION

By the end of this SkillBuilder you should be able to create a simple column or bar graph.

1.7.1 Tell me

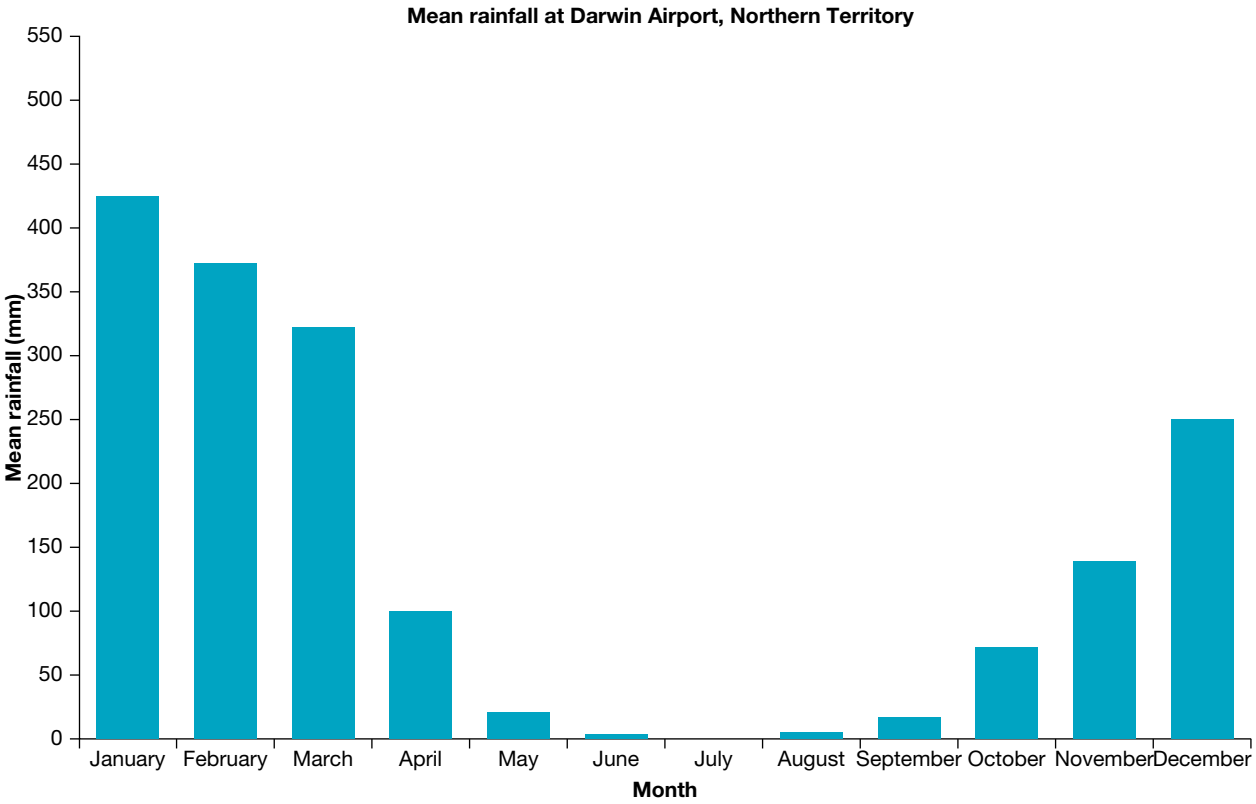
What are column or bar graphs?

Column graphs show information or data in vertical columns. In a bar graph, the data is shown in bars that are drawn horizontally. Column and bar graphs can be drawn by hand, or constructed using a computer spreadsheet.

How are column graphs useful?

Column graphs are useful for comparing quantities. They can help us understand and visualise data, see patterns and gain information. For example, we can use them to help understand rainfall patterns in different months (see **FIGURE 1**).

FIGURE 1 Rainfall at Darwin Airport



Source: © Bureau of Meteorology

A good column graph has:

- ruled axes
- labelled axes
- a space between each column
- a title
- the source of information.

1.7.2 Show me

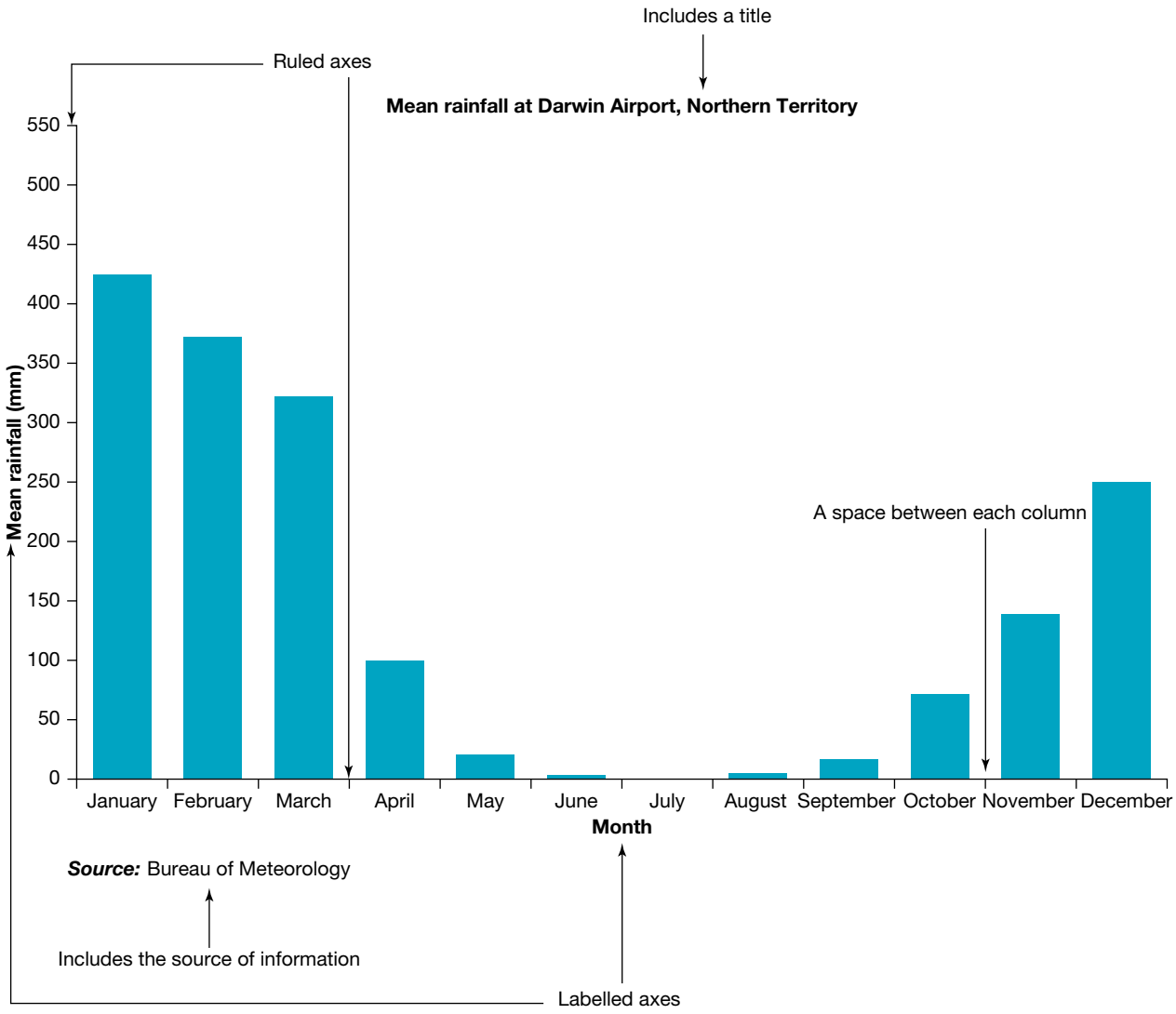
How to complete a column graph

You will need:

- a table of data (see **TABLE 1**)
- graph paper
- a pencil
- a ruler.

Model

FIGURE 2 A labelled column graph



Procedure

Step 1

Examine the data. Decide on the scale to use for your vertical axis. For this example, the vertical axis should start at zero and increase at intervals to suit the data. Because the highest rainfall for any month for Cardwell is 465.9 mm, intervals of 50 would be suitable. For this exercise, you could use 1 cm to represent 50 mm of rainfall. Draw your vertical axis according to the scale you have devised.

TABLE 1 Mean monthly rainfall (mm) for the years 1871 to 2016, Cardwell, Queensland

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
438.5	465.9	400	208.6	94.7	47	32.4	29.2	38.5	54.4	115.2	193.5

Source: © Bureau of Meteorology

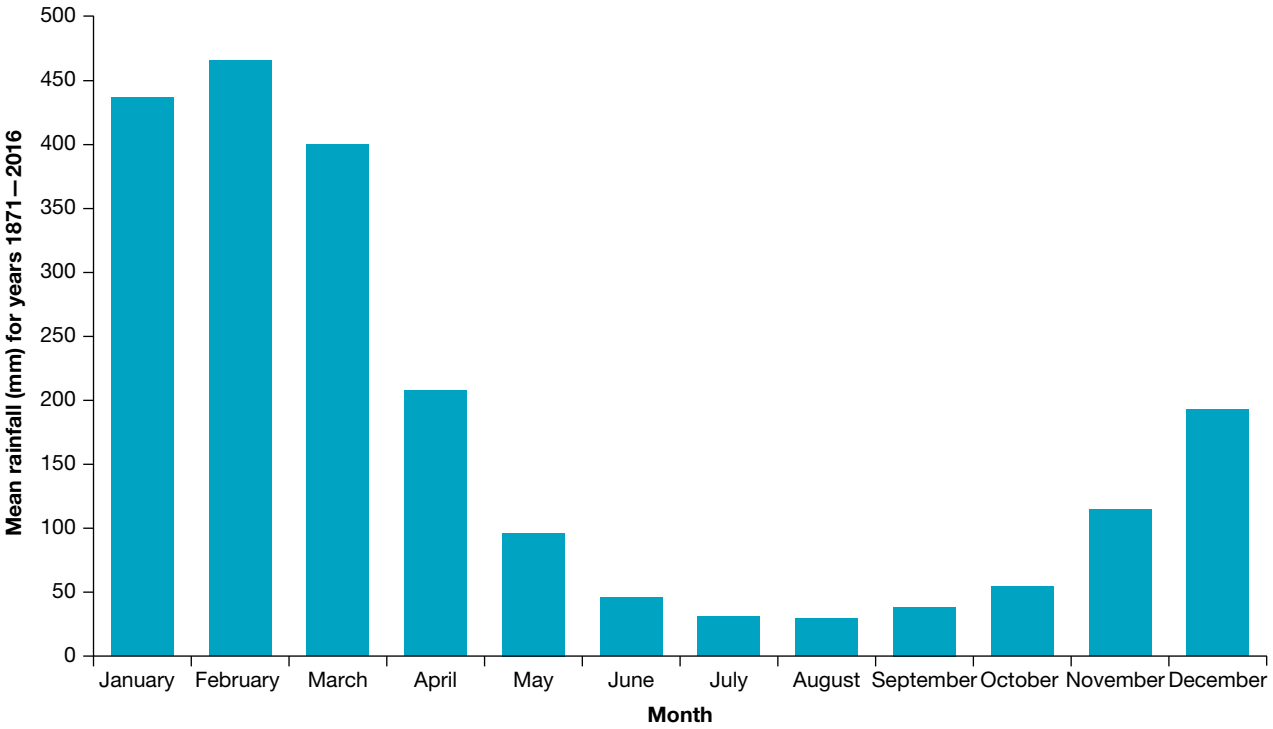
Step 2

Decide on the width and spacing of the columns and draw your horizontal axis to fit. Make sure that each column is the same width.

Step 3

For each column, mark the meeting point of the two pieces of information with a dot, and then use your ruler to neatly complete the column. Shade it in using colour.

FIGURE 3 Mean monthly rainfall for the years 1871 to 2016, Cardwell, Queensland



Source: © Bureau of Meteorology

Step 4

Label the vertical and horizontal axes and give the graph a title. Include a key if necessary.

Step 5

Provide the source beneath your graph, to enable the reader to locate the source data if they wish.

on Resources

Video eLesson Constructing a simple column or bar graph (eles-1639)
Interactivity Creating a simple column or bar graph (int-3135)

1.7.3 Let me do it

Complete the following activities to practise this skill.

1.7 ACTIVITIES

1. Using the data in **TABLE 2**, **construct** your own graph of average monthly rainfall for Innisfail, Queensland.

TABLE 2 Mean rainfall (mm) for the years 1881 to 2016, Innisfail, Queensland

Jan	Feb.	Mar.	Apr.	May	Jun	Jul	Aug	Sep	Oct	Nov.	Dec.
507.3	590.1	662.2	456.3	302.2	189	137.6	116.9	86.1	87.7	157.9	262.6

Source: Bureau of Meteorology

2. Once you have **constructed** your graph, **apply** the skills you have learned in this SkillBuilder to answer the following questions.
   a. Which month has the most rainfall?
   b. Which month is the driest?
   c. Imagine you are a filmmaker, planning to film on location in Innisfail for three months. Because rain would cause problems for your filming schedule, which months would be best for your requirements?

Checklist

I have:
- ruled axes
- labelled axes
- a space between each column
- included a title
- included the source of information.

LESSON
1.8 SkillBuilder: Using topographic maps

LEARNING INTENTION

By the end of this SkillBuilder you should be able to use a topographic map.

1.8.1 Tell me

What are topographic maps?

Topographic maps are more than just contour maps showing the height and shape of the land. They also show features of the natural environment, such as forests and lakes, and features of human environments, such as roads and settlements (places where a community of people live).

FIGURE 1 This is an aerial photograph of Mount Gambier, South Australia, an area with many extinct volcanoes. Lakes have formed in the craters of several volcanoes, and the most famous of these is Blue Lake. We can see many features in the photo, but a topographic map can give us more information, especially about the shape of the landscape — its topography.

Why are topographic maps useful?

All topographic maps use similar symbols to show the main features in the landscape. These conventional symbols make it easy for map readers to quickly identify the features shown in the legend, or key. Topographic maps are useful for a range of purposes, from bushwalkers wanting to gain an understanding of the landscape in which they plan to walk, to town planners and engineers needing to construct infrastructure such as roads and bridges.

1.8.2 Show me

How topographic maps help us to locate places on a map

You will need:

- a topographic map (see **FIGURE 3**).

Many observations can accurately be made from a topographic map. **FIGURE 3** is a topographic map extract of Mount Gambier. Blue Lake is a distinctive feature on this map, and it is surrounded by a steep slope. The built-up area, or township, is situated north of Blue Lake. A railway line passes through the town and the station is close to the civic centre and post office. The main town extends approximately four kilometres east–west and four kilometres north–south. The local golf club can be found in the north-east of town. These observations are made by using the legend, north arrow and scale.

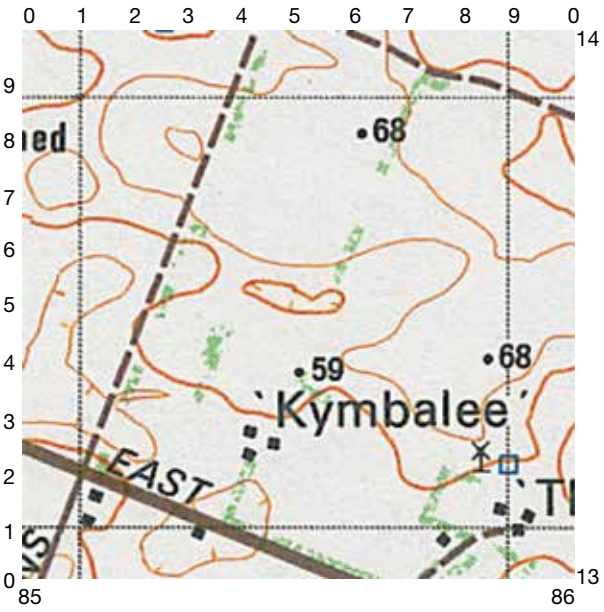
Area and grid references

A one-kilometre-square grid is overprinted on a topographic map. These grid lines are numbered with two-digit numbers in the map's margins. Lines that run up and down the map (north–south) are called eastings. The numbers increase as you move to the east. Lines that run horizontally across the map (east–west) are called northings. The numbers increase as you move north. In a grid reference, the eastings are given first, and then the northings.

Four-figure grid references tell you the grid square in which to find a feature. The letters AR are placed in front of a four-figure reference to show the area reference. For example, AR8513 contains the town of Kymbalee (see **FIGURE 2**).

Six-figure grid references pinpoint an exact point in the grid square. The third and sixth figures represent one-tenth of the distance between the two grid numbers. These divisions are not written on the map, so they must be estimated. The letters GR are used in front of a six-figure grid reference. No spaces are used between the digits in four- or six-figure references; for example, Kymbalee's grid reference is GR854132.

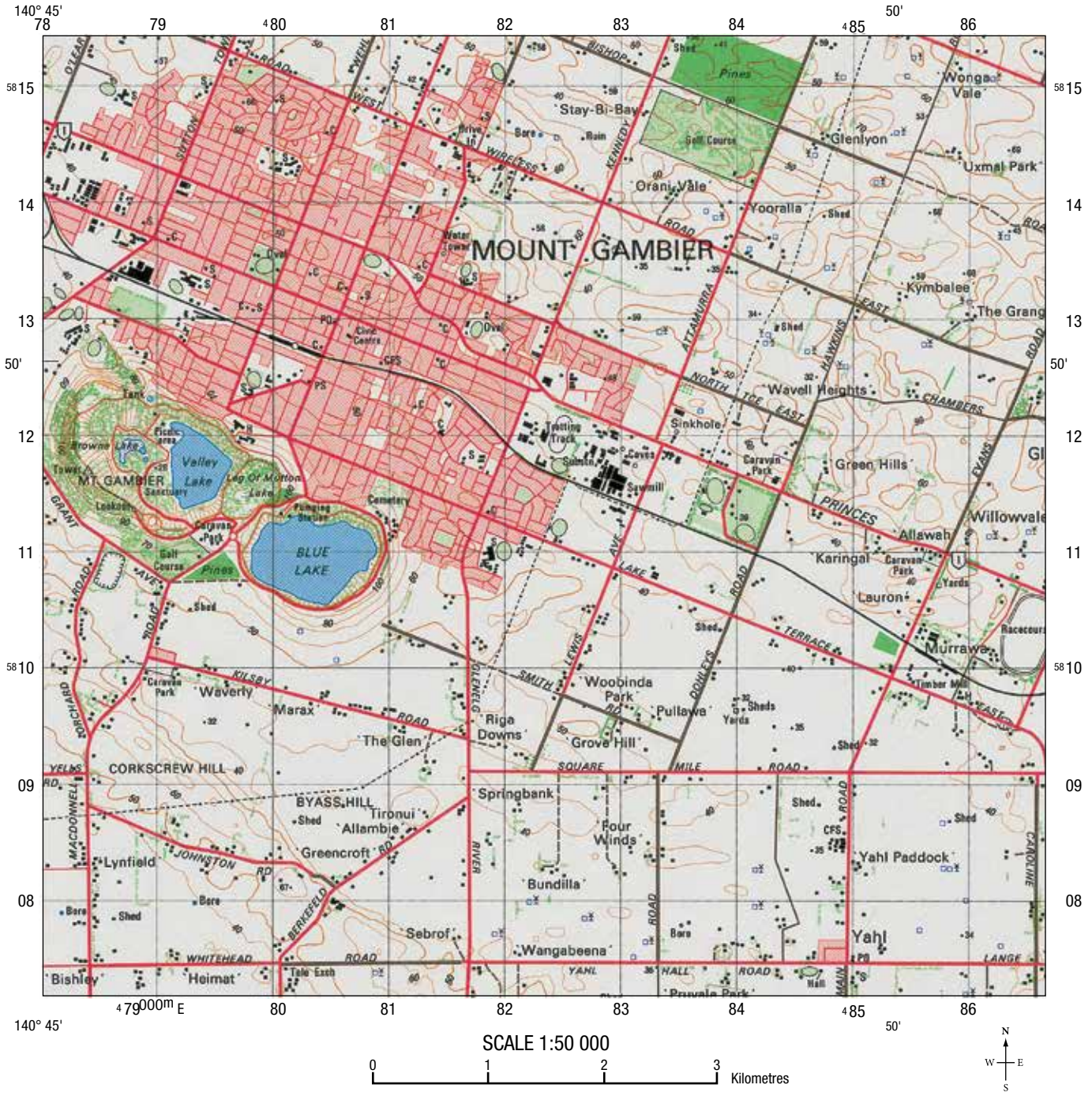
FIGURE 2 Working out a six-figure grid reference



Resources

- **Digital document** Topographic map extract — Mt Gambier (doc-17951)
- **Video eLesson** Using topographic maps (eles-1641)
- **Interactivity** Using topographic maps (int-3137)
- **Google Earth** Mount Gambier

FIGURE 3 This topographic map extract of Mount Gambier can be used to determine the location, direction and distance of physical and human features in the area shown on the map.



Built-up area; Parks, recreation areas.

Road, sealed surface, two or more lanes; National route marker.

Road, sealed surface, one lane.

Road, unsealed surface, two or more lanes; Bridge.

Road, unsealed surface, one lane; Gate; Cattle grid.

Vehicular track.

Railway, multiple track; Station; Siding.

Railway, single tract, Cutting; Embankment.

Building; Post office; Police station; School.

Hospital; Church; Mine; Windmill.

Fence; Guerry.

Power transmission line; Levee or bank.

Survey beacon; spot elevation.

Lake perennial; Watercourse.

Lake, intermittent; Land subject to inundation.

Dam or waterhole on watercourse; Tank or small dam.

Contours; Depression contours.

Cliff; Escarpment or low cliff.

Pine plantation; Orchard or low cliff.

Windmark.

Trees and scrub, scattered

Trees and scrub, medium, dense.

Source: Government of South Australia, Department of Environment, Water and Natural Resources.

1.8.3 Let me do it

Complete the following activity to practise this skill.

1.8. ACTIVITIES

Answer these questions using the **FIGURE 1** aerial photograph and **FIGURE 3** topographic map extract of Mount Gambier. Use the checklist provided to make sure you have covered all aspects of the task.

1. **Examine FIGURE 1**. From which direction was this photograph of the crater lakes taken?
2. **Examine FIGURE 3**. Look at the contour lines to the south of Blue Lake. Is the land flat or steep? How can you tell?
3. Sketch the special symbols used in the legend showing that the crater lakes:
   a. form a depression
   b. have steep sides.
4. Give the main features found at the following area references.
   a. AR8010
   b. AR8013
5. Give area references for the following features.
   a. Valley Lake
   b. The trotting track
6. Find the following features.
   a. GR858087
   b. GR816077
   c. GR807128
   d. GR812123
7. From the topographic map extract of Mount Gambier, give six-figure grid references for features that show the following.
   a. Mount Gambier has a large timber industry.
   b. Mount Gambier is a popular tourist resort.
   c. Mount Gambier has many sporting facilities.
   d. Mount Gambier is the centre of a farming region.
8. Approximately how wide is Blue Lake at its widest point?

Checklist

I have:

- identified north, south, east and west using the north point
- used the key to identify features
- used grid references to describe the location of a specific feature
- used the scale to calculate distances
- interpreted topography by considering how close together the contour lines are.

LESSON
1.9 SkillBuilder: Using alphanumeric grid references

LEARNING INTENTION

By the end of this SkillBuilder you should be able to use an alphanumeric grid reference.

1.9.1 Tell me

What are alphanumeric grid references?

Alphanumeric grid references are a combination of letters and numbers that help us locate specific positions on a map. They are linked to the lines that form a grid over certain kinds of maps. The letters and numbers are placed alongside the gridlines, just outside the map. The grid, letters and numbers allow you to pinpoint a place

or feature by stating its alphanumeric grid reference. For example, in **FIGURE 1**, the Queen Victoria Market is located at grid reference B1; Federation Square is located at F4 and the Rialto Tower is located at B4.

Why are alphanumeric grid references useful?

If it weren't for grid references, finding places in detailed books of maps such as street directories and atlases would be very time consuming. Grid references allow the user to quickly locate the information they want among the hundreds of other features shown on a map. They also allow people to communicate with one another about location when they are using the same map.

FIGURE 1 A section of the Melbourne CBD

Source: Russell Tate / Getty Images Australia

1.9.2 Show me

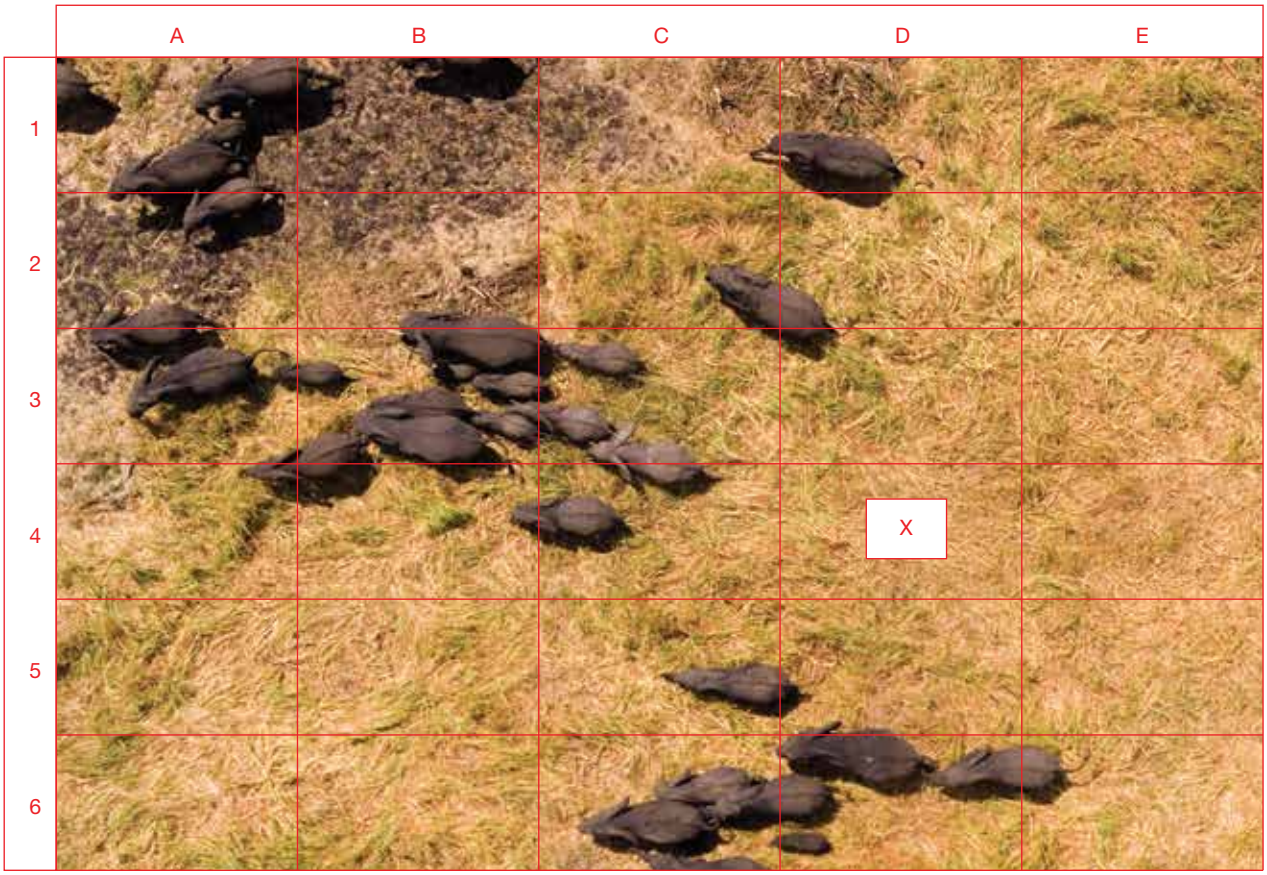
How to use alphanumeric grid references

You will need:

- a map that has alphanumeric grid references (see **FIGURE 3**)
- a pen and notebook.

Model

FIGURE 2 Aerial photo of elephants in Botswana



Procedure

Step 1

We will demonstrate this skill using the photo in **FIGURE 2**. In this aerial photograph of elephants in Botswana, we want to locate the veterinarian, Jessica, who is at point X.

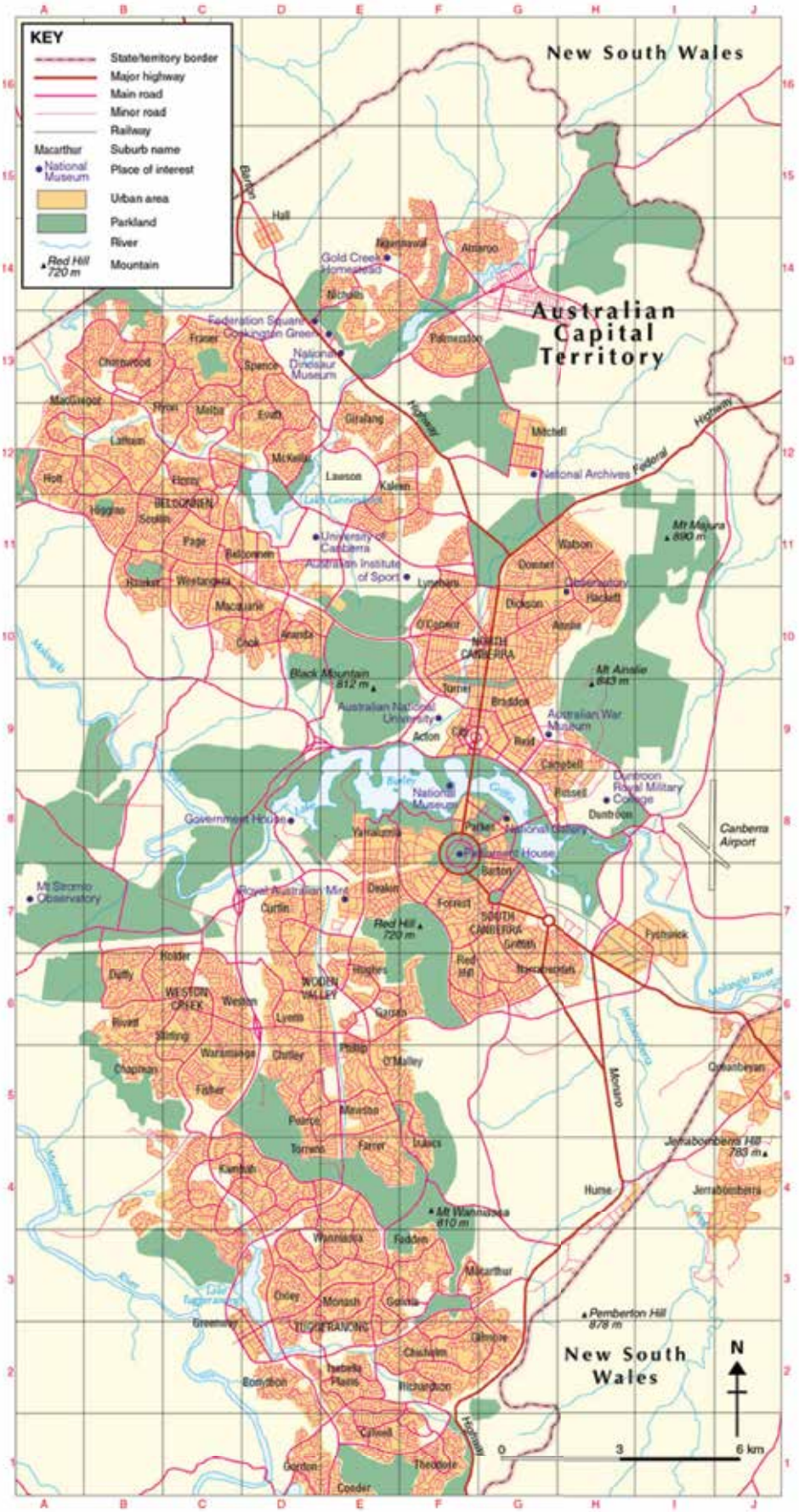
Step 2

Place your finger in the grid square that contains the X. By running your finger up the column of squares, you can see that Jessica is in column D. Write this down in your notebook.

Step 3

Now run you finger across the row of squares and you can see that she is in row 4. Write this down to the right of the letter D in your notebook. This gives us the grid reference for Jessica's location: D4. Now write the name of the feature (in this case, Veterinarian: Jessica) beside the grid reference.

FIGURE 3 Canberra and its suburbs



Source: MAPgraphics Pty Ltd, Brisbane.

Resources

Video eLesson Using alphanumeric grid references (eles-1642)
Interactivity Using alphanumeric grid references (int-3138)

1.9.3 Let me do it

Complete the following activities to practise this skill.

1.9 ACTIVITIES

1. Using **FIGURE 3**, give grid references for the following features.
   a. Canberra airport
   b. Queanbeyan
   c. Mt Ainslie
2. The Prime Minister is hosting a group of leaders from the Asia–Pacific region. As part of their trip, the leaders will be visiting some of the local attractions in and around Canberra. Use the Canberra map in **FIGURE 3** and the following grid references to report on the places of interest that the group visited.
   a. Before lunch, the group went to E7, E13 and F11.
   b. They had lunch at F9.
   c. After lunch, they visited G9 and H8 before making their way to A7.
   d. That night they had dinner at D8.

Checklist

I have:
- run up or down the column of squares first and then run across the row of squares to identify the grid references
- written the letter of the alphabet before the numeral for each reference
- double-checked my answers.

LESSON
1.10 SkillBuilder: Drawing a climate graph

LEARNING INTENTION

By the end of this SkillBuilder you should be able to draw a climate graph.

1.10.1 Tell me

What are climate graphs?

Climate graphs, or climographs, are graphs that show climate data for a particular place. They combine a column graph that shows average monthly precipitation (rainfall), and a line graph that shows average monthly temperature. The left axis represents temperature and the right axis represents rainfall, so you must take care to read from the correct scale when interpreting a climate graph. Temperature can be shown in one line, as mean monthly temperature; or it can be shown in two lines, representing mean maximum and mean minimum monthly temperatures.

Mount Isa is located around 1800 kilometres north-west of Brisbane, in the arid Gulf Country region of Queensland. It is one of the largest centres in outback Australia, being home to some 22 000 people. Most of these people are involved in the mining of the vast deposits of copper, silver and zinc found in the region. In the climate graphs for Mount Isa in **FIGURES 1** and **2**, you can see how one or two temperature lines can be used to give us an understanding of the climate.

FIGURE 1 Climate graph for Mount Isa, Queensland

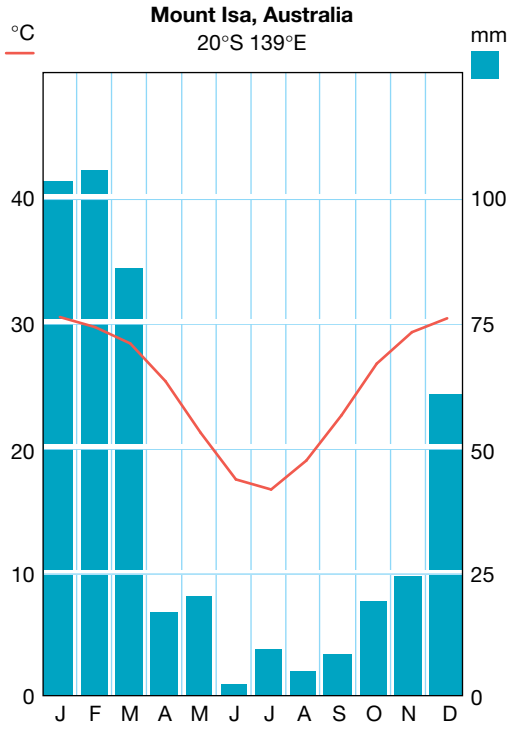
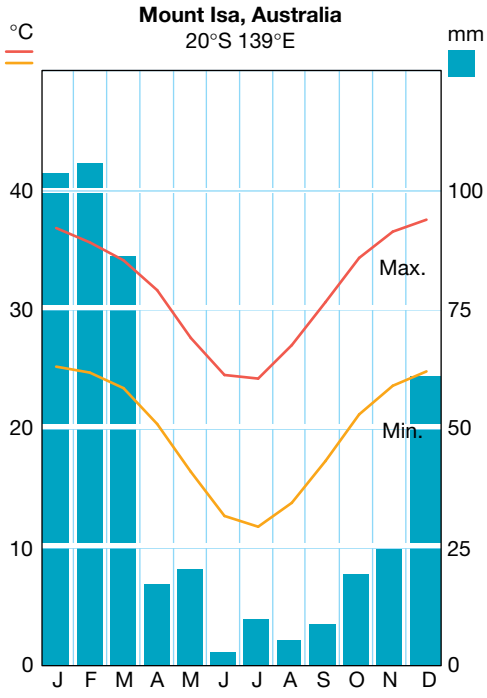


FIGURE 2 Climate graph for Mount Isa, showing average maximum and minimum temperatures



Why are climate graphs useful?

Climate graphs are used to show the climate of a place over a 12-month period. Because the red line on the graph shows temperature and the blue columns show rainfall, you can quickly understand the graph. It is much easier to compare the climate of two places by looking at their climate graphs than by looking at tables of statistics, so drawing and using these graphs is an important geographical skill. It also makes it very easy to compare climate patterns for different areas when the graphs are drawn using the same conventions.

A good climate graph:

- is drawn in pencil first, and then coloured
- has ruled axes
- has labelled axes
- makes use of small dots before a line is drawn
- has a smooth curve for the temperature line in red
- has rainfall columns shaded in blue
- includes a title
- includes a source.

1.10.2 Show me

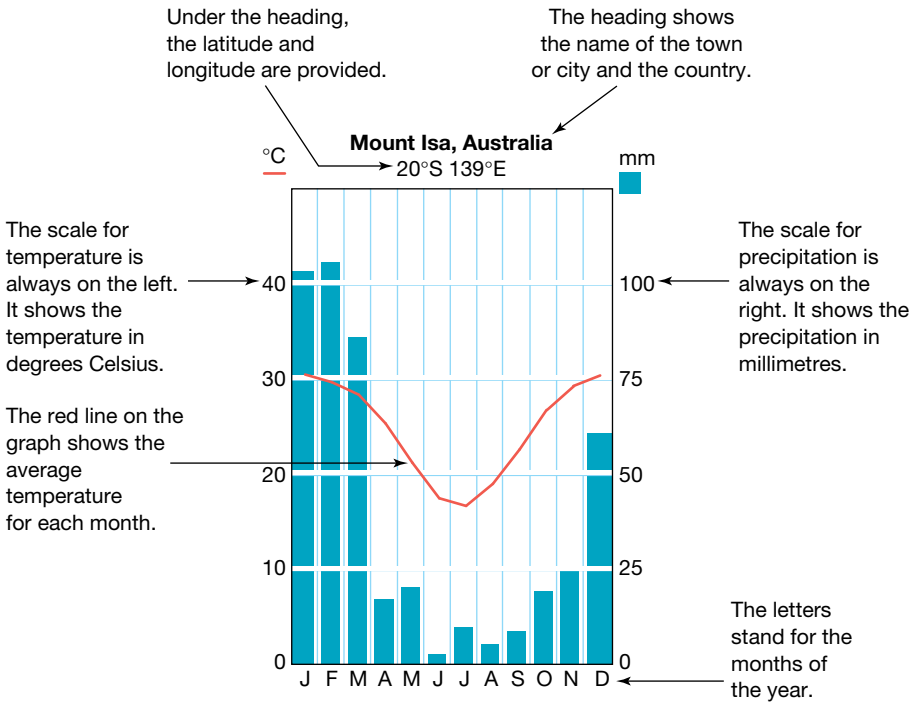
How to complete a climate graph

You will need:

- data to plot on your graph (see **TABLE 1**)
- graph paper
- a grey lead pencil
- a ruler
- a red pen and a blue pencil.

Model

FIGURE 3 Features of a climate graph



Procedure

Step 1

Look at the data in **TABLE 1**. Two sets of data are given: average monthly precipitation and average monthly temperature.

TABLE 1 New Delhi, 28°N 77°E, average monthly precipitation and average monthly temperature

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	14.1	16.9	22.4	28.6	32.8	33.8	31.0	29.8	29.2	26.0	20.3	15.4
mm	22.7	20.1	14.5	10.1	15.0	67.9	200.4	200.3	122.5	18.5	3.0	10.0

Source: www.worldclimate.com

Step 2

Consider the range of the data before you decide what scales will work for the vertical axes. For the right axis, find the wettest month. The precipitation scale begins at 0 and must extend far enough to include the wettest month. For the left axis, find the highest and lowest temperatures. A scale of 0 °C to 40 °C will suit most climate graphs. Try to use temperature and precipitation scales that prevent the line and column graphs from overlapping; however, this may not be possible if the place has a very high rainfall.

Step 3

Use a ruler and pencil to draw the axes on graph paper. Divide the horizontal axis into 12 equal sections to represent the months of the year. Label each month with its initial. Label the temperatures on the left vertical axis and precipitation on the right vertical axis.

Step 4

Construct a column graph showing the average monthly rainfall. Make sure you use the right vertical scale to plot your data. Rule a line across each column and colour the column blue.

Step 5

Construct a line graph showing the average monthly temperature. Plot the temperature by placing a dot in the centre of each month. Make sure that you use the left vertical scale. Use a red pen to join the dots with a smooth curve; don't use a ruler.

Step 6

Add a title, giving the name of the place, the country and the latitude and longitude. You can also indicate the elevation if you wish.

Step 7

Add the source details of the data used.

FIGURE 4 Set of axes for New Delhi climate graph

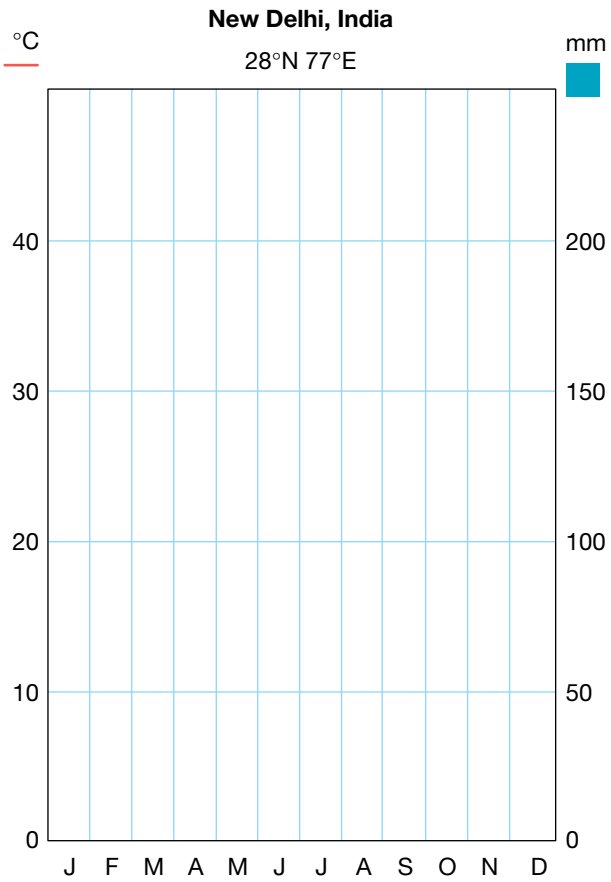
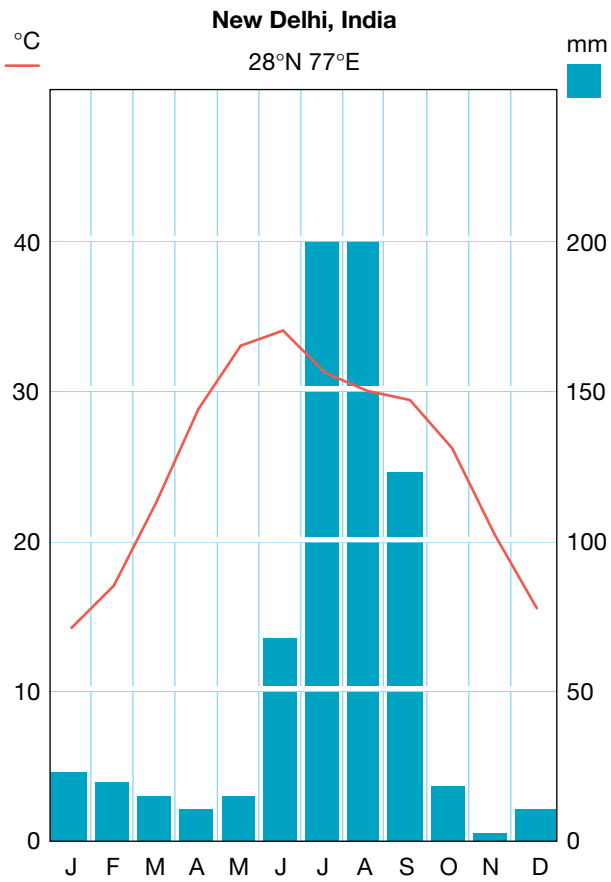


FIGURE 5 New Delhi climate graph



Resources

Video eLesson Drawing a climate graph (eles-1644)
Interactivity Drawing a climate graph (int-3140)

1.10.3 Let me do it

Complete the following activities to practise this skill.

1.10 ACTIVITIES

1. Mount Buller is a mountain in the Australian Alps. It is three hours' drive from Melbourne, and is the closest major mountain to Melbourne for skiing in winter. Use the data in **TABLE 2** to **construct** a climate graph for Mount Buller. Use the checklist provided to make sure you have covered all aspects of the task.

TABLE 2 Mount Buller, Victoria, 37.15°S, 146.44°E, elevation 1707 m, average monthly precipitation and average monthly temperature

	Jan.	Feb.	Mar	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	17.2	16.5	14.4	10.0	6.2	3.0	1.4	2.0	4.9	8.2	11.8	14.3
mm	59.0	68.0	44.8	76.1	110.0	154.2	161.0	145.6	143.0	110.6	126.8	84.3

Source: Australian Bureau of Meteorology

2. **Apply** the skills you have developed in this SkillBuilder to answer the following questions.
   a. Which month is warmest in Mount Buller?
   b. Which month is coolest in Mount Buller?
   c. Which month has the greatest precipitation in Mount Buller?
   d. Which month has the least precipitation in Mount Buller?
   e. **Describe** the climate of Mount Buller.

Checklist

I have:
- ruled the axes and labelled them
- drawn first in lead pencil and then used colour
- used small dots for the lines and then created a smooth curve with red pen
- shaded the columns in blue
- included a title and source.

LESSON
1.11 SkillBuilder: Creating and analysing overlay maps

LEARNING INTENTION

By the end of this SkillBuilder you should be able to create and analyse an overlay map.

1.11.1 Tell me

What are overlay maps?

An overlay map usually consists of two or more maps of the same area. These maps are drawn at the same size or scale but show different information. The base map often shows information that does not change very much. Another transparent overlay, showing different information, is laid over the base map.

Why are overlay maps useful?

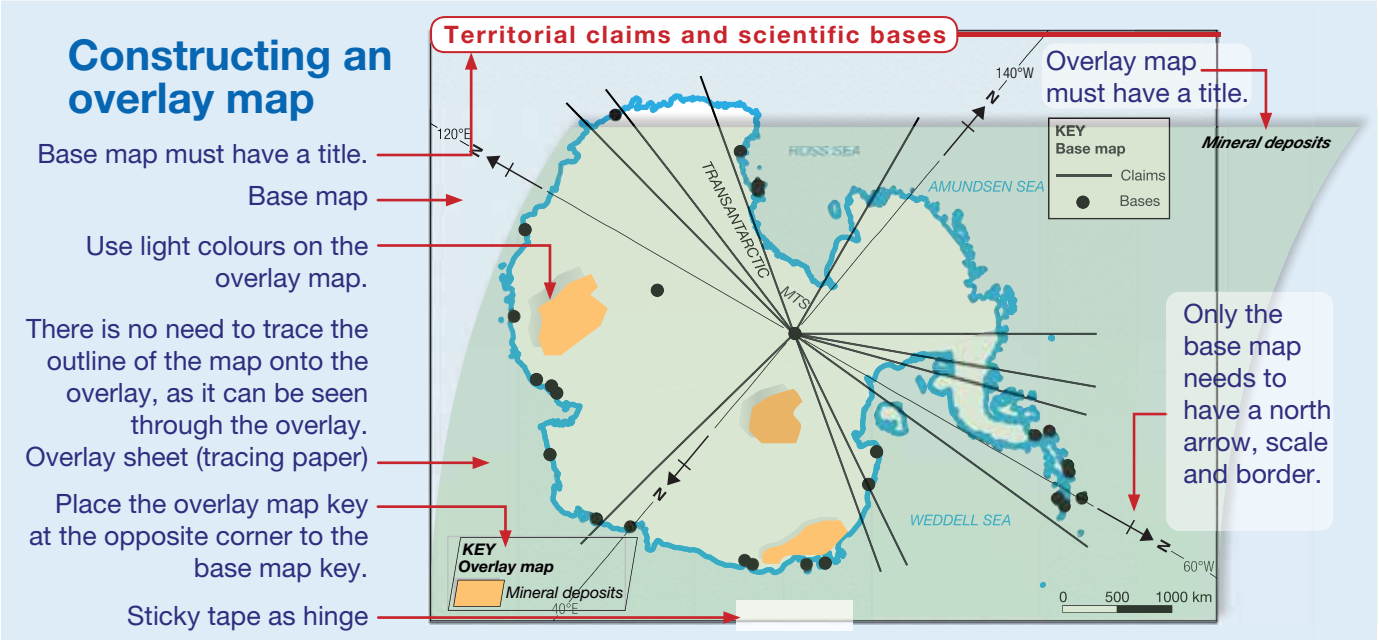
An overlay map is useful for comparing two different features on a map. It is really two maps in one — a base map drawn on paper and an overlay drawn on tracing paper to depict additional information.

Overlay maps allow map users to see the relationships between the information on two or more maps. They are useful when looking for patterns of spatial association — that is, features found in a similar distribution pattern.

Model

In the overlay map in **FIGURE 1**, the base map depicts the continent of Antarctica, territorial claims and scientific bases. The overlay illustrates mineral deposits.

FIGURE 1 Constructing an overlay map of mineral deposits in Antarctica



A good overlay map:

- is drawn in pencil first, with colour added later
- includes BOLTSS on the base map
- uses light colours on the overlay so the base map information remains visible
- includes a key for the element depicted on the overlay
- is hinged to the base map using sticky tape
- includes a title for the overlay.

1.11.2 Show me

How to complete an overlay map

You will need:

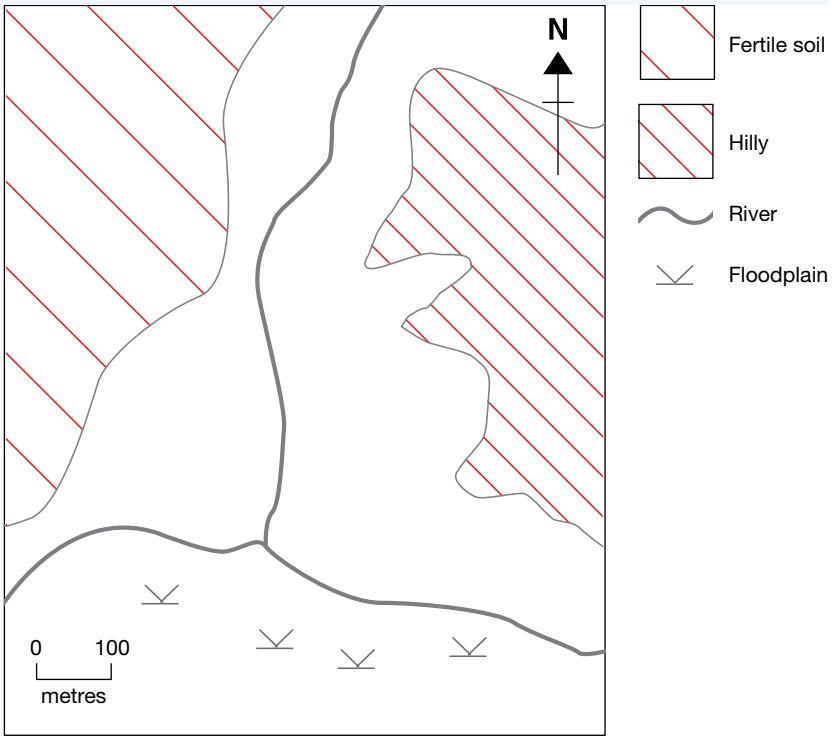
- two or more maps of the same area, drawn at the same scale, and showing different information
- tracing paper or clear transparency sheet
- cardboard (optional)
- clear adhesive tape
- a black lead pencil
- coloured pencils.

Procedure

Step 1

Create a base map of an area showing the distribution of features you want to display (see **FIGURE 2**). Base maps are drawn on clean white paper. To make a base map, find a map of the area that you want to show, and trace the features that are relevant to your purposes. Make sure you include BOLTSS.

FIGURE 2 The fictional Price Shire

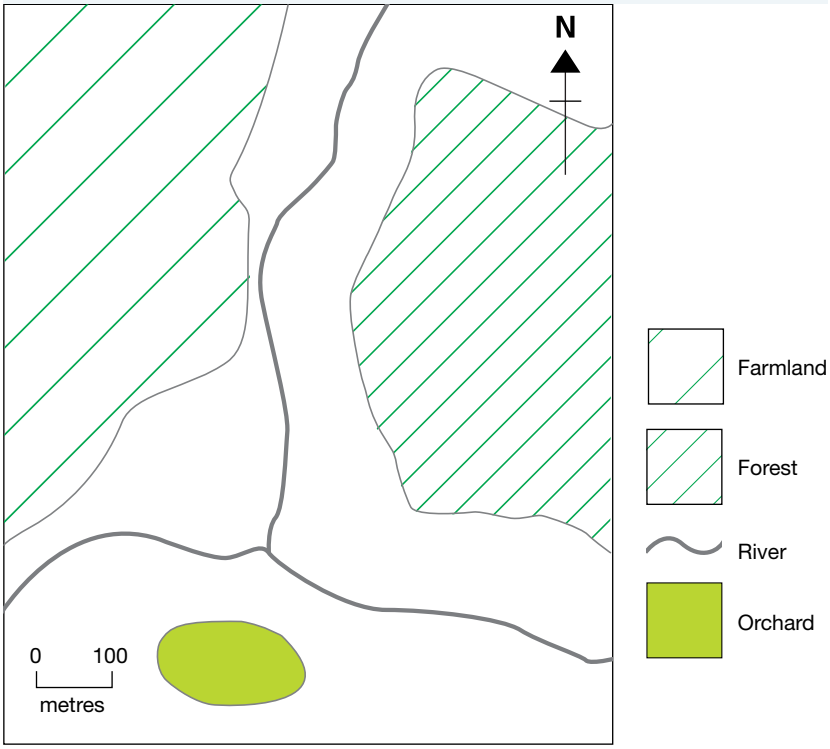


Source: Price Shire Council

Step 2

Create an overlay of a second feature on the tracing paper (see **FIGURE 3**). (Make sure the second map is of exactly the same area and is drawn to the same scale and size as the base map.)

FIGURE 3 Land use in Price Shire



Source: Price Shire Council

Step 3

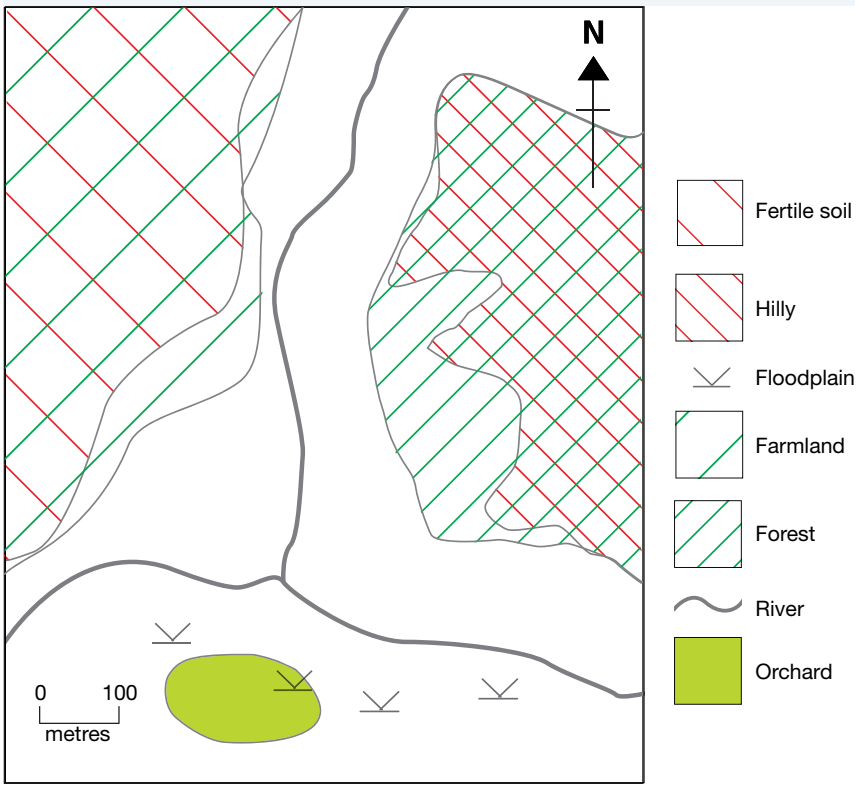
Join the base map and the overlay together using adhesive tape (see **FIGURES 4** and **5**). Before doing so, check that key features such as coastlines and major roads line up on both maps. You may wish to attach your base map to some cardboard to make it more durable. You can create more than one overlay, each depicting a different feature. If you do this, you can hinge each overlay from a different side of the base map.

FIGURE 4 Place the overlay onto the base map.

Resources

Video eLesson Creating and analysing overlay maps (eles-1645)
Interactivity Creating and analysing overlay maps (int-3141)

FIGURE 5 This overlay map reveals that farmland tends to be found in areas with fertile soils, and that forest tends to be found in hilly areas.



Source: Price Shire Council

1.11.3 Let me do it

Complete the following activities to practise this skill.

1.11 ACTIVITIES

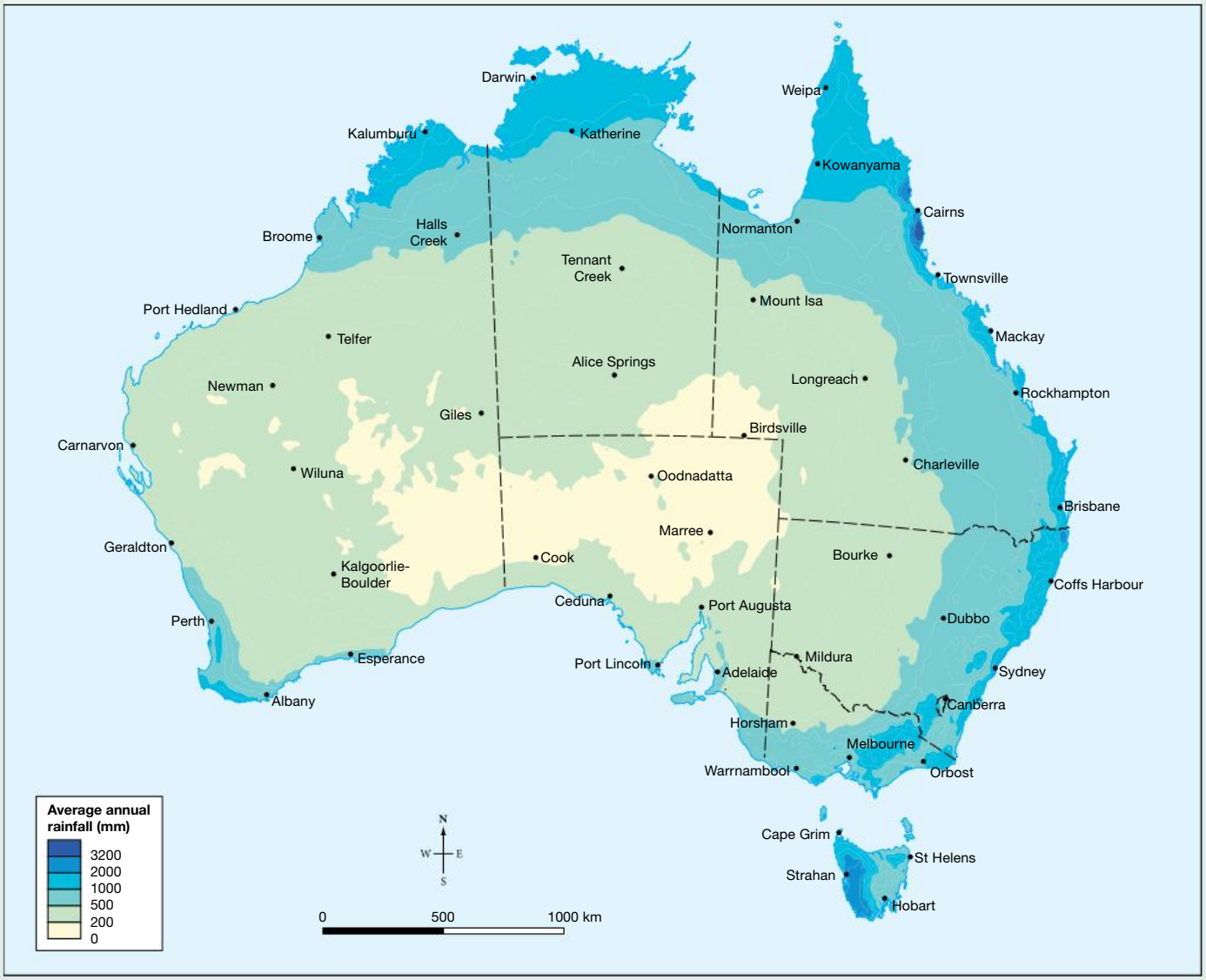
1. **Create** an overlay map to show the relationship between Australia's rainfall and population distribution. Use **FIGURE 6** to **create** a base map of rainfall patterns, and then use **FIGURE 7** to add the population overlay. Use the checklist provided to make sure you have covered all aspects of the task.
2. Once you have **created** your overlay map, using the skills you have developed in this SkillBuilder, answer the following questions.
   a. Look carefully at your base and overlay maps and hunt for patterns between them. Find examples where rainfall and population:
      i. mostly coincide with each other
      ii. sometimes coincide with each other
      iii. do not coincide at all with each other.
   b. **Describe** these areas, either by percentage or by amount of overlap.
   c. How strong is the **spatial** association (relationship) between the following?
      i. High rainfall and high population density
      ii. Low rainfall and a low population density

Checklist

I have:

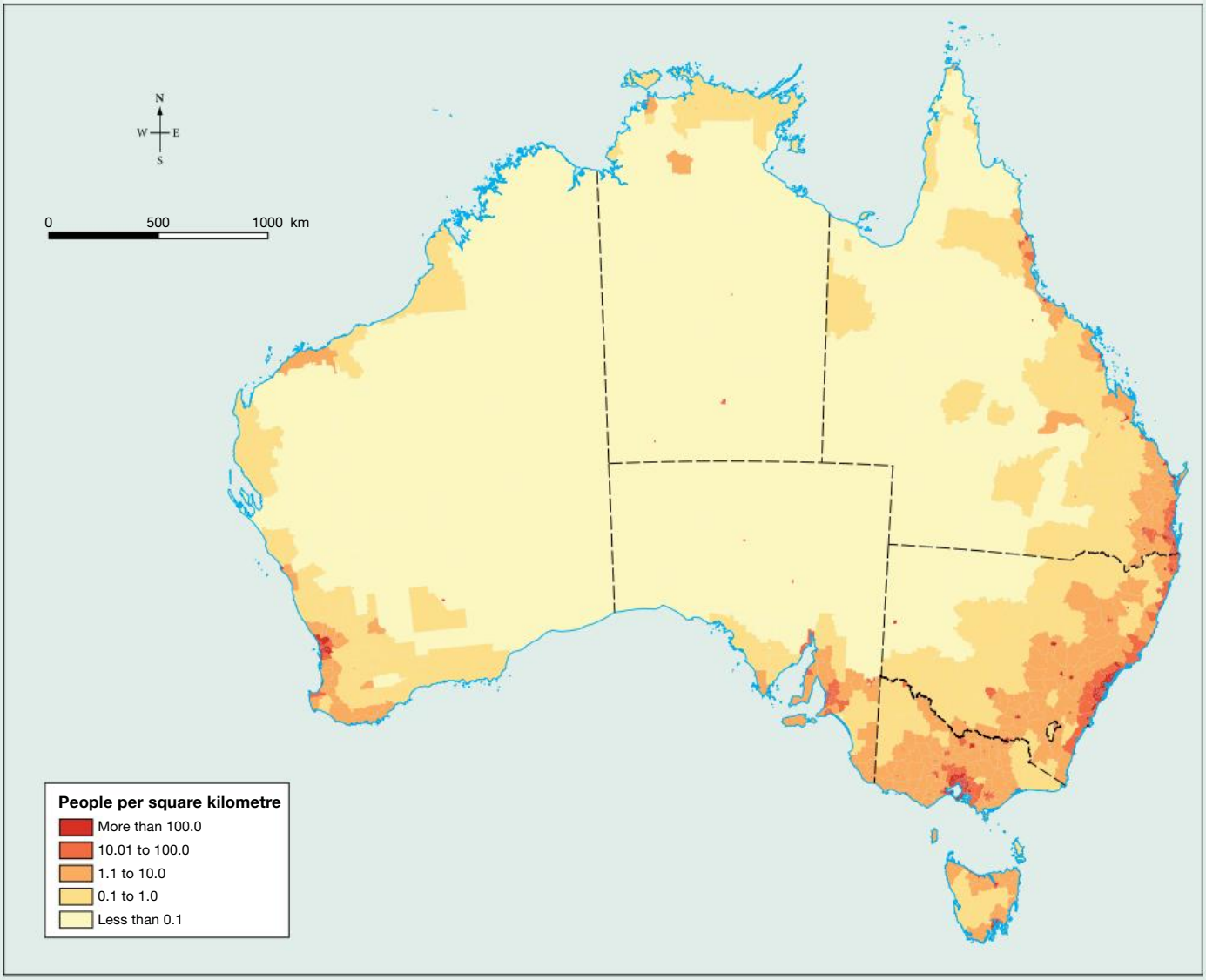
- drawn in pencil first and then added colour
- included BOLTSS on the base map
- used light colours on the overlay
- included a key on the overlay
- hinged the overlay to the base map using sticky tape
- included a title for the overlay.

FIGURE 6 Base map, Australian rainfall



Source: Bureau of Meteorology

FIGURE 7 Overlay map, Australian population density



Source: Australian Bureau of Statistics

LESSON
1.12 SkillBuilder: Annotating a photograph

LEARNING INTENTION

By the end of this SkillBuilder you should be able to annotate a photograph.

1.12.1 Tell me

Using annotated photographs in Geography

Photographs are used to show aspects of a place, but they don't always give us all the information. Often people will notice different elements in the same photograph, depending on their particular interest and knowledge. Annotations are added to photographs to draw the reader's attention to what can be seen and deduced. Look at **FIGURE 1** as an example. Because it is clearly shown in the photograph, we know the Campaspe River had water at the time the photograph was taken. However, we don't know what the water quality was like.

Moreover, photographs today are digital and can easily be resized and cropped, so it may be difficult to gain an accurate overview of the particular situation or environment depicted. It's also important to understand that the angle a photograph is taken from, and the time it is taken, can affect how easy it is to see some aspects in the photograph. You should consider the angle the photograph was taken from, and what might be outside the border of the photograph.

Why use annotated photographs?

Annotated photographs are useful in geographical inquiries as geographers are interested in analysing places, and photographs provide a snapshot at a point in time. The annotations are vital to fully understanding the photograph. When photographs are used to show spatial change over time, the same views are photographed at different times, and the annotations are used to highlight the changes.

A good annotated photograph includes:

- a clear title that includes the location of the photograph
- labels of the main features
- annotated processes if known
- date and time of when the photograph was taken
- the source of information — the photographer's name.

1.12.2 Show me

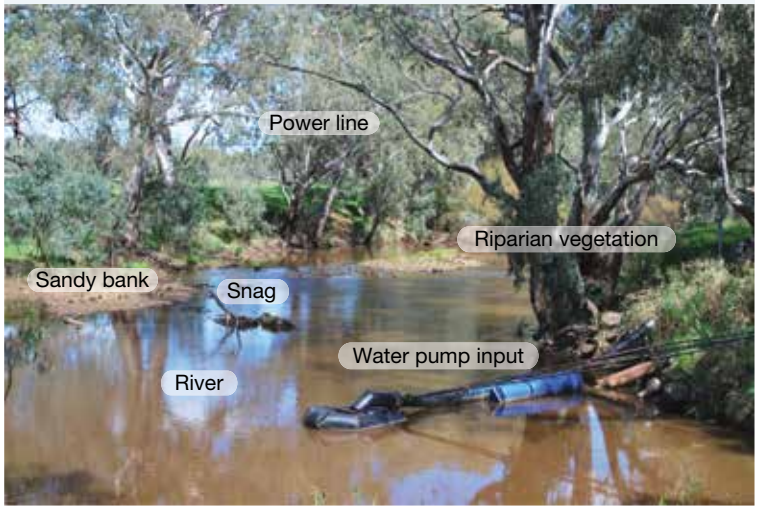
How to annotate a photograph

You will need

- a photograph
- a black fine-line felt-tipped pen
- a ruler.

Model

FIGURE 1 Campaspe River near Axedale, Victoria



Source: Taken by Mattinbgn, 17 March 2012. © Creative Commons

Procedure

Step 1

Examine the photograph in **FIGURE 2** carefully, looking for the key information it is showing you. You will notice that this particular image includes evidence that it was taken during a low flow period, because the water line is below the line of trees that mark a higher water level. Previous high flow or perhaps flood events of the river are shown by the large logs deposited in the currently dry bed of the river.

FIGURE 2 Annotating a photograph

Source: Taken by Paul Humphries, 5 February 2012. © Paul Humphries

Step 2

Check the date the photograph was taken. This photograph is tagged 5 February 2012. The photographer is Paul Humphries and the location is Campaspe River at Strathallen; therefore, a clear title might be *Campaspe River at Strathallen during summer low flow period*. It is important to provide the source underneath, because this provides the reader with information as to who took the photograph and the time of year at which it was taken. In this case, it is '*Source:* Taken by Paul Humphries, 5 February 2012'.

Step 3

Add labels to the image, focusing on the key aspects you wish the viewer to notice. These might include *River in low flow*, *Debris deposited in high flow* and *Gum trees*. Adding labels is often much easier if you took the photograph and made field notes while you were on site. For example, you could have determined if the river was flowing and in which direction. If, for the purpose of retaining clarity within the image, labels need to be placed outside the photograph, fine lines should be drawn from each annotation to the relevant feature.

on Resources

Video eLesson Annotating a photograph (eles-1633)
Interactivity Annotating a photograph (int-3129)

1.12.3 Let me do it

Complete the following activities to practise this skill.

1.12 ACTIVITIES

1. **Annotate** the following photograph. **Label** any physical processes that you can see. For example, the river is flowing towards the foreground of this photograph. **Label** the human activities that are shown. Use the checklist provided to make sure you cover all aspects of the task.

FIGURE 3 Yarra River, Melbourne, Australia

Source: Taken by Russell Moseley at 5 pm, 10 September 2012. © Russell Moseley http://www.free-things-to-do-melbourne.com

2. Once you have labelled your photograph, **apply** your skills to answer the following questions:
   a. Name two activities that you can see.
   b. What are the tall poles for?
   c. Where are boats stored? How do you know?
   d. What is the landing platform made of?
   e. Give evidence to support the idea that rivers such as this are an important resource for people.

Checklist

I have:
- a clear title that includes the location of the photograph
- labelled the main features
- included annotated processes, if known
- included the date and time of when the photograph was taken
- provided the source of the information.

LESSON
1.13 SkillBuilder: Drawing a line graph

LEARNING INTENTION

By the end of this SkillBuilder you should be able to draw a line graph.

1.13.1 Tell me

What is a line graph?

A line graph displays information as a series of points on a graph that are joined to form a line. A line graph can be drawn by hand or by using a spreadsheet program such as Excel.

How are line graphs useful?

Line graphs are very useful to show change over time. They can show a single set of data, or they can show multiple sets based on a common theme, such as water use in the Murray–Darling Basin compared to water use in South Australia (see **FIGURE 1**). This enables us to compare similarities and differences between two sets of data at a glance.

A good line graph has:
- been drawn in pencil
- an appropriate scale to show the data clearly
- labelled axes
- used small dots joined by a line to make a smooth curve
- a legend, if necessary
- a clear and accurate title that explains the purpose of the graph
- the source of the data.

1.13.2 Show me

How to complete a line graph

You will need:

- data (see **TABLE 1**)
- graph paper
- a pencil
- a ruler.

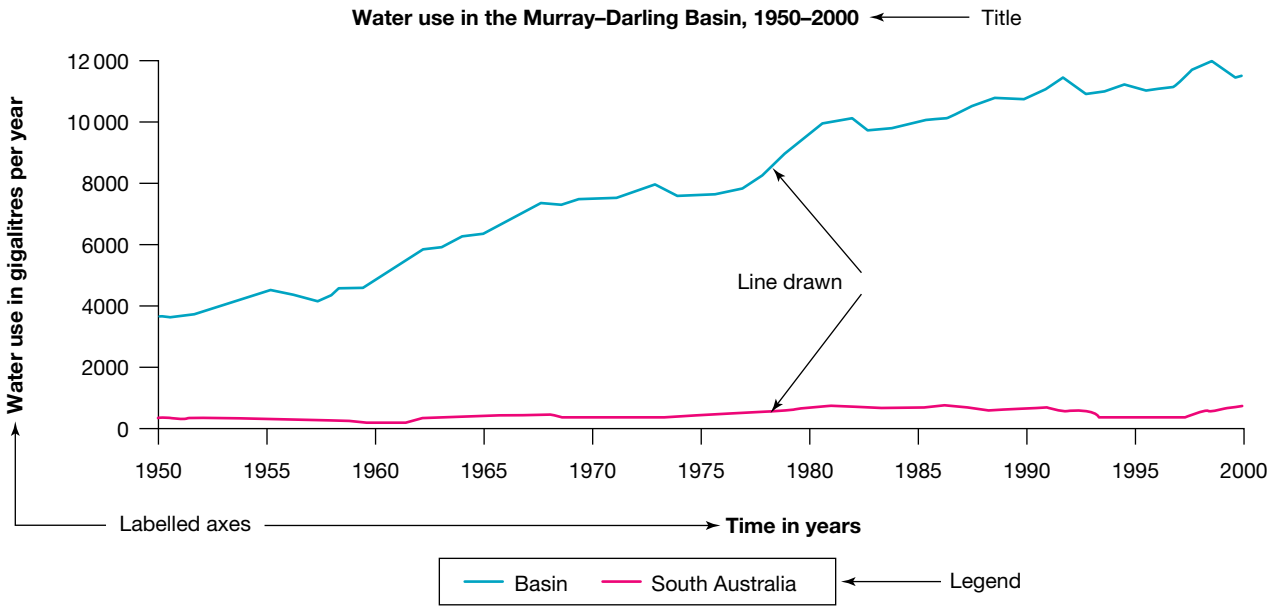
TABLE 1 Use of rainwater tanks by household, 2001–2010

Year	Use of rainwater tanks by household (%)
2001	16
2004	17
2007	19
2010	26

Source: © Australian Bureau of Statistics

Model

FIGURE 1 Water use in the Murray–Darling Basin and in South Australia



Source: © Department of Environment, Water and Natural Resources, South Australia Government

Procedure

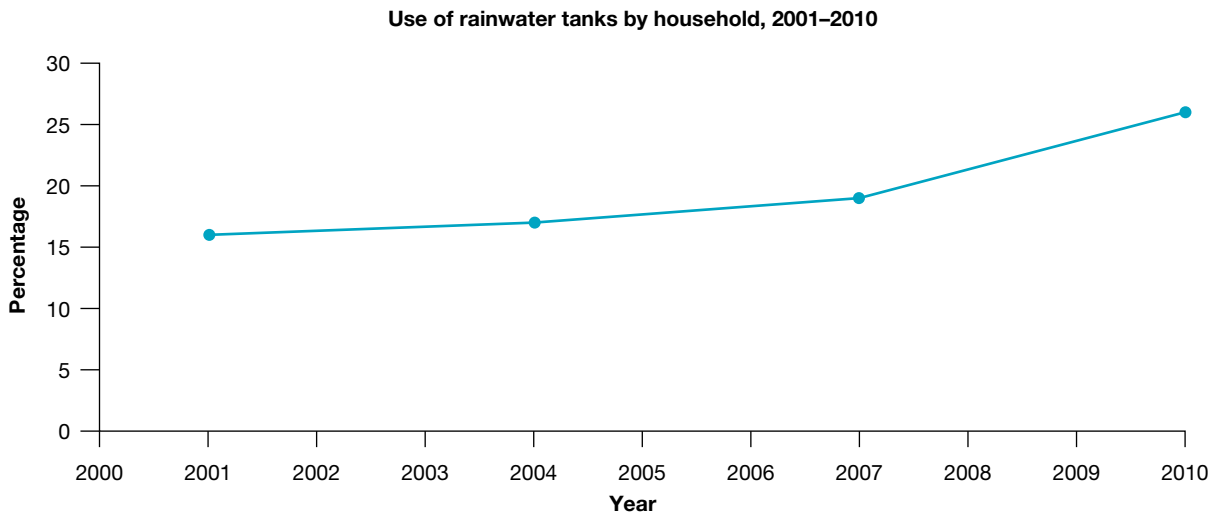
Step 1

Select the data you wish to compare or interpret (see **TABLE 1**).

Draw a horizontal and vertical axis using a ruler.

Evenly space and then label the years along the horizontal axis. Look carefully at your range of data and work out appropriate increments for the vertical axis, and then evenly space and label this information on the axis. Start at zero where the axes join. For the **TABLE 1** data, an increment of 5 percentage points would be appropriate.

FIGURE 2 Use of rainwater tanks by household, 2001–2010



Source: © Australian Bureau of Statistics

Step 2

Label the *x* and *y* axes. In this case, the *x*-axis would be labelled 'Year', and the *y*-axis would be labelled 'Percentage'.

Plot the statistics. Draw a dot at the point where the year on the horizontal axis meets the relevant position on the vertical axis. Once you have plotted all the statistics, join the dots. This can be done freehand or using a ruler.

Step 3

Add a title and a source to the graph.

on Resources

Video eLesson Drawing a line graph (eles-1635)
Interactivity Drawing a line graph (int-3131)

1.13.3 Let me do it

Complete the following activities to practise this skill.

1.13 ACTIVITIES

1. Use the data in **TABLE 2** to **create** a line graph. Use the checklist provided to make sure you cover all aspects of the task.

TABLE 2 Daily residential water consumption for South Australia

Year	Daily residential water consumption (litres)
2001	539
2002	502
2003	532
2004	460
2005	465
2006	440
2007	413
2008	410
2009	395

Source: SA Water, Annual Reports

2. Based on what you have learned in this SkillBuilder and referring to your graph, **apply** your skills to answer the following questions.
   a. In which year was water consumption lowest?
   b. **Describe** the pattern shown by the graph.
   c. What reasons might explain the changes from 2001 to 2009?
   d. When water restrictions were lifted in 2011, predict what happened to water consumption.
   e. If the government made every household adopt water saving measures in 2022, what might happen to water consumption?
   f. Find statistics for water consumption for your area and compare these to another area.
   g. **Explain** how useful the graph was in helping you understand the changes that occurred to water consumption in South Australia compared to reading a table of figures.

Checklist

I have:
- labelled the axes
- provided a clear title and source
- plotted the data accurately
- joined the points with a smooth line.

LESSON
1.14 SkillBuilder: Interpreting diagrams

LEARNING INTENTION

By the end of this SkillBuilder you should be able to interpret diagrams.

1.14.1 Tell me

What are diagrams?

A diagram is a graphic representation of something. In Geography, it is often a simple way of showing the arrangement of elements in a landscape and the relationships between those elements. A common diagram that you are probably familiar with is the water cycle (see **FIGURE 1**). Diagrams also have annotations: labels that explain aspects of the illustration. Interpreting diagrams involves examining the visual and text elements provided to gain an understanding of all the information presented.

What causes rainfall? Where does the water come from and where does it go? The answers lie in the water cycle. Water evaporates from oceans, lakes and vegetation, and condenses into clouds. The rain, sleet, hail or snow that falls from clouds flows back into rivers, lakes and oceans and underground, where the water cycle process continues.

How are diagrams useful?

Diagrams are useful for representing ideas visually. They are often used to increase understanding of written information. They can be used to:

- illustrate a process
- simplify a concept
- show flows and movements
- illustrate relationships spatially.

The diagram in **FIGURE 2** shows how properties can be designed to manage floods in new development areas and existing development areas.

A good diagram:

- is large so it can be easily interpreted
- has understandable annotations or labels
- is clear and simple
- includes a precise title or caption
- states the source – where it came from or who created it.

1.14.2 Show me

How to interpret a diagram

You will need:

- a diagram (see **FIGURE 3**)
- any information that is related to the diagram.

Model

The amount and intensity of rainfall is the most important factor in causing a flood, but many other factors can contribute to flooding. When it rains in a catchment, the amount of rainwater that flows into the rivers depends on land uses. Some water can soak into soil unless the soil is already saturated from previous rainfall. Urban areas have many hard surfaces such as roads, so water is less able to soak into the soil and more water

flows into drains and creeks. Heavy vegetation can slow the movement of water to rivers. Dams can be used to control the amount of water released downstream. The shape of the land is also an important factor, because more water usually runs off steep slopes.

Procedure

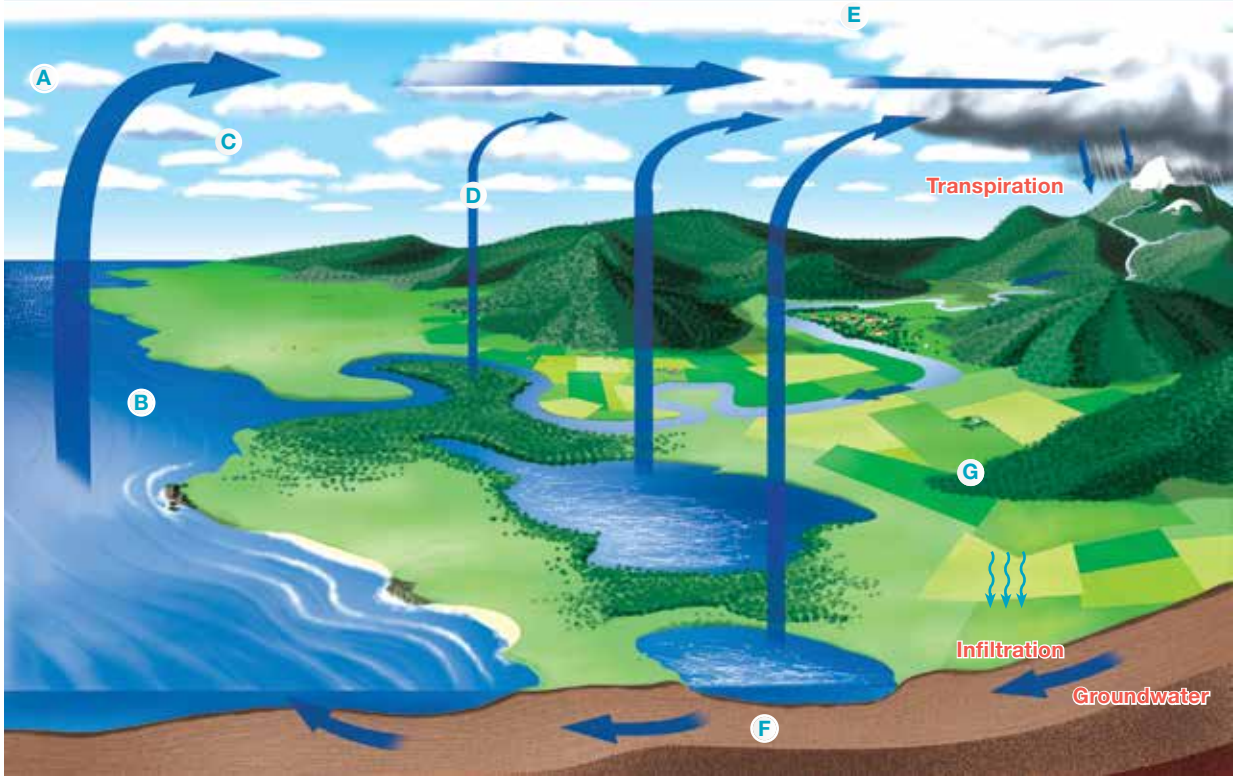
Step 1

Identify and carefully read the title of the diagram, because it helps you to understand the diagram's purpose. The diagram in **FIGURE 3** is illustrating factors that can affect flooding, and it is designed to be read with the explanatory text.

Step 2

Examine the diagram to identify all the elements being illustrated and the annotations. Look at each part of the diagram. You will notice that various factors are identified, including rainfall, run-off, vegetation, size of waterways, soil type, slope and land use.

FIGURE 1 The water cycle



- **A** The sun's heat provides the energy for the water cycle process.
- **B** The sun evaporates water from oceans, damp soil, leaves and people's skin, turning it into water vapour.
- **C** The warm air that absorbs evaporated moisture expands and rises into the atmosphere.
- **D** As warm, moist air rises, it cools. Water vapour that cannot be held in the air condenses into tiny water droplets or ice crystals. As more of these form, clouds appear. This process is known as condensation.
- **E** When the droplets or crystals in the cloud become too heavy to overcome the pull of gravity, they fall to Earth as precipitation.
- **F** Run-off from land returns to the sea via rivers and underground channels.
- **G** Infiltration occurs when water seeps into the soil.

FIGURE 2 Managing flood risks

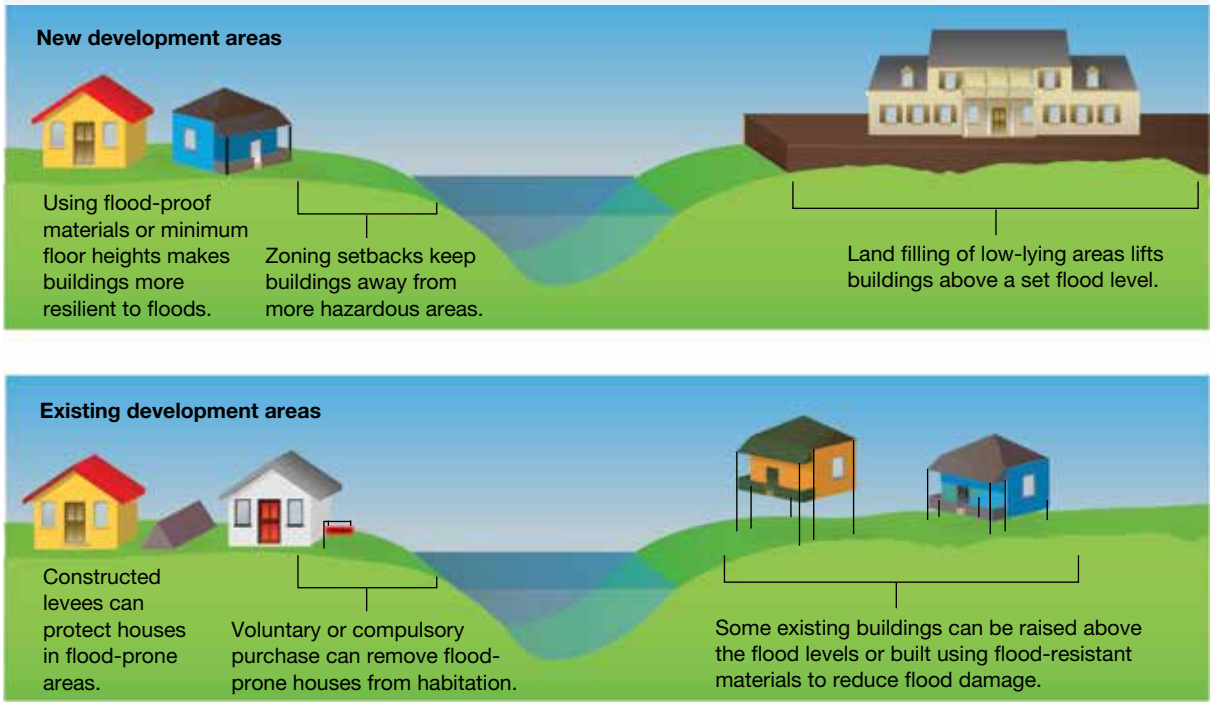
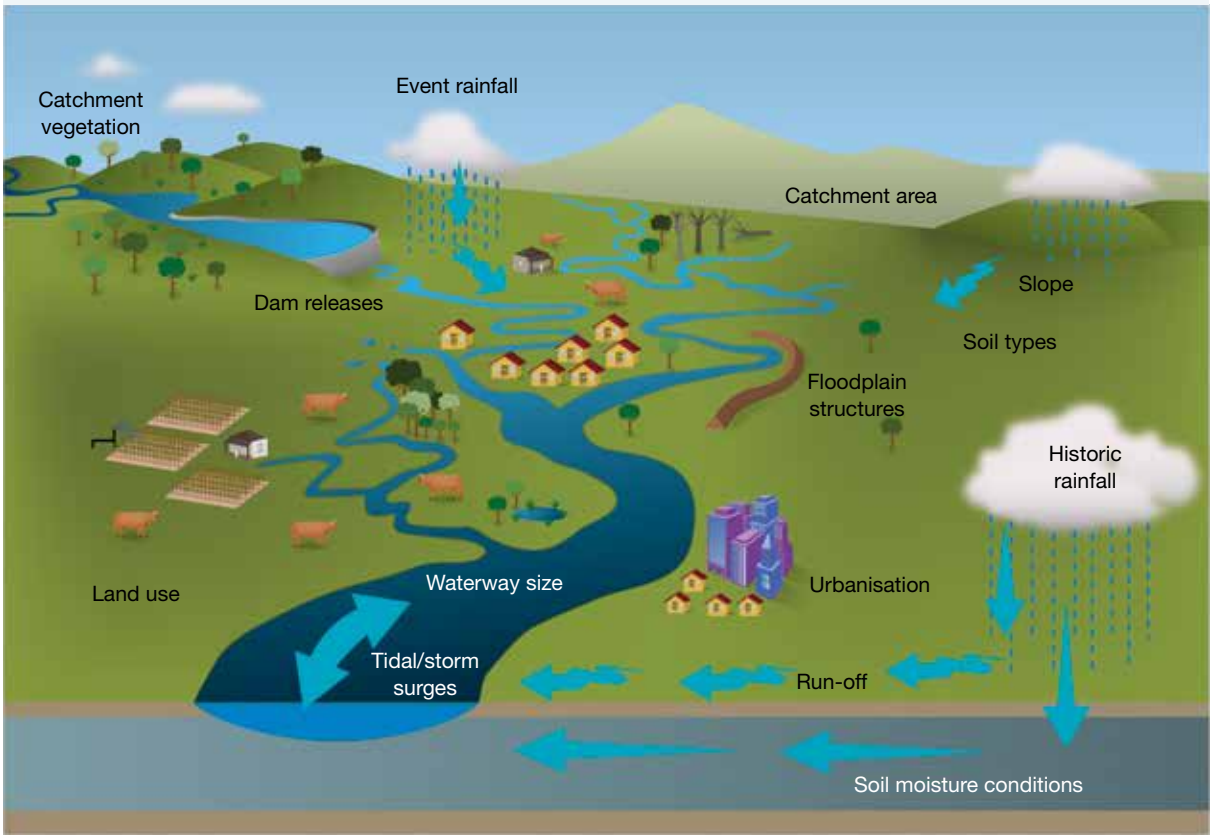


FIGURE 3 Factors that can affect flooding



Source: www.chiefscientist.qld.gov.au/publications/understanding-floods/what-is-a-flood.

Step 3

Now consider the diagram as a whole. Studying the diagram helps you conclude that many factors affect flooding. It is more complicated than simply how much rain falls and how quickly.

Resources

Video eLesson Interpreting diagrams (eles-1636)
Interactivity Interpreting diagrams (int-3132)

1.14.3 Let me do it

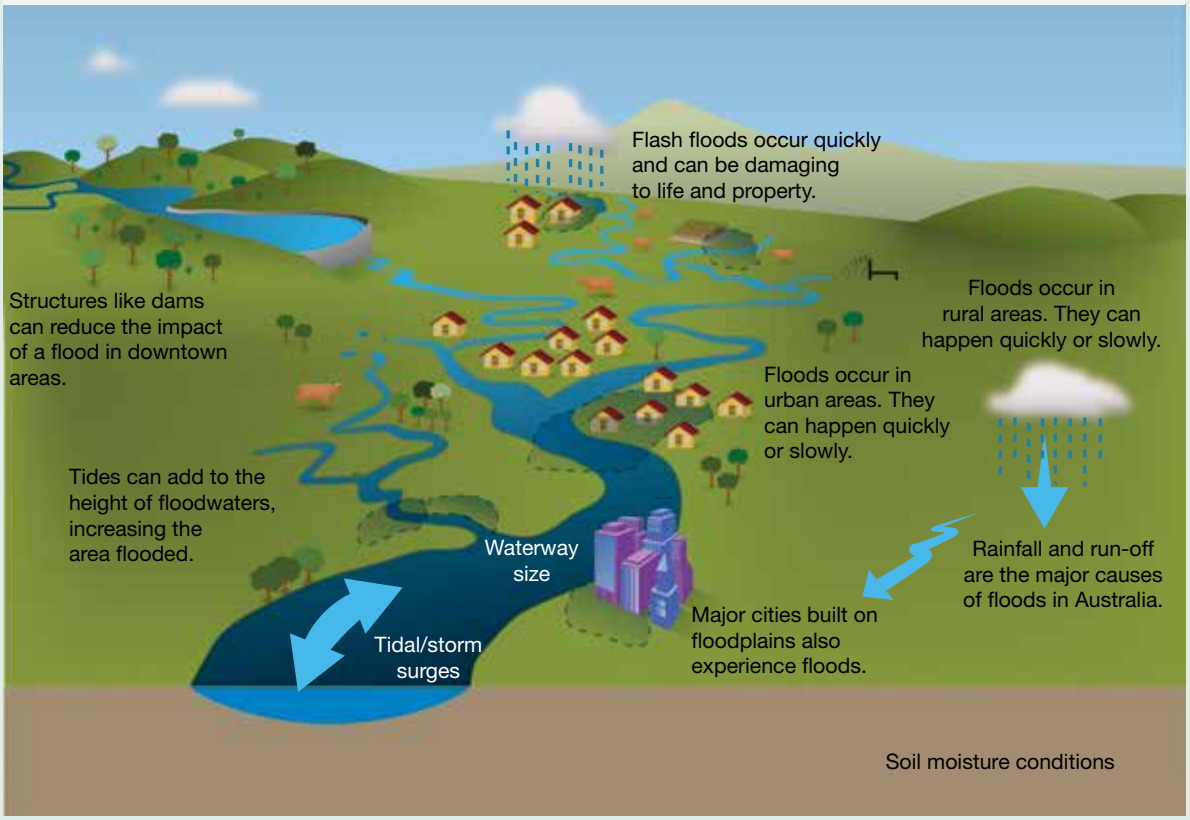
Complete the following activities to practise this skill.

1.14 ACTIVITIES

Rainfall is the main cause of flooding in Australia. Floods can happen quickly (flash flooding) or slowly, and they are difficult to predict. Cities and farms are often built on floodplains (land that is subject to occasional flooding) because they provide access to water and good quality soil. In coastal areas, tides can add to flooding.

1. **Apply** your skills to interpret **FIGURE 4** and answer the following questions.
   a. How might a dam affect flood events?
   b. What is run-off?
   c. What effect can high tides have during flooding in coastal areas?
   d. Why are cities sometimes built on floodplains?
   e. What are some effects of floods?

FIGURE 4 Characteristics of floods



Checklist

I have:

- understood the title
- **examined** all parts of the diagram — the illustrations, annotations and any accompanying text
- **considered** the diagram as a whole.

LESSON
1.15 SkillBuilder: Cardinal points — wind roses

LEARNING INTENTION

By the end of this SkillBuilder you should be able to interpret wind roses.

1.15.1 Tell me

What is a wind rose?

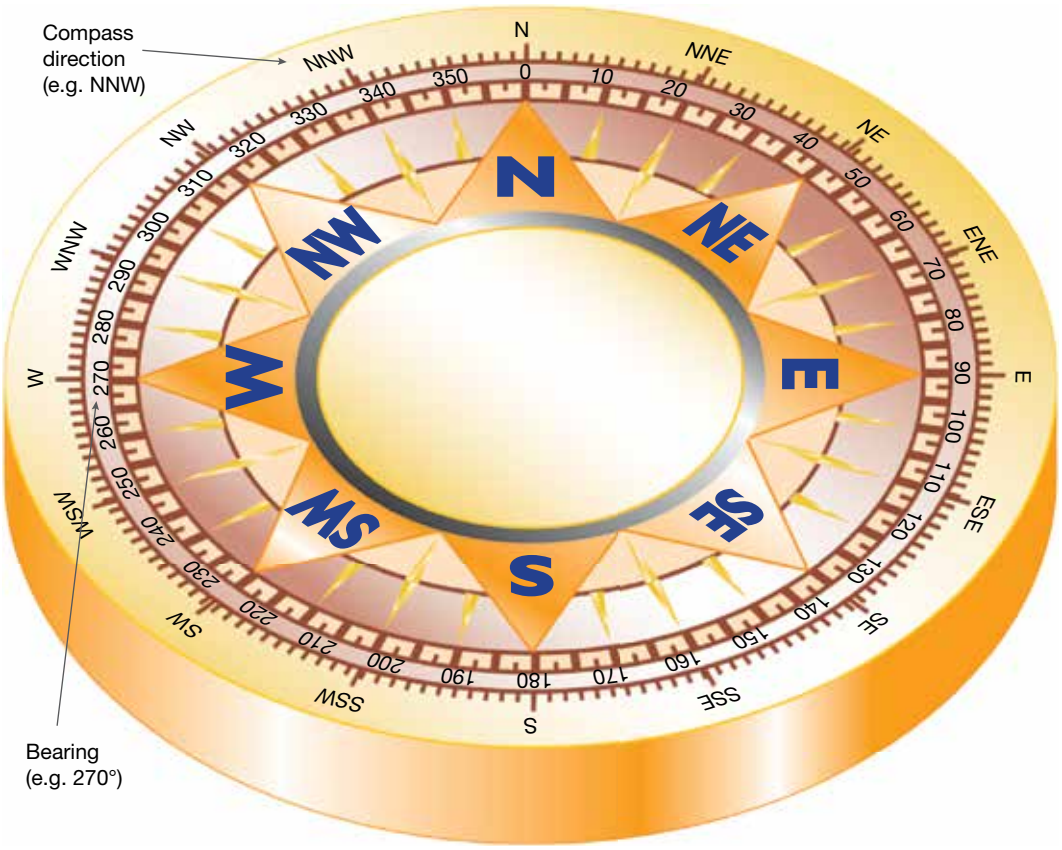
A wind rose is a diagram that shows the direction, speed and frequency of wind. We name wind direction according to the direction from which the wind is blowing. For example, a wind described as 'a southerly' is coming from the south. Wind direction can be described using 8 or 16 compass directions.

To understand a wind rose, you must know your cardinal points. Let's quickly revisit these.

What are cardinal points?

A compass has four main (or cardinal) points: north, east, south and west. These four cardinal points are used to describe direction. For example, if you are facing north, south is behind you, east is to your right and west is to your left. To give more accurate directions, the four cardinal points can be divided into inter-cardinal points: north-east, south-east, south-west and north-west. For even finer definition, we can further divide the inter-cardinal points (see **FIGURE 1**). For example, between north and north-west, is north-north-west (NNW); between north-west and west is west-north-west (WNW), and so on. Cardinal and inter-cardinal points are used in wind roses.

FIGURE 1 A compass



Why are wind roses useful?

Wind roses are useful because they allow us to quickly see patterns in relation to wind direction, speed and frequency.

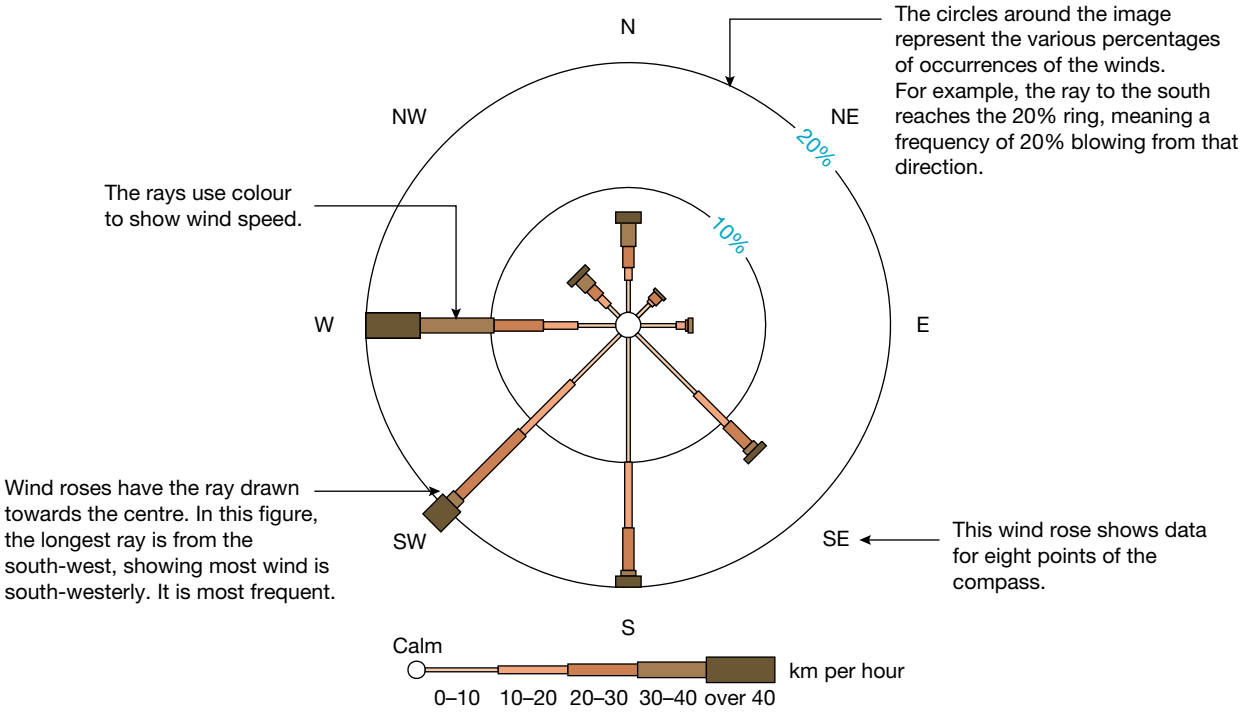
Interpreting a wind rose

To interpret a wind rose, remember the following points:

- Wind roses have the rays drawn towards the centre. In **FIGURE 2** the longest ray is from the south-west, which shows that most of the wind is south-westerly. It is most *frequent*.
- The circles around the image represent the various percentages of occurrences of the winds. For example, if the ray to the south just reaches the 20 per cent ring, it means a frequency of 20 per cent blowing from that direction.
- The rays use symbols and colour to show wind *speed*.

The **FIGURE 2** wind rose shows data for eight points of the compass.

FIGURE 2 A wind rose



1.15.2 Show me

How to read a wind rose

You will need:

- a wind rose (see **FIGURE 3**)
- a ruler.

Procedure

To describe wind patterns using a wind rose you need to examine the direction, length and width of the rays. We will use **FIGURE 3** to explore this process.

Step 1

Determine the direction of wind with the greatest frequency by finding the longest ray. In **FIGURE 3**, the longest ray is from the south, so we can say that the predominant average wind direction in Melbourne at 3 pm is a southerly.

Step 2

Determine the direction of wind with the highest speed by finding the widest ray. In **FIGURE 3**, we can see that the highest average speeds were reached by winds coming from the north (northerlies).

Step 3

Work out the general pattern and main features of wind direction and strength. The **FIGURE 3** wind rose shows us that in Melbourne at 3 pm, the predominant average winds are southerlies, occurring more than 30 per cent of the time. The next most frequent wind at 3 pm is a northerly, which blows more than 20 per cent of the time. Winds blow from the west only around 10 per cent of the time, and easterlies are very infrequent.

Resources

Video eLesson Cardinal points: wind rose (eles-1638)
Interactivity Cardinal points: wind rose (int-3134)

1.15.3 Let me do it

Complete the following activities to practise this skill.

1.15 ACTIVITIES

Interpret the wind roses in **FIGURES 3** and **4** to answer the following questions. Use the checklist provided to make sure you cover all aspects of the task.

1. In which direction are the highest frequency winds for Melbourne, 9 am?
2. In which direction are the highest speed winds for Melbourne, 9 am?
3. In which direction are the lowest frequency winds for Melbourne, 9 am?
4. In which direction are the lowest frequency winds for Melbourne, 3 pm?
5. **Compare** and **contrast** the wind direction patterns for Melbourne at 9 am and at 3 pm.

Checklist

I have:

- found the longest ray to determine the direction of wind with the highest frequency
- found the widest ray to determine the direction of wind with the highest speed
- worked out the general pattern and main features of wind direction and strength.

FIGURE 3 Wind rose for Melbourne, annual average at 3 pm

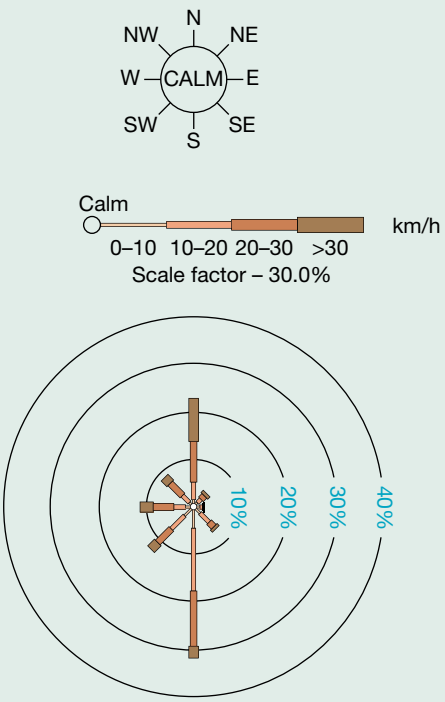
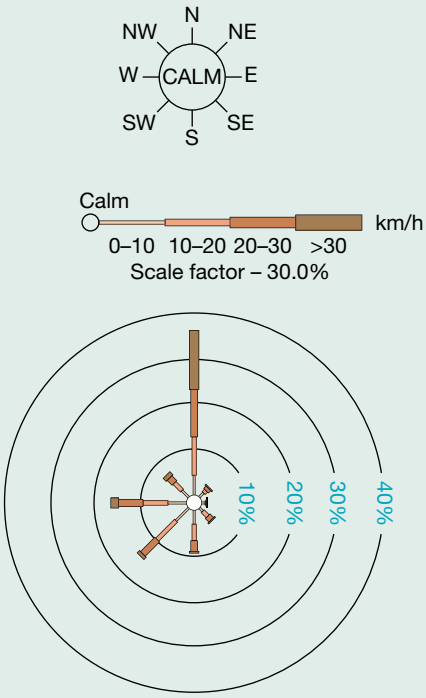


FIGURE 4 Wind rose for Melbourne, annual average at 9 am



LESSON
1.16 SkillBuilder: Creating a concept diagram

LEARNING INTENTION

By the end of this SkillBuilder you should be able to create a concept diagram.

1.16.1 Tell me

What is a concept diagram?

A concept diagram, sometimes mistakenly called a concept map, is a graphical tool that shows links between ideas, or concepts. Concept diagrams organise links into different levels.

Why are concept diagrams useful?

Concept diagrams enable you to organise your ideas and communicate them to others. They also help you to clarify and represent your knowledge of a topic or issue. They highlight the ways your thoughts and ideas relate to each other. They are useful for when you are reflecting on a topic or issue, especially towards the end of studying a topic, because they help you see connections between ideas and information. They can also be useful when brainstorming, and can help you in the further research of a topic.

A good concept diagram should:

- include a clear title
- be presented neatly and clearly
- explain what each colour represents
- be easy for another person to understand.

1.16.2 Show me

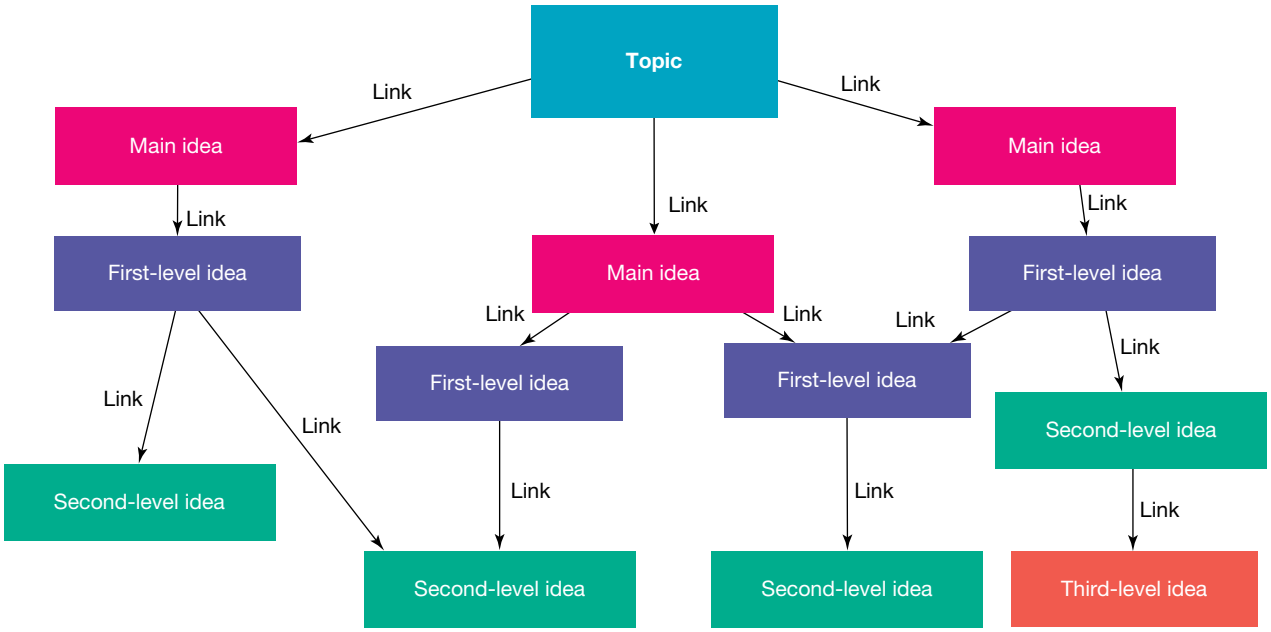
How to create a concept diagram

You will need:

- a blank sheet of paper
- a ruler
- colour pencils
- an eraser
- a black lead pencil.

Model

FIGURE 1 Example of a concept diagram

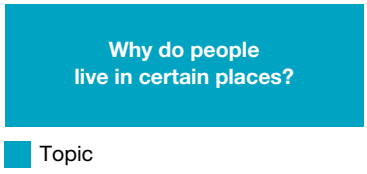


Procedure

Step 1

First, start with a topic. Place this in the middle of a blank sheet of paper. Rule a box or draw a circle around it.

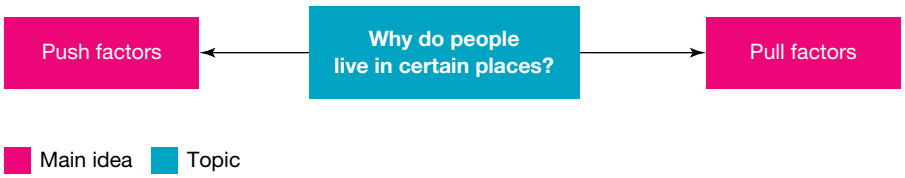
FIGURE 2 Start with the topic.



Step 2

Use your ruler to draw lines out from this box or circle and add key words about the topic or issue. This level is called the main ideas level.

FIGURE 3 Add your main ideas.



Step 3

Add other lines to each of the main ideas and add words that relate to each of them. This level is called first-level ideas.

Step 4

Add new lines and words, so that the diagram develops into something that resembles a spider web. This level is called second-level ideas. If you like, you can add extra information on some of the connecting lines. You may also choose to add colours to represent different levels or connections. Add a clear title.

FIGURE 4 Add your first-level ideas.

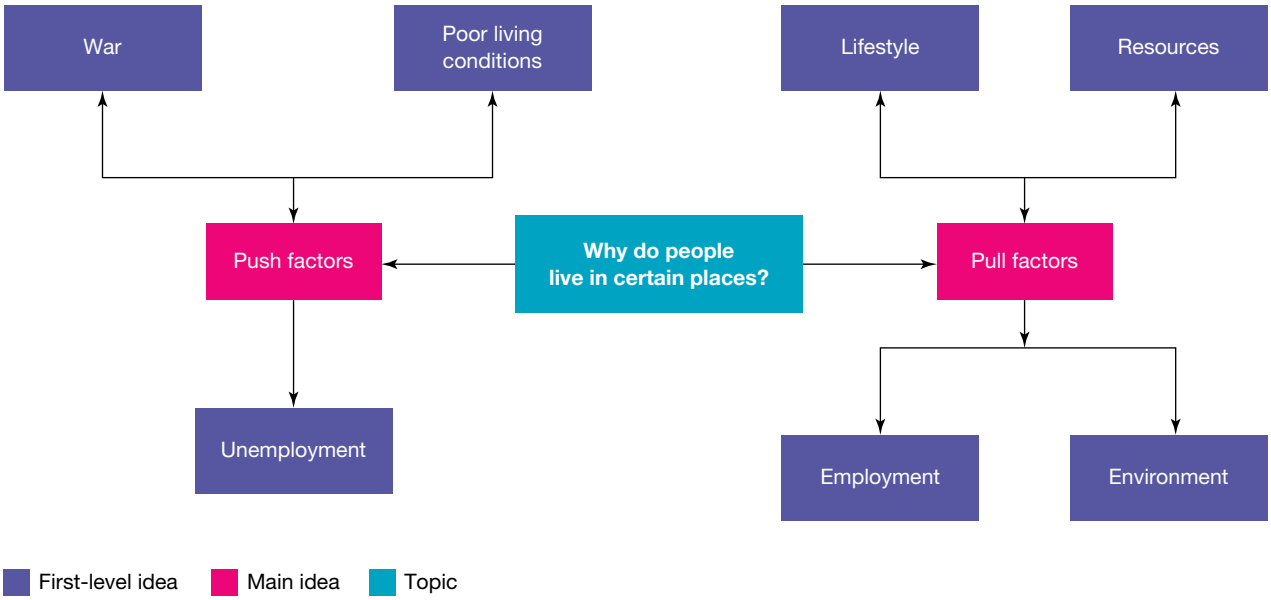
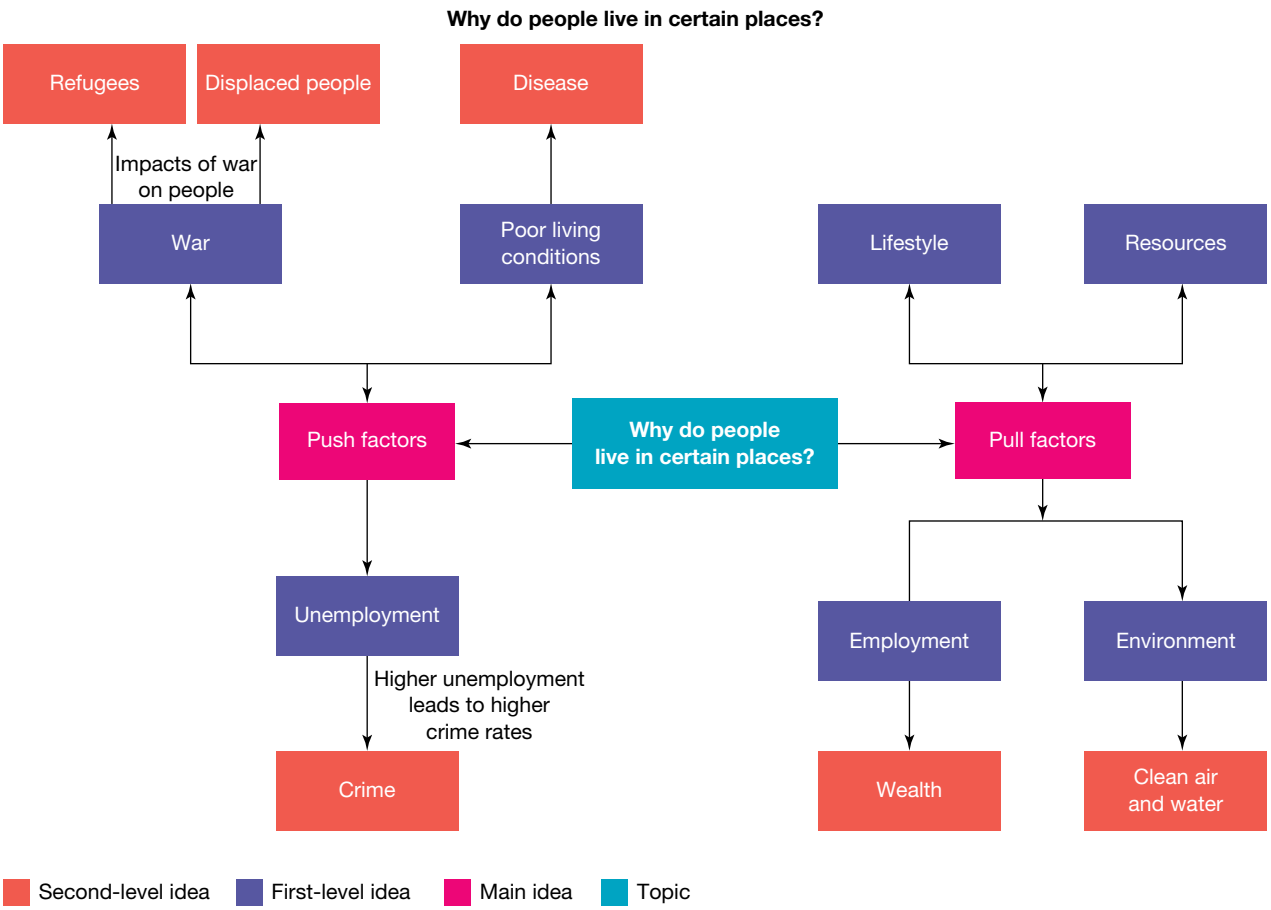


FIGURE 5 Add second-level ideas and give your concept diagram a title.



on Resources

Video eLesson Creating a concept diagram (eles-1640)
Interactivity Creating a concept diagram (int-3136)

1.16.3 Let me do it

Complete the following activity to practise this skill.

1.16 ACTIVITY

1. **Apply** what you have learned in this SkillBuilder to **create** a concept diagram of the reasons Australians live where they do. You may want to structure your concept diagram using some of the following aspects:
   - natural features or built features that attract people to live in certain places
   - push and pull factors
   - your own family's reasons for living where they do, or your classmates' families' reasons for living where they do
   - reasons remote areas are settled
   - lifestyle choices.

Checklist

I have:
- included a title
- neatly constructed and presented the information
- **explained** what each colour represents
- ensured the finished diagram is easy for another person to understand.

LESSON
1.17 SkillBuilder: Interpreting topological maps

LEARNING INTENTION

By the end of this SkillBuilder you should be able to interpret a topological map.

1.17.1 Tell me

What is a topological map?

Topological maps are very simple maps, with only the most vital information included. These maps generally:

- use pictures to identify places
- are not drawn to scale
- provide no sense of distance
- provide general directions
- exaggerate the size of certain places
- do not show exact routes.

However, everything is correct in its interconnection to other points.

How is a topological map useful?

A topological map is useful as a mental map to help you locate important features. Large areas can be drawn to show the viewer the important points. You could use these in class as summary maps of a topic, or as quick sketch maps to illustrate a point or to clarify something for another student.

They are also useful for:

- giving tourists a snapshot of where features are located
- quickly showing how to get to a place
- showing very large transport routes such as bus and train routes across a city
- planning international flights.

A good interpretation of a topological map:

- identifies and communicates key features
- clearly represents and communicates the data.

1.17.2 Show me

How to use a topological map

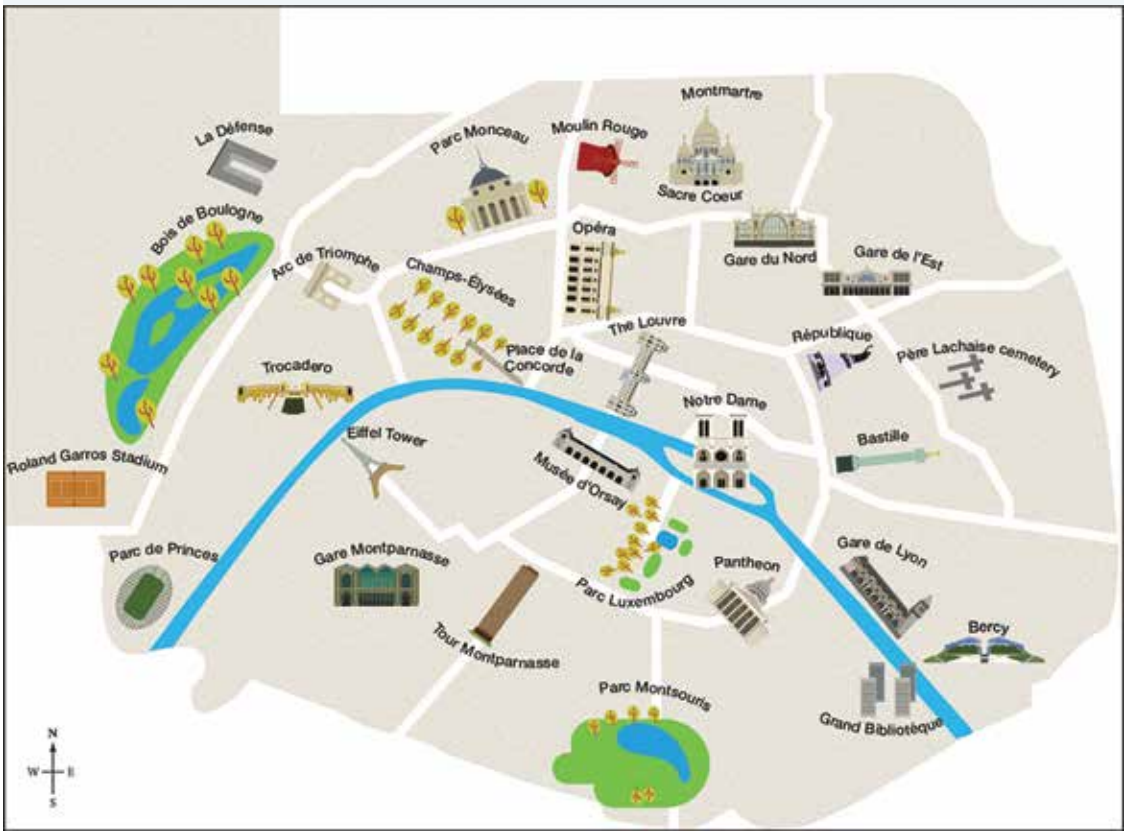
You will need:

- a topological map (see **FIGURE 1**).

Model

The topological map of central Paris shown in **FIGURE 1** is designed for people moving around Paris as tourists. It provides an indication of the major sites that tourists ought to visit, and allows them to see on which side of the river different monuments are found. For example, you would expect to find the Champs-Élysées and the Louvre on the same side of the river and quite close to each other. Major routes are given between monuments but these routes may not be the shortest distance, because no scale is provided with the map. This means judging the best way to get from the Eiffel Tower to Notre Dame Cathedral, for example, is difficult. The actual direction from one monument to the other is unlikely to be exact, because the lack of scale causes features to become distorted. This type of map, however, might help tourists plan their sightseeing, because it gives the user a general idea of where things are located. If going from the Eiffel Tower to the Arc de Triomphe, is it better to stroll along the river and up a major route?

FIGURE 1 A tourist map of Paris and its monuments



Procedure

Step 1

Look all around the topological map and identify the key features being shown. In **FIGURE 1**, almost 30 major tourist attractions of Paris are shown as drawings of each place. Some drawings are larger than others to show the significance and the popularity of these places with tourists.

Step 2

Think about the interconnection between features. On the map in **FIGURE 1**, the interconnection between the places is that each one is a Paris tourist attraction. Roads are shown, but these may not be the optimum route to travel. This pathway represents just one way to connect between the places.

Step 3

Since no scale is provided, could a tourist walk between all these places? Think about possible distances. Consider the distance from the Gare du Nord railway station to the city centre. A tourist may well have travelled this route and be able to give the map a sense of scale. Could you see all these monuments in a day? The answer to both questions is no. Interpreting a topological map gives a first impression, but it is not an accurate map. It may be useful for moving around an area, but it lacks detail.

Resources

Video eLesson Interpreting topological maps (eles-1736)
Interactivity Interpreting topological maps (int-3354)

1.17.3 Let me do it

Complete the following activities to practise this skill.

1.17 ACTIVITIES

1. Using the child's map shown in **FIGURE 2**, **describe** the route the child takes from home to school. Use the checklist to make sure you cover all aspects of the task.

FIGURE 2 Drawing by a child who walks to school

2. Use your skill in **understanding** and **interpreting** topological maps to answer the following questions.
   a. What is the purpose of this topological map?
   b. **Describe** the pattern of houses along the route.
   c. What symbols have been used to show the sporting area of the school grounds?
   d. Why do you think this child drew the road at such a size and included the road markings?
   e. **Describe** the environment along the route from home to school.

Checklist

I have:

- **identified** and **communicated** key features on the topological map
- clearly **represented** and **communicated** the information in the description.

LESSON
1.18 SkillBuilder: Understanding satellite images

LEARNING INTENTION

By the end of this SkillBuilder you should be able to understand a satellite map.

1.18.1 Tell me

What are satellite images?

Satellite images show parts of our planet from space. They are taken from satellites and transmitted to stations on Earth. Satellites can collect a variety of data, including standard photographic imagery, colour infrared and radar data. They can show Earth in close-up or from far away. Special computer techniques allow data from satellites to be used to highlight patterns on the Earth's surface.

The most common type of satellite image comes from Landsat satellites. They are positioned 700 kilometres above the ground, orbiting the Earth every 100 minutes, and they use special cameras to detect variations in the light reflected from features on Earth. The process of detecting and recording the reflection of light is known as remote sensing.

Different features can be highlighted in satellite images by selecting only certain bands of light reflected from Earth. These bands of light are assigned false colours to help reveal spatial patterns more clearly. In **FIGURE 1**, showing the Mt Lofty Ranges in South Australia, the labels point out the patterns.

Why are satellite images useful?

Satellite images help geographers observe a much larger area of the Earth's surface than photographs taken from an aircraft. They can also provide data relatively quickly, so they are often used to monitor natural disasters, including cyclone activity, bushfires and floods. Digital information from satellites is beamed to stations on Earth as radar or microwave signals. Computers are then used to enhance the images, which enable the study of landforms, farmland, disasters, environmental change, weather patterns and even military targets.

1.18.2 Show me

How to interpret a satellite image

You will need:

- a satellite image (see **FIGURE 2**).

Procedure

When you look at images taken from above, including satellite images, it can be confusing but your ability to interpret what you see will improve with practice. The following steps will help you to systematically gather the most information possible from images.

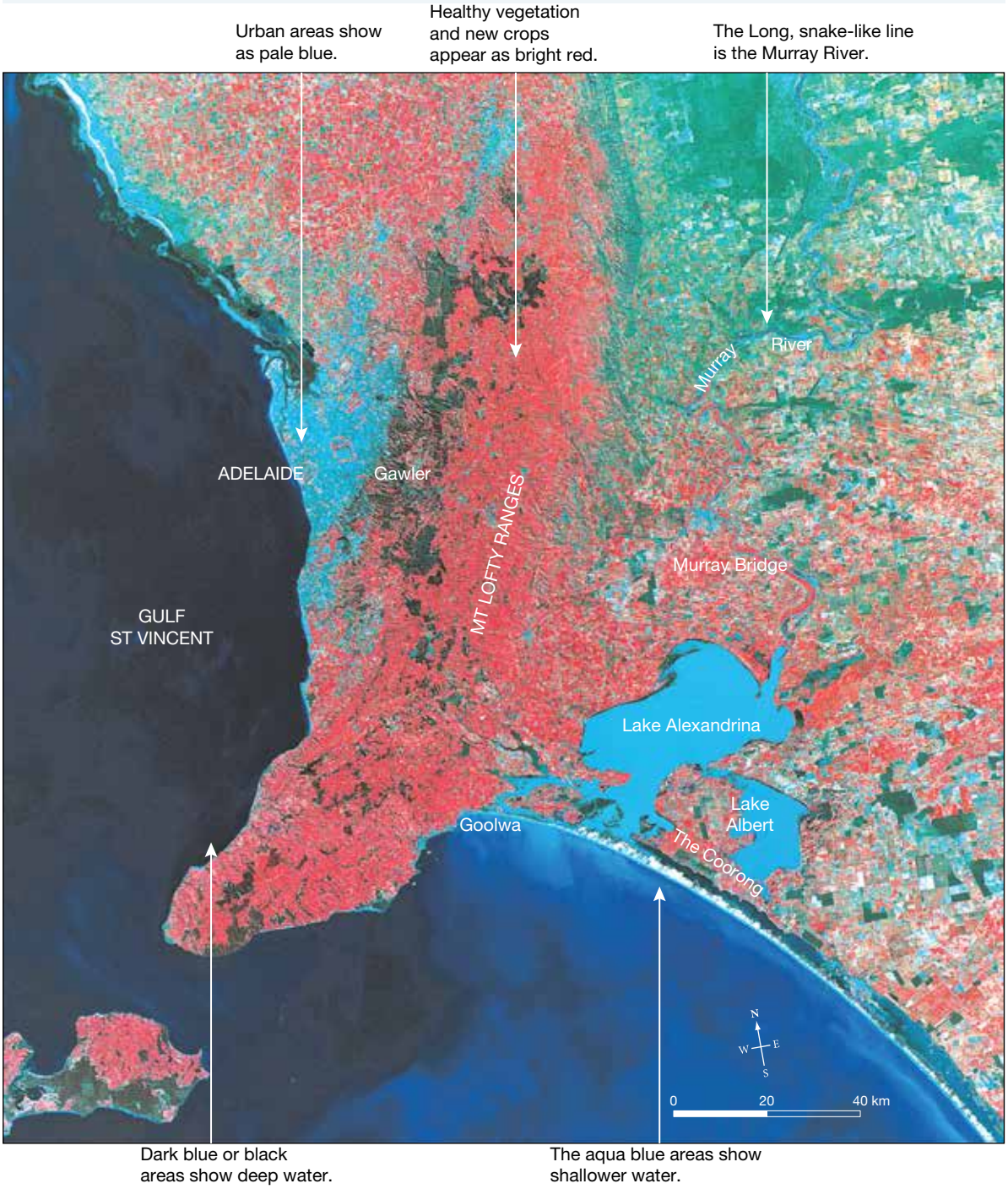
Step 1

Read the title and check for the date indicating when the image was taken. Read any accompanying information.

Step 2

Identify the main features of the image. What stands out? For example, roads will appear as continuous lines intersected by other lines. Rivers tend to be snake-like, and sometimes you may notice trees lining the riverbanks. Dwellings usually have rectangular roofs and are often clustered together.

FIGURE 1 A false-colour satellite image of the Mt Lofty Ranges



Source: © Commonwealth of Australia. Geoscience Australia 1982.

The **FIGURE 2** image of Canberra is centred on Parliament House, although its prominent central flag mast (visible at ground level) does not stand out. There appear to be wide circular roads and, if you can zoom in, cars are visible.

Step 3

Look for and label the biophysical features. For example, the black area is Lake Burley Griffin. Green vegetation in a city might be planted or it might be remnant vegetation. Look at the patterns of green to make predictions. Remnant (or remaining) vegetation will often be in an irregular pattern, whereas planted vegetation may be in rows.

Step 4

Look for and label the built features, such as roads, bridges, sports stadiums and residential housing. Again, look at patterns. Areas of small roofs with road access and surrounding vegetation suggest detached residential housing.

Step 5

Some colours, patterns and shapes may still be puzzling. Obtain a map of the same area — try an atlas or street directory, Google Maps, Bing or Nearmap. Find names of key features to use in your description. If the features you have identified are shown on the map, check whether your analysis so far matches the map. Use the map to investigate the aspects that are still puzzling. Be aware that the image may have been taken at a different date from the date the map was produced; this might explain other differences in what you see.

FIGURE 2 Satellite image of Canberra, by GeoEye, 26 September 2011

Source: © 2016 Digital Globe

Resources

Video eLesson Understanding satellite images (eles-1643)
Interactivity Understanding satellite images (int-3139)

1.18.3 Let me do it

Complete the following activities to practise this skill.

1.18 ACTIVITIES

If you have ever holidayed on the Gold Coast, you may have visited the Currumbin Wildlife Sanctuary. As seen in **FIGURE 3**, Currumbin generally has more natural vegetation than much of the Gold Coast, partly because it is more difficult to build on the steep hills there, and partly because the forests are valued as wildlife habitat. Currumbin is a popular surf beach and holiday destination.

FIGURE 3 Satellite image of Currumbin on Australia's Gold Coast, 8 May 2000

Source: Satellite image courtesy of GeoEye. Copyright 2009. All rights reserved

Study **FIGURE 3** and answer the following questions. Use the checklist provided to make sure you have covered all aspects of the task.

1. Look carefully at the satellite image and make a list of features you can recognise.
2. Find the bridge that crosses Currumbin Creek. Are any cars on the bridge?
3. What impact have visitors had on the plant life behind the beach?
4. Go to Google Maps and zoom in to Currumbin Beach, Queensland, to find a map of the area shown in **FIGURE 3**. Turn the satellite layer on. What changes can you see?
5. **Suggest** how the biophysical features and topography have influenced the settlement pattern in this area.

Checklist

I have:

- checked the title
- **identified** biophysical and built features
- **compared** the satellite image with another map to check my interpretation.

2 Water as a resource

LESSON SEQUENCE

LESSON
2.1 Overview

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What effect does the uneven distribution of water resources have on the lives of people?

2.1.1 Water as a precious and finite resource

Viewed from space, Earth is a sphere of blue. Water covers most of our planet. We depend on water for life; in fact, no life is possible without it.

Water is a precious and finite (limited) resource, yet most of Earth's water is too salty for humans, animals or plants to use. The amount of available fresh water on Earth needs to be shared among an ever-growing global population.

Access to water is a basic human right. It is a resource that must be used carefully so that current and future populations can have adequate supplies.

FIGURE 1 shows what all of Earth's water would look like if it was contained in a sphere, in comparison with the size of Earth. This small blue sphere representing all of Earth's water has a diameter of 1385 kilometres.

FIGURE 1 Water covers most of our planet, but the total amount is small compared to the size of the Earth.

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-13432)

Video eLesson Water as a resource (eles-1615)

LESSON
2.2 What are environmental resources?

LEARNING INTENTION

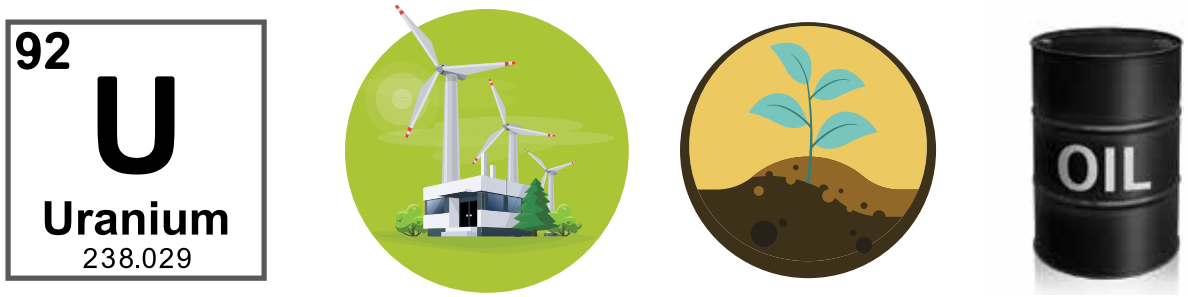
By the end of this lesson you should be able to classify environmental resources as renewable, non-renewable or continuous.

TUNE IN

Did you know that some materials sourced by humans from Earth are able to be replenished in our lifetime?

1. Which of the resources in **FIGURE 1** do you think can be replenished in our lifetime?
2. Discuss which of the resources has an unlimited supply. What factors may control the supply of this resource?
3. In what ways are the resources similar? In what ways are the resources different?

FIGURE 1 People use different kinds of resources.



2.2.1 Why do we need resources?

We depend on resources extracted from Earth to survive — including water to drink, soil to produce our food, and forests and mines to supply other materials. **Environmental resources** are materials found in nature that are necessary or useful to people.

The global distribution of environmental resources depends on geology (the materials and rocks that make up the Earth) and climate. Some minerals are rare and are found in only a few locations. For example, **uranium** is found mainly in Australia. Several countries in the Middle East, such as Saudi Arabia and Iran, have rich oil resources but are short on water. Many countries in Africa, such as Botswana, have mineral resources but lack the money to mine and process them.

The human activities of agriculture, fishing, logging and mining all depend directly on natural resources.

Environmental resources can be classified as renewable, non-renewable or continuous.

Renewable resources can be naturally replaced if they are carefully managed. For example, fish are a renewable resource that we rely on to feed human populations and to support healthy marine environments.

Non-renewable resources cannot be renewed in a short time and are finite. For example, fossil fuels such as oil, coal and natural gas are non-renewable because they take thousands of years to be replaced.

Continuous resources are those resources that are never used up by humans. Examples include solar or wind energy.

environmental resource a material found in nature that is necessary or useful to people

uranium a dense grey radioactive metal used as a fuel in nuclear reactors

renewable resource a resource that can be naturally replaced if carefully managed

non-renewable resource a resource that cannot be renewed in a short time and is finite

continuous resource a resource that is never used up by humans

Think about all the resources you have used today from the time you woke up until the time you reached the school gate. Perhaps you used water to shower, brush your teeth or fill your water bottle. Consider all the different foods that had to be farmed to provide the ingredients for your breakfast and today's snacks. Refer to **FIGURE 2** to identify the environmental resources relied on to produce two products featured in this image. Finally, how did you get to school? If you used a form of transport, a resource likely powered it.

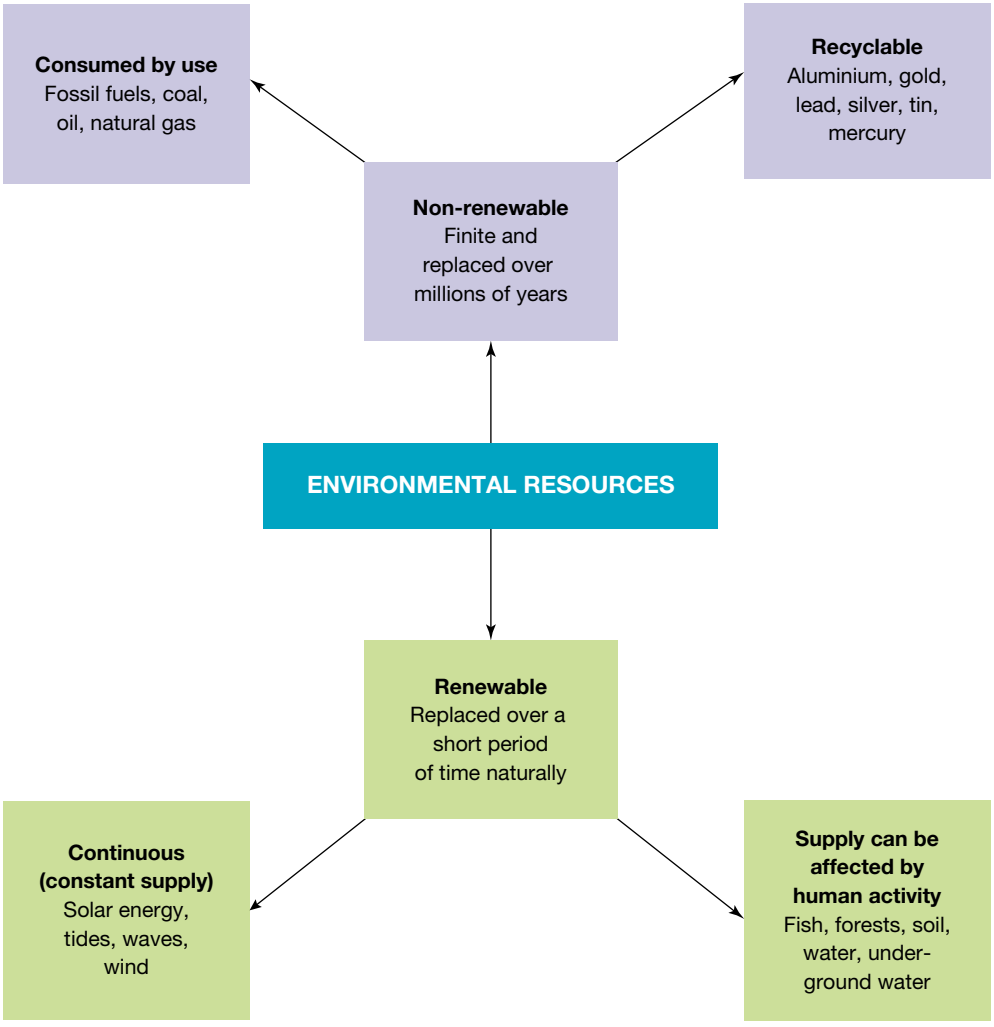
FIGURE 2 Many resources are required to provide a family with breakfast.

2.2.2 How do we classify resources?

Environmental resources either have a finite supply or a constant supply that will be replenished naturally. As **FIGURE 3** shows, the degree of human use and attitudes to resource management allows us to further classify environmental resources. The sustainable use of environmental resources ensures non-renewable resources are recycled and renewable resources are not exhausted beyond their capacity.

tlvd-10520

FIGURE 3 Environmental resources — renewable and non-renewable



2.2.3 What are continuous resources?

Environmental resources that are in constant supply and have an availability that is unaffected by human use are known as continuous. **FIGURE 4** shows a range of renewable environmental resources. Can you list the examples of continuous environmental resources?

FIGURE 4 Some sources of renewable energy: (a) solar, (b) biomass, (c) wind, (d) hydro-electric, (e) geothermal, (f) tidal

SkillBuilders to support skill development

- 1.8 Using topographic maps
- 1.9 Using alphanumeric grid references
- 1.12 Annotating a photograph

2.2 SKILL ACTIVITY: Communicating

Using the images presented in **FIGURE 4**, consider the most reliable and the least reliable energy-producing strategies shown in the images.

1. **Rank** all six of the renewable energy sources from the most reliable to the least reliable. **Justify** your ranking.
2. In your opinion, which of the activities are harmful to people or the environment in which they operate?
3. **Propose** how any of the strategies shown benefit the environment and/or communities.

2.2 Exercise

learnon

2.2 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 3, 4	2, 5, 6	7, 8

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Check your understanding

1. What are environmental resources?
   - A. Resources that can be replaced over a short period of time.
   - B. Resources that are limited and will eventually run out.
   - C. Radioactive metals used as fuel in nuclear reactors.
   - D. Raw materials that occur in the environment and are necessary or useful to people.
2. **State** the difference between renewable and non-renewable resources.
3. Complete the following table by **listing** two examples of each type of resource.

Renewable	Non-renewable

4. **Identify** which of the following environmental resources are continuous.
   - A. Iron ore
   - B. Soil
   - C. Wind
   - D. Tidal
5. **Explain** what distinguishes environmental resources from non-renewable resources.
6. Which renewable resources are most affected by human activity?
   - A. Fossil fuels, coal, oil, natural gas
   - B. Solar energy, tides, waves, water and air
   - C. Fish, groundwater supply, forests and soil
   - D. Aluminium, gold, lead, silver, tin, mercury

Apply your understanding

Communicating

7. **Explain** what the sustainable use of environmental resources refers to.
8. Refer to **FIGURE 3** to answer the following questions.
   - a. **List** the two sources of renewable energy generated by found in the atmosphere.
   - b. **Identify** places in the world where these two power sources may be more effective. Give reasons for your answer.

LESSON
2.3 How is water used as a resource?

LEARNING INTENTION

By the end of this lesson you should be able to understand how water changes its form and location within the environment.

TUNE IN

Recent Winter Olympic Games venues have used snow machines to ensure events can proceed with reliable snow cover. According to a recent article in *The Conversation,* 'Snow machines expel a fine water mist into the cold, dry atmosphere. Some of the water in each droplet quickly evaporates, carrying away heat and lowering the temperature of the rest of the droplet to below its freezing point.' ('We couldn't have the Beijing Olympics without snow machines. How do they work, and what's the environmental cost?', published 14 February 2022.)

FIGURE 1 A snow machine in action.

1. Identify where and when the last three Winter Olympic Games were held.
2. Brainstorm a list of the water cycle processes you think the snow machines imitate.
3. Predict the local environmental consequences of using snow-making techniques.

2.3.1 The water cycle

All the water on Earth moves through a cycle that is powered by the sun. This cycle is called the water cycle, or **hydrologic cycle**. Water is constantly changing its location (through constant movement) and its form vapour, liquid or solid through processes such as evaporation, condensation and freezing.

Experts estimate that up to 70 per cent of the Earth's fresh water is locked in ice sheets in the Arctic, Greenland and Antarctica. This water is, therefore, a **potential resource** — it exists in a location and in a form in which it cannot be immediately used. Water is also a potential resource when it exists as a gas (water vapour), as salt water or as wastewater.

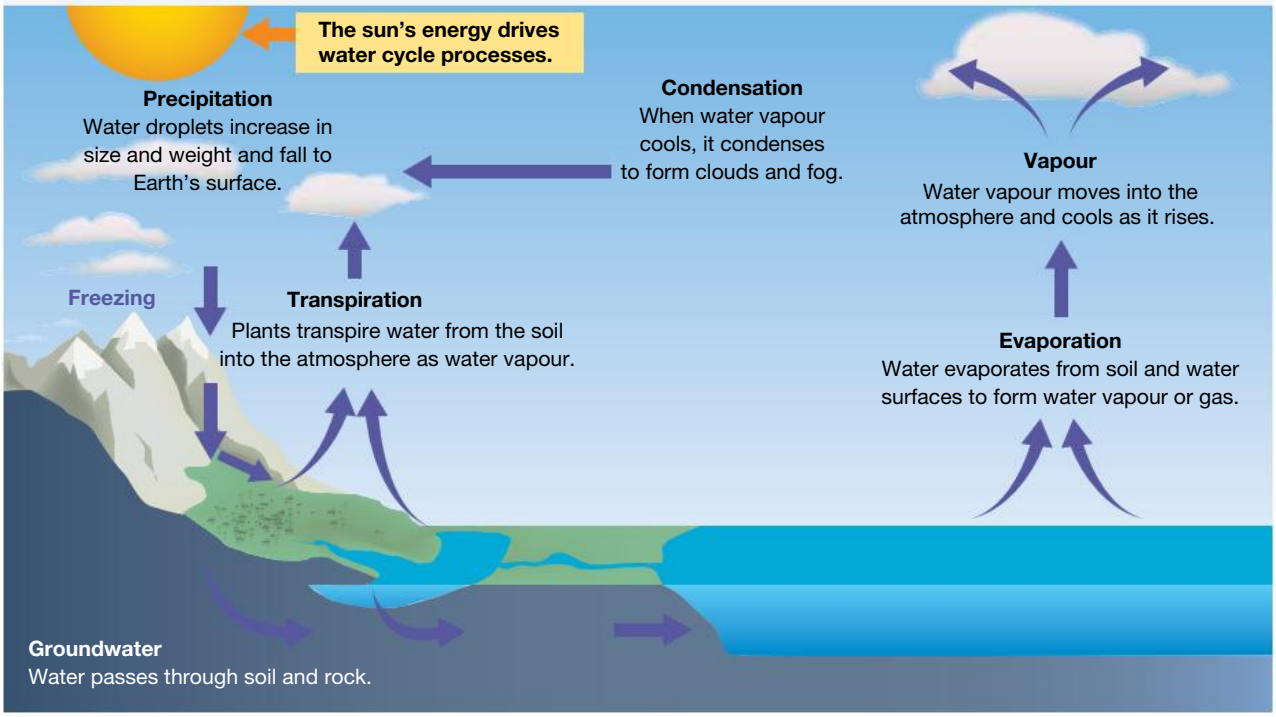
The model of the water cycle in **FIGURE 2** shows how water connects places. Water flows through the environment in different forms and is an essential resource for life. More liveable places are commonly situated on rivers and lakes to allow access to water and a reliable water supply. Rivers connect places and agriculture is connected to water supply (surface or groundwater).

hydrologic cycle another term for the water cycle

potential resource a resource that exists but is unusable in its current state, such as salt water, ice and water vapour

tlvd-10521

FIGURE 2 The operation of the water cycle



2.3.2 How long does water stay in one place?

Water can stay in one place very briefly or it can stay for many thousands of years. It has been calculated that water stays in the **atmosphere** for an average of nine days before it falls to Earth again as precipitation. Water stays in soil for between one and two months. If you live in an area that has experienced drought or a very long summer without rain, you may have noticed that the soil dries out and cracks form. Once the seasons change and it begins to rain, the soil absorbs water again and the cracks disappear.

Water spends between two and six months in snow and rivers but a lot longer in large lakes, glaciers, oceans and **groundwater**. The longest time water stays in one place is in the Antarctic ice sheets. Some ice core samples from Antarctica contain water that is 800 000 years old, but the average is about 20 000 years.

Some of the longest records of our climate have come from large ice sheets over three kilometres thick in Greenland and Antarctica. Ice core samples taken from these places reveal changes to our environment over several hundred thousand years.

FIGURE 3 A scientist working with ice core samples in Antarctica.

atmosphere the layer of gases surrounding Earth

groundwater a process in which water moves down from the Earth's surface into aquifers

2.3 SKILL ACTIVITY: Interpreting and analysing geographical data and information

Use reliable and accurate internet sources to **research** and complete the following.

1. **Identify** which place in the world has the highest recorded rainfall.
   a. What is the name of this place and in which country is it found?
   b. What is the average total rainfall per year (in metric)?
   c. What may be some of the locational factors that help explain this high rainfall total?
2. **Identify** which place in the world has the lowest recorded rainfall.
   a. What is the name of this place and in which country is it found?
   b. What is the average total rainfall per year (in metric)?
   c. What may be some of the locational factors that help explain this low rainfall total?
3. a. How reliable are the sources you used for this research?
   b. **State** one reason for your answer to part **a**.

2.3 Exercise

learnon

2.3 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 7	4, 6, 9	3, 5, 8, 10

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Check your understanding

1. Select the correct option to complete the sentence. Water is a **renewable** / **non-renewable** resource.
2. **Identify** how water can be used as a resource.
   A. Drinking
   B. Washing
   C. Swimming
   D. Agriculture
   E. All of the above
3. **Explain** how the hydrologic cycle moves water across the Earth.
4. **State** if the following are true or false.
   a. The sun's energy interrupts the operation of the water cycle.
   b. It has been calculated that water stays in the atmosphere for an average of nine days.
   c. It is estimated that up to 50 per cent of the Earth's fresh water is locked in ice sheets in the Arctic.
   d. Water spends between two and six months in snow and rivers.
   e. Precipitation is when water vapour cools and condenses to form clouds and fog.
   f. More liveable places are commonly situated on rivers and lakes.
5. **Identify** the place where water stays for the longest time during the operation of the water cycle.

Apply your understanding

Communicating

6. **Explain** how water vapour is related to the process of evaporation.
7. **Explain** how groundwater and surface water are interconnected.
8. **Explain** how ice core samples can be used to help us understand changes to the water cycle over time.
9. **Recall** how surface water reaches the watertable to become groundwater.
10. **Describe** conditions that might result in a watertable rising or falling.

LESSON
2.4 How is groundwater a resource?

LEARNING INTENTION

By the end of this lesson you should be able to understand how groundwater moves through the Earth's surface and provides a valuable resource for people living in places with poor access to reliable rainfall.

TUNE IN

Many countries in western Asia and northern Africa use valuable groundwater resources to grow agricultural crops for local food and trade supplies. The image in **FIGURE 1** shows circular irrigation systems that transform desert areas into farming plots.

FIGURE 1 How can crops be grown in a hot desert, such as this one in Dubai?

1. What do you think irrigation is?
2. Brainstorm three challenges that irrigating low rainfall desert lands may create for farmers.
3. Is the water sourced for this farming project a renewable or non-renewable resource?

2.4.1 Groundwater and the water cycle

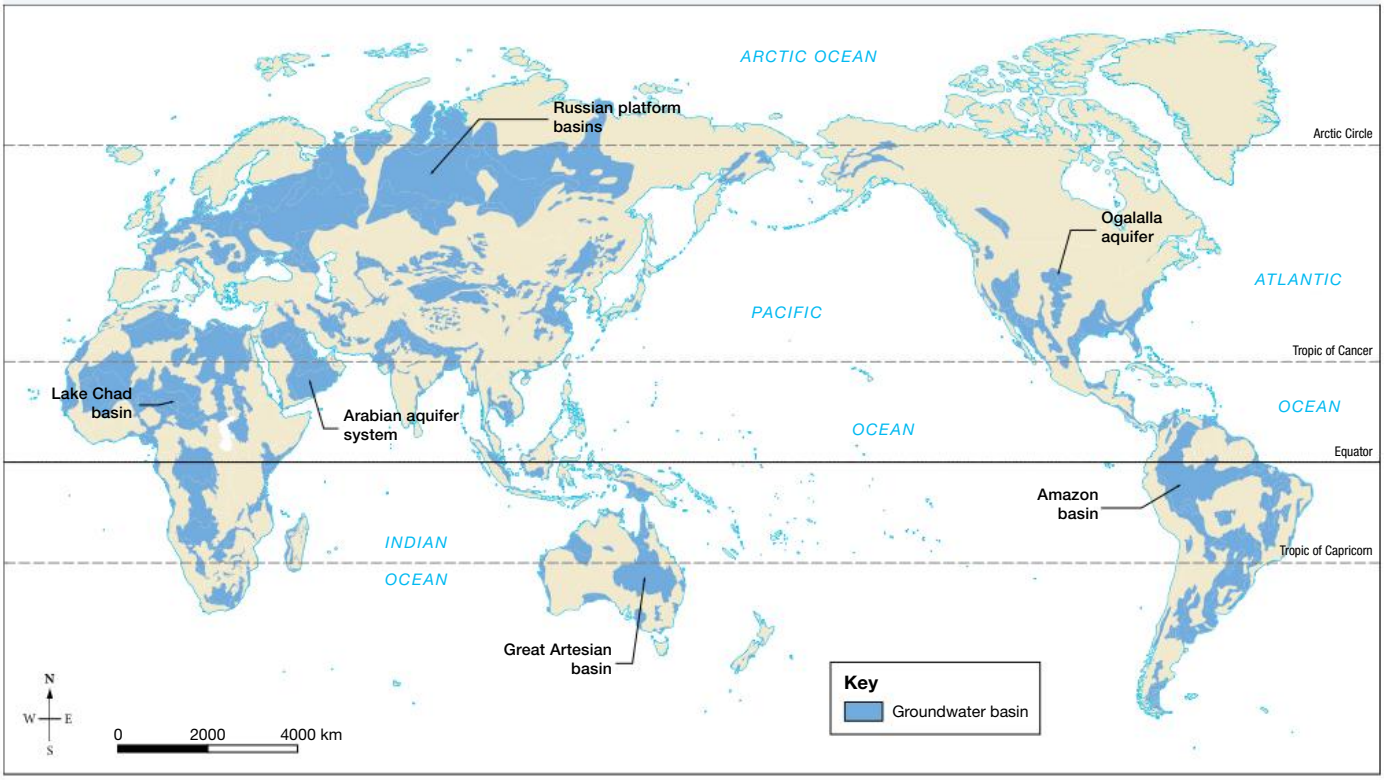
Approximately 1 per cent of Earth's water occurs as groundwater, compared with 0.4 per cent as rivers and lakes and 97.5 per cent as oceans. Groundwater is an important part of the water cycle that is found under the Earth's surface. Many settlements — especially those in arid and semi-arid areas — rely on groundwater for their water supply.

When rain falls to the ground, some flows over the surface into waterways (surface run-off) and some seeps into the ground (infiltration). Any seeping water moves down through soil and rocks that are permeable; that is, they have pores that allow water to pass through them. Imagine pouring water into a jar of sand or pebbles; the water would settle into the spaces between the sand or stones.

Groundwater is water held within water-bearing rocks, or **aquifers**, in the ground. These work like sponges. They hold water in the tiny holes between the rock particles.

aquifer a body of permeable rock below the Earth's surface that contains water, known as groundwater; water can move along an aquifer

FIGURE 2 The world's major groundwater basins



Source: BGR & UNESCO 2008: Groundwater Resources of the World 1 : 25 000 000. Hannover, Paris.

2.4.2 Artesian water

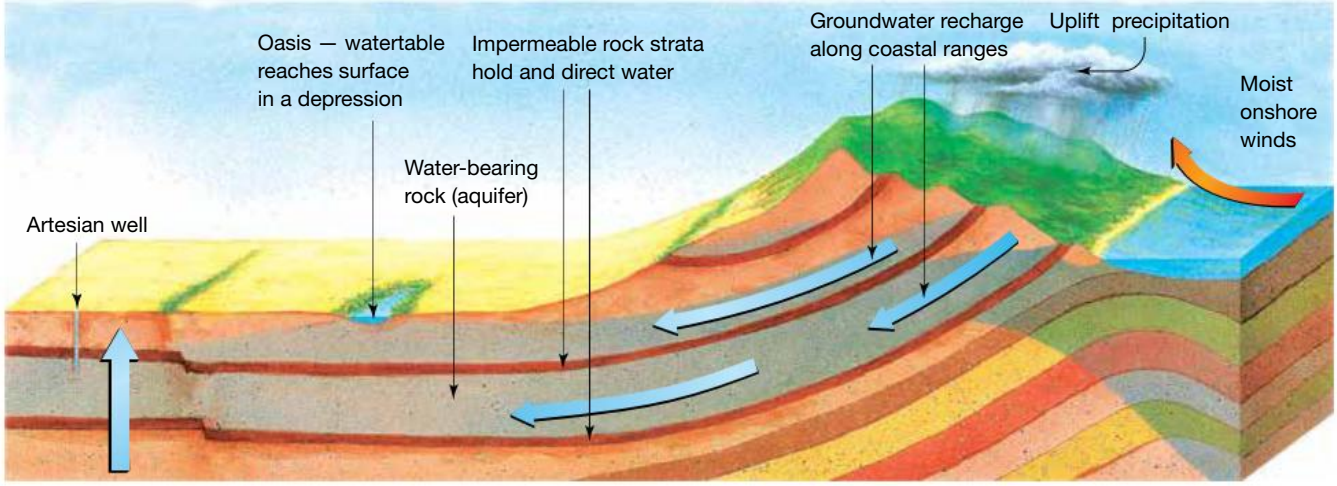
An **artesian aquifer** occurs between impermeable rocks. When a well is bored into an artesian aquifer, water often gushes out onto the surface. This flow will not stop unless the water pressure is reduced or the bore is capped (sealed).

Groundwater and surface water are interconnected — they depend on each other. Groundwater is only replenished when surface water seeps into aquifers. This is called groundwater recharge, (shown in **FIGURE 3** and it is affected by whether a lot of rain or a drought is occurring.

artesian aquifer an aquifer confined between impermeable layers of rock; the water in it is under pressure and can flow upward through a well or bore

tlvd-10522

FIGURE 3 How water moves from the east coast of Australia, where the rainfall is higher and more reliable, and enters the more porous rock layers



Groundwater is a vital resource for drinking, irrigation and industry use. Some industries bottle and sell spring and mineral water, or use it to make soft drinks and beer. Bore water may be used to water parkland, golf courses and crops. Groundwater is also important to the natural environment in wetlands and in supporting unique plants and animals. Groundwater keeps many of our rivers flowing, even during long periods without rain.

For many years now, people believed the supply of groundwater was unlimited. It is actually in danger of running out in some areas, while the large number of wells pumping water are destabilising land surfaces. Jakarta, the capital of Indonesia, and Mexico City, the capital of Mexico, are both sinking at an alarming rate due to groundwater depletion.

If people use more groundwater than is being recharged, aquifers may dry up. Groundwater is very slow-moving and can take many years to move into deep aquifers. For this reason, groundwater is a finite and non-renewable resource, and is often referred to as *fossil water*.

2.4 SKILL ACTIVITY: Questioning and researching using geographical methods

Bahariya Oasis is an ancient settlement located in the Sahara Desert region of Egypt. Agricultural products from the oasis were traded to the Nile Valley.

FIGURE 4 Bahariya Oasis

1. Use the **Bahariya Oasis** Google Earth link in the Resources panel to locate this place.
2. **Describe** the location of Bahariya Oasis in northern Africa.
3. What forms of land use can you see at or near this location?
4. **Suggest** at least three tourist activities available at this location.
5. Zoom out to view more of the surrounding countryside. Circular irrigation described in the Tune In feature in this lesson can be seen to the south of the area.
6. **Suggest** three threats to the local water supply that can be observed from the Google Earth image of Bahariya Oasis.

on Resources

Google Earth Bahariya Oasis

2.4 Exercise

learnon

2.4 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 5, 8	2, 4, 7	3, 6, 9, 10

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Check your understanding

1. **Explain** how important groundwater is to Earth's water supply.
2. **Identify** what the term 'permeable' means.
   - A. A barrier that blocks everything
   - B. A source of renewable energy
   - C. A barrier that holds back some substances and lets others though
   - D. Pressure that occurs between impermeable rocks
3. What is groundwater recharge?
   - A. When water is trapped between impermeable layers of rock
   - B. When the pressure of the water in bores raises it above the land surface
   - C. When water naturally seeps or gushes from the ground
   - D. When surface water seeps into the soil and filters down to aquifers
4. **Explain** the difference between an aquifer and an artesian aquifer. You could use a diagram to help.
5. **Select** the correct options from the provided list to complete the following passage.

drop	rise	rain	bores
water	sunlight	bottom	aquifers

When there is a lot of _____, with much of it infiltrating (seeping into) the soil, the watertable will _____. When this happens, _____ do not have to be sunk as deeply. After extended drought periods, when groundwater is not recharged by rain, or if too much groundwater is being used without recharge, the watertable will _____. Bores need to be dug deeper to reach the _____.

Apply your understanding

Communicating

6. **Describe** how groundwater and surface water are interconnected.
7. **Create** a diagram to show how surface water reaches the watertable to become groundwater.
8. **Describe** the location of the world's groundwater regions.
9. **Explain** what the quality of bore water is like. Is it suitable for humans to drink?
10. Water is a renewable resource. **Explain** why groundwater is sometimes thought of as fossil water and as a non-renewable resource.

LESSON
2.5 How does groundwater connect people?

LEARNING INTENTION

By the end of this lesson you should be able to describe how groundwater promotes social connection in low rainfall environments, and elaborate on the spiritual connection of First Nations Australians to our land and its environmental resources.

TUNE IN

Water is a strong symbol of creation in First Nations Peoples of Australia art. The rainbow serpent is a key symbol of creation, but its journey from underground to the surface also represents groundwater rising to the top via springs. The creation of water sources and where to find them is often told in First Nations stories or through artwork.

FIGURE 1 *Lundari* by First Nations Australian artist Rover Thomas is a painting depicting the Barramundi dreaming site on Dunham River.

The Dreaming story 'How the water got to the plains' is one story that describes how billabongs appeared in the dry inland plains. Use the **How the water got to the plains** weblink in the Resources panel to hear the story told by Butchulla elder Olga Miller and then discuss the story as a group.

on Resources

Weblink How the water got to the plains

2.5.1 How do First Nations Peoples of Australia use ground water?

First Nations Peoples have lived in the Australian landscape since the beginning of the Dreaming, tens of thousands of years by European estimates, and they have had the knowledge to survive many changes and challenges. To access water in the country's dry regions, particularly in Australia's deserts, they have needed to know where to find groundwater.

Many groundwater sources throughout Australia have long been used by First Nations Australians. One of these sources is called a **soak**: groundwater that comes to the surface, often near rivers and dry creek beds, and which can be identified by certain types of vegetation. Another source is known as a **mound spring**: mounds of built-up minerals and sediments brought up by water discharging from an aquifer.

Mound springs of the Oodnadatta Track

The Oodnadatta Track is located in the north-east of South Australia. The track follows the edge of the Great Artesian Basin and the south-western edge of Kati Thanda–Lake Eyre and, along its route, groundwater makes its way to the surface in several locations. The Great Artesian Basin covers more than 20 per cent of the Australia landmass.

The Oodnadatta Track crosses the traditional lands of three Aboriginal nations. In the south, between Lake Torrens and Kati Thanda–Lake Eyre, are the Kuyani people; most of the west of Kati Thanda–Lake Eyre is the land of the Arabana people; and to the north is the land of the Arrernte people.

Many springs have cultural significance today for local peoples, whose ancestors relied on the springs as water sources and as sacred sites for important ceremonies. Knowledge of the springs in this region has been passed down over many generations through **Dreaming** stories.

This knowledge was also passed on to explorers and colonisers. John McDouall Stuart followed this track to complete the first crossing of Australia's interior from south to north in 1862; the overland telegraph was constructed along its pathway; and the Great Northern Railway, which made the land of the Northern Territory accessible for European occupation, followed the same route.

FIGURE 2 Location of the Oodnadatta Track and Great Artesian Basin, one of the world's largest groundwater basins

Source: Spatial Vision/Geoscience Australia

Mound springs were very important for First Nations Peoples of Australia. The springs provided reliable water supplies in a very harsh, dry environment as well as being trading and spiritual places.

Witjira-Dalhousie Springs

Witjira-Dalhousie Springs is a popular oasis in the arid desert region of the northernmost part of South Australia. The Lower Southern Arrente people have used the area for thousands of years as a source of food, shelter and medicine, as well as a special place of cultural significance. Fed by the thermal waters of the Great Artesian Basin, the water in Witjira-Dalhousie Springs is between 34 and 38 °C.

soak place where groundwater moves up to the surface

mound spring mound formation with water at its centre, formed by minerals and sediments brought up by water from artesian basins

Dreaming The Dreaming in First Nations spirituality, the beginning of earth and the cycles of life and nature, explaining creation and the nature of the world, the place that every person has in that world and the importance of ritual and tradition

The springs were strung out over hundreds of kilometres, and they formed part of an important network of trading and communication routes across Australia. As people moved around the region, they traded goods and communicated with other nations and groups. This interconnection allowed them to trade resources such as ochre, stone and wooden tools, bailer shells and pituri. Pituri is a spindly shrub used by First Nations Peoples during ceremonies and to spike waterholes to catch animals for food.

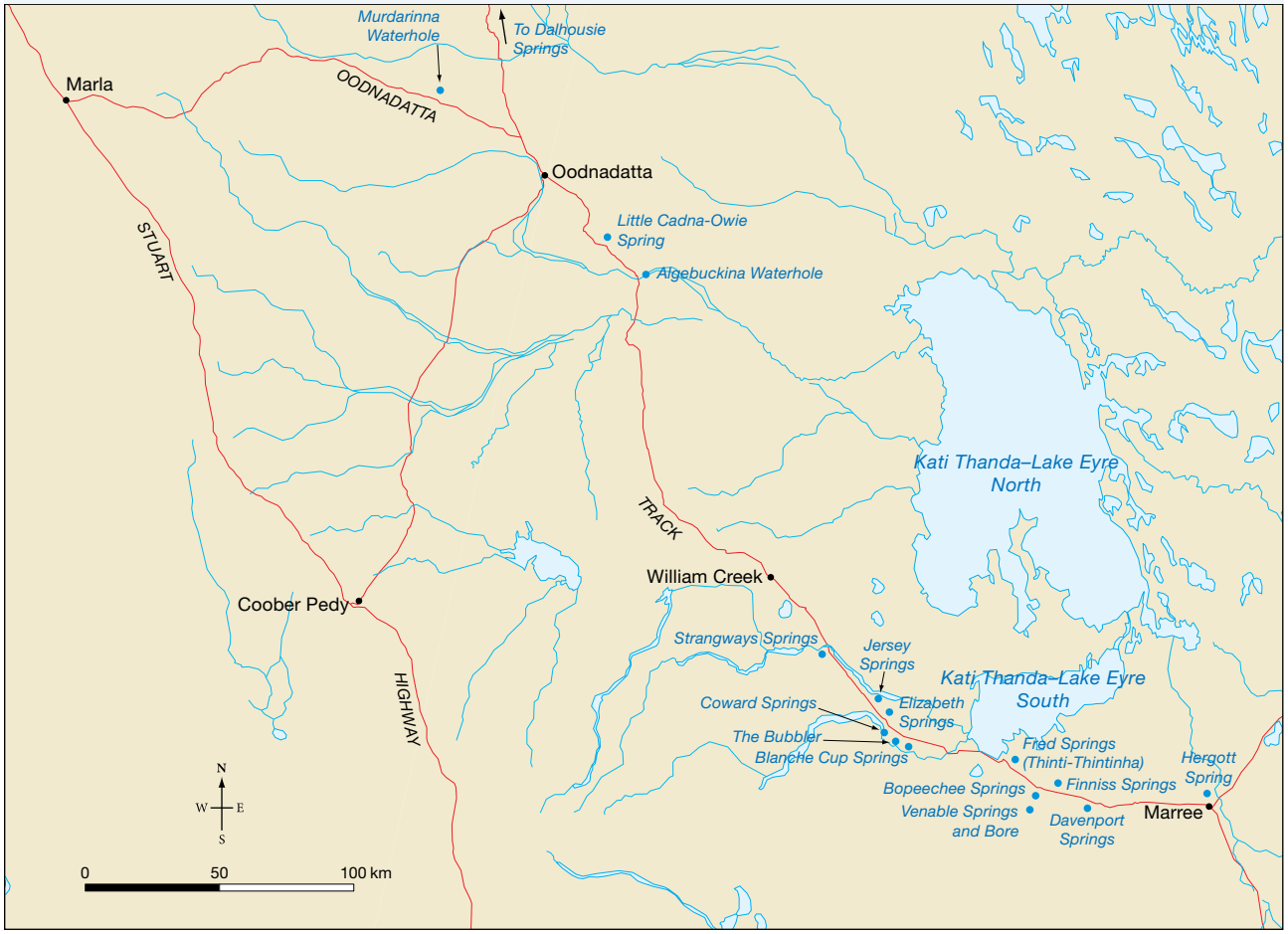
FIGURE 3 Witjira-Dalhousie Springs

2.5.2 Case study: Locating water

First Nations Australians' knowledge of the land and how to survive in it has been passed from generation to generation through Dreaming stories. During the dry seasons and periods of drought, they congregated at the mound springs. These springs were linked by First Nations songs and Dreaming stories and are often connected to rain-making rituals.

tlvd-10523

FIGURE 4 Groundwater springs along the Oodnadatta Track



Source: Redrawn with permission from the SA Arid Lands Natural Resources Management Board; © Copyright Commonwealth of Australia Geoscience Australia 2006

Dreaming stories

Thutirla Pula (Two Boys Dreaming)

This is one of the most important stories of the Wangkangurru and other peoples of central Australia. Thutirla Pula is how the spirits of the Dreaming first crossed the desert they call Munga-Thirri (land of sandhills). The story tells of two boys crossing the Simpson Desert, through Queensland and back to just north of Witjira (Dalhousie) in the Finke River area. The songline contains information on every waterhole or soak that was known in the Simpson Desert. Following this songline meant you could cross the Simpson Desert using available groundwater along the way, taking 600 kilometres off the usual journey south of the Simpson Desert to Kati Thanda–Lake Eyre, then back north along the Diamantina River.

FIGURE 5 The Old Bubbler on the Oodnadatta Track

Thinti-Thintinha Spring (Fred Springs)

The willy wagtail (or thinti-thintinha) danced his circular dance to create this spring and the surrounding soils, which are easily airborne in windy conditions. The moral to the story is that while it is easy to catch the skilful little willy wagtail, you must never do so because of the terrible dust storms that may follow.

2.5 SKILL ACTIVITY: Interpreting and analysing geographical data and information

1. Complete the **Oodnadatta Track** interactivity in the Resources panel.
2. Use Google Earth and enter the search terms 'Oodnadatta' or 'William Creek' to locate the Oodnadatta Track. You can also study **FIGURE 6** below.

FIGURE 6 Aerial view of the William Creek town, South Australia

a. **Describe** the landscape you see.
b. Why is finding groundwater so important in this ***environment***?

3. Use internet research to **investigate** the value of the spring water found in one area of inland Australia.
   a. **Locate** a secondary source that shows what the springs meant to early explorers; for example, select information from an explorer's journal to present a viewpoint.
   b. **Locate** a secondary source that shows what the springs meant to First Nations Australians and select information from it to **present** a viewpoint.
   c. **Locate** evidence to show the importance of springs water sources as social gathering sites.

on Resources

Interactivity Oodnadatta Track (int-3079)

2.5 Exercise

learnon

2.5 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3	5, 8	4, 6, 7

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Check your understanding

1. Why are Dreaming stories important to First Nations Peoples in the Oodnadatta region?
   A. They provide entertainment.
   B. They provide people with knowledge about where water could be found in the Oodnadatta region.
   C. They provide knowledge about where food could be hunted anywhere in Australia.
   D. They provide people with knowledge about agriculture.
2. How do Dreaming stories help people find water in the Oodnadatta region?
   A. By providing information about the rainfall patterns
   B. By including descriptions of place names and specific locations
   C. By providing information about where the lakes and rivers are
   D. By providing information about how to best extract water from the ground
3. A soak is where groundwater can be found at the surface and can be identified by certain types of vegetation. True or false?
4. The Oodnadatta track follows the edge of the Great Artesian Basin and crosses the traditional lands of three Aboriginal nations. **Recall** the names of these three nations.
5. **Explain** the significance of groundwater soaks, mounds and springs to European colonisers and explorers of Australia's inland areas.

Apply your understanding

Communicating

6. **Explain** how Dreaming stories help to identify the cultural value placed on these water environments.

Interpreting and analysing geographical data and information

7. Witjira-Dalhousie Springs in the Great Artesian Basin is a cluster of around 60 mound springs that contain water that is approximately 34 to 38 °C. Study **FIGURE 4** and **propose** a reason the water in Witjira-Dalhousie Springs may be so warm.

Concluding and decision-making

8. The Witjira-Dalhousie springs is a very popular tourist destination. **Suggest** three challenges that tourists may create for the team who manages this precious water resource.

LESSON
2.6 How is water distributed across the world?

LEARNING INTENTION

By the end of this lesson you should be able to describe the distribution of water across the world and explain the impact of climate change on water distribution.

TUNE IN

The quality of our water supply differs across the city or the state we live in.

1. Brainstorm any factors you think might influence the quality of the water supply that comes through our water taps.
2. How would you rate the water quality of the water supplied to your home? Explain your rating.
3. Create a list of your three most important factors when judging water quality (for example, the taste of the water you drink).

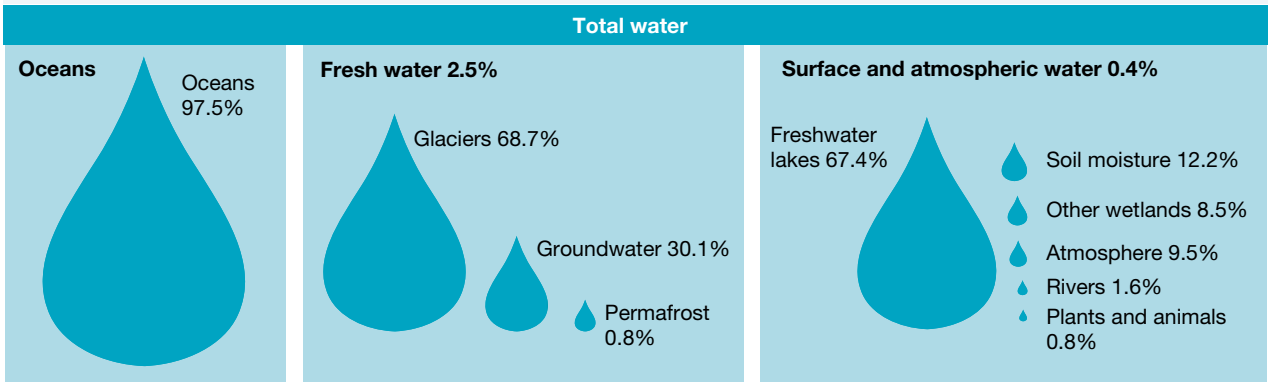
FIGURE 1 How do we measure water quality?

2.6.1 The world's water

Water is vital to our survival and essential to most human activities. Although the Earth appears blue from space, not much of the water we see is available for use. And of the useable fresh water that can be seen, access to it is unequal across the globe.

Water covers about 75 per cent of the Earth's surface. Yet, as **FIGURE 2** shows, almost all this water (97.5 per cent) is salt water and only 2.5 per cent of the world's water is fresh. More than two-thirds (69.5 per cent) of this fresh water is locked up in glaciers, snow, ice and permafrost. Water that exists as salt water, ice and water vapour is known as a potential resource. Of the remaining amount, 30.1 per cent is found in groundwater. Only 0.4 per cent is left — found in rivers, lakes, wetlands and soil as well as in the bodies of animals and plants.

FIGURE 2 The distribution of water on Earth



2.6.2 Global rainfall

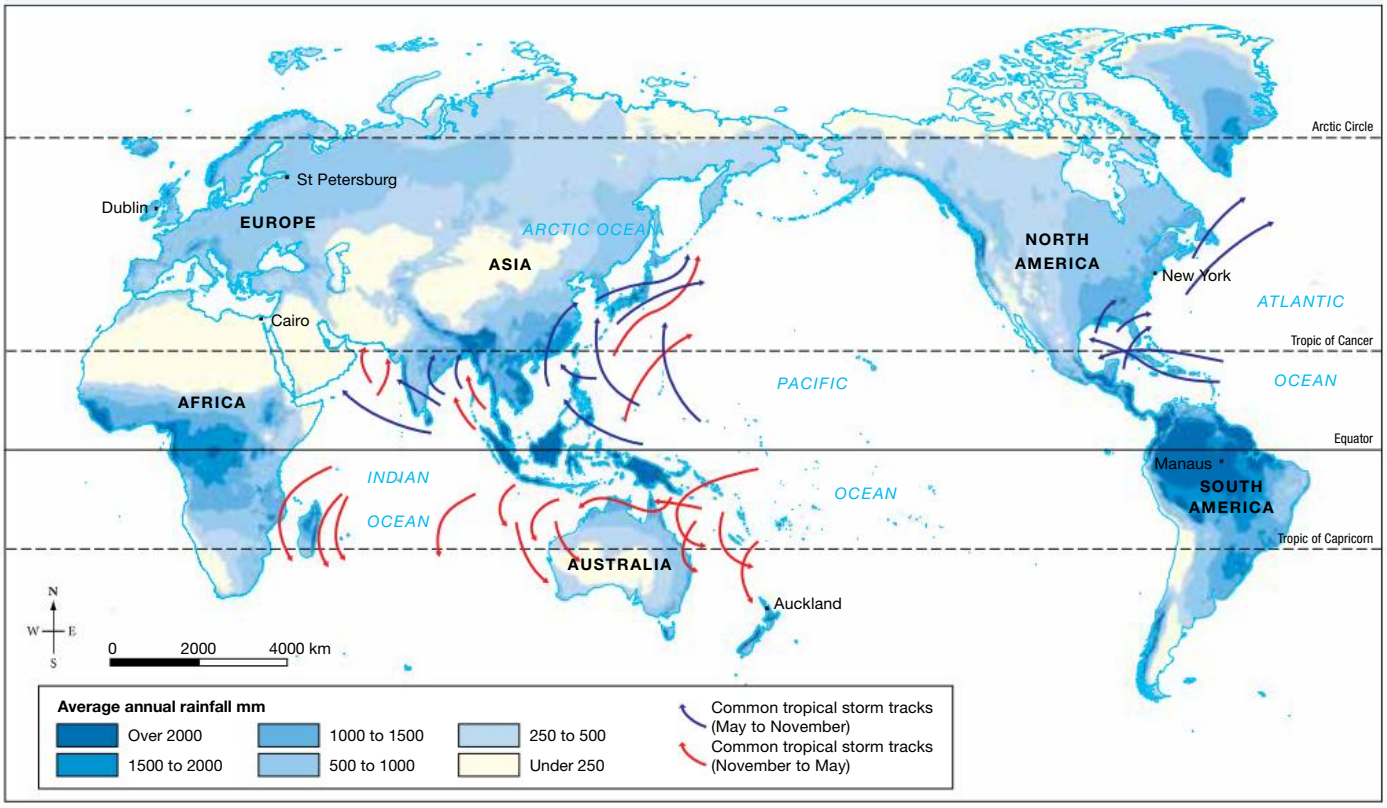
int-8939

tlvd-10524

The Earth's water is constantly moving. Rainfall patterns show which world regions receive more rain than others. The amount of rainfall, or **precipitation**, is related to the amount of water available for people to use. **FIGURE 3** shows the distribution of global rainfall, and comparisons can be made between Australia and other regions.

precipitation rain, sleet, hail or snow and other forms of water that fall from the sky when water particles in clouds become too heavy

FIGURE 3 The distribution of global rainfall



Source: WorldClim

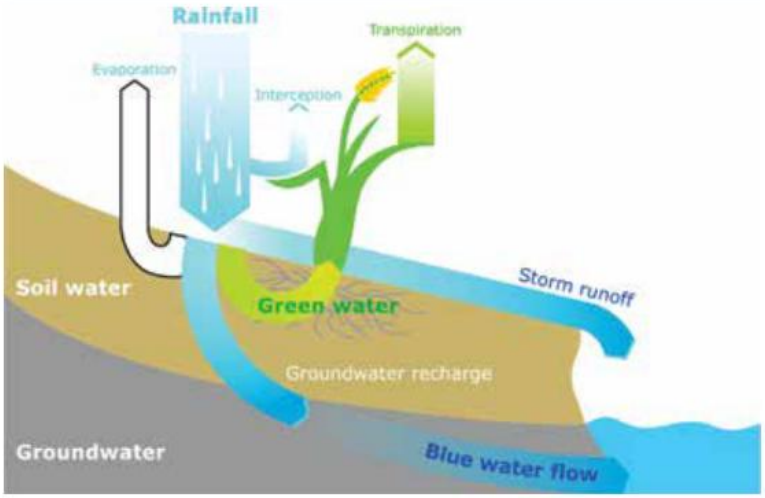
2.6.3 Green and blue water

tlvd-10525

Water is sometimes categorised as blue water and green water. Water that does not run into streams or recharge groundwater but is stored in the soil or stays on top of the soil or vegetation is known as green water. This water eventually evaporates or transpires through plants (see **FIGURE 4**), and is used by crops, forests and grasslands.

Blue water refers to water that flows over the Earth's surface or from groundwater sources. It is available for use. The amount of blue and green water available changes throughout the year, from year to year, and according to changes in the environment.

FIGURE 4 Green water can be lost through evaporation or transpiration.



2.6.4 Climate change and impact on rainfall and run-off

The majority of climate scientists believe that **climate change** will have an impact on rainfall patterns and run-off. Climate models as used in **FIGURE 5** show that areas in the northern latitudes are likely to experience more rain, and areas closer to the equator and mid-latitudes will receive less rain. Some regions will experience droughts, while others will experience high rainfall and even flooding.

climate change any change in climate over time, whether due to natural processes or human activities

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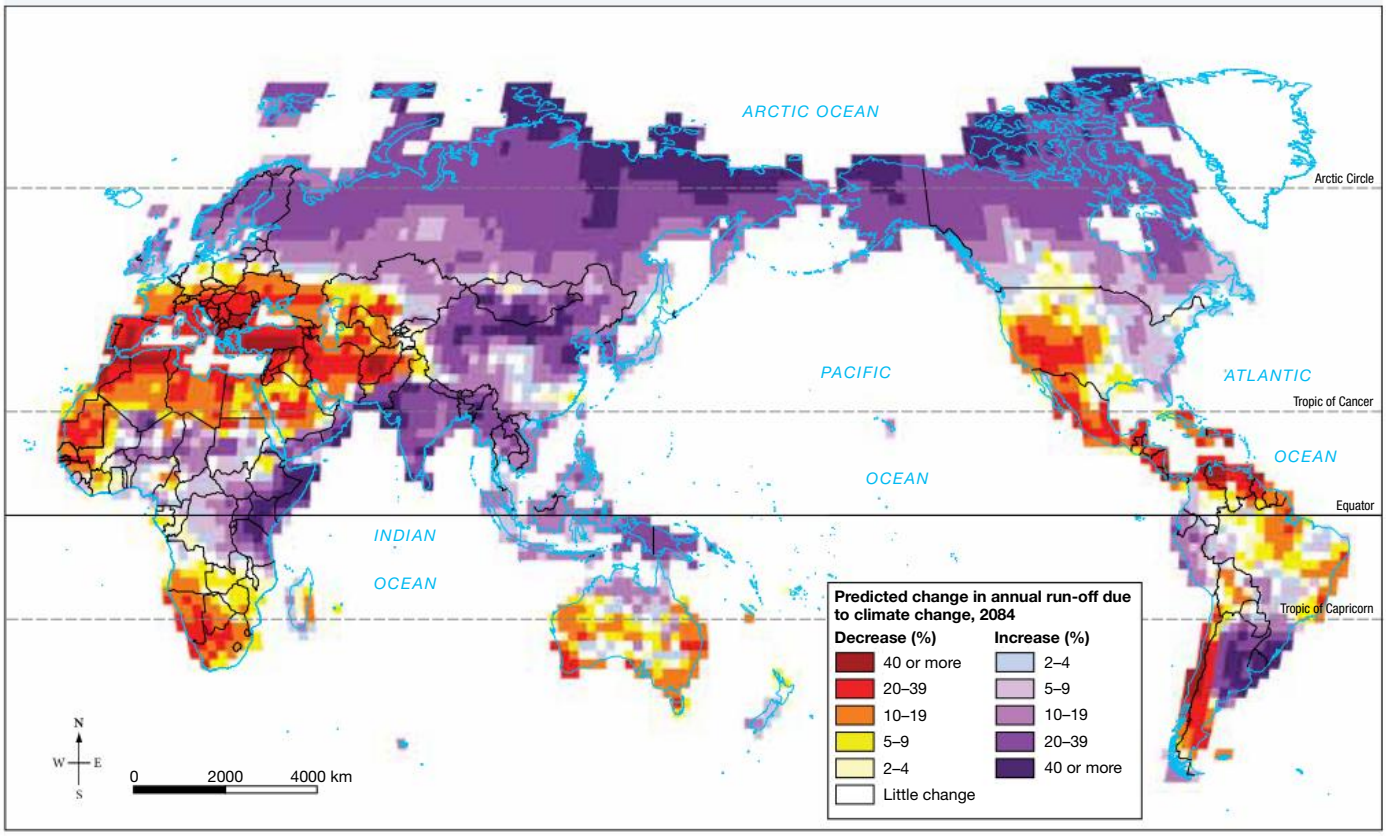
int-8957

FIGURE 5 Predicted change in annual run-off due to climate change, 2084



Source: Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration

Already, in the last 100 years, global rainfall patterns have changed. In some areas such as North America, South America, northern Europe, and northern and central Asia, rainfall has increased significantly. In other areas such as the Sahel, the Mediterranean, southern Africa and parts of Asia, rainfall has decreased.

2.6 SKILL ACTIVITY: Communicating

1. Work in groups of three to list what might happen to people and the environment in regions that receive the following.
   a. More rainfall than they do now
   b. Less rainfall than they do now
2. **Create** a consequence chart for each.

2.6 Exercise

learnon

2.6 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4	3, 6	5, 7, 8

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Check your understanding

1. **State** the percentage of the world's water that is the following.
   a. Salty
   b. Available for use by people
2. What percentage of the world's freshwater is locked up in glaciers?
   A. 68.7 per cent
   B. 71.9 per cent
   C. 79.3 per cent
   D. 83.9 per cent
3. How will climate change affect rainfall patterns?
   A. Some places will receive more rainfall and others less.
   B. There will be no change.
   C. All places will receive more rainfall.
   D. All places will receive less rainfall.
4. a. **Outline** the difference between blue and green water.
   b. **List** two things that might change the amount of blue and green water available.
5. Study **FIGURE 5** and an atlas.
   a. Select three regions from the following list that are predicted to receive more run-off due to climate change.
      A. Northern, southern and north-east Africa
      B. Europe — Scandinavian countries and the United Kingdom
      C. South America — south-east Brazil, Uruguay and northern Argentina
      D. Australasia — northern Australia and the South Island in New Zealand
      E. South America — eastern Argentina and Chile, Brazil and the northern countries, and all of Central America
   b. Select three regions from the following list that are predicted to receive less run-off due to climate change.
      A. Northern, southern and north-east Africa
      B. Europe — Scandinavian countries and the United Kingdom
      C. South America — south-eastern Brazil, Uruguay and northern Argentina
      D. Australasia — northern Australia and the South Island in New Zealand
      E. South America — eastern Argentina and Chile, Brazil and the northern countries, and all of Central America

Apply your understanding

Interpreting and analysing geographical data and information

6. Study **FIGURE 3**. **Determine** which of the following statements are true and rewrite any false statements to make them true.
   a. Most places with very low rainfall have lower run-off.
   b. All places with very high rainfall experience increased run-off.
   c. The places with the greatest change in run-off will be northern Russia and northern Canada.
7. Study **FIGURES 3** and **5**. **Describe** how much rain falls in North Africa and West Asia (the Middle East).
8. Study **FIGURES 3** and **5**. **Identify** what is predicted to happen to annual run-off in the regions of North Africa and West Asia as a result of climate change. What impact might this have on people and the environment?

LESSON
2.7 How does Australia's climate affect its water availability?

LEARNING INTENTION

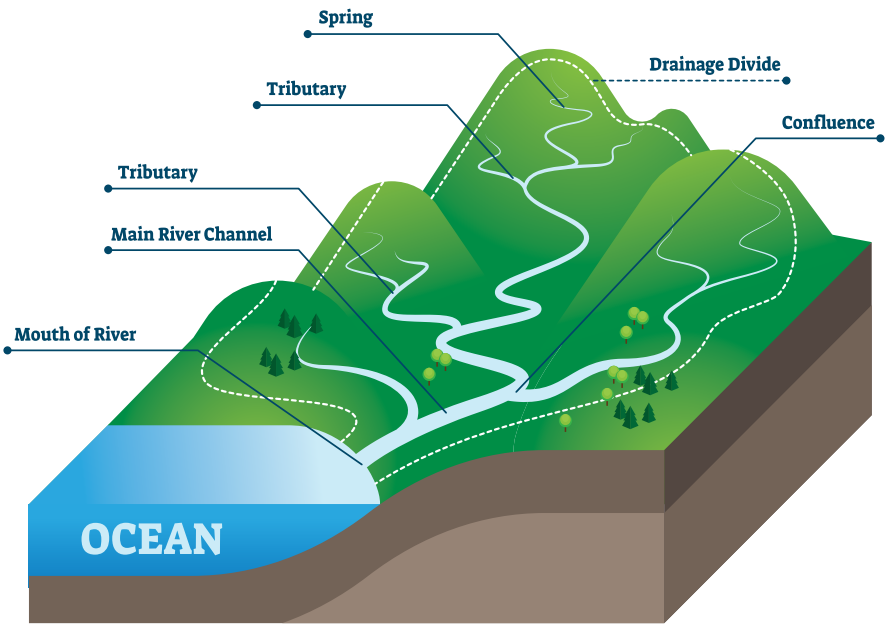
By the end of this lesson you should be able to explain how Australia's climate affects water availability and describe how Australia's different climate areas affect water availability.

TUNE IN

Most of the water that Australians use is found in surface water such as the drainage basin shown in **FIGURE 1**.

1. What direction is this river flowing towards? What evidence supports this response?
2. What do you notice about changes to the shape of the river and to the way it moves as it makes its way to the sea?
3. Brainstorm four ways humans could capture water in this drainage basin for future use.

FIGURE 1 How drainage basins work



2.7.1 Dry, variable and evaporated

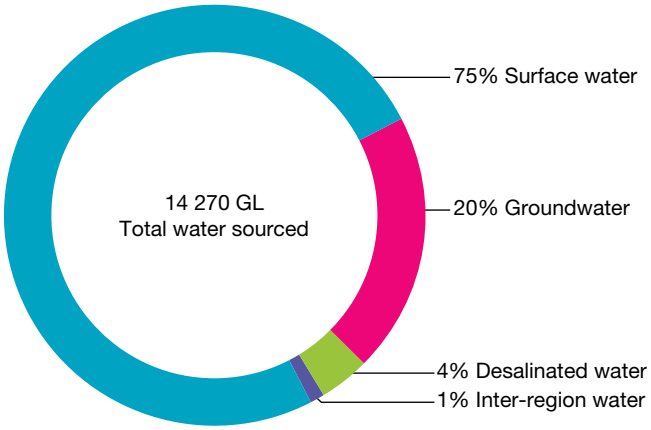
Australia is the driest inhabited continent (only Antarctica is drier), and very little fresh water is available for our use. Rain falls unevenly across the country and from season to season.

The driest part of Australia is around the Lake Eyre Basin, and the wettest locations are places in north-east Queensland and western Tasmania.

The availability of Australia's water resources varies with environmental factors such as climate, rainfall and evaporation.

As **FIGURE 2** shows, 75 per cent of water used in Australia is taken from surface water and 20 per cent of water is taken from groundwater supplies.

FIGURE 2 Sources of water used in Australia, 2019–20



2.7.2 Australia's climate

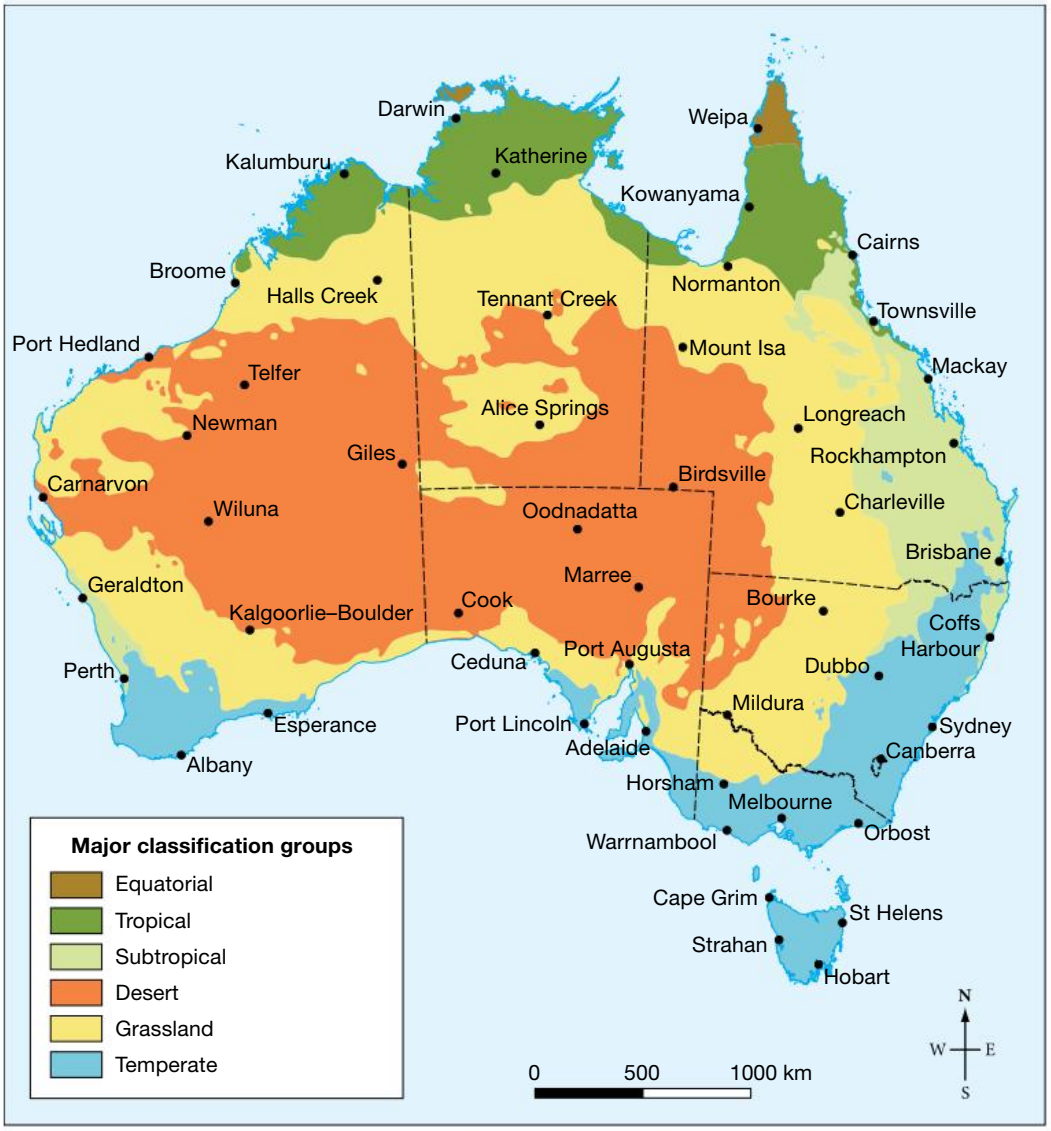
Weather refers to the daily changes in the atmosphere; however, climate is the average condition of the atmosphere measured over a long period of time. The average totals of rainfall and temperature are useful when climate patterns are being compared.

Australia's climate pattern is shown in **FIGURE 3**. Notice the changes that take place with latitude and distance from the coast.

int-8940

tlvd-10527

FIGURE 3 Climate zones of Australia



Source: Map redrawn by Spatial Vision © Copyright Commonwealth of Australia 2022, Bureau of Meteorology.

2.7.3 Water variability

Rainfall variability is the way rainfall totals in a given area vary from year to year. For example, if an area has low rainfall variability, it means rainfall will tend to be consistent from year to year. Many coastal areas show this kind of rainfall pattern. In contrast, high rainfall variability means rainfall is likely to be irregular from one year to the next; heavy rainfall may occur in some years and little or no rainfall in

rainfall variability the change from year to year in the amount of rainfall in a given location

others. Desert areas in central Australia tend to have low rainfall and high rainfall variability. Refer to **FIGURE 4** and **5** to compare Australia's average annual rainfall with its rainfall variability.

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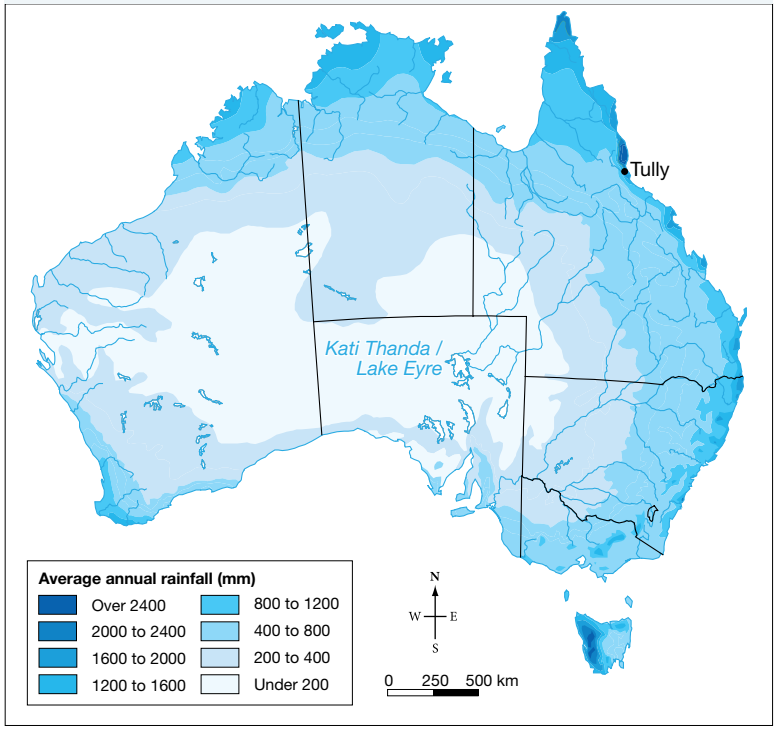
tlvd-10528

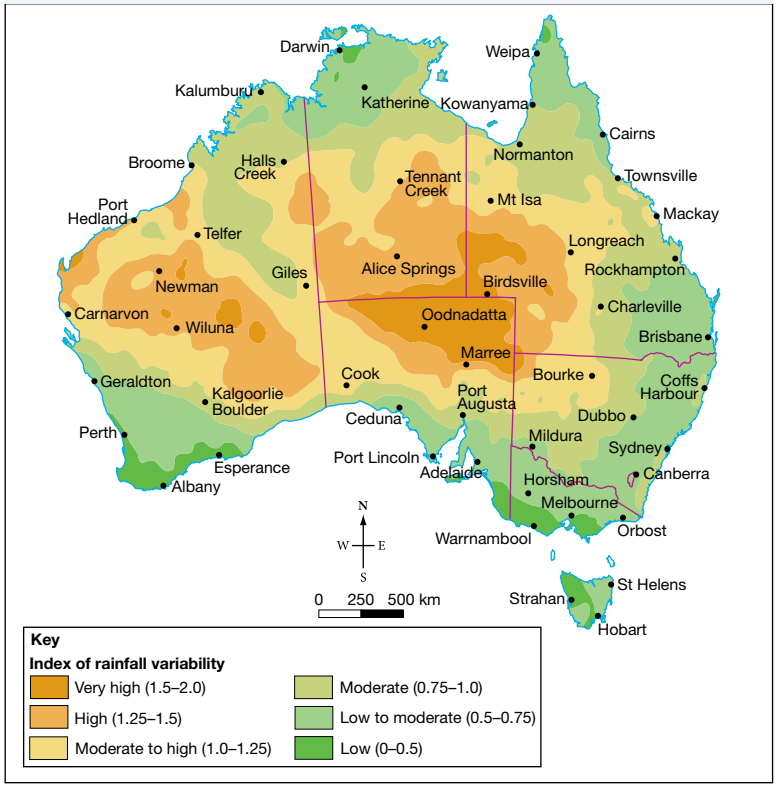
FIGURE 4 Australia's average annual rainfall



Source: Bureau of Meteorology 2003, on the Australian Water Map, Earth Systems Pty Ltd

int-7777

FIGURE 5 Australia's rainfall variability



Source: MAPgraphics Pty Ltd, Brisbane

2.7.4 Evaporation

A challenge for Australians wanting to use water as a resource is that most rainfall does not end up in rivers; much of it evaporates. Of all the water carried by the world's rivers, Australian rivers contain only 1 per cent of that total — even though Australia has 5 per cent of the world's land area. On average, only 10 per cent of our rainfall runs off into rivers and streams or is stored as groundwater. This figure drops to 3 per cent in dry areas and rises to 24 per cent in wetter places. Areas in central Australia are very dry and, as a result, have high **evaporation** rates.

Relative humidity is a measure of the air's moisture content expressed as a percentage of the maximum moisture the air can contain at a certain temperature. Warm air can contain more moisture than cool air.

Relative humidity tends to be higher in coastal regions, as is rainfall, because areas with a lot of surface water have high evaporation. It is also higher in the parts of Australia that have very high rainfall, such as north Queensland and western Tasmania.

evaporation the process by which water is converted from a liquid to a gas and thereby moves from land and surface water into the atmosphere

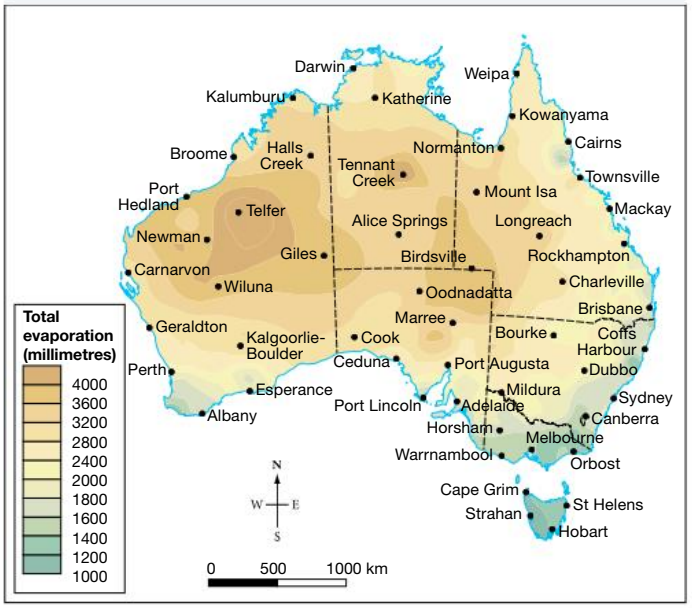
relative humidity the amount of moisture in the air

int-7778

int-7779

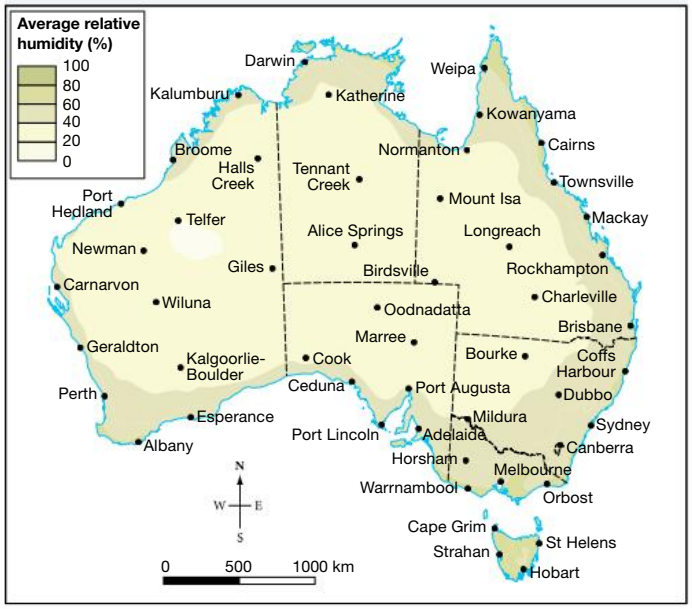
tlvd-10529

FIGURE 6 Average annual evaporation, Australia



Source: Bureau of Meteorology

FIGURE 7 Average relative humidity across Australia



Source: Bureau of Meteorology

2.7 SKILL ACTIVITY: Communicating

1. Find the place where you live on the map of Australia. Study **FIGURES 5, 6** and **7** in this lesson and complete a table similar to the one provided. Compare where you live with another place in your state or territory, and with a place a long way from where you live.

	Average rainfall	Rainfall variability	Average evaporation	Relative humidity
Where I live: _____				
Another place in my state/territory: _____				
A place far from where I live: _____				

2. **Conduct research** online to **list** some of the short-term effects that drought can have on Australia.
3. **Predict** some long-term impacts that Australia and its people would experience if drought continued for up to ten years.

2.7 Exercise

learnon

2.7 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3	4, 5, 6	7, 8

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Check your understanding

1. Select the correct options from the list provided to complete the following statement about rainfall variability.

amount	high	change	particular
more	irregular	variability	

Rainfall variability is the _____ from year to year in the _____ of rainfall in a _____ location. _____ variability means that rainfall is likely to be _____ from year to year.

2. **Identify** the two regions that receive the most rainfall in Australia.
   - A. South-east Queensland and eastern Tasmania
   - B. North-east Queensland and western Tasmania
   - C. Southern Victoria and northern Tasmania
   - D. New South Wales and the Northern Territory
3. Relative humidity is a measure of the air's moisture content at a certain temperature. True or false?
4. Study **FIGURE 4**. **Identify** where the driest part of Australia is located.
5. Study **FIGURE 5**. **Identify** which parts of Australia have the most variable rainfall.

Apply your understanding

Interpreting and analysing geographical data and information

6. Study **FIGURES 4** to **7**. **Describe** the interconnections between these features of our climate.
7. Use **FIGURES 4, 6** and **7** to record the following statistics for Tennant Creek in the NT.
   - a. Total evaporation
   - b. Average relative humidity
   - c. Average rainfall
8. a. Refer to **FIGURES 3** and **5**. **Determine** the climate zone in Australia that has the most rainfall variability and the climate zone that has the least rainfall variability.
   b. **Predict** the factors that may contribute to this variation in rainfall reliability across Australia.

LESSON
2.8 Investigating topographic maps: The value of water in Noosa

LEARNING INTENTION

By the end of this lesson you should be able to describe perceptions of the social, cultural and economic value of water at Noosa.

2.8.1 Noosa's beaches and rivers

Noosa is about 140 kilometres north of Brisbane, Queensland, between the mouth of the Noosa River and the headland of Noosa National Park. With its beaches and rivers, Noosa demonstrates how water can have value in different ways.

Noosa is a popular tourist destination and, as such, the water at nearby beaches and in local rivers and lakes contributes economic value to the area. Hotels with water views will charge tourists higher prices than those without water views. Similarly, Noosa's water has an aesthetic value — it is visually appealing and is part of the attraction of Noosa. People enjoy looking out to the ocean or over the river. The aesthetic and social value of water helps visitors relax and unwind, and the many water-based activities in Noosa such as cruises, canoeing, surfing and kite-surfing contribute to the culture of place.

FIGURE 1 Visitors enjoy the spectacular views from Noosa National Park.

FIGURE 2 An oblique aerial photograph of Noosa, 2009

FIGURE 3 Many activities for holiday makers at Noosa are water-based.

int-8955

FIGURE 4 Topographic map extract of Noosa

Legend

- Spot height (121)
- Building
- Index contour
- Contour (Interval: 20 m)
- Highway (route no. 70)
- Major road
- Minor road
- Track
- Transmission line
- Stream
- River
- Water body
- Intertidal
- Vegetation
- Mangrove
- Wetland
- Urban area
- Recreation
- National park

N, W, E, S

0 1 2 km

Source: Data based on QSpatial, State of Queensland (Department of Natural Resources, Mines and Energy, Department of Environment and Science), http://qldspatial.information.qld.gov.au/catalogue/

Resources

eWorkbook	Investigating topographic maps — The value of water in Noosa (ewbk-10690)
Digital document	Topographic map of Noosa (doc-39380)
Video eLesson	Investigating topographic maps — The value of water in Noosa — Key concepts (eles-6011)
Interactivity	Investigating topographic maps — The value of water in Noosa (int-8955)
Google Earth	Noosa Heads

2.8 Exercise

learnon

2.8 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2	3, 5	4, 6

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- Receive immediate feedback
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Check your understanding

1. **State** the contour interval of the map in **FIGURE 4**.
2. **State** the feature at the following area references.
   a. AR0376
   b. AR0470
   c. AR0583.
3. **State** the spot height at AR1081.

Apply your understanding

Communicating

4. **List** different ways in which people use the water around Noosa. What evidence is shown on the map for these uses?
5. **Explain** why you think the settlements around Noosa have developed in their current locations. Support your answer with observations from **FIGURE 4**.

Concluding and decision-making

6. **Predict** how increased tourism and development around Noosa may have an impact on the value of water in the region in the future. In your answer, refer to the economic, aesthetic and cultural/spiritual value of water.

LESSON
2.9 Does everyone have enough water?

LEARNING INTENTION

By the end of this lesson you should be able to identify and explain the three main uses of water by people, and describe what virtual water is and how it affects water consumption.

TUNE IN

Many people are unaware of how much water is used to grow or manufacture common items that we use every day. For example, do you know how much water is used to create the clothes you wear?

Brainstorm the steps involved in creating the T-shirt shown in **FIGURE 1**. Consider the following to help you.

1. What crops are grown to produce the fabric?
2. Identify two processes required to colour and to clean the fabric.
3. How would water be used to produce this garment from the farm to the shops?
4. What is the quality of the water that remains after the garment has been washed and colour dyes have been used?

FIGURE 1 A tie-dyed T-shirt

2.9.1 Water as an environmental resource

All people use water in three main ways: growing food, producing goods and electricity, and using it in the home. The amount of water consumed for each of these uses differs from one place to another. A problem that we face as a global community is that while the total amount of fresh water is fixed, the amount used per person is increasing.

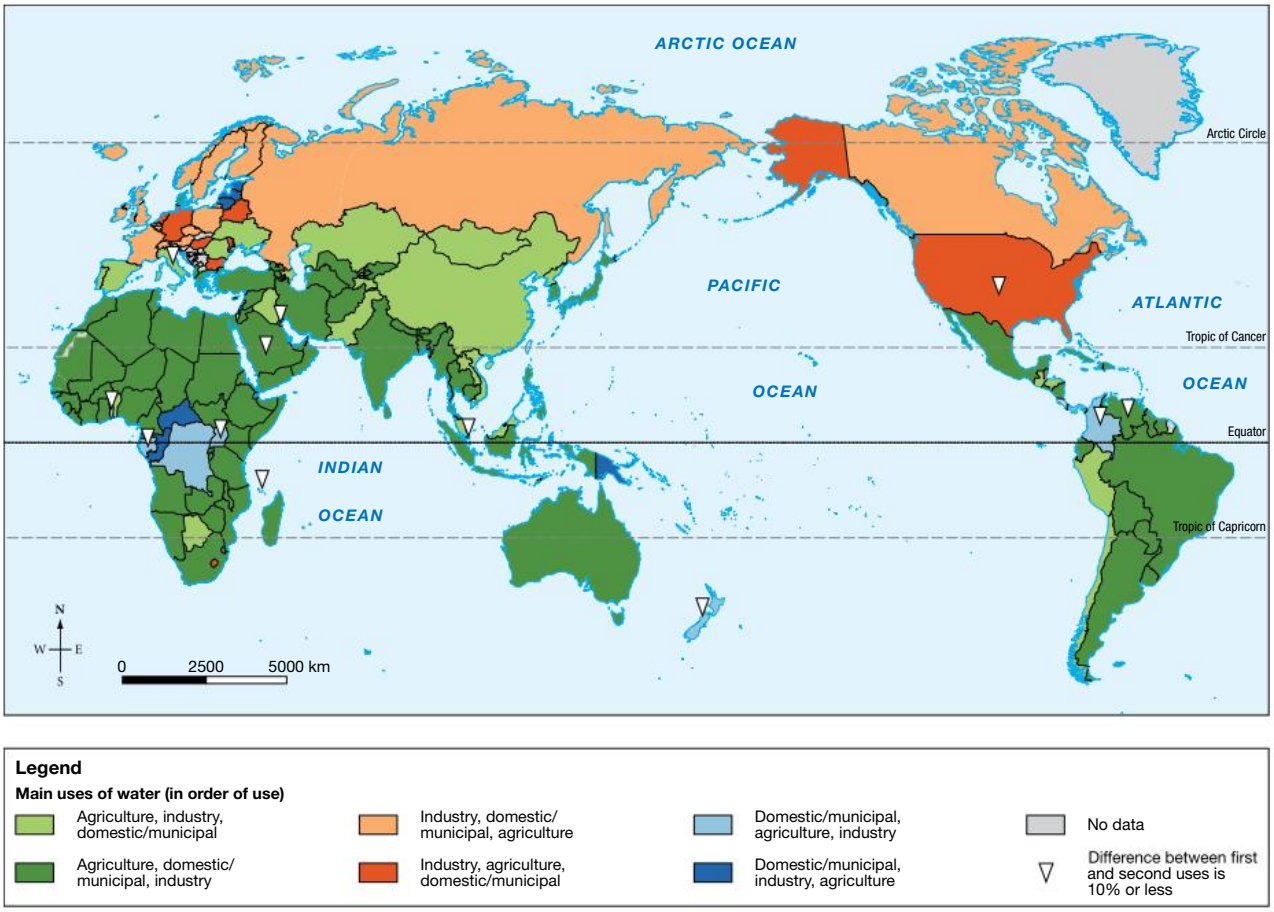
The global average of water use is 1240 cubic metres per person, per year. Some countries such as the United States and Thailand consume nearly twice as much as the global average. Peru and Somalia are examples of countries that consume the least amount of water per person.

FIGURE 2 shows that most of the world's water is used in agriculture, to grow food for the world's increasing population. This is especially the case in the drier parts of the world such as northern Africa and western Asia, where rainfall to grow crops or grass for animals is not enough. A strong interconnection exists between the amount of rainfall in a region and the amount of water used in agriculture.

FIGURE 3 shows how water use varies by region; however, countries within these regions may show a different pattern of water use. In some countries, the water used in agriculture and industry is greater than the amount of water used in homes for domestic use. In other places, people consume more water for domestic use than for either agriculture or industry.

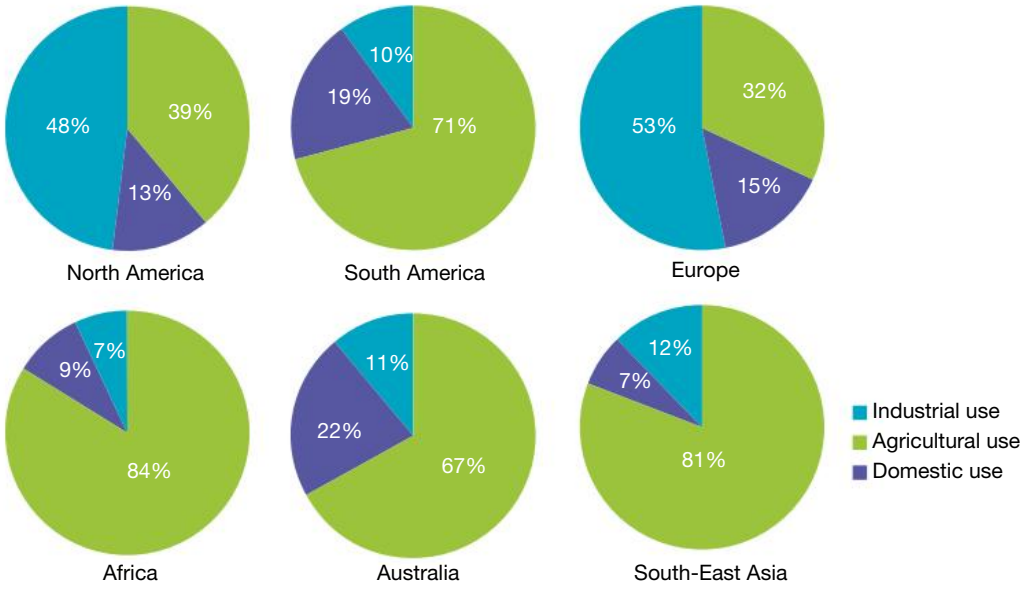
int-8956

FIGURE 2 Countries in the world differ in their use of water.



Source: Mekonnen, M.M. and Hoekstra, A.Y., 2011. National water footprint accounts: The green, blue and grey water footprint of production and consumption' , *Value of Water Research Report Series No. 50,* UNESCO-IHE, Delft, the Netherlands

FIGURE 3 Regional use of water for different purposes



2.9.2 How is water used in Australia?

Agriculture is an important industry in Australia, and it is our thirstiest industry. It produces most of our food requirements and contributes enormously to Australia's export earnings.

Around 70 per cent of Australia's fresh water is used as irrigation for farming. Irrigation water is sourced from many sources, and it is applied to crops using technology. Many crops are grown in dry areas where up to half the available water evaporates from the soil surface or seeps down too low into the ground for plant roots to reach it. The water used in irrigation can be carefully applied to ensure correct amounts needed by plants. In manufacturing industries, most water is used to produce food, beverages and paper.

FIGURE 4 Australia is one of the most irrigated countries in the world.

TABLE 1 Fresh water used to irrigate different crops in Australia

Crop type	Water (gigalitres)	%
Livestock, pasture, grains and other agriculture	8795	56
Cotton	1841	12
Rice	1643	11
Sugar	1236	8
Fruit	704	5
Grapes	649	4
Vegetables	635	4

Note: One gigalitre = 1 000 000 000 litres or one thousand million litres or 400 Olympic-sized swimming pools

2.9.3 What is virtual water?

Water is often a 'hidden' ingredient in the production process for goods and services such as clothing, food and manufacturing. Hidden in a hamburger are 2400 litres of water used to grow the feed for the cattle over many years, to grow wheat for the bread roll, to grow all the other ingredients in the hamburger, and to process all the food. **Virtual water** is a term used to refer to all the water used to produce goods and services, and it needs to be considered in our **water footprint**.

virtual water all the hidden water used to produce goods and services

water footprint the total volume of fresh water that is used to produce the goods and services consumed by an individual or a country

Regions that are water stressed and that export food and other products (such as Australia and some countries in Africa and Asia) are also effectively exporting their precious water in these goods.

FIGURE 5 Water used to wash citrus fruits

2.9 SKILL ACTIVITY: Concluding and decision-making

Use the **Just add water** weblink in the Resources panel to listen to an audio program about the water footprint in food production.

1. **Describe** the relationship between water-stressed countries and food production.
2. **Provide** an example where the water footprint figure is in conflict with the opinion of farmers.
3. **Propose** individual action to reduce your personal water footprint.

on Resources

Weblink Just add water

2.9 Exercise

learnon

2.9 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 5	3, 4, 7	6, 8

These questions are even better in jacPLUS!

- Receive immediate feedback
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Check your understanding

1. **Identify** what most of the world's water is used for.
   - **A.** Agriculture
   - **B.** Domestic
   - **C.** Industry
   - **D.** Municipal

2. a. Which regions of the world use the majority of their water in agriculture? **Select** all that apply.
   - **A.** South America
   - **B.** Europe
   - **C.** Africa
   - **D.** North America
   - **E.** Australia
   - **F.** South-East Asia

   b. Which countries use water mainly for industrial purposes? **Select** all that apply.
   - **A.** South America
   - **B.** Europe
   - **C.** Africa
   - **D.** North America
   - **E.** Australia
   - **F.** South-East Asia

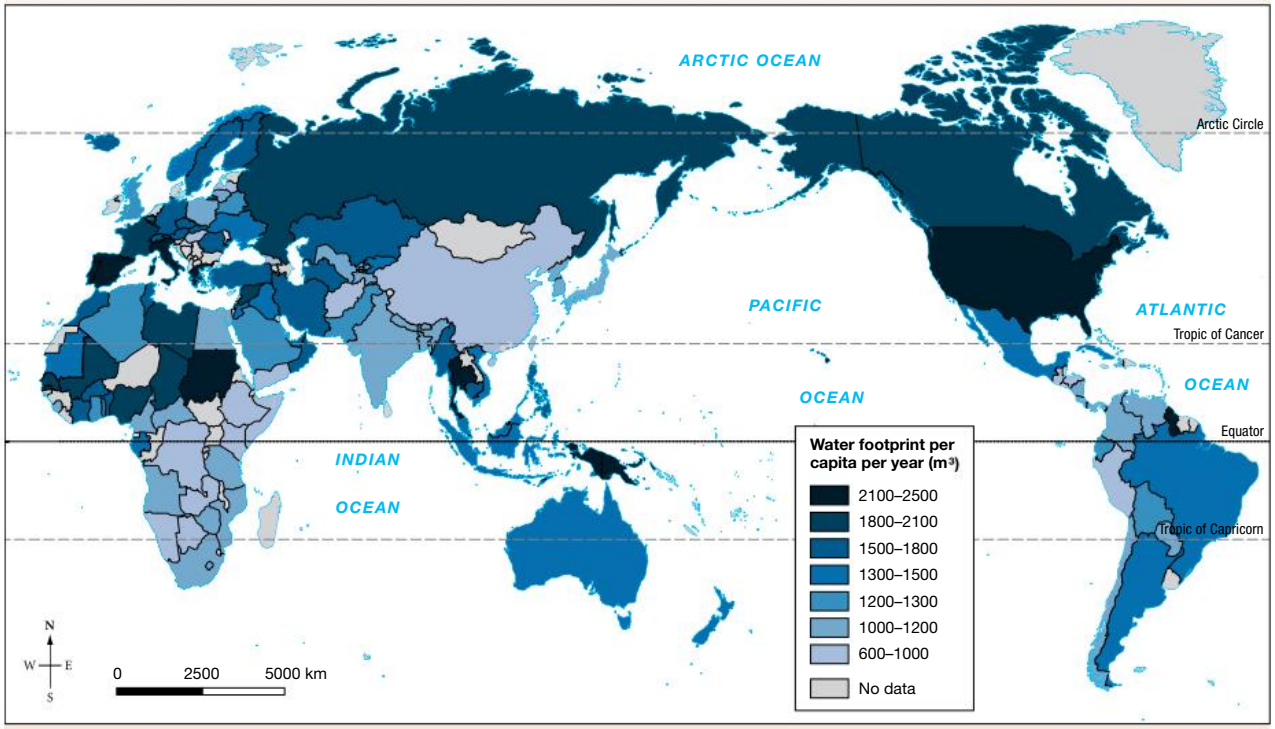
3. **Explain** why some countries might use more water in industry than in agriculture or domestic use.
4. **Define** the terms 'virtual water' and 'water footprint'.
5. **Examine TABLE 1**. **Select** the correct options to complete the following sentences. The crop/s that use the most water are **vegetable** / **cotton and rice** / **grapes** / **grain and pasture.** The crop/s that use the least water are **vegetable** / **cotton and rice** / **grapes** / **grain and pasture.**

Apply your understanding

Interpreting and analysing geographical data and information

6. Refer to **FIGURE 6**. **Describe** the patterns you notice over space of countries with (i) very high and high water footprints and (ii) very low and low water footprints.

FIGURE 6 Average global water footprints



Source: World Water Exchange (2016)

7. a. Study **FIGURE 2** and **determine** which of the following statements are true and which are false. If the statements are false, rewrite the statements with the main uses of water in the correct order of use.
   i. Australia uses most water for agriculture, then industry, and then domestic/municipal.
   ii. Countries in North Africa use most water for agriculture, then domestic/municipal, and then industry.
   iii. Belarus uses most water for industry, then agriculture, and then domestic/municipal.
   iv. Indonesia uses most water for industry, then agriculture, and then domestic/municipal.

   b. If any statements are false, **rewrite** the statements with the main uses of water in the correct order of use.

8. Study **TABLE 2**. Choose two meat, two grain, one dairy, two non-food, two fruit, two vegetable and two processed products from the list.
   Calculate how much water is used to produce a vegetarian diet and a meat-based diet. **Decide** which diet uses more water.

TABLE 2 Global average water used to produce everyday products per kilo (unless otherwise stated)

Product	Global average water (litres)
Apple 	
Beef 	
Cheese 	
Chocolate 	
Cabbage 	
Cotton shirt (1) 	

(continued)

Product	Global average water (litres)
Hamburger (1) 	
Mango 	
Paper (1 A4 sheet) 	
Pork 	
Rice 	
Tomato 	
Wheat 	

LESSON
2.10 What water scarcity exists in Australia and the world?

LEARNING INTENTION

By the end of this lesson you should be able to describe the global distribution of water scarcity and explain the interconnection between water quality, sanitation, and health.

TUNE IN

Water is very heavy and difficult to carry. The burden of this water fetching usually falls on girls and women, who carry the heavy load on their head or back.

FIGURE 1 Women and girls often bear the burden of collecting water.

The average distance that women in Africa and Asia walk to collect water is six kilometres. The average weight they carry on their heads or backs is about 20 kilograms.

1. Design a walking course around your school that would be six kilometres in length.
2. Predict how many school bags would be needed to weigh 20 kilograms.
3. Brainstorm the consequences of water collection on the schooling opportunities for girls and young women in these places.
4. Suggest two ways Australians might change their attitude to water use if their supply was more difficult to access.

2.10.1 What is the human right to water?

The right to water is a human right that is protected by many international agreements, yet not everyone has access to this life-giving resource. Water is more important to survival than food. In hot conditions, a person can survive up to three weeks without food but only two or three days without water.

Ideally, each individual needs one cubic metre (1000 litres) of drinking water per year, about 100 cubic metres for other personal needs, and 1000 cubic metres to grow all the food that he or she consumes. **Water stress** occurs when not enough water is available for all demands. A country with less than 1000 cubic metres of renewable fresh water per capita (per person) is under water stress. The term '**water scarcity**' may refer to water shortages or poor access to available water supplies for local communities.

water stress a situation that occurs in a country with less than 1000 cubic metres of renewable fresh water per person

water scarcity when the demand for water is greater than the supply available

2.10.2 Access to water

FIGURE 2 highlights areas where water stress is extremely high across central Asia and northern Africa. In 2018, the UN estimated that, as climate change conditions take hold, 5 billion people could suffer water shortages by 2050. The problem of lack of water is often worse in rural areas, so many people move from the countryside into towns and cities, hoping for a better water supply. These people are sometimes called water refugees. However, the water in some cities is also inadequate because it is in short supply or is very polluted.

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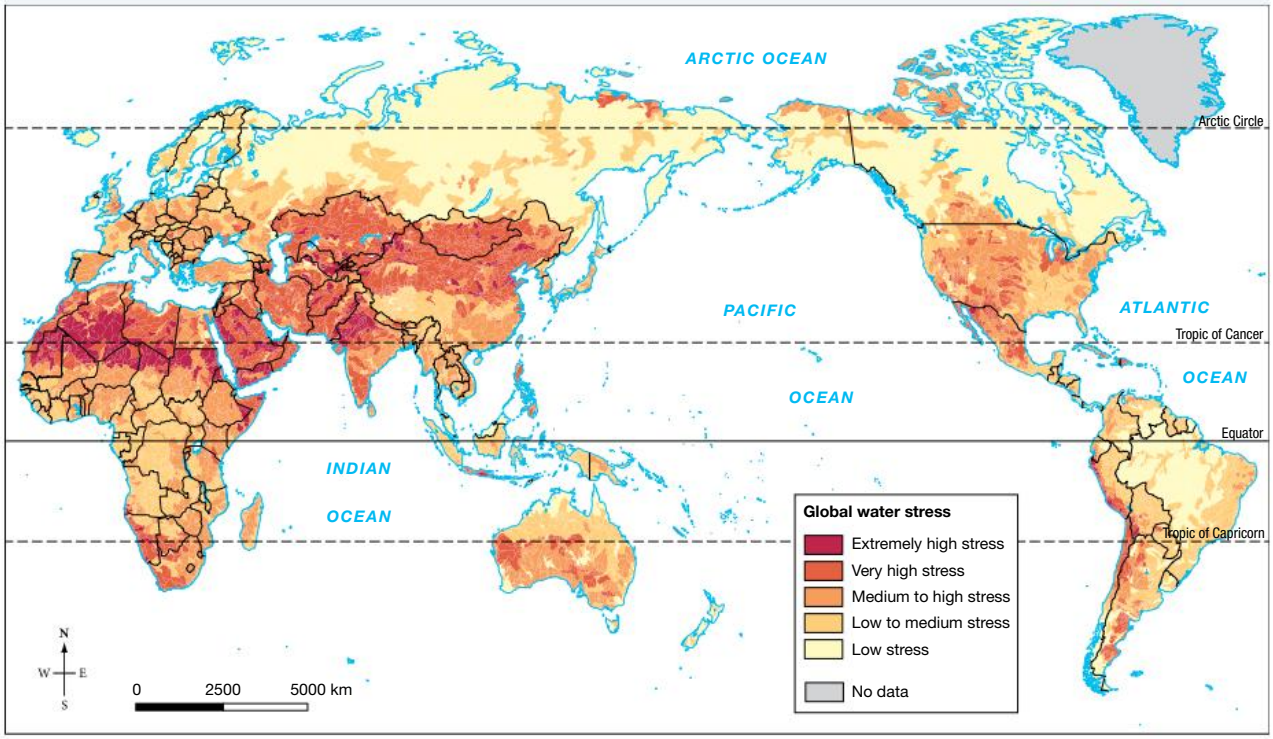
FIGURE 2 Distribution of global water stress



Source: Aqueduct (2019)

2.10.3 How does dirty water affect health?

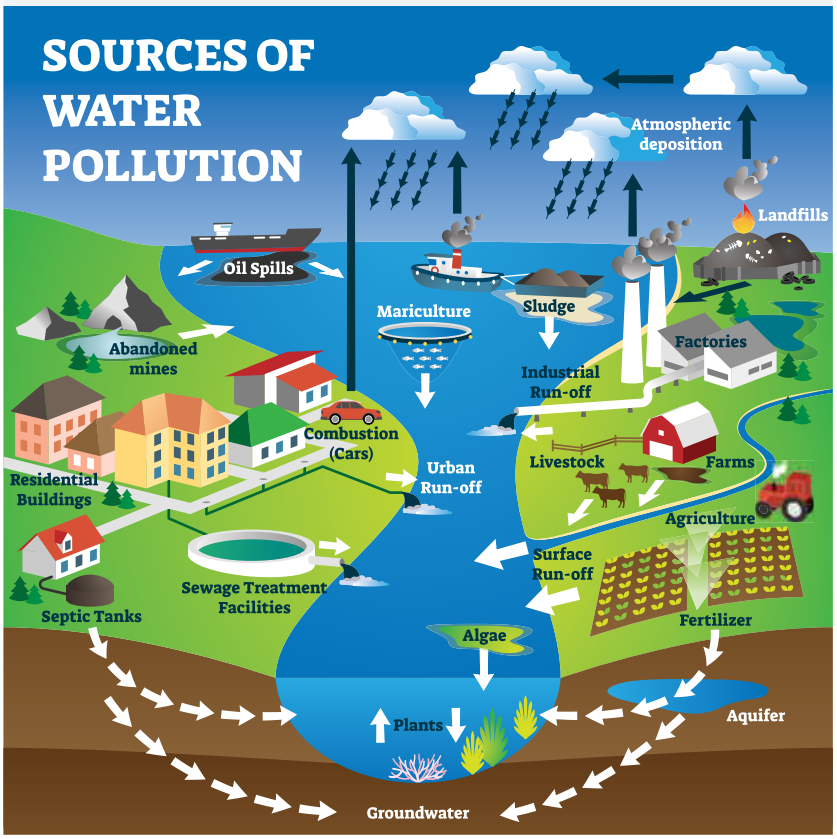
The right to water is linked to many other rights, including the right to food and to health. In 2018, nearly 850 million people in the world had no access to clean water, and more than 2.3 billion people had no safe way of disposing of human waste. Lack of toilets means many people defecate in open spaces or near the same rivers from which they drink. Experts estimate that 90 per cent of sewage in some countries ends up flowing straight into rivers and creeks.

2.10.4 Polluted rivers

Water quality can affect health in many ways. Rivers and streams act as drainage systems and, when it rains, water transports rubbish, chemicals and other waste into drains and, eventually, rivers.

As shown in **FIGURE 3**, different pollutants — including faeces (human and animal), food wastes, pesticides, chemicals and heavy metals — can come from industrial wastewater, domestic sewage, cars, gardens, farmland, mining sites and roads, and flow into waterways. Some countries, cities and local areas are better than others at providing services and enforcing laws to prevent pollutants from entering waterways.

FIGURE 3 Sources of water pollution in a drainage basin



2.10.5 What is a drought?

Australia is the driest inhabited continent on Earth. The main reason Australia is so dry is that much of the continent lies in an area dominated by high atmospheric pressure for most of the year, which brings dry, stable, sinking air to the country. Australia also experiences great variation in its rainfall due to the **southern oscillation** and **El Niño**.

Low average rainfall and extended dry spells are a normal part of life throughout most of Australia. The continent is located in a zone of high pressure that creates conditions of clear skies and low rainfall. Drought conditions occur when the high-pressure systems are more extensive than usual, creating long or severe rainfall shortages.

Droughts affect all parts of Australia over a period of time. Some droughts can be localised while other parts of the country receive good rain. Droughts can be short and intense, such as the drought that lasted from April 1982 to February 1983; or they can be long-lived, such as the 2002 to 2009 drought.

Different weather systems affect different parts of Australia, so all of Australia is highly unlikely to experience drought at the same time.

southern oscillation a major air pressure shift between the Asian and east Pacific regions; its most common extremes are El Niño events

El Niño the reversal (every few years) of the more usual direction of winds and surface currents across the Pacific Ocean; this change causes drought in Australia and heavy rain in South America

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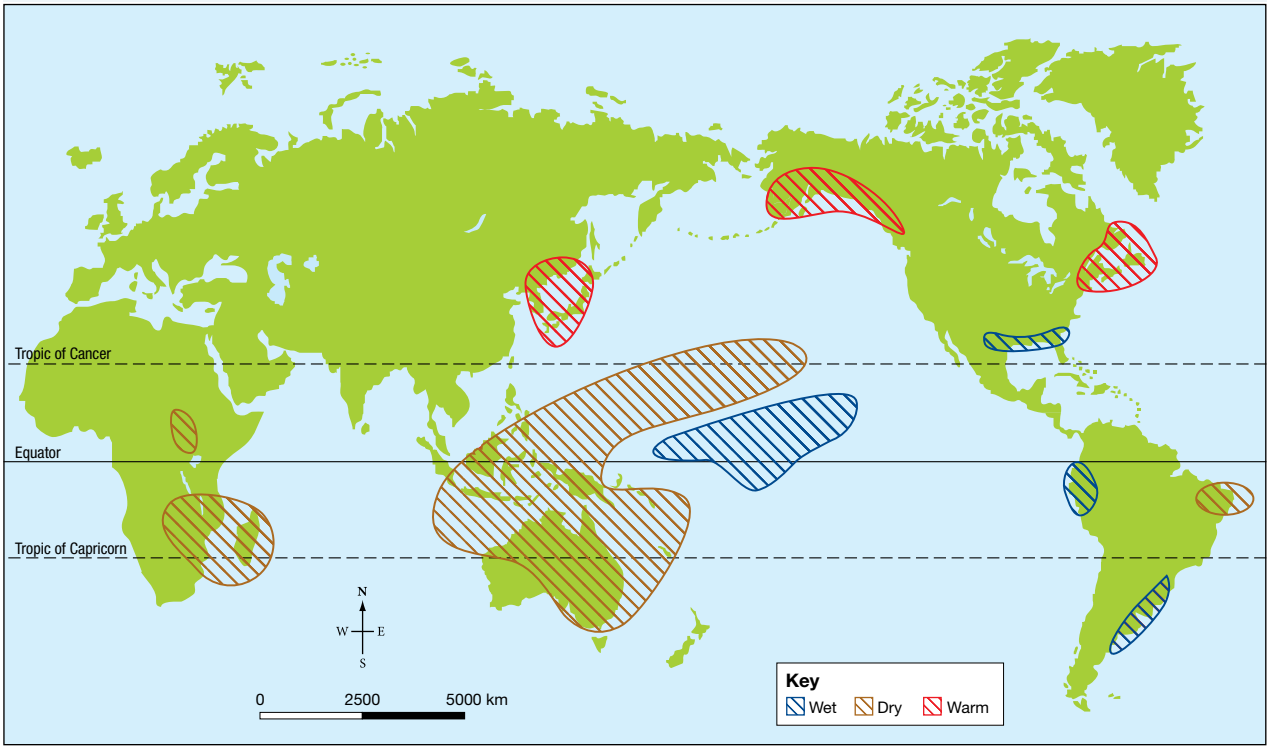
FIGURE 4 Areas affected by El Niño



Source: MAPgraphics Pty Ltd, Brisbane

2.10.6 Case study: Managing water in the Nile Basin, North Africa

The Nile River is the longest river in the world at 6695 kilometres long. It flows northward through the tropics and the highlands of eastern Africa and drains into the Mediterranean Sea in north Africa. **FIGURE 6** shows how the Nile River flows through medium to extremely high water stressed places.

The Nile Basin (the Nile River and all its tributaries) covers an area of about 3.1 million square kilometres (almost the same area as the Northern Territory). The Basin covers 10 per cent of the African continent.

Ten countries share the water and land in the Nile Basin: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Uganda and United Republic of Tanzania. More than 330 million people live in these ten countries — 160 million live within the watershed boundaries of the Nile Basin and share its water.

Water in the Nile Basin countries is used for hydro-electricity generation, town/city and industrial water supply, agriculture, fishing, recreation, transport, tourism and waste disposal. Most people earn a living in the Nile Basin through agriculture; it sustains millions of people. The topography of the Nile enables power generation, especially in Ethiopia. Hydropower is a major water user in the Nile, relying on water passing through turbines to generate electricity.

FIGURE 5 Farming in the lower Nile relies heavily on river water

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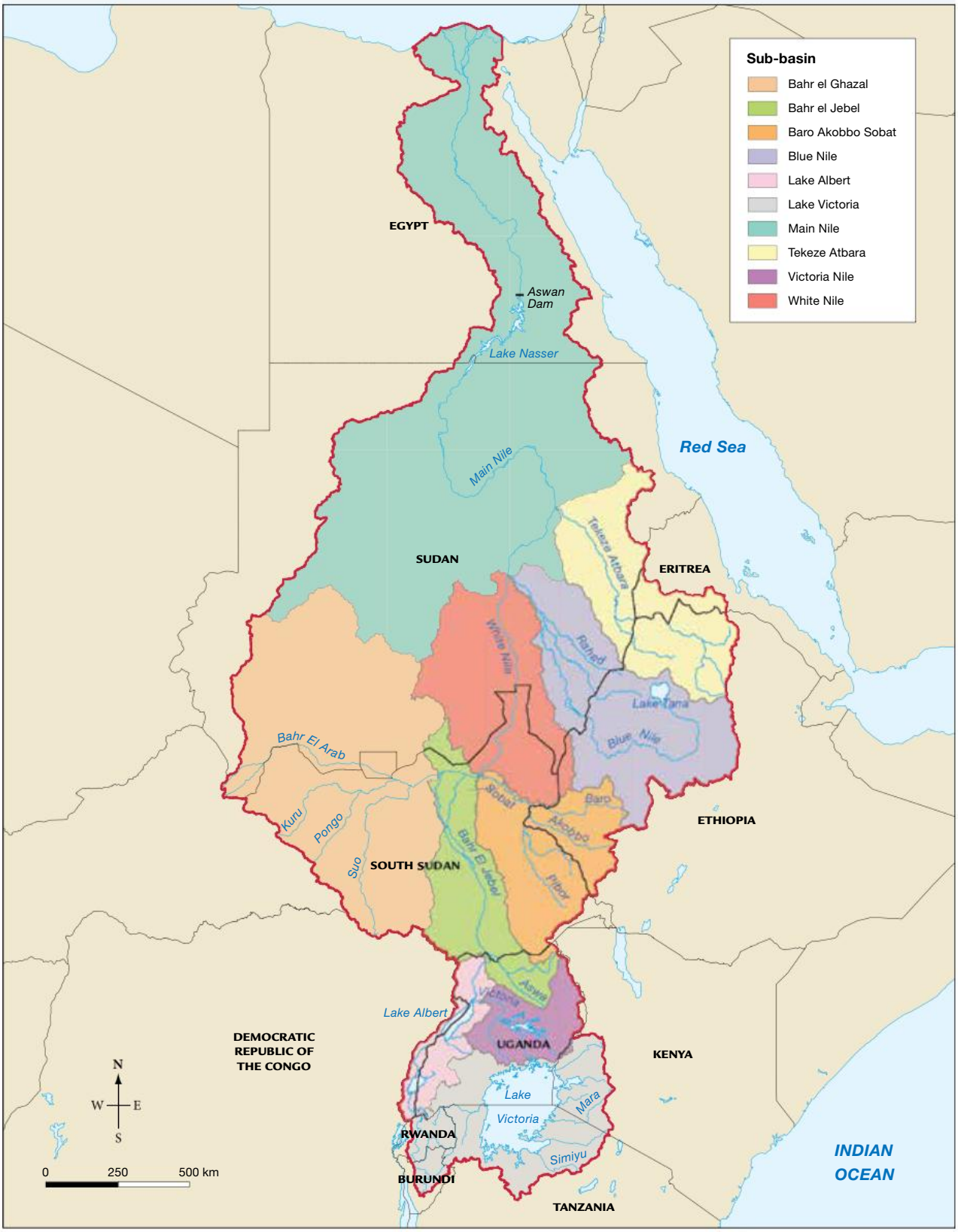
FIGURE 6 The sub-basins and countries sharing the water and land of the Nile River Basin



Source: Nile Basin Initiative

Nile Basin Sustainability Framework

Since the 1990s, many initiatives and agreements have been introduced regarding sharing the Nile's water. All have been based on a framework for cooperation and trying to ensure use of this important resource is equitable.

Approved in 2011, the Nile Basin Sustainability Framework (NBSF) outlines the guiding principles for water resource management and development across the Nile Basin countries.

This framework guides national policy and seeks to build consensus. It supports transboundary investment projects and promotes shared benefits and environmental concerns to help ensure projects have long-term benefits.

FIGURE 7 As the Nile is a shared resource, careful management is required.

A significant effort was made to strengthen database and shared geographical information system (GIS) skills so that up-to-date water flow and rainfall data are available. Without the NBSF, there would be no guidance for the sustainable development or cooperation in sustainable water management and development in the Nile Basin.

2.10 SKILL ACTIVITY: Questioning and researching using geographical methods

A survey is a useful tool that captures the thoughts and ideas of people about a particular subject such as water use. Questions can be asked verbally, digitally using a survey application or by using a printed question sheet. The choice is yours.

The questions prepared here use a variety of question styles and direct the person with their answers. Closed questions that require a yes or no response are easier to measure and display in a graph. Open-ended questions allow a person to elaborate on the topic.

Task

1. **Survey** the attitudes of three to five friends and family about water use in their personal lives. You may use the sample questions provided or your own questions.

Sample questions:

a. How important is wise water use to you and/or your family? (Please select one option.)
   i. Very important
   ii. Somewhat important
   iii. Not important at all
b. What steps are taken by your family to use water wisely?

2. Once you have conducted the survey, **discuss** the following.
   - How reliable are the results of this survey?
   - What steps could you take in future surveys to improve the quality of your survey results?

2.10 Exercise

learnon

2.10 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4	3, 6, 7	5, 8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. How many people in the world do not have access to sanitation?
   - A. 660 million
   - B. 90 per cent
   - C. 2.3 billion
   - D. 315 000
2. **Identify** three key changes drought brings to the environment.
   - A. Loss of soil
   - B. Increased soil fertility
   - C. New soil blows in
   - D. Creation of dust storms
   - E. Severe lack of water
3. **Define** 'water scarcity' and 'water stress'.
4. What is meant by the term 'water refugees'?
   - A. People who live on islands
   - B. People who move because their homes were flooded
   - C. People who take boat people into their homes
   - D. People who move to another location because there is a lack of water where they live
5. Refer to **FIGURE 4** showing the areas affected by El Niño. **State** whether each of the following places will be wetter, drier or warmer during an El Niño event?
   - a. Australia
   - b. Japan
   - c. Canada
   - d. Pacific Ocean
   - e. Madagascar
   - f. Argentina

Apply your understanding

Interpreting and analysing geographical data and information

6. Refer to **FIGURE 3** and your own knowledge to **explain** how rivers become polluted.
7. Refer to **FIGURE 2** and an atlas to answer the following questions.
   - a. **Identify** three countries that are experiencing extremely high water stress.
   - b. **Compare** Australia's level of water stress to New Zealand's.

Communicating

8. If water and sanitation is a human right, **explain** why some people are unable to access fresh water.
9. a. **Identify** two factors that can cause water stress or water scarcity.
   b. **Describe** the impact on a country if it is under water stress or water scarcity.

Interpreting and analysing geographical data and information

10. Read the section 2.10.6 case study on the Nile Basin and study **FIGURE 6**.
    - a. **Identify** the direction in which the Nile River flows towards.
    - b. **Outline** the potential water use conflicts along the Nile River as it makes its way to the Mediterranean sea.

LESSON
2.11 How can people overcome water scarcity?

LEARNING INTENTION

By the end of this lesson you should be able to identify global management strategies to enable water to be shared in a sustainable way.

TUNE IN

Did you know?

- One in three people around the world do not have access to safe drinking water.
- 3.6 billion people do not have access to a safe toilet.

FIGURE 1 A typical household uses water in many ways.

1. Consider the ways water is used in your household.
   a. Predict which appliance in your home uses the most water for one cycle of use: the washing machine, toilet or dishwasher?
   b. Predict how much water is used in an average shower and in an average handwash.
2. Brainstorm the names of three infectious diseases linked to a lack of safe water.
3. Describe one social impact on people that lack of access to a safe toilet could have.

2.11.1 Sustainable Development Goals: working to address water scarcity on a global scale

To promote a more sustainable future where all people gain access to water, sanitation and hygiene, the United Nations has developed 17 Sustainable Development Goals (SDGs). These goals aim to end all forms of poverty, protect the planet and ensure that all people enjoy peace and prosperity, with targets to be reached by the end of 2030. A summary of these 17 goals is shown in **FIGURE 2**.

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FIGURE 2 The UN Sustainable Development Goals

Goal 6 of the SDGs focuses on clean water and sanitation, and aims to 'ensure access to water and sanitation for all'. From 1990 to 2015 the percentage of people who had access to clean water increased from 76 to 91 per cent. The improvements in water access and sanitation are shown in **FIGURES 3** and **4**.

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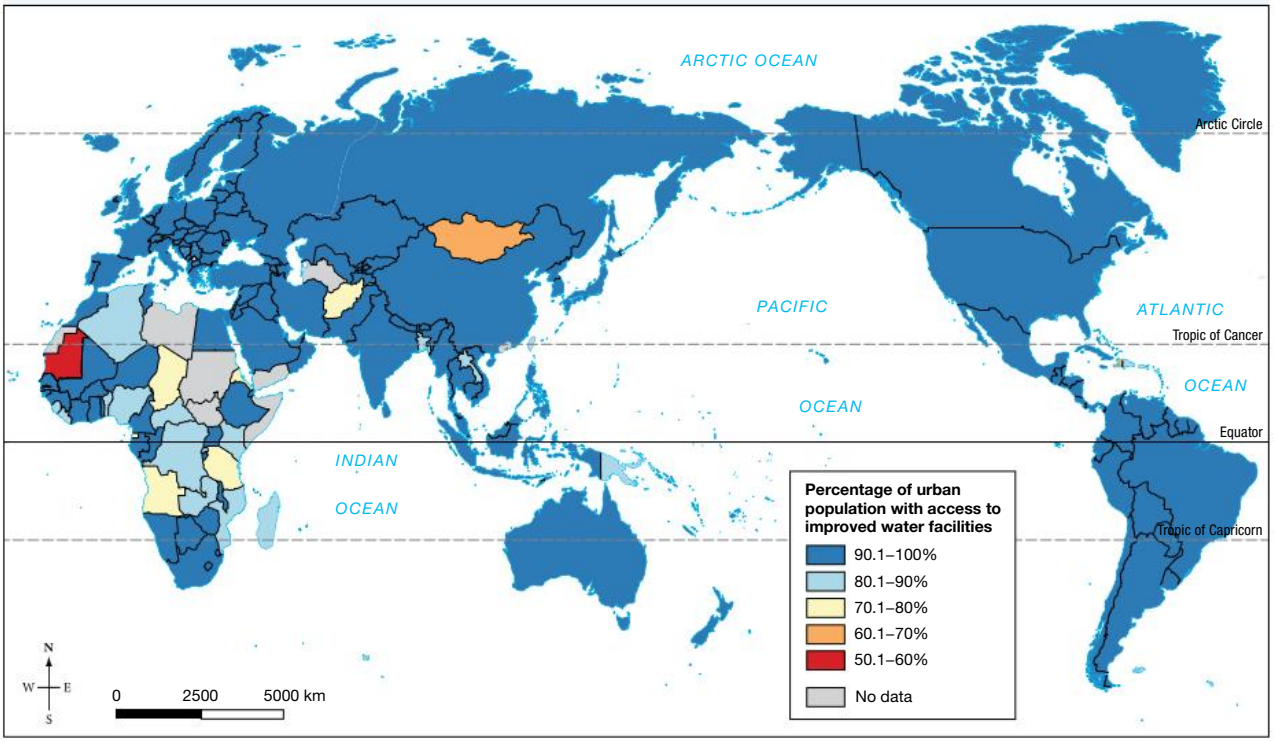
FIGURE 3 Percentage of global population with access to improved water facilities, 2015



Source: World Bank (2015)

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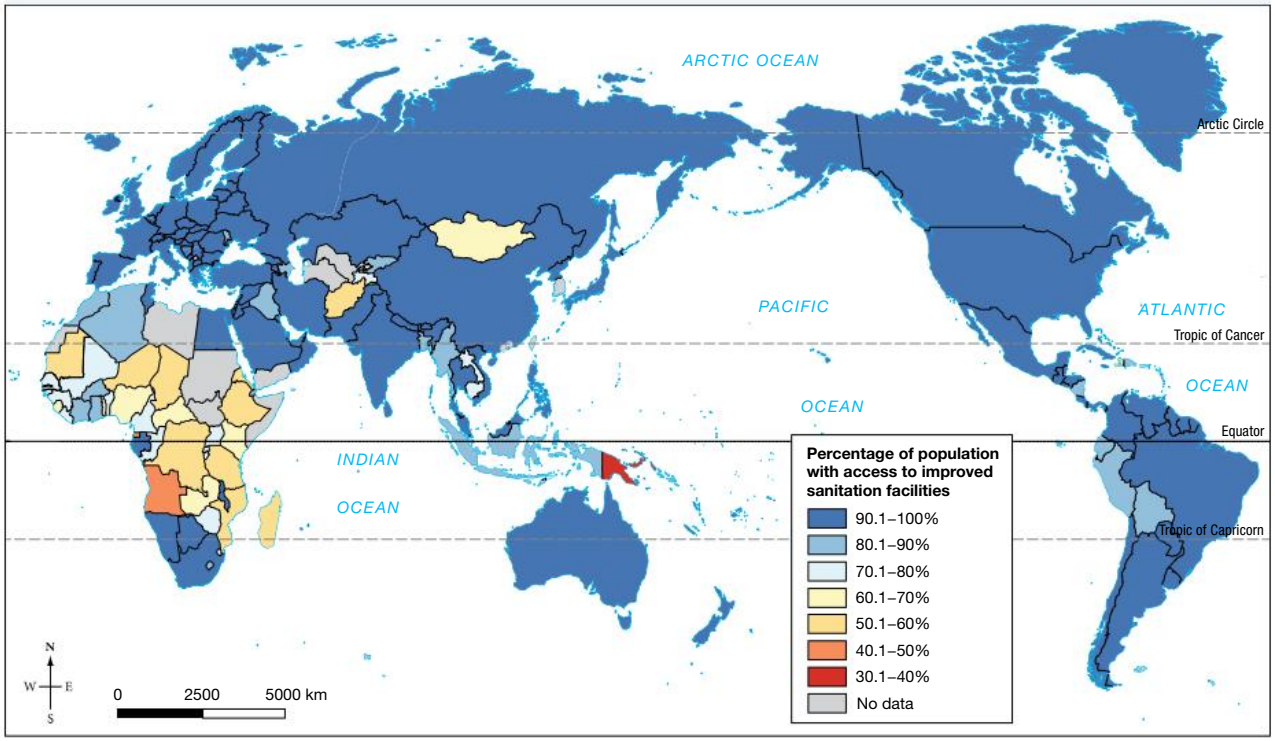
FIGURE 4 Percentage of global population with access to improved sanitation facilities, 2015



Source: World Bank (2015)

Goal 6

Some of the targets (by 2030) for Goal 6 are to:

- provide universal and equitable access to safe and affordable drinking water for all
- provide access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally
- substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (this goal was by 2020).

FIGURE 5 Goal 6 of the Sustainable Development Goals

Source: The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States. https://www.un.org/sustainabledevelopment/

2.11.2 Managing Australia's water supply

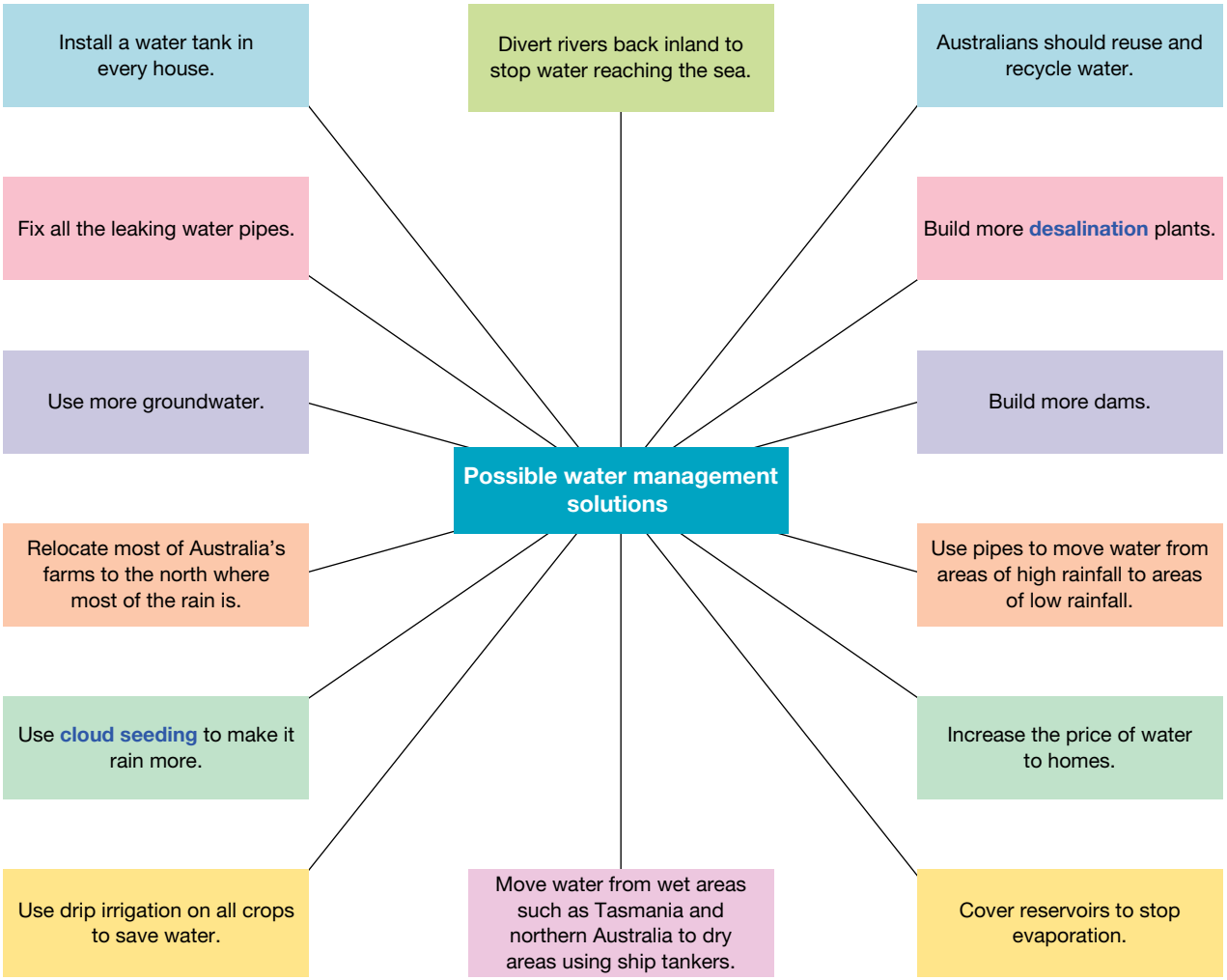
More water cannot be created, but it can be managed better. With a growing global population, and the predicted effects of climate change, the pressure on this finite resource requires a number of solutions.

Introducing effective water management can be a challenge at any scale, whether local, national or global. It needs the cooperation of all users, including farmers, industry, individuals, and upstream and downstream

people in different countries or different states. With all the competing demands on water, management is often easier to approach at a local scale.

FIGURE 6 outlines some of the ways we can develop more efficient uses for Australia's valuable water resources.

FIGURE 6 Possible water management solutions



Agriculture uses the greatest amount of water in Australia (refer to section 2.9.2). Making irrigation systems more efficient and getting more production for every drop of water used makes sense. Some irrigation systems waste up to 70 per cent of their water through leaks and evaporation, so changing the irrigation method can save water. Other management practices include recycling, using desalinated water and using stormwater.

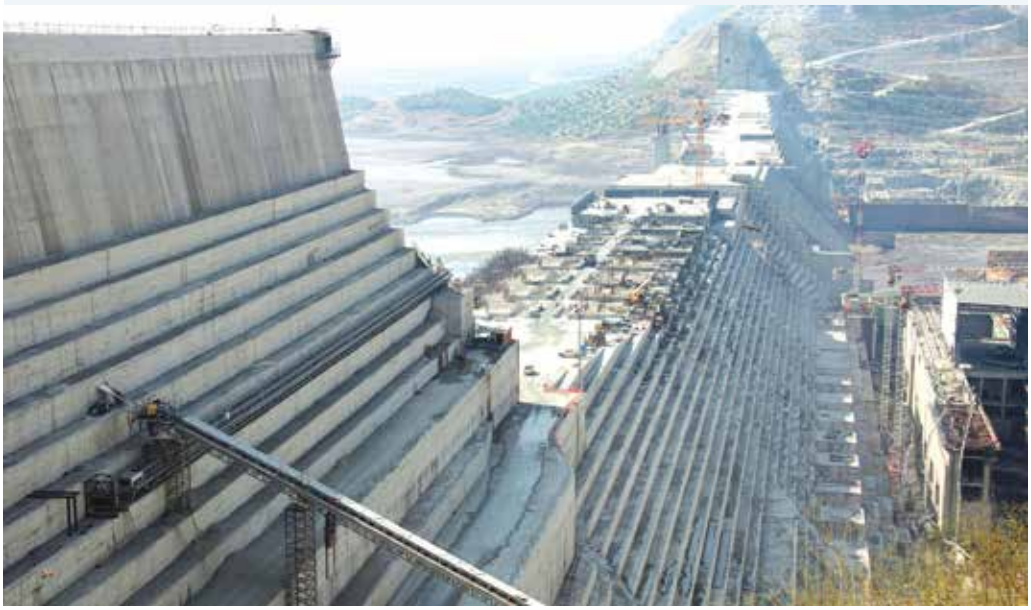
2.11.3 Managing water across borders

About 260 drainage basins across the world are shared by two or more countries, and 13 river basins are shared by five or more countries. Depending on their location in the **catchment**, some countries can suffer reduced access to water because of other countries' usage. This shows the interconnection between places — what happens in one place affects another. Diverting rivers, building dams, taking large amounts of water out for irrigation, and creating pollution can all lead to conflict between countries, states and political groups.

desalination a process that removes salt from sea water
cloud seeding implanting clouds with substances to cause rain
catchment the drainage basin of a river

Country disputes have occurred in the Nile Basin in north Africa, along the Mekong River in Asia, the Jordan River Basin in west Asia (the Middle East) and along the Silala River in South America. **FIGURE 7** shows construction of the Grand Ethiopian Renaissance Dam along an upstream section of the Blue Nile in northern Africa. The dam is being built by Ethiopia to produce hydroelectricity and the effects of the dam has caused a dispute with the downstream countries of Egypt and Sudan.

FIGURE 7 The construction in Ethiopia of Africa's biggest dam has caused regional conflict.



Conflict can also happen within a country, which has happened with the Murray–Darling Basin in Australia, across four states and one territory. Upstream uses of the water impact water quality and water security for downstream users of this precious resource.

Some countries sign international agreements or treaties to try to share water between nations. These include the Rhine and Danube rivers in Europe, and the Ganges and Brahmaputra rivers in Asia.

2.11.4 How can water-borne diseases be reduced?

Access to water does not ensure people have access to clean and fresh water. Dirty water and lack of proper hygiene kill around 315 000 children around the world every year, most of them younger than five. The diseases that can be passed on to people as a result of contaminated water include diarrheal diseases such as cholera, typhoid and dysentery. Malaria, a disease transmitted by mosquitoes, kills about one million people every year.

People use different methods to treat the water they have collected. They can let it stand and settle, strain it through a cloth, filter it, add bleach or chlorine, or boil it. Some people do not treat their water at all.

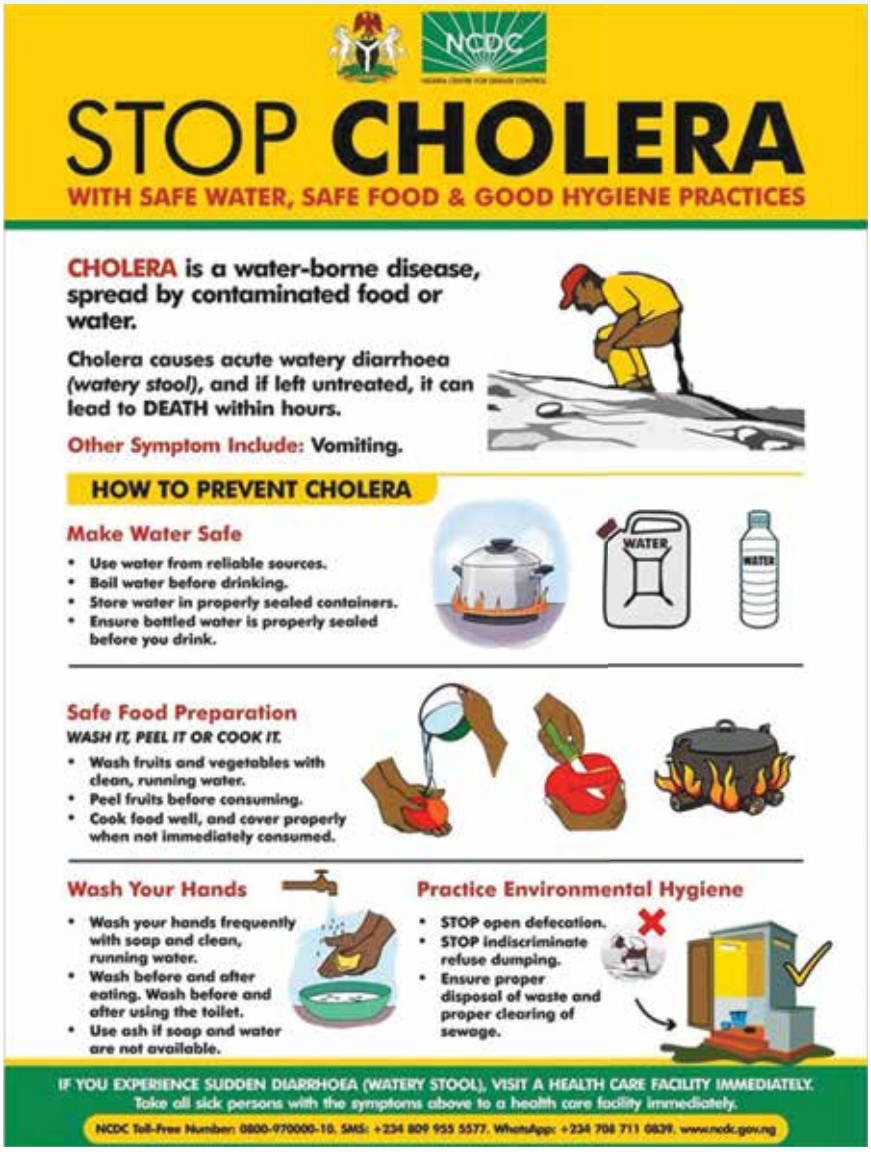
When barely enough water is available to drink or to cook with, it is difficult for people to set aside water for washing hands and cleaning clothes. However, hygiene and sanitation are very important for health.

Many aid groups (such as Water.org, Clean Water Fund, Global Water Challenge and The Water Project) work on projects to improve sanitation and access to clean water. Building cheap and effective toilets and teaching the community about good hygiene all help to reduce disease.

FIGURE 8 Collecting water that is unsafe to drink

FIGURE 9 The Citarum River in Indonesia is one of the most polluted rivers in the world.

FIGURE 10 A poster educating people about cholera and the measures to prevent it



2.11 SKILL ACTIVITY: Communicating

Geographers like to look at patterns over ***space***. Find an atlas map showing population density and compare it with **FIGURE 3**. Refer to countries in North Africa and West Asia in your answers. (Refer to the **Regions** resource in the digital documents section of the Resources panel.)

1. **Name** three coastal and two landlocked countries in these regions.
2. **Conduct research** to find out how many countries in these regions suffer deaths caused by poor sanitation and dirty water.
3. **Name** the continents and regions that have the fewest deaths.
4. Why do you think this spatial pattern exists? (*Hint:* look at maps in your atlas that show wealth.)
5. Many aid agencies work in countries and regions to improve access to sanitation and clean water. **Choose** one of those listed in this topic and find out more about what they are doing. How will their work make a difference to the living conditions of the people?
6. **Plan** a video presentation that is interesting and catchy and will help people understand the action needed to improve access to clean water and sanitation. Use video and video editing programs and internet research in your planning.

Resources

Digital document Regions (doc-17950)

2.11 Exercise

learnon

2.11 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4	3, 5, 6, 8	7, 9, 10

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Check your understanding

1. **Select** the correct options to complete the sentence. Desalination is a process that removes **pollutants** / **salt** / **clean water** from **sea water** / **river water** / **greywater**.
2. What is the aim of a desalination plant? **Select** the best option from the list provided.
   - A. To provide drinking water
   - B. To add minerals to drinking water
   - C. To produce salt
   - D. To remove salt from spring water
3. **Explain** why it is difficult to manage water when the water supply crosses country or state borders.
4. **Determine** if the following are true or false.
   - a. Goal 6 of the SDGs focuses on clean water and sanitation,
   - b. The 17 Sustainable Development Goals (SDGs) are only aimed at developing countries.
   - c. Dirty water and lack of proper hygiene kill around 200 000 children around the world every year.
5. **Identify** two ways the government attempts to ensure a reliable water supply.

Apply your understanding

Communicating

6. **Explain** what community-led sanitation projects aim to do.

Interpreting and analysing geographical data and information

7. Refer to an atlas, **FIGURE 3** and **FIGURE 4** to answer the following questions.
   - a. **Describe** the location of places with poor access to water and sanitation.
   - b. **Suggest** two reasons these places are unable to access improvements to water and sanitation.

Concluding and decision-making

8. a. From the list of strategies outlined in the poster in **FIGURE 10**, **identify** which would be the most challenging to adopt and why. Which strategy would be the easiest to adopt and why?
   - b. **Indicate** whether each of the following factors are advantages or disadvantages of using recycled water.
     - i. Reduces stress on drinking water
     - ii. Creates jobs
     - iii. Perception of a higher risk of contamination
     - iv. Good for farming through increased nutrients for the soil
     - v. Perception of a potential risk to health

Communicating

9. a. **Explain** how the SDGs aim to improve accessibility to clean water and sanitation.
   - b. **Elaborate** on two ways Goal 6 of the SDGs aims to improve global water stress and water security.
10. **Describe** two sustainable ways of reducing the impacts of drought. Give reasons for your choices.

LESSON
2.12 INQUIRY: What is the water quality of a local waterway?

LEARNING INTENTION

By the end of this lesson you should be able to research the water quality of a local catchment or waterway and produce a report and presentation on your findings.

Background

Water is our most valuable resource, and the management of this vital resource should be a priority at a local, regional and global level. Everybody lives near some sort of catchment—a river, creek, drain or other waterway is usually close to your home, school or neighbourhood. Water quality can affect health in many ways. Rivers and streams act as drainage systems. When it rains, water transports rubbish, chemicals and other waste into drains and, eventually, rivers.

Your team has been selected to research the water quality of a local catchment or waterway and produce a report and presentation on your findings. Be sure to measure water quality at different locations along the river, creek or stream, and try to determine the causes of different water quality.

A full investigation of water quality requires primary and secondary methods of research. **Primary research** in Geography refers to field observations, photographs and data collection that takes place by you or your team on a specific day. **Secondary research** refers to the use of published material that has been prepared by an organisation or another team such as a topographic map, media article or stream watch report.

Examples of primary research methods include:

1. collecting and testing water samples from a body of water
2. documenting evidence of litter and water contamination
3. observing water bugs, which provide evidence of a healthy body of water.

FIGURE 1 When investigating water quality, primary research methods include collecting water samples, documenting evidence of litter and observing water bugs.

primary research collection of original information

secondary research collection of resources on an issue, prepared by others and offering different viewpoints

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

Research the main features of your local river catchment area.

- **What** sort of data and information will you need to study water quality at your fieldwork sites?
- **How** will you collect and record this information?
- **Where** would be the best locations to obtain data? You can determine this once you know which waterway(s) you are visiting.
- **How** will you record the information you are collecting? Consider using GPS, video recorders, cameras and mobile devices (laptop computer, tablet, mobile phone).

Step 2: Interpreting and analysing geographical data and information

Gain some knowledge of the fieldwork location and requirements before you visit the site.

- Access topographic maps and Google Earth to help you become familiar with the location. Using these tools, **complete** a sketch map of the waterway(s) and label the sites you are going to visit.
  You can then scan your sketch map and have it available electronically on the field trip. Alternatively, use Google Maps to record all the sites you visit.
- **Determine** what equipment and resources you will need to bring with you to each site to collect the data. Working in groups to collect the data is useful, with each group collecting different data at each site.
- Access the supplied data collection templates to use electronically on your mobile device, or print copies.

FIGURE 2 Data can be collected at the site and then entered immediately into data collection templates.

Step 3: Concluding and decision-making

Collect, collate and share your data, and then **decide** what information to include in your report and the most appropriate way to show your findings.

If using spreadsheet data, make total and percentage calculations. Some measurements are best presented in a table, while others are better in graphs or on maps. If you have used a spreadsheet, you may like to produce your graphs electronically.

Use photographs as map annotations (either scanned and attached to your electronic map or attached to your hand-drawn map) to show features recorded at each site. You may also like to **annotate** each photograph to show the geographical features you observed.

Describing and **interpreting** your data is important. Broad descriptions can also be made of your findings, which might include answering some or all of the following:

- Where is water quality highest (best) in the waterway studied?
- Is water quality better in the upper reaches of the river or creek?
- Does an urban waterway have better water quality than a rural waterway?
- Does surrounding land use have an impact on water quality?
- Do large waterways have better water quality than smaller waterways?
- What were the main contributors to poor and good water quality?
- How does surrounding vegetation affect water quality?

Access the **digital documents** section of the Resources panel to download the following:

- Data recording template
- Presentation template
- Record sheets
- Report template

Step 4: Communicating

Communicate your findings. You will now produce a fieldwork report and presentation to present your findings. Your report and presentation should include all of the research that you completed and all evidence to support your findings.

Ensure that your report includes the following:

- a title
- an aim
- a hypothesis (what you think you will find). Write this before you go into the field.
- your findings
- a conclusion.

You will also need to recommend some type of action that needs to be taken to improve water quality in the creek or river you visited.

Complete your self-assessment using the **Inquiry rubric** or access the 2.12 exercise set to complete it online.

on Resources

Digital documents
Inquiry rubric (doc-39245)
Data recording template (doc-39246)
Presentation template (doc-39247)
Record sheets (doc-39248)
Report template (doc-39249)

LESSON
2.13 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

Find all this and MORE in jacPLUS

2.13.1 Key knowledge summary

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

2.2 What are environmental resources?

- People depend on the Earth's environmental resources for survival.
- Environmental resources can be renewable and non-renewable.
- Careful use of environmental resources will ensure their sustainability.
- Australia has an abundance of environmental resources, both renewable and non-renewable. These include minerals, soils, forests and natural scenery.

2.3 How is water used as a resource?

- Water is a renewable resource in most forms.
- The water cycle is a process that cycles water in different forms across places.
- Water connects places as it moves through the environment.

2.4 How is groundwater a resource?

- Groundwater is water stored in aquifers under the ground and is an important source of water for people living in arid and semi-arid regions.
- If more groundwater is used than is being recharged, aquifers may dry up; groundwater can, therefore, be regarded as a finite and non-renewable resource.
- Many groundwater sources throughout Australia have long been used by First Nations Peoples, and passed on in Dreaming stories and songs.

2.5 How does groundwater connect people?

- First Nations Australians use groundwater sources in dry regions to sustain life.
- Many springs and soaks have cultural significance for local Aboriginal Peoples whose ancestors relied on the springs for survival.
- Knowledge of the springs has been passed down over many generations through Dreaming stories.

2.6 How is water distributed across the world?

- Of all the water in the world, only a small fraction is available to people to use.
- Rainfall varies widely across the world.
- Green water, blue water and potential water sources are found in places around the world.
- Climate change is affecting the amount of water available in many locations around the world.

2.7 How does Australia's climate affect its water availability?

- Australia is the driest permanently inhabited continent in the world.
- Australia's rainfall is highly variable even at a global level.

2.8 Investigating topographic maps: The value of water in Noosa

- The environment around Noosa is valued for economic, aesthetic and cultural reasons.
- Management strategies help to ensure the demands of tourist and locals are met.

2.9 Does everyone have enough water?

- Globally, water is mainly used for agriculture, but this varies from region to region.
- Australia uses 70 per cent of its water for agriculture.
- Virtual water includes the water used to manufacture food and goods.
- Some foods and goods require very large amounts of water to be produced.
- Countries that export these high water-use products are virtually exporting their water; countries importing these goods are virtually importing water.
- A strong relationship exists between First Nations Australians' use of water and the landscape.

2.10 What water scarcity exists in Australia and the world?

- Access to adequate and clean water and to adequate sanitation varies across the world.
- Africa has the worst data related to water and sanitation provisions.
- Women are over-represented in the task of fetching and carrying water.
- Australia is the driest inhabited continent on Earth and, although it has several large rivers, the availability of fresh water is scarce.
- A drought is a prolonged period of below-average rainfall, when not enough water is available to supply our normal needs.
- Weather events such as El Niño can produce extended periods of drought.

2.11 How can people overcome water scarcity?

- Water needs to be carefully managed for enough people to receive an adequate supply.
- Access to clean and sufficient water and adequate sanitation reduces health-related deaths.
- Work on the Sustainable Development Goals have resulted in improved access to clean water and sanitation but a lot of work is still to be done to improve this for many more people.
- Cross-boundary water management needs to be carefully planned to ensure upstream and downstream populations share the resource equitably.
- Personal behaviours can help minimise water use and wastage.
- Governments have a significant role in managing drought and water scarcity. Proper water management includes the development of technologies, such as desalination plants, and encouraging more responsible household water use.

2.12 INQUIRY: What is the water quality of a local waterway?

- Water quality will vary depending on the location of the testing site and whether or not rain has fallen in the previous 24 hours.
- All recordings should be dated to add validity to the results.

2.13.2 Key terms

aquifer a body of permeable rock below the Earth's surface that contains water, known as groundwater; water can move along an aquifer

artesian aquifer an aquifer confined between impermeable layers of rock; the water in it is under pressure and can flow upward through a well or bore

atmosphere the layer of gases surrounding Earth

catchment the drainage basin of a river

climate change any change in climate over time, whether due to natural processes or human activities

cloud seeding implanting clouds with substances to cause rain

continuous resource a resource that is never used up by humans

desalination a process that removes salt from sea water

Dreaming The Dreaming in First Nations spirituality, the beginning of earth and the cycles of life and nature, explaining creation and the nature of the world, the place that every person has in that world and the importance of ritual and tradition

El Niño the reversal (every few years) of the more usual direction of winds and surface currents across the Pacific Ocean; this change causes drought in Australia and heavy rain in South America

environmental resource a material found in nature that is necessary or useful to people

evaporation the process by which water is converted from a liquid to a gas and thereby moves from land and surface water into the atmosphere

groundwater a process in which water moves down from the Earth's surface into aquifers

hydrologic cycle another term for the water cycle

mound spring mound formation with water at its centre, formed by minerals and sediments brought up by water from artesian basins

non-renewable resource a resource that cannot be renewed in a short time and is finite

potential resource a resource that exists but is unusable in its current state, such as salt water, ice and water vapour

precipitation rain, sleet, hail or snow and other forms of water that fall from the sky when water particles in clouds become too heavy

primary research collection of original information

rainfall variability the change from year to year in the amount of rainfall in a given location

relative humidity the amount of moisture in the air

renewable resource a resource that can be naturally replaced if carefully managed

secondary research collection of resources on an issue, prepared by others and offering different viewpoints

soak place where groundwater moves up to the surface

southern oscillation a major air pressure shift between the Asian and east Pacific regions; its most common extremes are El Niño events

uranium a dense grey radioactive metal used as a fuel in nuclear reactors

virtual water all the hidden water used to produce goods and services

water footprint the total volume of fresh water that is used to produce the goods and services consumed by an individual or a country

water scarcity when the demand for water is greater than the supply available

water stress a situation that occurs in a country with less than 1000 cubic metres of renewable fresh water per person

2.13.3 Reflection

Revisit the inquiry question posed in the Overview:

What effect does the uneven distribution of water resources have on the lives of people?

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

eWorkbooks Customisable worksheets for this topic (ewbk-13432)
Reflection (ewbk-10543)
Crossword (ewbk-10542)

Interactivity Water as a resource crossword (int-7700)

2.13 Review exercise

Students, these questions are even better in jacPLUS

Receive immediate feedback and access sample responses

Access additional questions

Track your results and progress

Find all this and MORE in jacPLUS

Multiple choice

1. What is the main difference between a renewable and a non-renewable resource?
   - A. Renewable resources are cheaper than non-renewable resources.
   - B. Renewable resources are more expensive than non-renewable resources.
   - C. Renewable resources can be replaced in a longer period of time than non-renewable resources.
   - D. Renewable resources can be replaced in a shorter period of time than non-renewable resources.
2. Which statement explains the phrase 'Freshwater: lifeblood of the planet'?
   - A. Earth is made up of 90 per cent water.
   - B. Rivers and streams carry water.
   - C. Water is precious because it is the basis of all living things.
   - D. Earth is made up of 50 per cent water.
3. Only 2.5 per cent of the world's water is fresh water. Where is most of this locked up?
   - A. Groundwater
   - B. Wetlands
   - C. Glaciers, snow and ice
   - D. Atmosphere
4. How are groundwater and surface water interconnected?
   - A. They are not interconnected but are two different water systems.
   - B. Surface water is evaporated and then precipitated back to Earth.
   - C. Rivers slowly fill up aquifers.
   - D. Groundwater is replenished when surface water infiltrates deep into water-bearing rock or aquifers.
5. What is groundwater?
   - A. Water that collects on the surface of the ground
   - B. Pools of water formed after heavy rainfall
   - C. Water found in the pores within soil, sand and rock in the earth
   - D. Water that has been boiled and is safe to drink
6. Water can be classified as either blue or green water. What does green water refer to?
   - A. Water that is stored in the soil, stays on top of the soil or in plants
   - B. Water that is contaminated by blue-green algae
   - C. Water that is stored in underground aquifers
   - D. Water stored in oceans (salty water)
7. What is the result of unequal access to resources?
   - A. Poverty
   - B. Dropping food prices all over the world
   - C. Rising food prices all over the world
   - D. End to famines

8. When does water scarcity occur?
   - **A.** When the demand for water is greater than the supply available.
   - **B.** When the demand for water is less than the supply available.
   - **C.** When too much water is available to fulfill all demands.
   - **D.** When not enough water is available to fulfil all demands.
9. Approximately 10 per cent of people in the world do not have access to water that is safe to drink. Approximately how many people in the world do not have access to safe drinking water?
   - **A.** 84 million
   - **B.** 8 billion
   - **C.** 844 million
   - **D.** None
10. Investigating geographical issues using primary and secondary research methods ensures many viewpoints and original data are included in the study. What is an example of primary research methods?
    - **A.** A media article about a local river
    - **B.** An image taken by a local photographer of the pollution in the river
    - **C.** Water quality measurements taken by you at the local river
    - **D.** Information about the river from the council website

Short answer

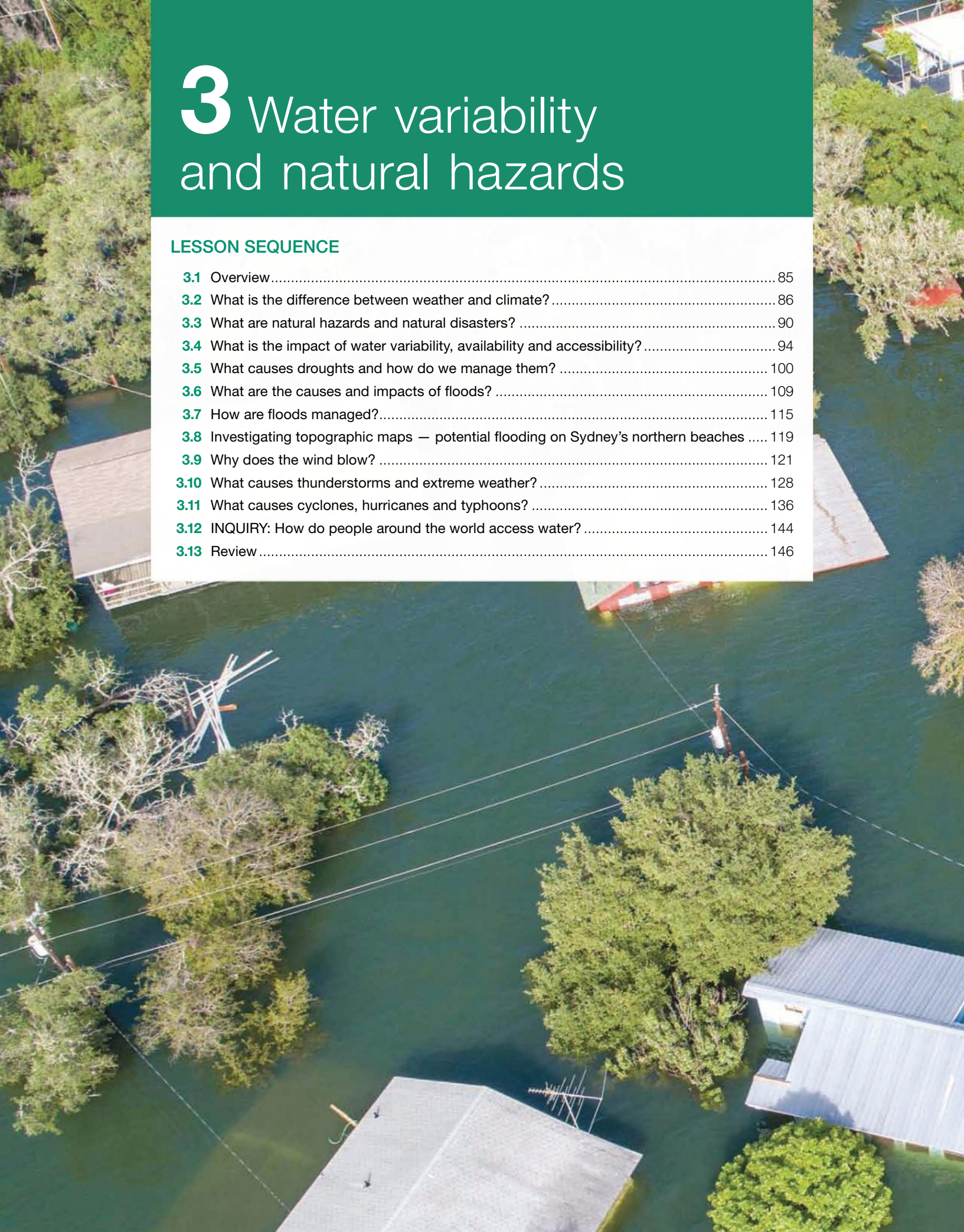
Communicating

11. Answer the following.
    - **a.** **Suggest** three ways that people use groundwater as a resource.
    - **b.** **Explain** how groundwater is used unsustainably.
12. Drinking unsafe water creates a number of problems. **Identify** two impacts of unsafe drinking water on the lives of people in developing countries.
13. **Explain** one social impact of water scarcity on a local community in a less economically developed region.
14. **Explain** two water management strategies used by communities to improve the sustainability of water as an environmental resource.

Concluding and decision-making

15. Climate scientists predict that many areas of the world will receive less rain as global temperatures increase. **Identify** two problems that may arise in regions of the world where rainfall decreases. You should consider problems that may arise for people and for the environment.

3 Water variability and natural hazards



LESSON SEQUENCE

LESSON
3.1 Overview

Hey students! Bring these pages to life online

Watch videos

Engage with interactivities

Answer questions and check results

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How does weather and climate, including severe weather events, influence the distribution and wellbeing of human populations?

What impact could the lack of water resources have on communities and how can it be improved?

3.1.1 Introduction

Have you ever wondered why the weather isn't the same across the entire country, state or even city? Weather patterns change depending on a number of geographic factors and this, in turn, influences the frequency and amount of rain received in each location.

Weather influences the level of precipitation experienced in different places. If too little rain falls, drought can develop, sometimes producing heatwaves — days of dry, hot weather. If too much rain falls, flooding will occur. These extreme weather events have many effects, and these can be more severe in certain parts of the world. While we cannot control these events, we can learn from the past and plan to minimise the impacts of these events in the future.

FIGURE 1 Weather changes can produce droughts in some places and flooding in others.

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-13433)

Video eLesson Water variability and natural hazards (eles-6031)

LESSON
3.2 What is the difference between weather and climate?

LEARNING INTENTION

By the end of this lesson you should be able to understand the differences between weather and climate and how each system plays a role in water availability.

TUNE IN

As you will learn in this lesson, the terms weather and climate relate to connected but separate systems.

Working with a partner, write a list of the weather and climate related events of which you know.

Once you have a completed list, try to classify these into weather events or climate events.

FIGURE 1 Weather and climate are related yet separate systems.

3.2.1 How does weather change?

Our Earth is surrounded by a band of gases called the atmosphere. It protects our planet from the extremes of the sun's heat and the chill of space, making conditions just right for supporting life. The atmosphere has five different layers (see **FIGURE 2**). The layer that starts at ground level and ends about 16 kilometres above Earth is called the troposphere. Our weather is the result of constant changes to the air in the **troposphere**. These changes sometimes cause extreme weather events.

Droughts, **floods**, **cyclones**, tornadoes, heatwaves and snowfalls — even cloudless days with gentle breezes — all begin with changes to the air in the troposphere. The five main layers in the Earth's atmosphere all differ from one another. For example, the troposphere contains most of the **water vapour** in the atmosphere. As a result, this layer has an important link to **precipitation**.

All weather conditions result from different combinations of three factors: air temperature, air movement and the amount of water in the air. The sun influences all three.

First, the sun heats the air. It also heats the Earth's surface, which in turn heats the air even more. How hot the Earth's surface becomes depends on the season and the amount of cloud cover.

troposphere layer of the atmosphere closest to the Earth, extending about 17 kilometres above the Earth's surface, but thicker at the tropics and thinner at the poles; where weather occurs

drought a long period of time when rainfall received is below average

flood inundation by water, usually when a river overflows its banks and covers surrounding land

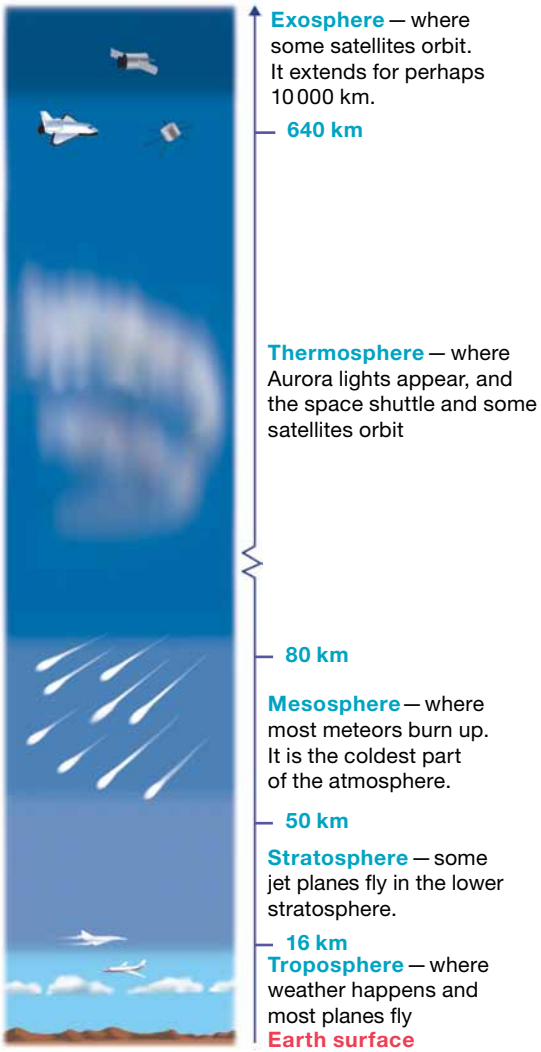
cyclones intense low-pressure systems producing sustained wind speeds in excess of 65 km/h; they develop over tropical waters where surface water temperature is at least 27 °C

water vapour water in its gaseous form, formed as a result of evaporation

precipitation rain, sleet, hail, snow and other forms of water that falls from the sky when water particles in clouds become too heavy

tlvd-10535

FIGURE 2 Structure of the Earth's atmosphere (not to scale)



Second, the sun causes air to move. This is because the sun heats land surfaces more than it heats the oceans. As the warm air over land gets even warmer, it expands and rises. When hot air rises, colder air moves in to take its place.

Third, the sun creates moisture in the air. The heat of the sun causes water on the Earth's surface to **evaporate**, forming water vapour. As this water vapour cools, it condenses, forming clouds. It may return to Earth as rain, dew, fog, snow or hail.

evaporate to change liquid, such as water, into a vapour (gas) through heat

At times these three factors — temperature, air movement and water vapour — can create extreme weather events. Very high air temperatures influence heatwaves; rapidly rising air plays a part in the formation of cyclones; and excess rain can create flooding.

3.2.2 The difference between weather and climate

Weather is the day-to-day, short-term change in the atmosphere at a particular location. Extreme weather events are often described as unexpected, rare or not fitting the usual pattern experienced at a location.

Climate is the average of weather conditions that are measured over a long time. Places that share the same type of weather are said to lie in the same climatic zone. Because of the size of the Australian continent, its climate varies considerably from one region to another.

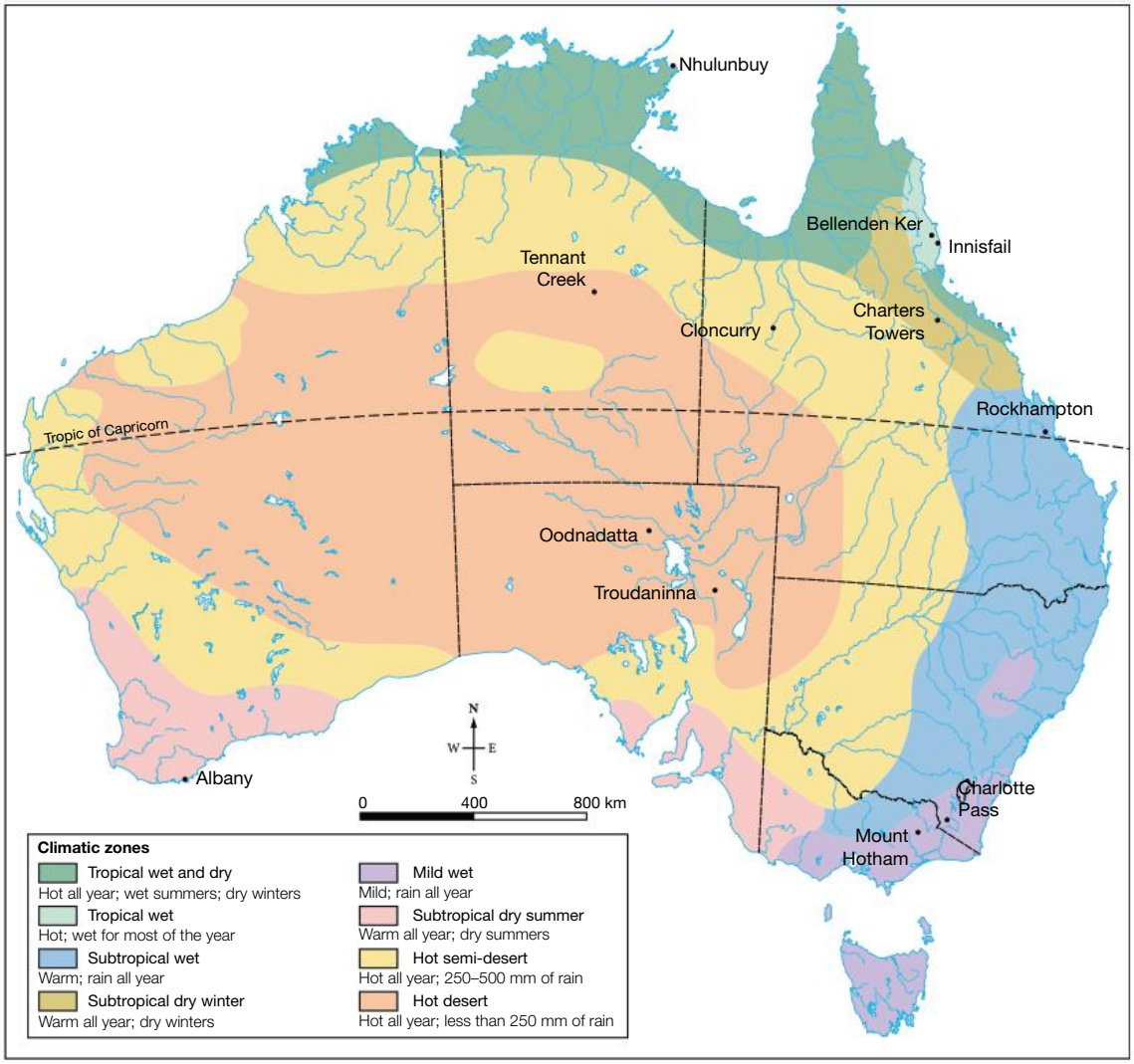
FIGURE 3 Australia experiences a diversity of weather, which has a major effect on how we live.



int-5288

tlvd-10534

FIGURE 4 Climatic zones of Australia



Source: MAPgraphics Pty Ltd, Brisbane

SkillBuilders to support skill development

- 1.6 reading a weather map
- 1.14 Interpreting diagrams

3.2 SKILL ACTIVITY: Interpreting and analysing

In a magazine or newspaper or online, find a photograph that shows an example of one type of weather.

Paste the picture in the centre of a page and add labels about the impact of that weather on the environment (for example, creating puddles) and on what we do (such as the clothes people wear).

3.2 Exercise

learnon

3.2 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 8, 9	4, 6	5, 7, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. **Identify** the name of the layer of the atmosphere where all Earth's weather happens.
   - A. Troposphere
   - B. Stratosphere
   - C. Mesosphere
   - D. Exosphere
2. The term 'troposphere' refers to the section of the atmosphere where most meteors burn up. It is the coldest part of the atmosphere. True or false?
3. In which levels of the atmosphere are the following features found?
   - a. Most passenger planes: _____
   - b. Orbiting satellites: _____
   - c. Burning meteors: _____
   - d. The Aurora lights: _____
4. **Explain** the difference between weather and climate.
5. Draw three diagrams to help you **explain** the factors that influence the following weather conditions.
   - a. Air temperature
   - b. Air movement
   - c. The amount of water in the air

Apply your understanding

Interpreting and analysing

6. Look carefully at the photographs in **FIGURE 3**.
   - a. **Describe** the weather event in each photograph.
   - b. How would each weather event affect people's lives?
7. Look carefully at the map of Australia's climatic zones in **FIGURE 4**. **Predict** which two settlements, or places, might be at risk of flood. Make sure you **explain** why you chose them.
8. Look at the environment outside a window right now.
   - a. What is the weather like? Do you think it matches the climatic zone in which you live? **Explain**.
   - b. Now check to see your climatic zone using **FIGURE 4**. If your answers are different, **explain** why this may have occurred.
9. **Describe** how the weather affected you yesterday. **Consider** the activities in which you participated either at school or after school.
10. **Describe** the relationship between Australia's climate and the places where we choose to live.

LESSON
3.3 What are natural hazards and natural disasters?

LEARNING INTENTION

By the end of this lesson you should be able to explain how natural hazards can become disasters that affect communities and environment across different scales.

TUNE IN

Both of the images in **FIGURE 1** show volcanic eruptions. One image shows a hazard and one image shows a disaster. Identify the hazard and the disaster, providing a justification for your decision.

FIGURE 1 Hazard or disaster?

3.3.1 What are natural hazards?

Australia is prone to a wide variety of **natural hazards**, which range from drought and bushfire to flooding. Many of these events are part of the weather's natural cycle. However, human actions such as the burning of fossil fuels, overgrazing, deforestation and the alteration of natural waterways have sometimes increased the impact of these hazards.

Natural hazards are different from **natural disasters**. A hazard is an event that is a *potential* source of harm to a community. A disaster occurs as the result of a hazardous event that dramatically affects a community. The four broad types of natural hazard are as follows:

1. atmospheric — for example, cyclones, hailstorms, blizzards and bushfires
2. hydrological — for example, flooding, wave action and glaciers
3. geological — for example, earthquakes and volcanoes
4. biological — for example, disease epidemics and plagues.

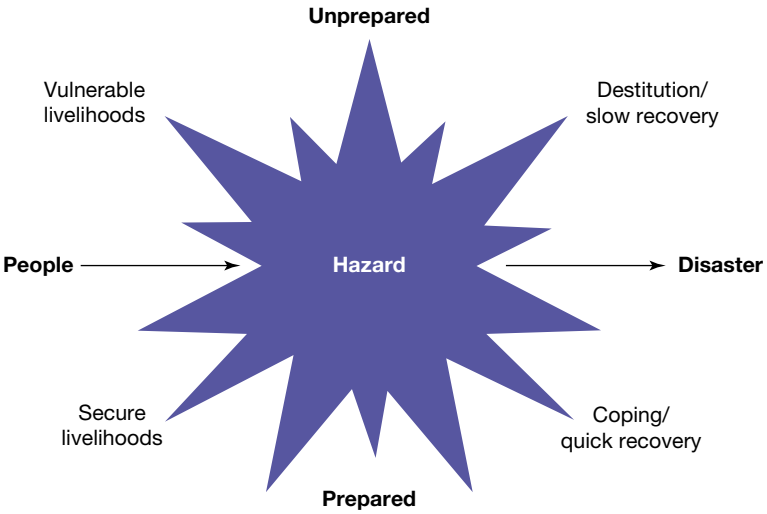
Natural hazards that are linked to the weather are categorised into the atmospheric and hydrological types. Hazards such as flooding and cyclones could also be termed extreme weather events.

natural hazard an extreme event that is the result of natural processes and has the potential to cause serious material damage and loss of life

natural disaster an extreme event that is the result of natural processes and causes serious material damage or loss of life

Some natural hazards are influenced by the actions of people and where they choose to locate themselves. For example, the severity of a flood depends not only on the amount and duration of rainfall that occurs. Humans can influence floods by building on floodplains and not planning well for disaster. Environmental degradation and poor urban planning can also turn natural hazards into natural disasters.

FIGURE 2 The link between vulnerability and disaster



Australia's costliest natural disasters

The following are some of Australia's costliest natural disasters from the last 50 years:

- *Floods, Queensland and New South Wales, 2022:* 22 deaths, estimated $10 billion cost.
- *Bushfire, 'Black Summer', Australia-wide, 2019–20:* 34 deaths, $103 billion cost.
- *Drought, Australia-wide but mainly in New South Wales, 2018:* $12 billion cost.
- *Floods, Queensland, New South Wales and Victoria, 2010–2011:* 35 deaths, 20 000 homes destroyed in Brisbane alone, $5.6 billion cost.
- *Bushfire, 'Black Saturday', Victoria, 2009:* 173 deaths, 2029 houses lost, more than $4 billion cost.
- *Earthquake, Newcastle, 1989:* 13 deaths, 50 000 buildings damaged, more than $4 billion cost.
- *Cyclone, Cyclone Tracy, Darwin, 1974:* 65 deaths, 10 800 buildings destroyed, $4.18 billion cost.

World's most deadly recent disasters

The following are the world's most deadliest disasters so far in the twenty-first century:

- *Earthquake, Haiti, 2010:* estimated range 100 000 to 316 000 deaths.
- *Tsunami, Indian Ocean 2004:* approximately 230 000 deaths.
- *Cyclone, Cyclone Nargis, Myanmar, 2008:* at least 146 000 deaths.
- *Earthquake, Sichuan, China, 2008:* approximately 87 400 deaths.
- *Earthquake, Kashmir, Pakistan, 2005:* approximately 79 000 deaths.

Risk is the possibility of negative effects caused by a natural hazard. Therefore, the type of hazard experienced, along with the **vulnerability** of the people affected, will determine the risk faced. The poorest people in the world are vulnerable because their ability to recover from the impact of a hazard is hampered by their lack of resources. In an event such as a flood or earthquake, for example, people lose their personal belongings, homes and livestock, which are often linked to their incomes, continuing the cycle of poverty. However, in regions that are adequately prepared, and where there is support to cope and rebuild, people recover more quickly.

vulnerability the state of being without protection and open to harm

int-5281

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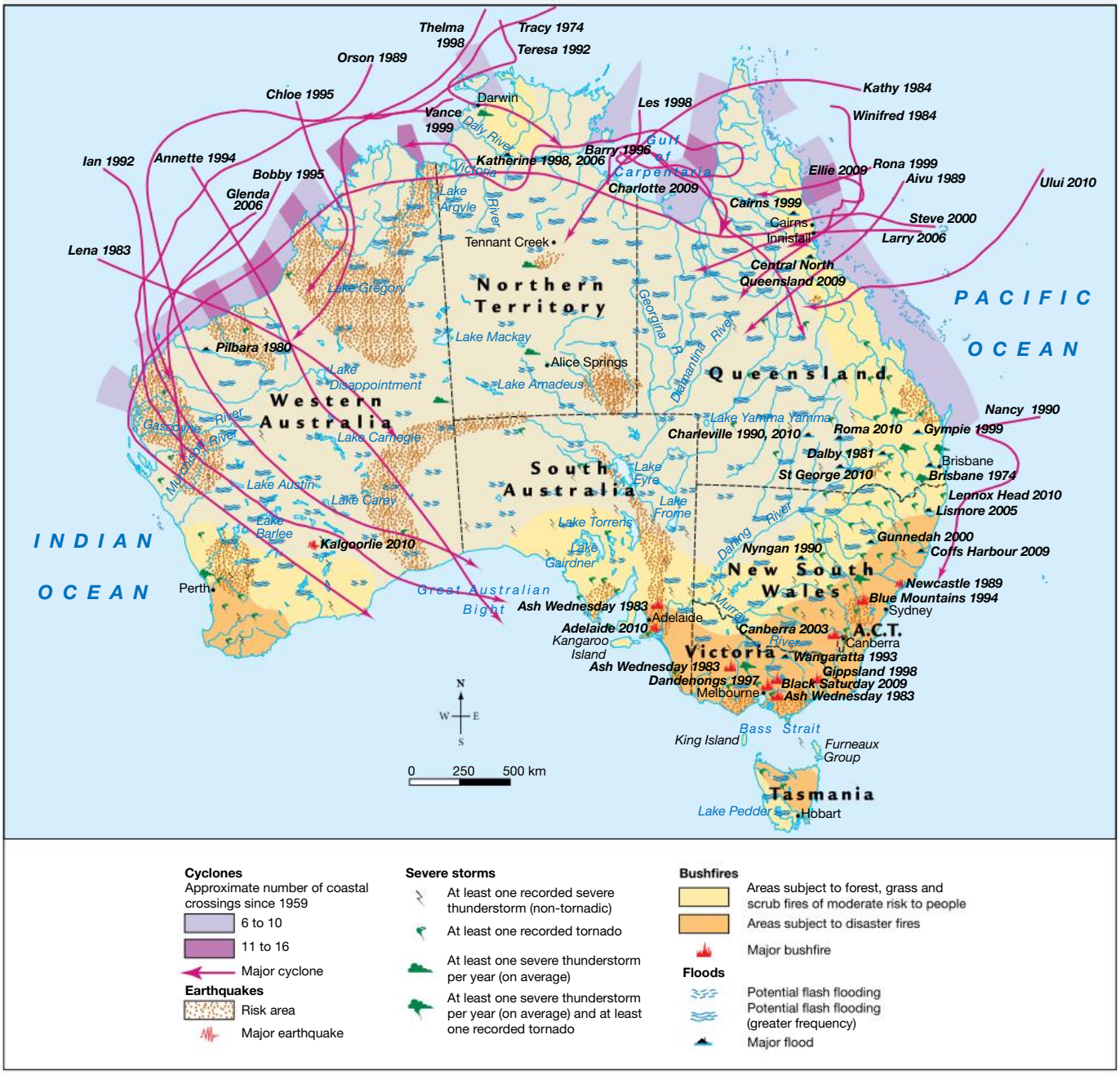
FIGURE 3 Australia's natural hazards and disasters



Source: MAPgraphics Pty Ltd, Brisbane

3.3 SKILL ACTIVITY: Questioning and researching using geographical methods

Using the internet, **research** a recent disaster that has occurred in an Asian country. **Describe** the following aspects of the disaster.

1. What was the original hazard and how did this hazard become a disaster?
2. What were the impacts of the disaster?
3. How were these impacts managed?

3.3 Exercise

learnon

3.3 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 8	4, 5, 6, 7, 9	3, 10

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Check your understanding

1. Complete the following sentence to **explain** how natural hazards and natural disasters differ.
   A _____ is the potential for an event to occur, while a _____ is when the event begins to affect people and environments.
2. A flood is both a natural and human hazard. True or false?
3. **Explain** why the risk of experiencing a natural disaster depends on the geographical location of a community.
4. **Describe** key changes that natural hazards and natural disasters can cause to an environment.
5. **Match** the following natural disasters to the correct details provided by placing the corresponding letter in the answer column.

Earthquake		**a.** Darwin, 1974: 65 deaths, 10 800 buildings destroyed, $4.18 billion cost
Drought		**b.** Haiti, 2010: estimated range 100 000 to 316 000 deaths
Cyclone Nargis		**c.** Australia-wide but mainly in New South Wales, 2018: $12 billion cost
Flood		**d.** Myanmar, 2008: at least 146 000 deaths
Cyclone Tracy		**e.** Queensland, New South Wales and Victoria, 2010–2011: 35 deaths, $5.6 billion cost

Apply your understanding

Communicating

6. Refer to **FIGURE 3**.
   a. What types of natural disasters occur most often in Australia?
   b. **Describe** the location of Australia's cyclone hazard zone.
   c. Give one example of a place that has suffered a bushfire disaster.
   d. What type of hazards are places around Newcastle subject to?
   e. What would be the likely impact of a large earthquake occurring in the earthquake-risk area in the Northern Territory?
7. The casualty rate for the Haitian earthquake is heavily debated. **Suggest** possible reasons for a lack of accuracy in this case.
8. Is your local area at risk of any natural disasters? If so, **identify** the category of disaster that is most likely to affect your area.
9. **Explain** the difference between risk and impacts in reference to natural disasters.
10. What role can Australia play in supporting countries in our region that experience frequent natural disasters?

LESSON
3.4 What is the impact of water variability, availability and accessibility?

LEARNING INTENTION

By the end of this lesson you should be able to explain the impact of water variability, availability and accessibility, and how this differs between countries.

TUNE IN

In many countries, women and children walk for several kilometres each day, just to collect water. These journeys can commonly take over six hours.

If women and children are spending this much time collecting water, what other opportunities are they missing?

Discuss this issue with a partner and document your observations.

FIGURE 1 In some countries, women and girls can spend up to six hours each day collecting water.

3.4.1 Water, water everywhere?

int-8944

Wouldn't it be amazing if anyone, no matter where they were in the world, could simply turn on a tap to watch high-quality drinking water pour out? Wouldn't it be incredible if every farmer in the world knew exactly when and how much it was going to rain so that they could plan their planting cycles accordingly? Unfortunately, this is far from reality for millions of people around the world, and tens of thousands of people in Australia as well. In communities across the world, significant variability exists in the amount of water that is available and accessible. Before an investigation of issues such as drought, flooding and other meteorological hazards can be conducted, it is necessary to discuss the following different but connected terms: water variability, water availability and accessibility, and water scarcity.

FIGURE 2 Lake Carnegie as it is regularly seen (a) and after unseasonably high rainfall (b)

3.4.2 Water variability

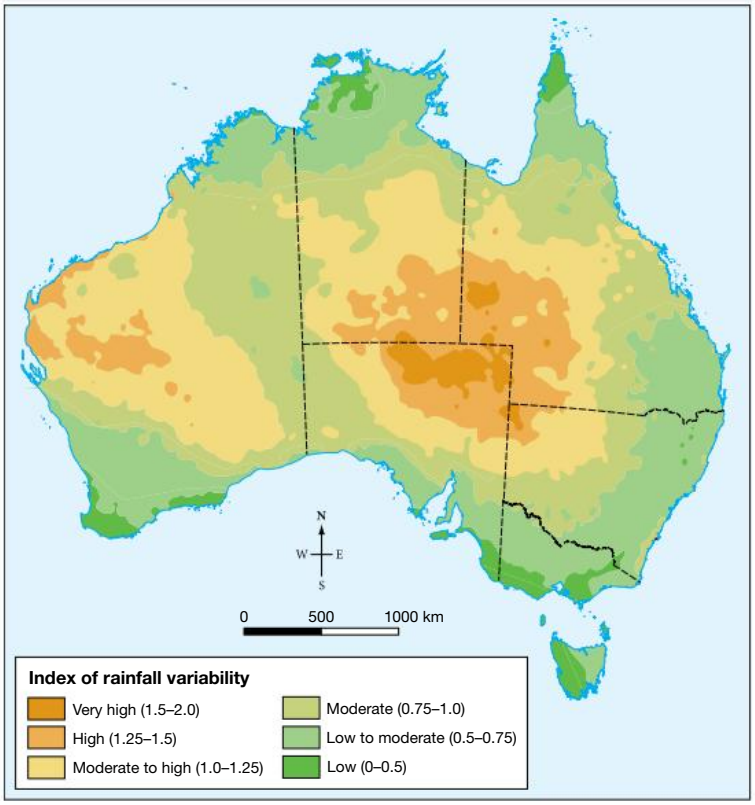
The amount of rainfall a location receives can vary significantly, and depends on a number of seasonal and environmental factors. Locations can often see inconsistency in the amount of rain received across a range of time frames. This is known as water variability, and is most severe in locations that experience

extreme environmental conditions. Australia experiences a particularly high degree of water variability. This fact itself may not surprise you, especially if you live along Australia eastern coast. However, you may be surprised to learn that water variability also impacts some of the country's driest environments. Bureau of Meteorology Research Scientist Dr Blair Trewin explains this variability through the example of Lake Carnegie in central Western Australia. Lake Carnegie receives an average annual rainfall of only 225 millimetres per year. (For comparison, Melbourne's annual average rainfall is 518 millimetres, while Adelaide receives 547 millimetres per year, Sydney 1042 millimetres and Brisbane 1080 millimetres.) Yet on just one day in 2020, 270 millimetres of rain fell on Lake Carnegie (more than its yearly average). The difference in the landscape can be clearly seen in **FIGURE 2**. Similar variability can also be observed in **FIGURE 3**, which shows many other areas of extreme rainfall variability, including locations in outback New South Wales, Queensland, Western Australia, South Australia and the Northern Territory.

int-8945

tlvd-10537

FIGURE 3 Australia's rainfall variability from 1900 to 2019



Source: Map redrawn by Spatial Vision © Copyright Commonwealth of Australia 2020, Bureau of Meteorology.

What influences Australia's water variability?

The unique characteristics of Australia's rainfall patterns are largely due to the influence of two equally unique climate events — **El Niño** and La Niña. El Niño and La Niña are the warm and cool phases of a recurring climate pattern across the tropical Pacific, known as the El Niño–Southern Oscillation, or ENSO for short.

El Niño and La Niña

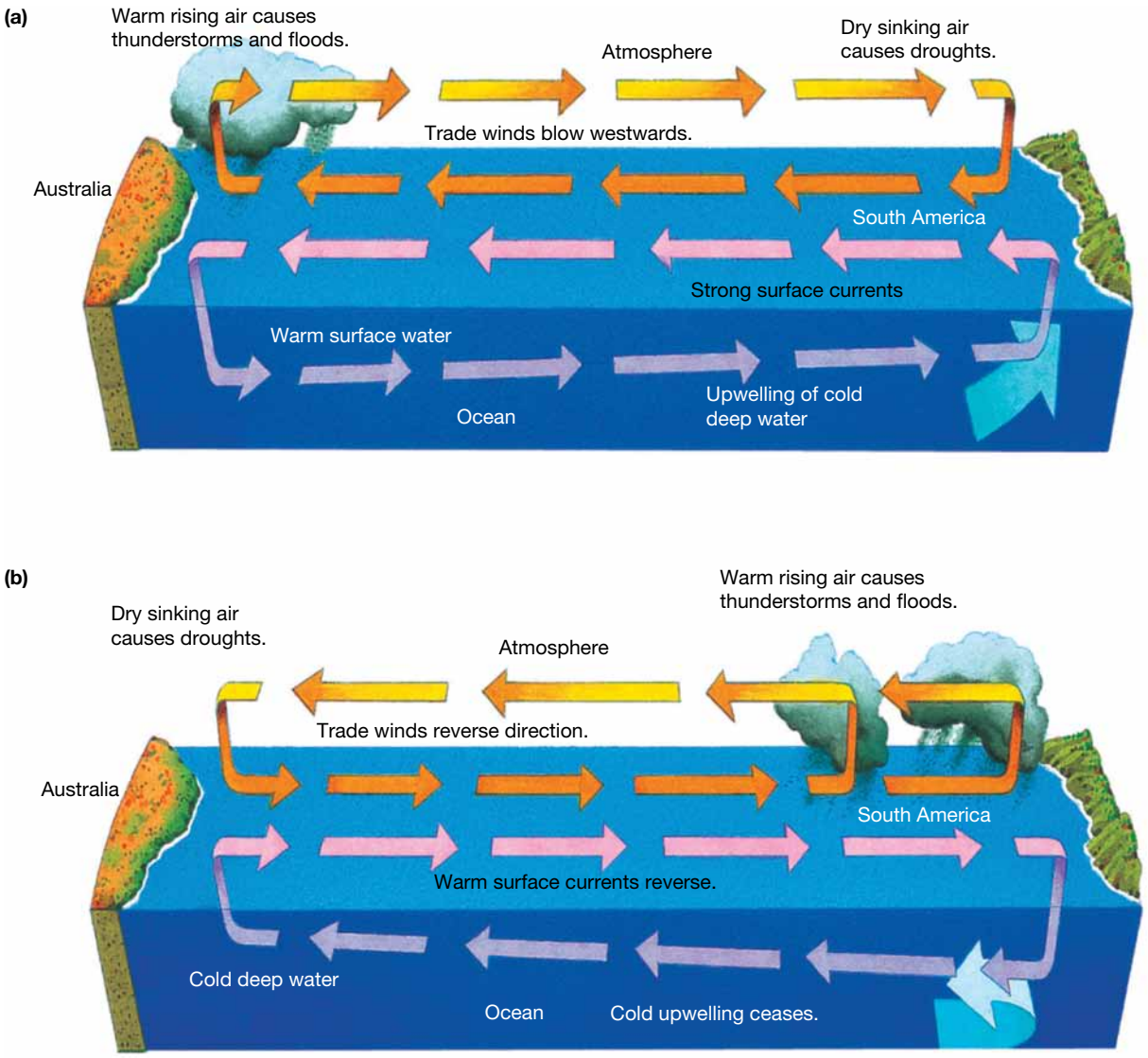
Australian droughts are heavily influenced by what **meteorologists** call an El Niño event. In a normal year, warm surface water is blown west across the Pacific Ocean towards Australia. This brings heavy rain to northern Australia, Papua New Guinea and Indonesia. On the other side of the Pacific, South America experiences drought. When an El Niño event occurs, these winds and surface ocean currents reverse their direction. The warm, moist air is pushed towards South America, producing rain in South America and drought in Australia.

El Niño the reversal (every few years) of the more usual direction of winds and surface currents across the Pacific Ocean; this change causes drought in Australia and heavy rain in South America

meteorologist a person who studies and predicts weather

tlvd-10538

FIGURE 4 Weather events in (a) a typical year and (b) an El Niño year



El Niño and the southern oscillation

Fluctuations in rainfall have several causes that are not fully understood. Probably the main cause of major rainfall fluctuations in Australia is the **southern oscillation**, which is a major air pressure shift between the Asian and east Pacific regions. The strength and direction of the southern oscillation is measured by a simple index called the Southern Oscillation Index (SOI). The SOI is calculated from monthly or seasonal fluctuations in air pressure between Tahiti and Darwin. In an average rainfall year with 'typical' pressure patterns, the SOI is between −10 and +10. If the SOI is strongly negative (below −10), this means that the air pressure at sea level in Darwin is higher than in Tahiti, and an El Niño event occurs.

During an El Niño event, less than average rainfall is experienced over much of Australia. During this period, drought will occur. If the SOI becomes strongly positive (above +10), this means the air pressure in Darwin is much lower than normal and a La Niña event occurs. During this period, above average rainfall will occur.

In recent years, scientists have made great advances in understanding and forecasting El Niño and southern oscillation events. The National Climate Centre in Australia produces outlooks on rainfall three months ahead. These outlooks are proving to be of great value to farmers, and especially valuable for ecologically sustainable development in rural areas.

southern oscillation a major air pressure shift between the Asian and east Pacific regions; its most common extremes are El Niño events

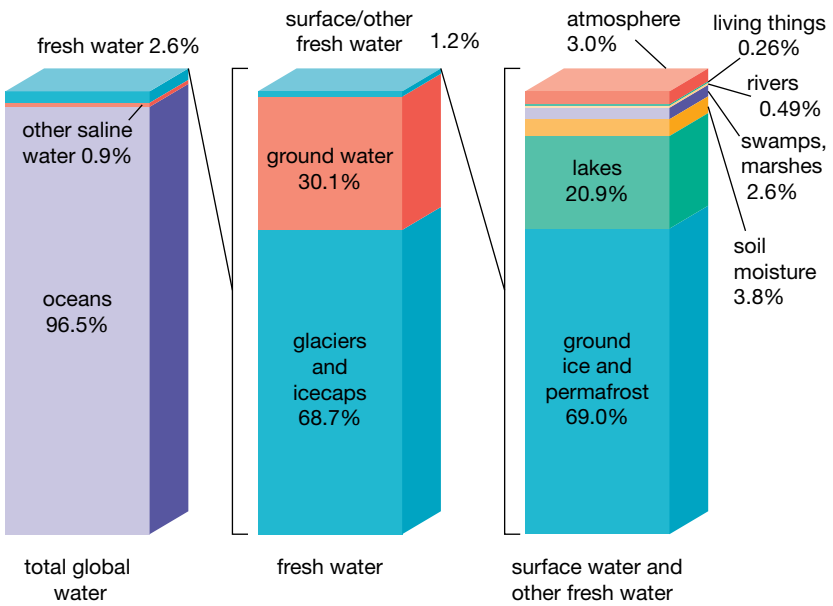
3.4.3 Water availability and accessibility

Imagine that it is lunchtime on a regular school day. Your stomach has been rumbling all morning and it is finally time for lunch. You open your bag and staring back at you is a lunchbox filled with all your favourite foods. We can say that your lunch is *available* because it is there for you, ready to be used. We can also say that your lunch is *accessible* because you can easily get to it. If you have lunch in your bag but it's not yet lunchtime, then your lunch is available but it is not accessible. This simplified example can be used to explain the difference between a location's water availability and accessibility. The distinction between these two terms is important — firstly, to understand the reasons a location may not have reliable water and, secondly, to develop solutions to improve the supply of water.

Although 70 per cent of the Earth is water, a tiny proportion of that water is available for human consumption. Of that 70 per cent, 96.5 per cent is contained in our oceans, with only 2.6 per cent present as freshwater. However, the majority of *that* water is trapped with glaciers, icecaps and groundwater, with just 1.2 per cent of that 2.6 per cent present in surface water. If we keep following this surface freshwater, we discover that, again, a remarkably small percentage of water is available for direct human consumption, largely in rivers and lakes. These statistics (see **FIGURE 5**) clearly demonstrate that the availability of fresh water on a global scale is significant issue. With the seemingly never-ending increase of human population, the scope of this issue becomes even more apparent.

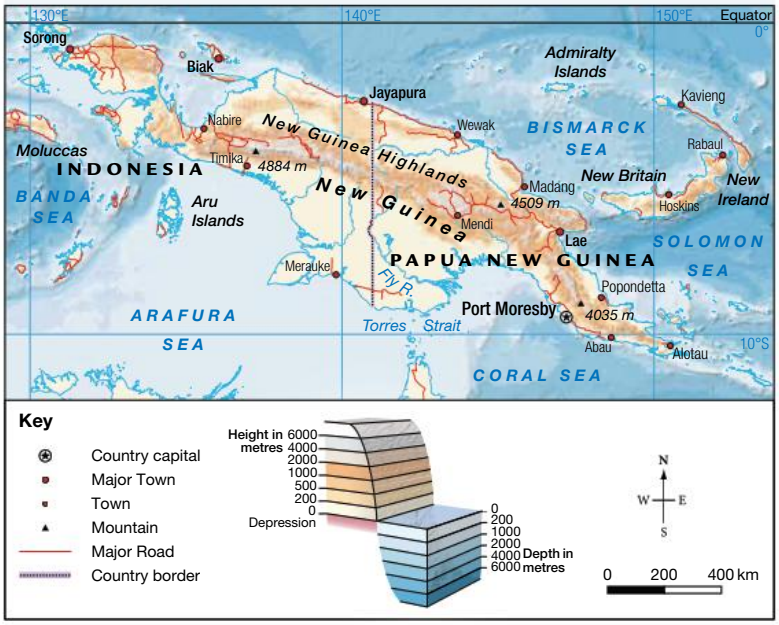
For some countries, water *accessibility* is a greater concern than *availability*. Papua New Guinea can be used as an example of such a country. Located directly to the north of Australia, Papua New Guinea is the third wettest country in the world, with an average annual rainfall of over 3000 millimetres. This incredibly large amount of rain shows us that it is not the availability of water that is the problem for Papua New Guinea. Instead, the accessibility of water in Papua New Guinea is affected by the country's extremely mountainous topography and its dense jungle environments. These geographic characteristics make it difficult for the people of Papua New Guinea to collect and distribute water across the country. Sadly, this means that although Papua New Guinea has strong water availability, it has poor water accessibility. This, in turn, negatively influences Papua New Guinea's economic capability, making it one of the poorest countries in the world.

FIGURE 5 Water availability breakdown



tlvd-10539

FIGURE 6 This topographic map highlights how difficult it is for the people of Papua New Guinea to collect and distribute water.



Source: Based on data from Natural Earth and ETOPO1: doi:10.7289/V5C8276M. Map drawn by Spatial Vision.

3.4.4 Water scarcity

The last aspect of water variability is scarcity. Water scarcity is defined as deficiency or lack of safe water supply. This does not simply refer to locations that lack sufficient rainfall or flow of water (often referred to as physical water scarcity).

Water scarcity can affect any location, particularly those which have rapidly increasing populations. In these locations, the demand for water is far greater than supply.

This is a particular problem in countries that have both high populations *and* low water availability or accessibility — such as those located in in Sub-Saharan Africa.

Countries with low economic capacity are also commonly affected by water scarcity. Often, the solutions to water scarcity (digging wells, effective water catchment, and water distribution and treatment infrastructure) require significant financial investment.

Unfortunately, these are investments that vulnerable countries can simply not afford to make.

3.4 SKILL ACTIVITY: Communicating

The World Health Organization has published a fact sheet that explains the issues and impacts that a lack of fresh drinking water can have on a country.

Use the **Drinking water fact sheet** weblink in your Resources panel and **create** your own infographic on these issues. You may want to focus on a specific country or even a region to provide a reference point for your infographic.

on Resources

Weblink Drinking water fact sheet

3.4 Exercise

learnon

3.4 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 5, 6, 8	4, 7, 9	3, 10

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Check your understanding

1. **Match** each of the terms to the statement provided that best describes it by placing the corresponding letter in the answer column.

Water variability		**a.** Water that is readily accessible for consumption and use.
Water availability		**b.** The amount of rainfall a location receives can vary significantly and depends on a number of seasonal and environmental factors.
Water accessibility		**c.** The quantity of water that can be used for human purposes.

2. The majority of the Earth's fresh water is trapped in glaciers. True or false?
3. **Identify** any problems that can be caused by a high degree of water variability.
4. What are the key reasons Australia experiences such high water variability?
5. **State** the key difference between water availability and accessibility.
6. El Niño is the result of the interconnection that occurs between Australia and South America. True or false?

Apply your understanding

Communicating

7. Refer to the sources in this lesson to **describe** the areas that become (a) wetter, (b) drier and (c) warmer during an El Niño event.
8. Papua New Guinea receives over 3000 millimetres of rain per year, yet still has poor water accessibility. **Discuss** how this is possible.
9. Consider the map in **FIGURE 6**. **Describe** the interconnection between Papua New Guinea's topography and its water accessibility.
10. What do you think is more important — water availability or water accessibility? **Justify** your response.

LESSON
3.5 What causes droughts and how do we manage them?

LEARNING INTENTION

By the end of this lesson you should be able to explain why droughts occur and describe the impacts of drought in Australia.

TUNE IN

The two photographs in **FIGURE 1** both show Menindee Lakes, a system of nine large but relatively shallow lakes, located in south-west New South Wales on the Darling River. Identity the similarities and differences between the two photographs.

FIGURE 1 Menindee Lakes, a series of lakes along the Darling River, during rainy and drought conditions

3.5.1 What is a drought?

Australia is the driest inhabited continent on Earth. The main reason Australia is so dry is that much of the continent lies in an area dominated by high atmospheric pressure for most of the year, which brings dry, stable, sinking air to the country. Australia also experiences great variation in its rainfall due to the southern oscillation and El Niño (refer to lesson 3.4).

Low average rainfall and extended dry spells are a normal part of life throughout most of Australia. The continent being located in a zone of high pressure that creates conditions of clear skies and low rainfall. Drought conditions occur when the high-pressure systems are more extensive than usual, creating long or severe rainfall shortages. A drought is a prolonged period of below-average rainfall, when not enough water is available to supply our normal needs. Because people use water in so many different ways and in such different quantities, there is no universal amount of rainfall that defines a drought.

The term *drought* should not be confused with low rainfall. Sydney could experience a drought and have more rainfall during that period than Alice Springs, for example, which could be experiencing above-average rainfall. If low rainfall meant drought, much of Australia would be in drought most of the time.

Droughts affect all parts of Australia over a period of time. Some droughts can be localised while other parts of the country receive good rain. Droughts can be short and intense, such as the drought that lasted from April 1982 to February 1983; or they can be long-lived, such as the Millennium Drought.

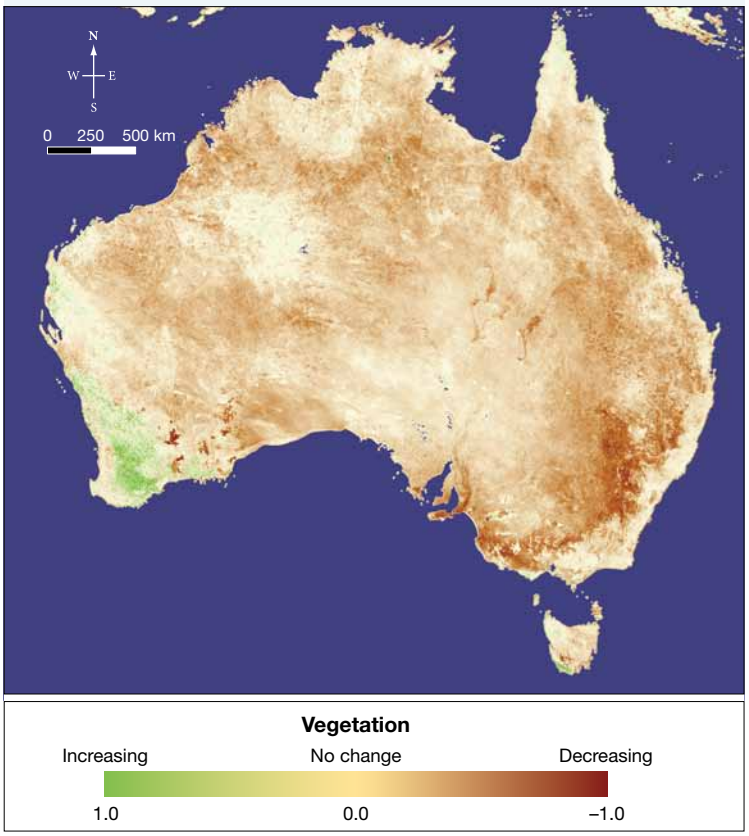
Different weather systems affect different parts of Australia, so all of Australia is unlikely to experience drought at the same time.

3.5.2 Impacts of drought: the Millennium Drought

Drought can have devastating impacts for communities and natural environments. Droughts can be relatively brief or they can last for years or decades. Droughts can be localised or they can be widespread. The impacts of a drought are directly related to its severity, scale, longevity and the existing socio-economic conditions of the affected region.

The prelude to the Millennium Drought in Australia began in the late 1990s with a period of extremely dry conditions followed by a strong El Niño event. This event eventually subsided in the early 2000s; however, although some significant rainfall occurred in the following years, it was not enough to break the drought being experienced across much of south-eastern Australia. Dry conditions persisted for several years, with the drought reaching the peak of its severity in 2006. During this year, the situation became dire for people and communities in South Australia, Victoria, New South Wales and Queensland. The Murray–Darling Basin recorded its second driest season since 1900, as did the entire state of South Australia — which only recorded 108 millimetres of rain for the whole year! Conditions again improved slightly in some areas but the drought and its impacts still persisted. It was not until a La Niña event began in 2010 that the Millennium Drought was officially declared over.

FIGURE 2 Extent of the drought — changes in vegetation cover, 2005



Source: Spatial Vision

int-8946

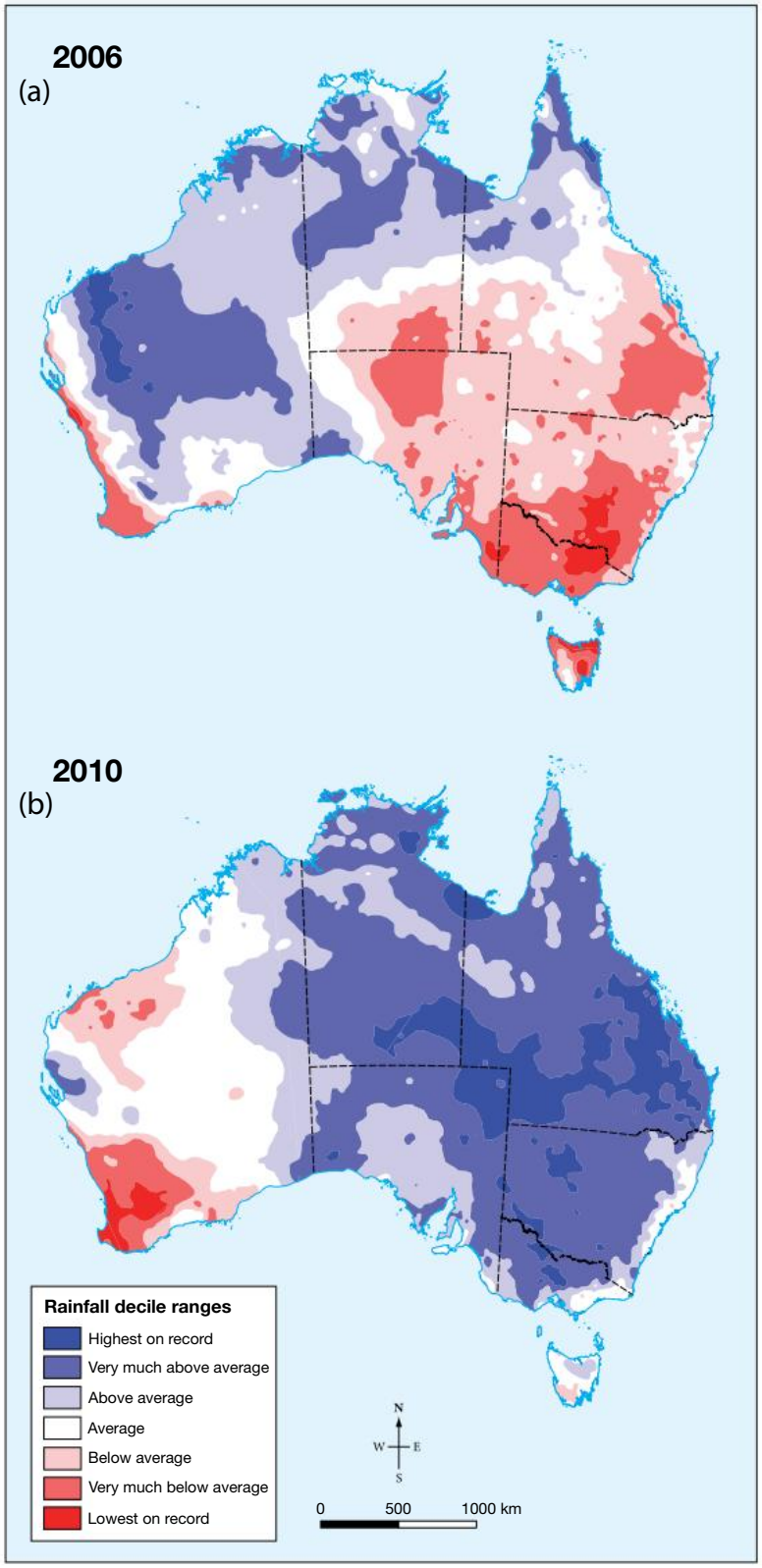
In rural towns, jobs were lost and many businesses failed. Some people found themselves forced to leave drought-affected areas in search of other work. Many never returned. Very long droughts cause rural communities much heartache, and this can result in the break-up of families. The conditions can also lead to severe depression in some individuals. However, the Australian government set up a fund that farmers and people in agricultural businesses can apply to for financial relief when their incomes are disrupted by drought. Counselling hotlines are also available to offer support.

When Australia experiences a drought, agriculture suffers first and most severely, but eventually the impact spreads. Due to the severe lack of water caused by the Millennium Drought, many farmers faced production losses because they were not able to sustain their crops or sufficiently feed their livestock. This had negative economic impacts:

- By 2004, dairy farmers had experienced a 4.5 per cent drop in their incomes.
- Cotton crops were devastated by the shortage of water, affecting up to 20 cotton communities and approximately 10 000 people in the industry.
- Some communities had to cut production by 60 to 100 per cent.
- Cattle and sheep farmers found it hard to find stockfeed, and prices increased. As a result, herds grew smaller.

Along with these economic and social impacts, the Australian environment suffers in drought. Droughts have a bad effect on topsoil in Australia. During drought conditions, millions of tonnes of topsoil may be blown away (see **FIGURE 4**). This loss takes many years to replace naturally, if it is ever replaced. The loss of topsoil can make many regions far less productive, making it harder for farmers to recover once the drought has broken.

FIGURE 3 Australia's annual rainfall in 2006 (a) and 2010 (b)



Source: Map redrawn by Spatial Vision © Copyright Commonwealth of Australia 2021, Bureau of Meteorology.

FIGURE 4 'Dust' (topsoil) blown from drought-affected inland Australia blankets Sydney, 23 September 2009

on Resources

Video eLesson Weather events in a typical year and an El Niño year (eles-2275)
Weblink News report: dust storms

3.5.3 Managing the impact of drought

During times of extreme water shortages, governments, communities and individuals often attempt to ensure a reliable water supply. The Millennium Drought in Australia sparked many different water-saving actions. Since it is difficult to manage a drought once it has begun, the key management strategies involve drought *prevention*.

Option 1: government action

The Queensland Government developed the South-East Queensland (SEQ) water grid in order to secure alternative sources of water in an environment that seemed to be growing drier. Although the project began back in 2004, it remains an excellent example how the impacts of drought can be managed. This strategy aimed to connect the water sources of the region through a pipe network that could move water to different areas and thus meet the needs of local communities. The grid includes existing dams, three water treatment plants and a desalination plant, all connected by approximately 450 kilometres of pipes.

In 2008, the Western Corridor Recycled Project was completed at a cost of $2.5 billion. This project is part of the SEQ water grid and is the largest recycled water scheme in Australia. The project can supply up to 230 megalitres per day of recycled water to industry and power plants. The water also has the potential to be used by farmers and to top up drinking supplies. However, these last two uses of recycled water have created wide debate among communities.

FIGURE 5 The desalination plant at Tugun produces drinking water for south-east Queensland.

The desalination plant at Tugun on the Gold Coast can provide up to 133 megalitres of drinking water per day. Essentially, this project produces drinking water by removing salts and other minerals from sea water. This technology is very successful and has been used in other regions of Australia for years, including Coober Pedy, where desalination is used to treat bore water. Internationally, approximately 7500 plants are in operation. These desalination plants enable safe drinking water to be produced without having to rely on rainfall.

Water measurements

- 1 ML = 1 megalitre
- 1 megalitre = 1 000 000 litres
- 10 megalitres = 4 Olympic-size swimming pools

Stages of the desalination process

1. Sea water is piped from the ocean through a submerged inlet tunnel to the plant.
2. At the pre-treatment stage, particles in the sea water are micro-filtered, the pH is adjusted, and an inhibitor is added to control the build-up of scale in pipelines and tanks.
3. The sea water is forced through layers of membrane to remove salt and minerals. Concentrated salt water is separated and returned to the ocean.
4. During post-treatment, small amounts of lime and carbon dioxide are added to the water, along with chlorine for disinfection.
5. For the Tugun plant, the desalinated water is blended with other Gold Coast water supplies and joins south-east Queensland's water grid to supply homes and industry.

Based on information from www.watersecure.com.au.

In times of drought, governments may introduce water restrictions to limit the pressure placed on water supplies by individual households and businesses. They may also introduce **incentive** schemes that provide a **rebate** on water-saving devices such as water tanks, which help relieve the strain on the water supply.

incentive encourages a person to do something

rebate a partial refund on something that has already been paid for

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tlvd-10540

FIGURE 6 The SEQ water grid

Source: Seqwater

Option 2: You and me — personal action

During 2019–20, 11 231 gigalitres of water was used by Australian households. Although this figure was down on household water use from the previous year, it is still a large amount of water. With so much water used in our homes, this domestic use seems an obvious place for water conservation to begin.

FIGURE 7 Collecting rainwater from your roof can provide water for flushing toilets, watering the garden or washing the car. Making changes in the bathroom such as a shower timer or adding an attachment to your tap can also help you save water.

Many of our day-to-day activities require the use of water. We can take action to use this water more efficiently to ensure it is not wasted. Some ideas include:

- putting aerators on taps so less water comes out
- using a hose with a shut-off nozzle
- cleaning driveways and paths with a broom rather than a hose.

More ideas are shown in **FIGURE 8**. Personal action can have a big impact. If every individual seeks to minimise wastage, significant water savings can be achieved.

FIGURE 8 Ways we can use water wisely

Ensure your next washing machine has lots of water-efficiency stars.

Ensure you completely fill your dishwasher before using it.

Don't keep the tap running when washing fruit and vegetables. Wash them in a bowl instead.

Install a dual-flush toilet.

Dispose of tissues in the bin — don't flush them down the toilet.

Have short showers. Try for three minutes!

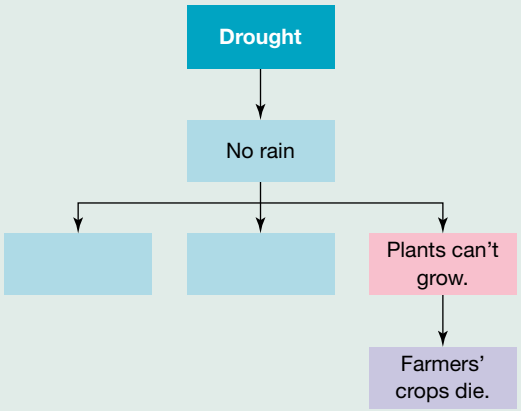
Don't run the tap when brushing your teeth.

Use a water-saving showerhead and keep a bucket in the shower for excess water to use on the garden.

Cover soil in mulch and water the garden in the early morning or evening to reduce evaporation.

3.5 SKILL ACTIVITY: Communicating

1. Think about all the environmental, economic and social impacts of drought. **List** these impacts.
2. Using this list, **create** a flow diagram to illustrate how these three groups relate to, connect to and influence each other.
   Use the provided flow diagram to get you started. You can add more boxes and arrows to show how elements are connected.
3. **Compare** your flow diagram with the class, add further connections.



3.5 Exercise

learnon

3.5 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 3, 8	2, 4, 6, 7	5, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. What is drought?
   - A. A long period of below-average rainfall, when not enough water is available to supply our normal needs.
   - B. A long period of average rainfall, when not enough water is available to supply our normal needs.
   - C. A long period of above-average rainfall, when enough water is available to supply our normal needs.
   - D. A long period of average rainfall, when enough water is available to supply our normal needs.
2. Why Australia is so dry?
   - A. The temperature is too high.
   - B. Rainfall is too low.
   - C. It is dominated by high-pressure systems.
   - D. It is dominated by low-pressure systems.
3. Complete the following sentence to **explain** what desalination is.
   Desalination is a process that removes _____ from _____.
4. **Identify** two ways the government attempts to ensure a reliable water supply.
5. **List** and **explain** the factors that contributed to the severity of the Millennium Drought.

Apply your understanding

Communicating

6. **Describe** three ways in which droughts can affect environments.
7. **Describe** three ways in which droughts can affect communities.
8. **Explain** why all of Australia is unlikely to be affected by drought at the same time.
9. Will the SEQ water grid be effective in managing water during a drought period? **Justify** your response.
10. Reducing personal water use is an excellent strategy to minimise the impacts of drought. **Determine** what obstacles you believe prevent people from reducing their personal water use.

LESSON
3.6 What are the causes and impacts of floods?

LEARNING INTENTION

By the end of this lesson you should be able to investigate the causes and impacts that floods can have on environments and communities.

TUNE IN

After hours of trying to keep the floodwaters at bay, you've made the decision to flee your house.

You only have 10 minutes to throw your most treasured possessions in your dingy and head to higher ground.

Write a list of the items that you would bring with you. Consider how your priorities might change in those few minutes. Share some of your chosen items with the class.

FIGURE 1 What would you pack if you had to evacuate during a flood?

3.6.1 Why does it flood?

Floods are naturally occurring hazards that can cause devastating impacts for natural environments and communities alike. As you will learn in this lesson, the threat posed by floods to human populations can be increased due to our tendency to establish settlements on floodplains. A floodplain (**FIGURE 2**) is an area of relatively flat land that borders a river and is covered by water during a flood. Floodplains are formed when the water in a river slows down in flat areas. The river begins to meander and gradually deposits **alluvium**, which builds up the floodplain and other landforms such as deltas.

These fertile, flat areas are used for farming and settlement around the world. In Australia, many of our richest farmlands are on floodplains, and towns are often built on them, close to the rivers. Such towns are subject to flooding. The possibility of flood is also increased when vegetation in **catchment areas** has been cleared or modified. Native vegetation can slow down run-off and reduce the chance of flooding.

alluvium the loose material brought down by a river and deposited on its bed, or on the floodplain or delta

catchment area the area of land that contributes water to a river and its tributaries

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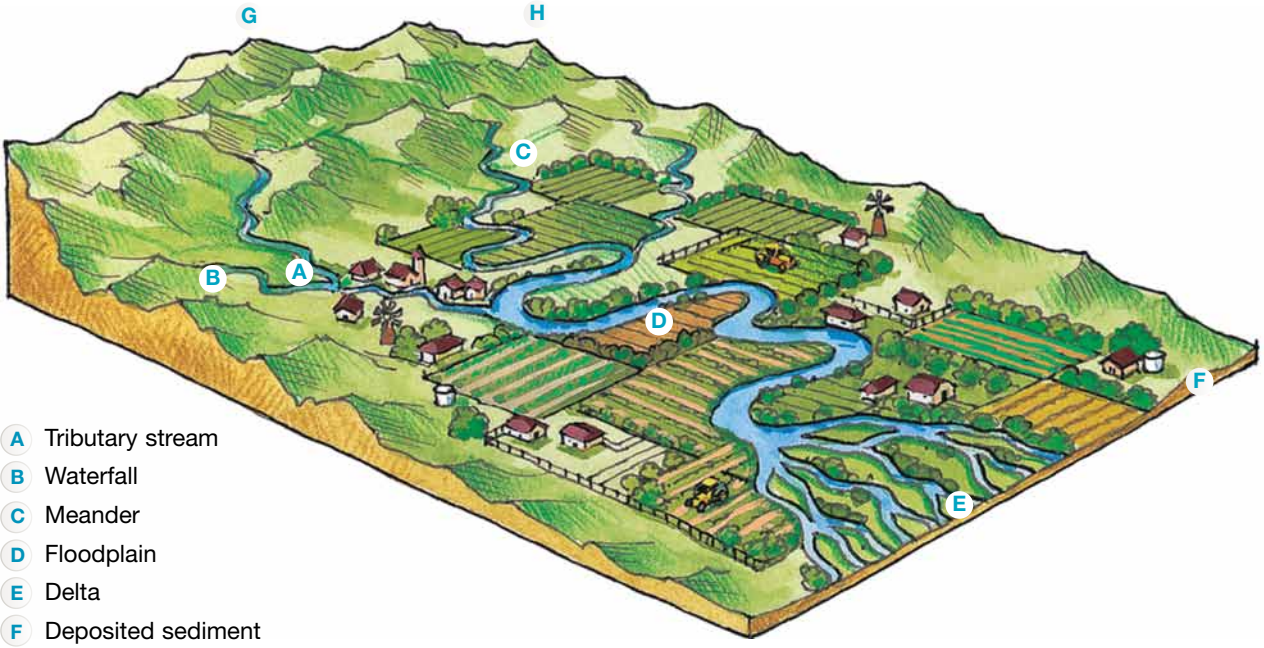
FIGURE 2 Flat, fertile floodplains are often preferred areas for settlement and farming.



A Tributary stream
B Waterfall
C Meander
D Floodplain
E Delta
F Deposited sediment
G Mountains
H Watershed

3.6.2 Types of floods

Even though Australia is the driest of all the world's inhabited continents, we experience periods of very heavy rainfall and flood. Flood disasters in Australia damage property, kill livestock and cause the loss of human life. In some cases, entire sections of a town have been washed away, as in 1852, when one-third of the town of Gundagai disappeared.

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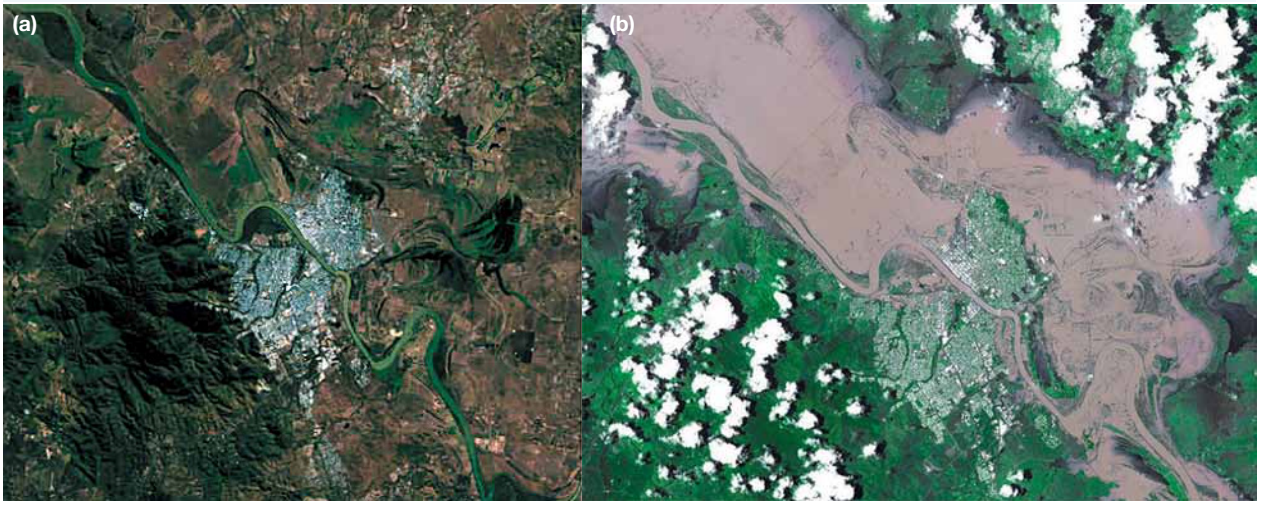
FIGURE 3 How did the floods affect Rockhampton? Rockhampton (a) before the 2011 flood and (b) after the flood



The three main types of flood are:

1. *Slow-onset floods:* these occur along the floodplains of inland rivers, and may last for weeks or months. They are caused by heavy rain and run-off upstream. The water can take days or weeks to affect farms and towns downstream.
2. *Rapid-onset floods:* these occur in mountain headwaters of larger inland rivers or rivers flowing to the coast. The rivers are steeper and the water flows more rapidly. Rapid-onset floods are often more damaging because people have less time to prepare.
3. *Flash floods:* these are caused by heavy rainfall that does not last long, as occurs in a severe thunderstorm. This type of flooding causes the greatest risk to property and human life because it can happen so quickly. It can be a serious problem in urban areas where drainage systems are inadequate.

FIGURE 4 The Lismore floods

3.6.3 CASE STUDY: The Queensland floods, 2011 and 2022

When the Brisbane River broke its banks on 11 January 2011, Australians were shocked and saddened by the devastation left in its wake. Thankfully those affected were able to gain some comfort from the assistance they received from the community as they began the slow process of recovery. However, this is not always an option for those affected by floods in other regions of the world. Australia has experienced several flooding events since 2011, some even more significant than the Brisbane floods. The 2022 floods experienced in Brisbane and parts of south-eastern Queensland were far more significant.

During the 2022 floods, greater Brisbane received 676 millimetres of rain in just three days! However, a discussion of the 2011 flooding event allows us to compare what happened in Brisbane to another flooding event that occurred on the other side of the world on the exact same day.

Queensland, Australia, 2011

Country background

Australia is considered a developed nation with a strong economy. Australians earn on average $52 000 per person. Approximately 26 million people live in Australia, with 5.2 million of those living in Queensland. About 84 per cent of all Australians are located within 50 kilometres of the coast.

Why?

The flooding that affected this region in 2011 was due to a strong La Niña event. Long periods of heavy rain over Queensland catchments caused rivers to burst their banks.

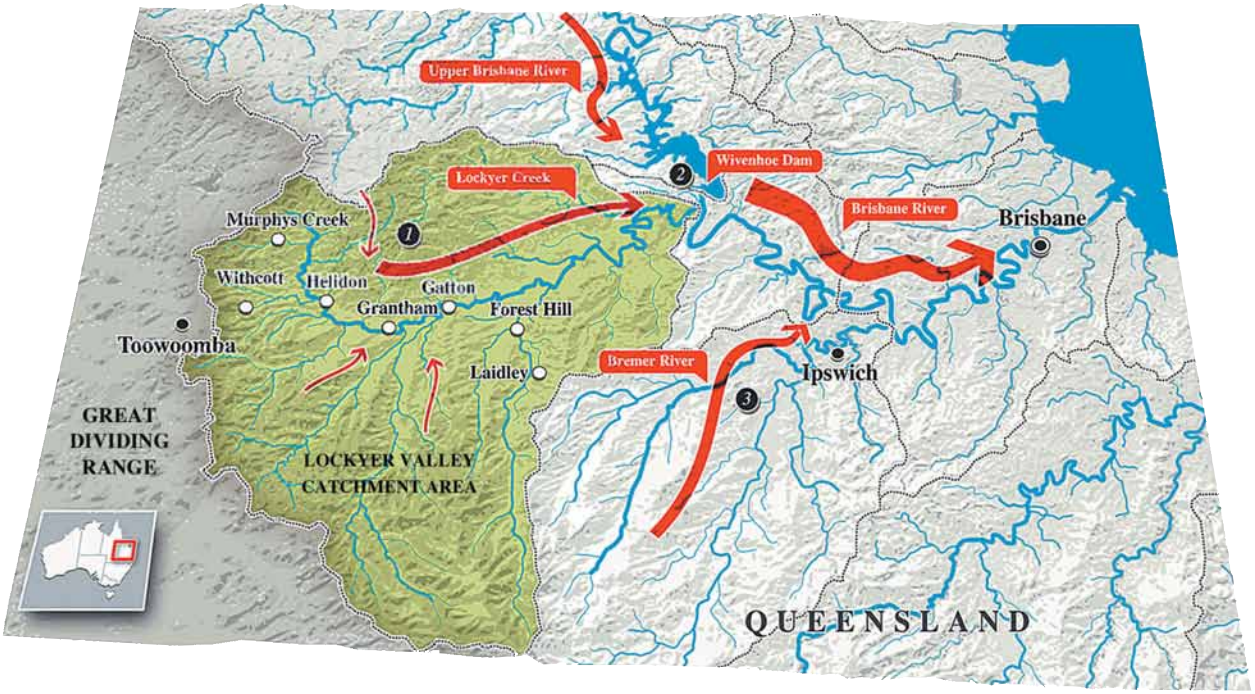
Effects

- Three-quarters of the state was declared a disaster zone.
- At least 70 towns and over 200 000 people were affected.
- There were 35 deaths.
- The cost to the Australian economy was at least $10 billion.
- Up to 300 roads were closed, including nine major highways.
- Over 20 000 homes were flooded in Brisbane alone.
- Massive damage and loss of property occurred.

Assistance and recovery

- $1.725 billion was raised by the federal government via a flood levy in the tax system.
- $281.5 million was raised through the Disaster Relief Appeal set up by the then Queensland premier, Anna Bligh.
- Over $20 million was donated to aid agencies such as the St Vincent de Paul Society to help those suffering.
- About $1.2 million was raised through charity sporting events such as Rally for Relief, Legends of Origin and Twenty20 cricket.
- The Australian Defence Force was mobilised to help with the clean up.
- The Mud Army was formed, consisting of 55 000 volunteers registered to help clean up the streets; thousands more unregistered people joined them.
- Improvements were made to dam manuals to help manage the release of water from dams during floods.

FIGURE 5 Anatomy of a flood



Town heights above sea level in metres: Toowoomba, 700 m; Murphys Creek, 704 m; Withcott, 262 m; Helidon, 143 m; Grantham, 110 m; Gatton, 111 m; Forest Hill, 95 m; Laidley, 135 m; Ipswich, 54.8 m; Brisbane 28.4 m.

1. Floodwaters from **Lockyer Creek**, which flows into **Brisbane River**. The Lockyer Valley was hit by more than 200 mm of rain.
2. More than 490 000 million litres were released from **Wivenhoe Dam** into Brisbane River.
3. Floodwaters from the **Bremer River**, which is also fed by the **Lockyer Valley**. After passing Ipswich, where it burst its banks, the Bremer River flows into the Brisbane River.

3.6.4 CASE STUDY: The Brazil floods, 2011

State of Rio de Janeiro, Brazil, 2011

Country background

Brazil is considered a developing nation. Brazilians earn on average $10 200 per person per year.

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Approximately 212 million people reside in Brazil, with 650 000 living in the three towns worst affected by the flooding.

Why?

Due to the equivalent of a month's rain falling in 24 hours on 11 and 12 January 2011, flash flooding occurred in a mountainous region in Rio de Janeiro State and São Paulo State. Hillsides and riverbanks collapsed due to landslides. It is believed that illegal construction and deforestation may have contributed to the instability of the land.

Effects

- Approximately 900 people died — most of them in poverty-stricken areas with poor housing conditions and no building policies.
- Forty per cent of the vegetable supply for the city of Rio de Janeiro was destroyed.
- Around 17 000 people were left homeless.
- Widespread property damage occurred, most of it to homes built riskily at the base of steep hills.

FIGURE 6 Areas affected by the floods in Brazil, 13 January 2011

Source: Spatial Vision

Assistance and recovery

- $460 million was set aside by Brazil's president for emergency aid and reconstruction.
- Troops were deployed to help.
- Clothes and food were donated to the area from other Brazilians.
- About $450 million was loaned by the World Bank.
- Support was given by internal and international charities.

FIGURE 7 Hills collapsed after the heavy rains, destroying homes.

3.6 SKILL ACTIVITY: Interpreting and analysing

In a table, **classify** (in point form) the impacts on people, the economy and the environment of the Brisbane and Brazilian floods.

3.6 Exercise

learnon

3.6 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 7	3, 8, 10	4, 5, 6, 9

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Check your understanding

1. What are the three main types of floods? **Select** all possible answers.
   - A. Slow-onset floods
   - B. Rising floods
   - C. Sinking floods
   - D. Rapid-onset floods
   - E. Casual floods
   - F. Flash floods
2. A floodplain is an area of relatively hilly land that is near a river and is always covered by water. True or false?
3. What is alluvium and why is it important to agriculture?
4. Think back on the floods mentioned in this lesson.
   - a. **Explain**, in your own words, the three causes of the Brisbane floods.
   - b. **Explain** the causes of the Brazil floods.
   - c. **Compare** the causes of these two floods by identifying the similarities and differences between them.
5. Read the case studies on the 2011 Brisbane and Brazil floods.
   - a. **Compare** the scale of these floods.
   - b. Give reasons for the differences in the scale of these floods.

Apply your understanding

Concluding and decision-making

6. Should people continue to build on floodplains? Why or why not? Think globally when formulating your argument. Consider environmental, cultural and economic factors that could have an impact on a person's reasoning when choosing a place to settle.
7. Why do floods occur on floodplains and in deltas?
8. How might the effects of floods in urban spaces differ from effects in rural spaces?
9. Suggest a few strategies that could be implemented to lessen the impact of floods if they occurred in Brisbane and Brazil regions again.
10. Imagine both Brisbane and Brazil had been given warning that these floods were going to occur. Suggest at least two changes you would expect in relation to the impacts of these two flood events.

LESSON
3.7 How are floods managed?

LEARNING INTENTION

By the end of this lesson you should be able to describe and evaluate different methods of flood control and management.

TUNE IN

Sandbags are a commonly used strategy to combat rising flood waters.

1. Suggest how sandbags can protect buildings and homes from the impacts of floods.
2. Evaluate the success of sandbagging as a flood management strategy.
3. Describe another strategy that could be used instead of sandbagging.

FIGURE 1 Sandbags are often used during floods.

3.7.1 Flood management

Managing the effects of floods is important if the amount of damage caused is to be minimised. Unfortunately, not all countries have the same resources to tackle this problem. Those countries that are able to invest in flood-prevention **infrastructure** have a greater chance of reducing the risk of flood.

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

FIGURE 2 Lake Wivenhoe, Queensland, at 190 per cent capacity, January 2011

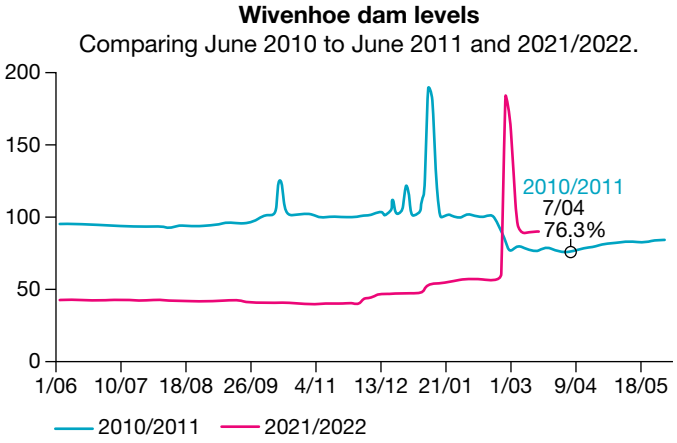
The most common form of flood management is to build a barrier that prevents excess water from reaching areas that would suffer major damage. Levees (see **FIGURE 4**), **weirs** and dams are examples of structures that are built to contain floodwaters. Dams that are used to stop flooding need to be kept below a certain level to allow space for floodwater to fill. Wivenhoe Dam in south-east Queensland was built in response to floods in 1974 (see **FIGURE 2**).

weir a barrier across a river, similar to a dam, which causes water to pool behind it; water is still able to flow over the top of the weir

However, some debate emerged about whether this dam could have been used more effectively during the 2010–2011 floods. During these floods, engineers had some difficult decisions to make. If they allowed the dam to become too full, they risked flood waters spilling over the side of the dam and eroding the dam wall.

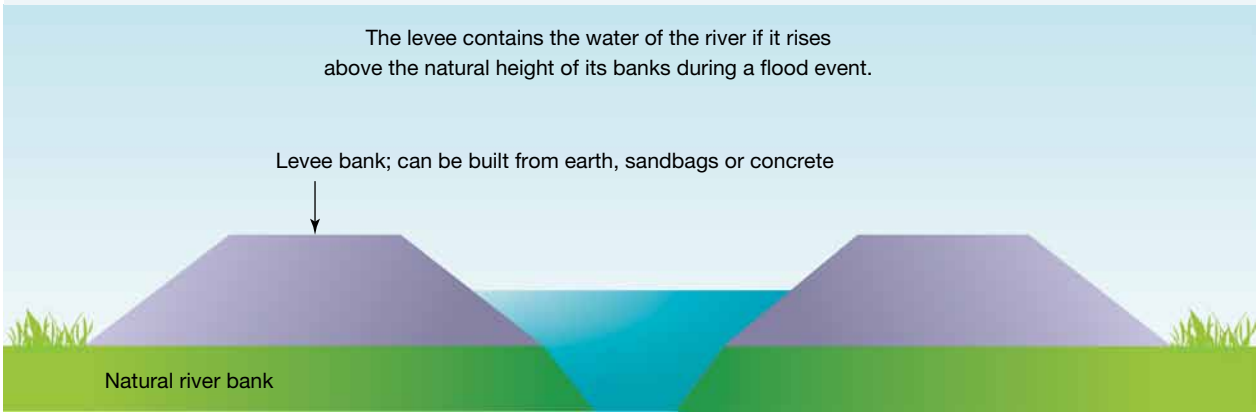
Yet by releasing water through the spillway, the engineers actually contributed to the severity of the flood. **FIGURE 3** compares the levels of the Wivenhoe Dam during the 2011 floods to those during the floods of 2022. Although Wivenhoe was more full during the 2011 event, the rate of increase in the 2022 was far greater.

FIGURE 3 Wivenhoe Dam levels, 2011 and 2022



Source: ABC News and Seqwater

FIGURE 4 An artificial levee



To prevent London being flooded during unusually high tides and storm surges, the city constructed the Thames Barrier, a system of floodgates that stretch across the width of the river (see **FIGURE 5**). The barrier is activated when predicted water levels are above a certain height. If this happens, the gates rise to stop the incoming water. Once the water recedes, the danger has passed and the gates are lowered.

DISCUSS

Around the world, floods are becoming more frequent and their impact on people and the environment more damaging and costly. Write an argument that supports and then an argument that would challenge the following viewpoint: People should not be allowed to live in areas that are prone to flooding.

Another way to manage the risk of damage from floods is to stop building on low-lying land that is subject to regular flooding events. Unfortunately, in many urban areas this land has been developed, which increases the chance of property damage in a flood.

Since 2006, the Brisbane City Council has offered a residential property buy-back scheme. This scheme gives people the opportunity to sell their property to the council if they live in a low-lying area that has a 50 per cent chance of flooding every year. People will not be allowed to build on this land again. For this initiative to be successful, the price offered by the council needs to be similar to what the owners would get in a private sale; otherwise, there is no incentive to use it. The owners of 207 properties were presented with this opportunity; only 45 had accepted the offer before the 2011 floods swept through Brisbane.

Unfortunately, not all countries have the finances to fund property buy-backs or large-scale barrier building. Bangladesh, for example, experiences annual flooding during the **monsoon** season. In response to this, homes are usually built on raised land above flood levels or on stilts.

In order to prepare the population for the arrival of floods, Bangladesh has developed a flood forecasting and warning system that can be broadcast via newspapers, television, radio, the internet and email. Regrettably, due to the growing population in the capital of Dhaka, building is now occurring on low-lying land that was previously used to store floodwater (see **FIGURE 6**). As a result, many people are still being affected by flooding. In 1998, 65 per cent of Bangladesh was **inundated**, and 20 million people needed shelter and food aid for two months. In this flood, 1050 people lost their lives, which remains the most significant flood in Bangladesh's history.

FIGURE 5 The Thames flood barrier

FIGURE 6 In Dhaka, homes are built on stilts to avoid the floodwaters.

monsoon rainy season accompanied by south-westerly summer winds in the Indian subcontinent and South-East Asia

inundate to cover with water, especially floodwater

3.7 SKILL ACTIVITY: Concluding and decision-making

1. Use the **Bureau of Meteorology** weblink in your Resources panel to find out more about flood warnings.
2. **Create** an information sheet that could be released to a rural community about to be affected by a major flood event. Ensure your information sheet includes tips on what to do before, during and after the event.
3. Search for the area you live in and check any flood warnings it has had in the past.

on Resources

Weblink Bureau of Meteorology
Google Earth Lake Wivenhoe

3.7 Exercise

learnon

3.7 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 7	3, 4, 9	5, 6, 8, 10

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Check your understanding

1. What flood management techniques are being used in Brisbane?
   - **A.** Free sand bags
   - **B.** Construction of dams
   - **C.** Coupons to use on boat hire
   - **D.** Property buy-back scheme
2. Where are you at most risk from flood when building?
   - **A.** On flood plains
   - **B.** In the high country
   - **C.** Several kilometres from the river
   - **D.** In the desert
3. Look at **FIGURE 4** and use it to **define** the term 'levee'.
4. How can an early warning system reduce the risk of a flood disaster?
   - **A.** It allows people to adequately prepare for the flood.
   - **B.** It allows people to sell their homes before they flood.
   - **C.** People know they need to purchase extra brooms.
   - **D.** People know they should go on holidays at this time.
5. **Explain** the interconnection between population growth and the risk posed by floods.

Apply your understanding

Communicating

6. **Predict** what would happen if a dam, built to prevent floods, was already full to capacity and the area received more heavy rainfall? What might be some of the consequences?
7. Dams are the most common method used to manage the impacts of floods. **Outline** why you think this is the case.
8. The River Thames in London has unique geographic conditions that need to be managed. **Explain** these conditions and how engineers have attempted to solve the problems these conditions can cause.
9. **Explain** the dilemma Wivenhoe Dam engineers faced in 2011. What would you have done in the same situation?
10. Bangladesh faces severe floods on a yearly basis. **Evaluate** why building dams would not help manage the impact of these floods successfully.

LESSON

3.8 Investigating topographic maps — potential flooding on Sydney's northern beaches

LEARNING INTENTION

By the end of this lesson you should be able to identify on a topographic map some places that are likely to be affected by flooding.

3.8.1 Narrabeen Lagoon

Narrabeen Lagoon is 55 square kilometres in size and is the largest coastal lagoon in the Sydney region. The suburbs around the lagoon support many residents who are attracted to the relaxed coastal lifestyle of the

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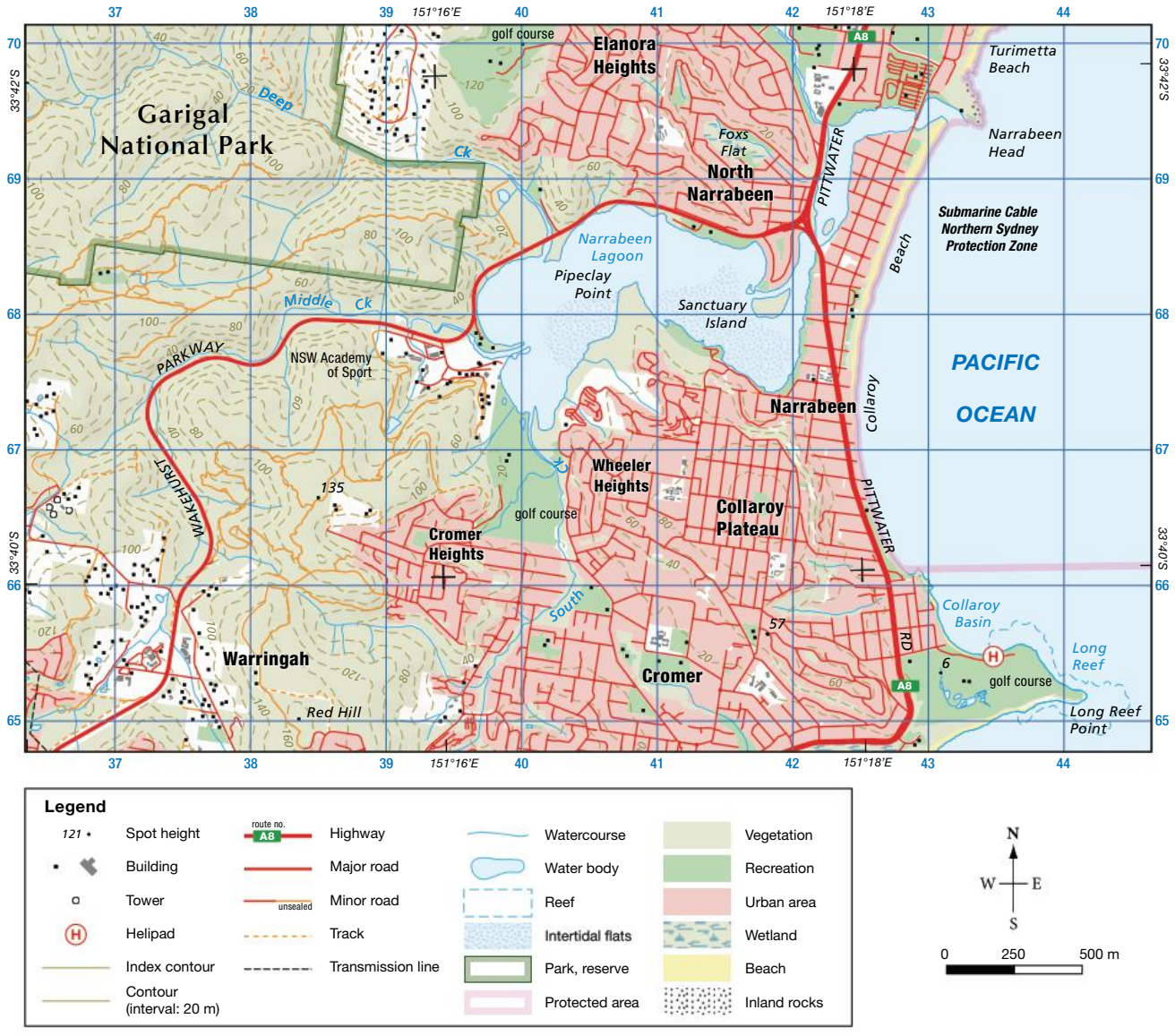
FIGURE 1 Topographic map extract of Narrabeen Lagoon



Source: Land and Property Information, NSW.

northern beaches. Tourists are attracted to the area for the range of outdoor recreational opportunities such as fishing, kayaking, cycling, sailing, walking and picnicking.

The main body of Narrabeen Lagoon is fed by stream flow that drains off surrounding elevated suburbs. The lagoon is connected to the sea by a narrow channel that is often blocked by sand movement along North Narrabeen beach. Severe storms can result in flooding of the low-lying suburbs and roads. Rainfall totals and river levels are monitored throughout the catchment, and warnings are issued to motorists and residents when flooding is predicted.

Resources

eWorkbook	Investigating topographic maps — Potential flooding on Sydney's northern beaches (ewbk-10545)
Digital document	Topographic map of Narrabeen Lagoon (doc-39382)
Video eLesson	Investigating topographic maps — Potential flooding on Sydney's northern beaches — Key concepts (eles-6012)
Google Earth	Narrabeen Lagoon

3.8 Exercise

learnon

3.8 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
2, 3	1, 4	5, 6

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Check your understanding

1. **Identify** the direction of stream flow along Deep Creek.
2. What is the area reference of the following?
   a. Cromer Heights
   b. Sanctuary Island
   c. The lagoon mouth (where the lagoon flows out to the sea)
3. **Identify** the human feature found at the following.
   a. GR390705
   b. GR422687
   c. GR435655

Apply your understanding

Interpreting and analysing

4. The Wakehurst Parkway is an important link between places in Sydney's north.
   a. Where do you think the flood gates that block the road during flooding are located?
   b. Use evidence from the map to **explain** why you think this would be a good location for the gates.
5. Download the map or print the digital document version from your online Resources panel. **Highlight** the areas that you think are likely to flood.
6. Which areas would require residents to evacuate during flooding? **Explain** why.

LESSON
3.9 Why does the wind blow?

LEARNING INTENTION

By the end of this lesson you should be able to explain the role that wind plays in creating weather conditions.

TUNE IN

Wind turbines provide clean, reliable and renewable energy. Do you believe that using wind turbines on a larger scale could be useful in Australia? Outline the positive and negatives of wind turbine use.

FIGURE 1 Wind turbines provide clean, reliable and renewable energy.

3.9.1 How wind influences weather

The Earth's atmosphere protects us from the extremes of the sun's heat and the chill of space, making conditions right to support life. The air in the lowest layer of the atmosphere is called the troposphere. Weather is the result of changes in this layer of the atmosphere (refer to lesson 3.2).

The air around us has weight. The weight of the air above us pushes down on the surface, creating pressure. If we were to tie a **barometer** to a hot air balloon, we would see the pressure readings fall as the balloon rises in the atmosphere. This is because less air is higher up in the atmosphere. You may have read about mountain climbers and athletes having difficulty breathing when they are at high altitudes.

barometer an instrument used to measure air pressure

Air pressure

When a person blows up a balloon, the pressure inside the balloon is higher than the surrounding air. When the neck of the balloon is released, the air rushes out of the balloon, as shown in **FIGURES 3** and **4**. This is wind. If we did not have wind, temperatures would continue to rise over the equator and decrease at the poles.

Meteorologists are able to measure air pressure using a unit of measure called a millibar. The average weight of air is about 1013 millibars. Measurements higher than this indicate areas of high pressure; here, the air is sinking. Measurements lower than 1013 millibars indicate areas of low pressure; here, the air is rising. Wind is caused by air moving from areas of high pressure to areas of low pressure.

FIGURE 2 A barometer is an instrument used to measure atmospheric pressure

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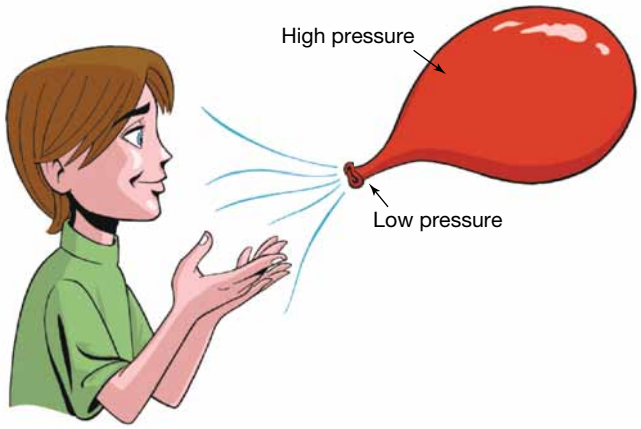
FIGURE 3 The pressure inside a balloon is higher than the pressure of the surrounding air.

FIGURE 4 When the neck of the balloon is released, air rushes out, moving from a space of high pressure to one of low pressure.



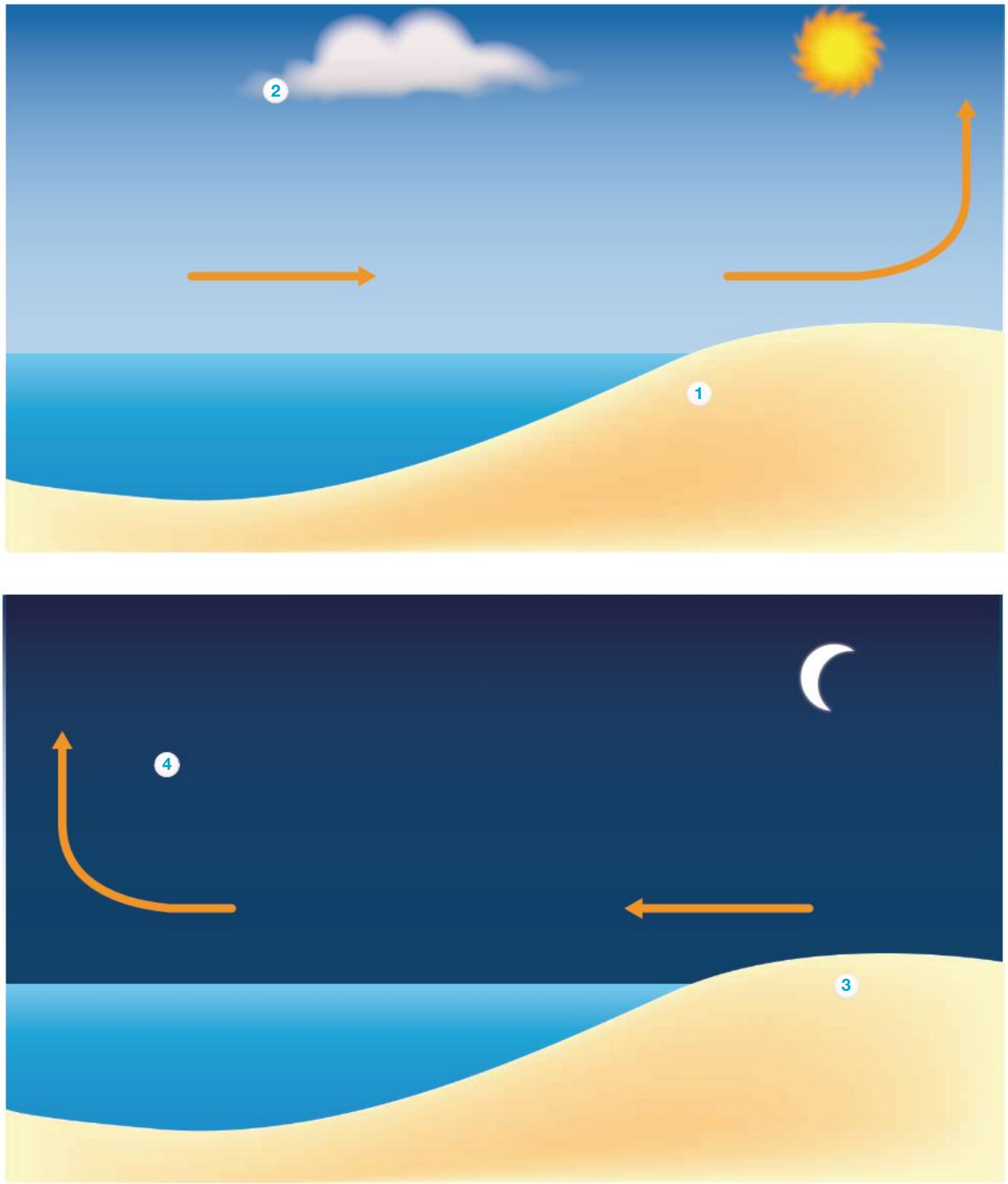
Effects of the sun

Variations in air pressure are the result of the heating effect of the sun and the rotation of the Earth. The warming influence of the sun varies with the time of day (see **FIGURE 5**) and latitude (distance from the equator). Temperatures are higher in the middle of the day, and higher at the equator than at the poles.

Warm air is also less dense than cold air. This is because as the air heats, it expands, causing it to rise. Air pressure over the equator is less than at the poles. As the warm air over the equator rises and expands, cooler air from near the poles rushes in to replace it. As a result, air is circulated around the Earth, and this movement of air is what we call wind.

FIGURE 5 On a small scale, this diagram shows the effect of the sun on a sea breeze.

Land heats up and cools down more quickly than the sea.

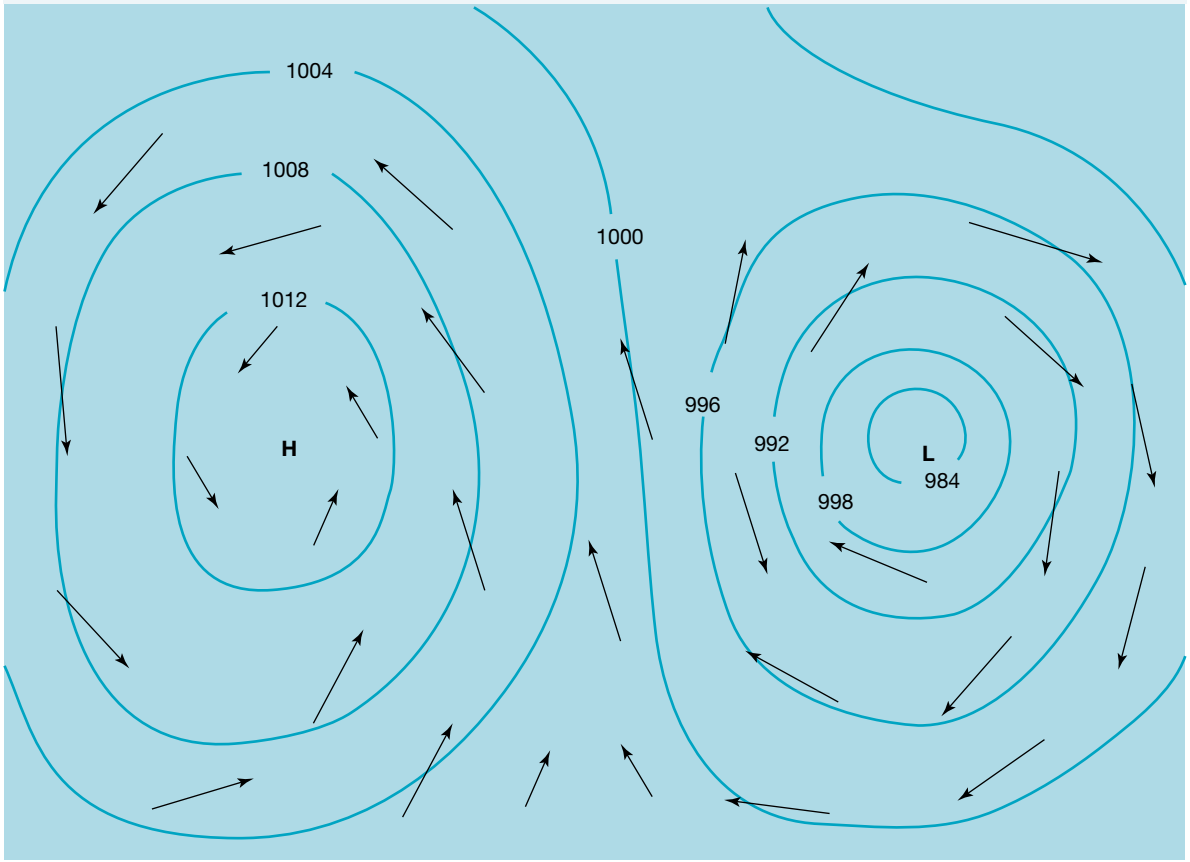


1. During the day the air above the land heats up, expands and rises.
2. The atmospheric pressure above the land drops and air moves in from above the sea, where the air pressure is higher. This causes a sea breeze or an onshore breeze.
3. During the evening, the temperature of the land drops much faster than the temperature of the sea.
4. The air above the sea becomes hotter than the air above the land, so it rises and a breeze flows from the coast out to sea, reversing the effect.

Effect of the Earth's rotation

The rotation of the Earth on its axis causes the air above the surface of the Earth to be deflected rather than to travel in a straight line. This causes the wind to circle around high- and low-pressure systems. The direction in which winds circle depends on whether you are in the northern or southern hemisphere. As the air moves from an area of high pressure to an area of low pressure, winds circle in the opposite direction in each hemisphere. In an area of high pressure, the winds circle in an anticlockwise direction in the southern hemisphere and a clockwise direction in the northern hemisphere. This deflection of winds is known as the Coriolis effect (see **FIGURE 6**).

FIGURE 6 Wind is caused by air moving from areas of high pressure to areas of low pressure. Its direction is influenced by the rotation of the Earth.



3.9.2 How is wind shown on a weather map?

Differences in air pressure lead to variations in the strength of the wind. You can work out the strength of the wind by looking at weather maps, the behaviour of objects or by using instruments designed to measure the strength of the wind. Winds are named according to their source. This means that a northerly wind is coming from the north and a southerly from the south.

If you study the **isobars** on a weather map, you will notice that they are not evenly spaced. Look closely at the map in **FIGURE 7**. The wind is strongest in the southern regions of this map, where the isobars are close together, and gentler in the northern parts of the map, where the spacing between them is much greater.

The symbols shown in **FIGURE 8** are also commonly used on weather maps to give a more accurate representation of wind speed and to provide information on the direction of the wind.

isobars lines on a map that join places with the same air pressure

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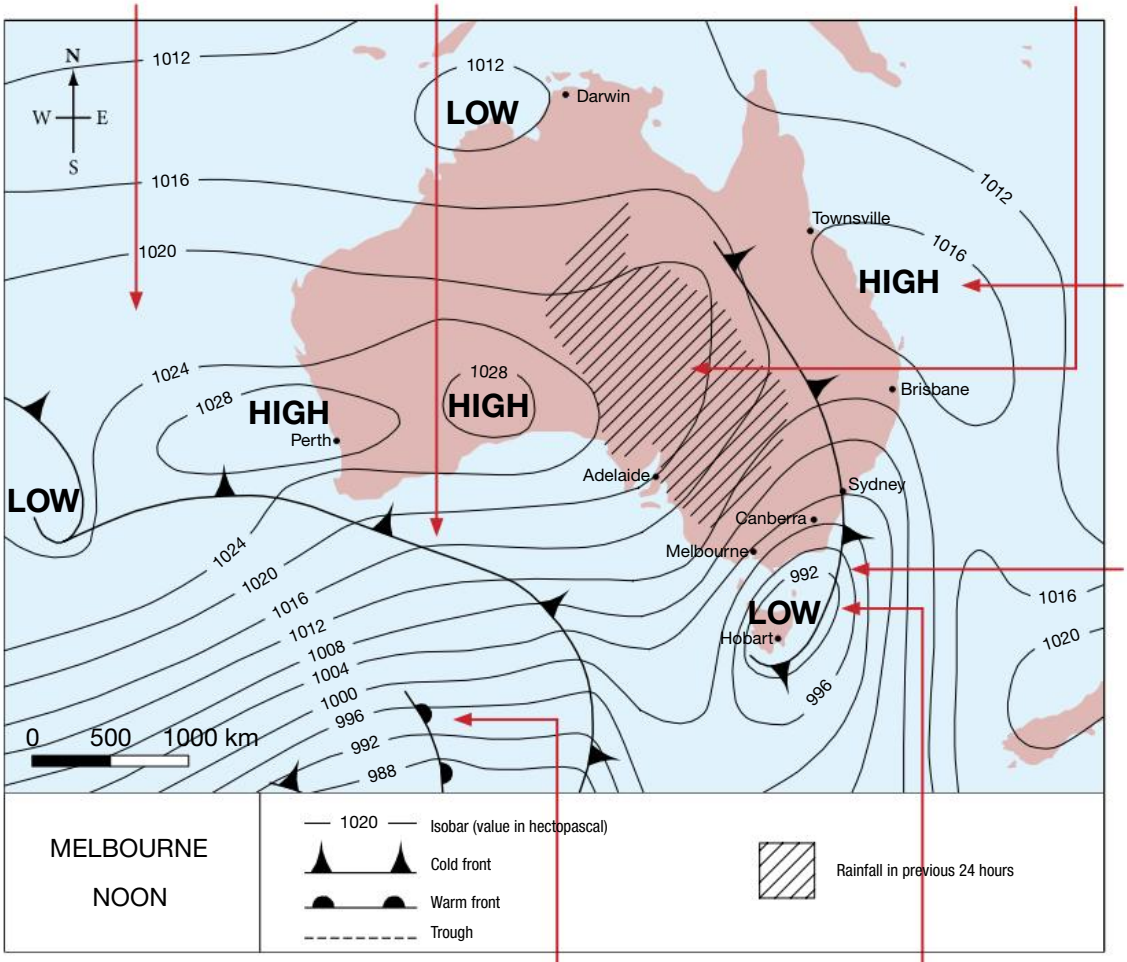
FIGURE 7 A typical weather map

Greater distance between isobars indicates wind is weaker in these regions.

Cold front advancing from west to east — towards southern Australia. Note how the isobars behind it are close together, indicating strong winds.

Shading indicates rain fell in the previous 24 hours.



Source: MAPgraphics Pty Ltd, Brisbane.

High pressure system. Note how the isobar is joining points with an atmospheric pressure of 1016 (higher than 1013 average).

The cold front that has just passed over Melbourne has brought unsettled, rainy weather behind it. More rainy weather is likely for Melbourne when the cold front coming towards it from the west gets closer.

The main influences on Melbourne's weather are the low pressure system south of it, the high pressure system to the north-west, and the cold fronts to the west and east.

Warm front advancing from west to east behind the cold front. Note the lower atmospheric readings on the isobars.

Low pressure system. Note how the isobar is joining points with an atmospheric pressure of 992 (lower than the 1013 average).

FIGURE 8 Symbols commonly used to indicate wind strength

calm (0–2 km/h)	3–7 km/h	8–12 km/h
13–17 km/h	18–22 km/h	23–27 km/h
28–32 km/h	33–37 km/h	38–42 km/h
43–47 km/h	48–52 km/h	53–57 km/h

FIGURE 9 Reading wind symbols on a weather map

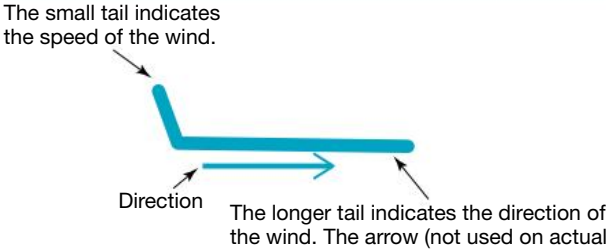


FIGURE 10 The Beaufort scale is based on the observable impact of winds.

0 Calm
Less than 2 km/h
Smoke rises vertically

1 Light air
2–5 km/h
Smoke drift shows wind direction, wind vanes don't move

2 Light breeze
6–12 km/h
Wind felt on face, wind vanes move

3 Gentle breeze
13–20 km/h
Leaves and small twigs in motion, hair disturbed, clothing flaps

4 Moderate breeze
21–30 km/h
Dust and loose paper move, small branches move

5 Fresh breeze
31–40 km/h
Small trees with leaves begin to sway, wind force felt on body

6 Strong breeze
41–51 km/h
Large branches move, umbrellas difficult to use, difficult to walk steadily

7 Moderate gale
52–63 km/h
Whole trees in motion, inconvenience felt when walking

8 Gale
64–77 km/h
Twigs broken off trees, difficult to walk

9 Strong gale
78–86 km/h
People blown over, slight structural damage, including tiles blown off houses

10 Whole gale
88–101 km/h
Trees uprooted, considerable structural damage

11 Storm
102–120 km/h
Widespread damage

12 Hurricane/cyclone
Greater than 120 km/h
Widespread devastation

on Resources

Interactivity Highs and lows (int-3086)

3.9 SKILL ACTIVITY: Interpreting and analysing

Over the course of the next week, collect weather maps from the daily newspaper or online and find your location.

1. Is the weather being influenced by a high- or a low-pressure system?
2. Will the wind be moving in a clockwise or anticlockwise direction? Give reasons for your answer.

3. Using the weather maps you collected, and the observations you made, **write** a weather forecast for tomorrow. In your forecast, refer to both wind speed and direction.
4. Collect tomorrow's weather map and make observations. Record your findings.
5. **Compare** what you have written for this activity. How accurate were your predictions? Suggest factors that might influence the accuracy of such predictions and changes that you observe.

3.9 Exercise

learnon

3.9 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 8	3, 4, 7	5, 6, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. What is wind?
   - A. Air mixing with the water in the oceans
   - B. Air circulating around the Earth
   - C. A noise heard when the weather changes
   - D. A build-up of pressure
2. **Explain** why you are not affected by the pressure of the atmosphere.
3. **Identify** the two factors that influence wind.
   - A. Air pressure
   - B. Where it occurs in the atmosphere
   - C. Temperature variations
   - D. The number of pressure systems
4. Use the provided terms to complete the following sentence and **explain** the role the sun plays in causing wind.

sun	poles	circulation	cooling
heating	pressure	systems	air

The _____ heats and cools the _____ above the surface of the Earth. Its _____ and cooling effects vary from the equator to the _____. This heating and _____ leads to the development of _____ systems. The sun helps drive the Earth's _____ pattern as air moves between different pressure _____.

5. **Describe** the change that difference in air pressure causes.

Apply your understanding

Interpreting and analysing

6. **Determine** the interconnection between our atmosphere and the weather we experience at the Earth's surface.
7. Using **FIGURE 7**, **describe** the wind speeds and directions in Western Australia and along the east coast of Australia on that day.
8. Refer to **FIGURES 7** and **9**. **Create** wind symbols to represent the following wind speeds and directions.
   - a. Northerly; 28–32 kph
   - b. South-westerly; 8–12 kph
   - c. Easterly; 13–20 kph
9. Refer to **FIGURE 7**; a cold front is approaching Brisbane. **Describe** how the weather will change when the cold front arrives.
10. **Evaluate** the relationship between the Coriolis effect and wind.

LESSON
3.10 What causes thunderstorms and extreme weather?

LEARNING INTENTION

By the end of this lesson you should be able to identify the causes and characteristics of thunderstorms and other types of extreme weather.

TUNE IN

Extreme weather can occur in range of different environments and take an even greater range of forms.

Recall a situation when you experienced an extreme weather event yourself. Write a brief story about the event, including a description of the type of weather you saw and the impacts the event caused.

FIGURE 1 What extreme weather events have you experienced?

3.10.1 What causes thunderstorms?

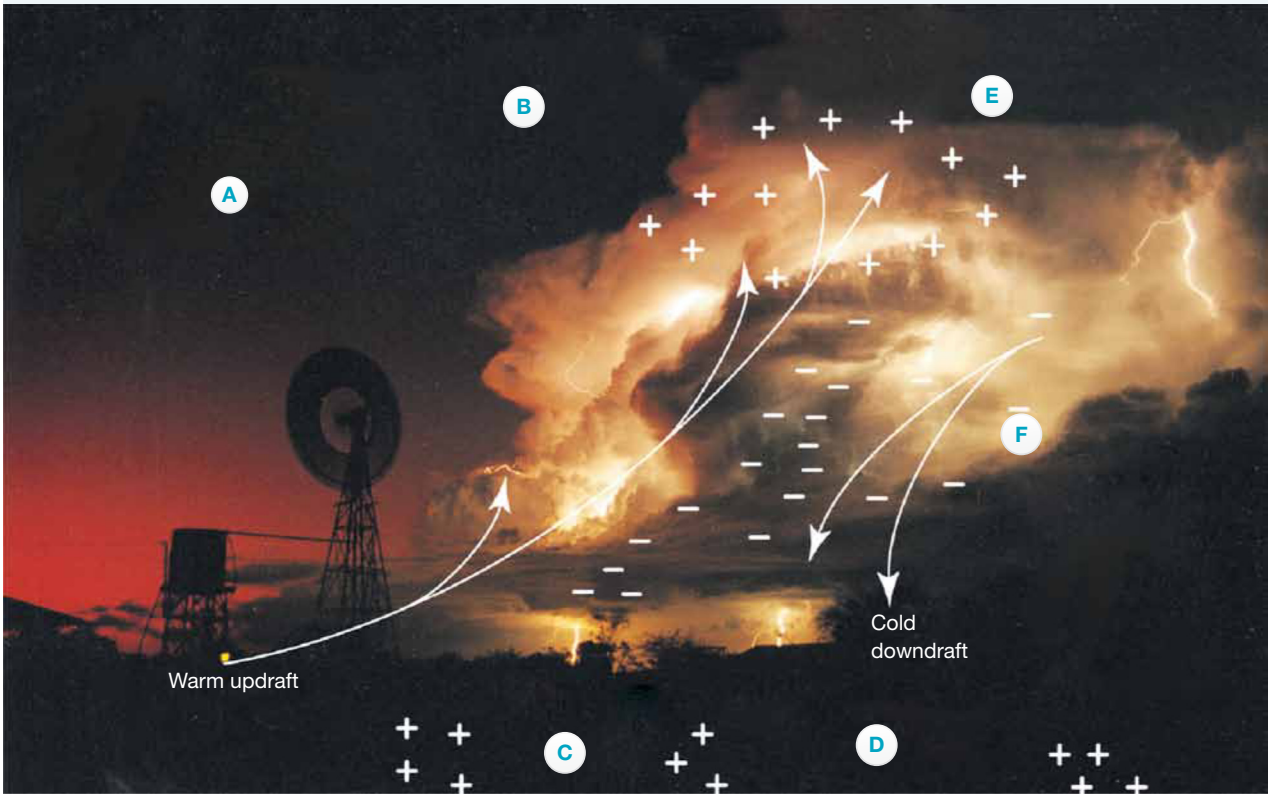
Thunderstorms, also known as electrical storms, form in unstable, moist atmospheres where powerful updrafts occur, which happens when a cold front approaches. Around the Earth, experts estimate 1800 thunderstorms occur each day, along with 8 million lightning strikes per day! Darwin is the thunderstorm capital of Australia with an average of 80 thunderstorms per year. Yet this pales in comparison to Lake Maracaibo in Venezuela, which averages nearly 300 thunderstorms per year!

The Vikings thought thunder was the rumble of Thor's chariot. (He was their god of thunder and lightning.) Lightning marked the path of his mighty hammer Mjöllnir when he threw it across the sky at his enemies. Today we know that thunderstorms occur when large **cumulonimbus clouds** build up enough static electricity to produce lightning, as shown in **FIGURE 2**. Lightning instantly heats the air through which it travels to about 20 000 °C — more than three times as hot as the surface of the sun. This causes the air to expand so quickly that it produces an explosion (thunder). The time between you seeing a lightning flash and hearing the crash of thunder tells you how far away the lightning is (a 5-second delay means that the lightning is 1.6 kilometres away).

cumulonimbus clouds huge, thick clouds that produce electrical storms, heavy rain, strong winds and sometimes tornadoes; they often appear to have an anvil-shaped flat top and can stretch from near the ground to 16 kilometres above the ground

tlvd-10544

FIGURE 2 How a thunderstorm works



A As air currents in a cumulonimbus cloud become more violent, they fling ice crystals and water droplets around faster. The more these crystals and droplets smash into one another, the more friction builds up. This creates huge energy stores of static electricity in the cloud.

B Lighter particles with a positive electric charge drift upwards. Heavier particles with a negative charge sink.

C The ground below the cloud has a positive charge.

D Lightning travels to the ground via the shortest route. This is why it sometimes strikes buildings or tall trees.

E A bolt of lightning actually consists of a number of flashes that travel up and down between the cloud and the ground. This happens so quickly we can't see it.

F The difference in energy between the positive charge on the ground and the massive negative charge at the bottom of the cloud becomes huge. A lightning bolt corrects some of this difference.

3.10.2 Severe thunderstorms

According to the Bureau of Meteorology, a thunderstorm can be classified as severe if it has one or more of the following features.

- Flash flooding. Thunderstorms often move slowly, dropping a lot of precipitation in one area. The rain or hail may consequently be too heavy and long-lasting for the ground to absorb the moisture. The water then runs off the surface, quickly flooding local areas.
- **Hailstones** that are two centimetres or more in diameter. The largest recorded hailstone had a diameter of 20.3 centimetres and a circumference of 47 centimetres.
- Wind gusts of 90 kilometres per hour or more. Cold blasts of wind hurtle out of thunderclouds, dragged down by falling rain or hail. When the drafts hit the ground, they gust outwards in all directions.

hailstone an irregularly shaped ball of frozen precipitation

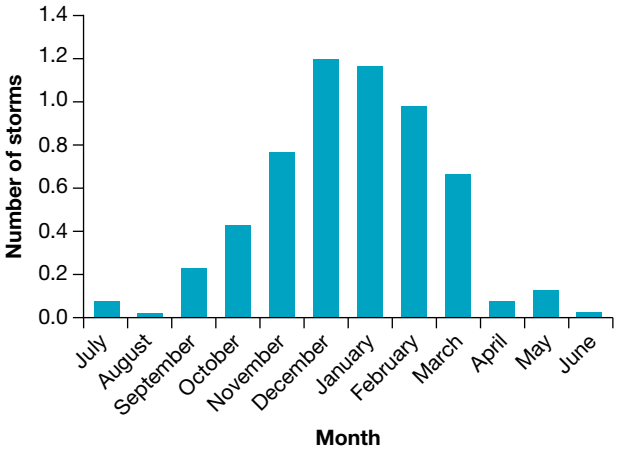
In the right conditions, tornadoes can occur. These are rapidly spinning updrafts of air that can develop as a result of thunderstorm activity. Although severe tornadoes are not common in Australia, around 400 tornadoes have been recorded here.

3.10.3 When do thunderstorms occur?

Thunderstorms can occur at any time of the year, but they are more likely to occur during spring and summer, as shown in **FIGURES 3** and **4**. This is due mainly to the warming effects of the sun and the fact that warm air can hold more moisture than cold air.

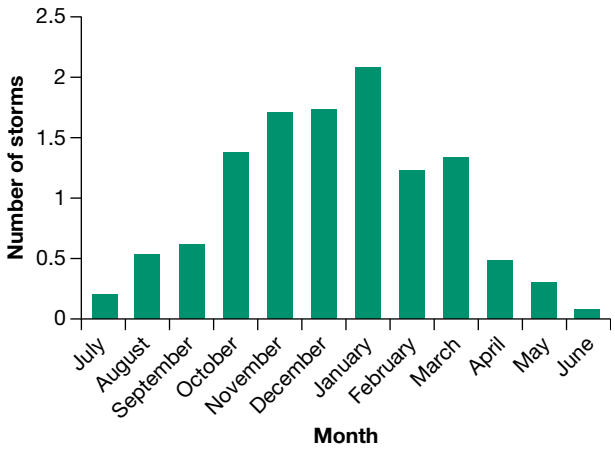
Thunderstorms are created when cooler air begins to push warmer, humid air upwards. As the warm air continues to rise rapidly in an unstable atmosphere, the cloud builds up higher and begins to spread. Thunderstorms can quickly develop when the atmosphere remains unstable or when it is able to gather additional energy from surrounding winds.

FIGURE 3 Average monthly distribution of thunderstorms in Darwin



Source: Bureau of Meteorology

FIGURE 4 Average monthly distribution of thunderstorms in Melbourne

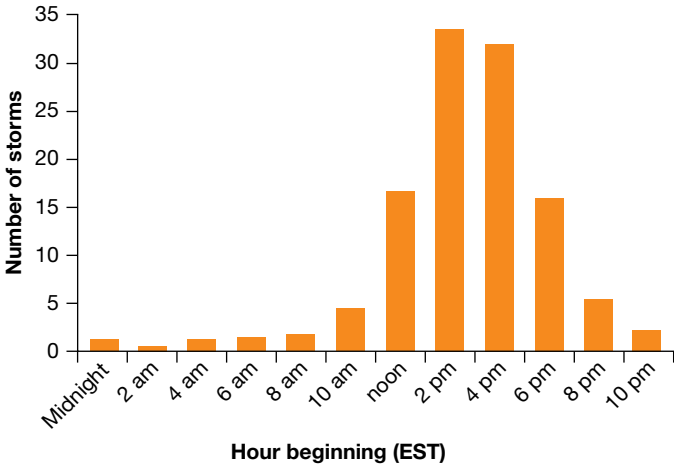


Source: Bureau of Meteorology

The time of day when thunderstorms are more likely is shown in **FIGURE 5**. You will notice that thunderstorm activity is greater in the afternoon. This is linked to the daily heating of the Earth by the sun, which peaks in the afternoon.

When we think about thunderstorms, we often think only of the high winds, thunder and lightning, but significant damage is also caused by hailstones. Any thunderstorm that produces hailstones large enough to reach the ground is known as a **hailstorm**. Hailstones in Australia tend to range in size from a few millimetres to the size of a tennis ball (see **FIGURE 6**).

FIGURE 5 Hourly distribution of thunderstorms in New South Wales and the Australian Capital Territory



Source: Bureau of Meteorology

hailstorm any thunderstorm that produces hailstones large enough to reach the ground

3.10.4 Inside a storm

January 2016 saw widespread supercell storm activity across Queensland, New South Wales, Victoria and South Australia.

On 13 January, Melbourne sweltered through temperatures of about 43 °C. Intense thunderstorm activity with wind gusts up to 100 kilometres per hour swept through in the early evening, causing the city to be blanketed by a cloud of dust. Up to 1000 homes were left without power.

The following day, a severe storm struck Sydney with winds gusting up to 98 kilometres per hour bringing down power lines, damaging buildings and cars, and causing flash flooding. More than 40 000 homes and businesses reported power outages. The temperature plummeted by more than 10 °C in five minutes. Emergency services responded to 145 storm-related incidents, including a gas leak.

FIGURE 6 Hailstones can be the size of a golf ball or even bigger.

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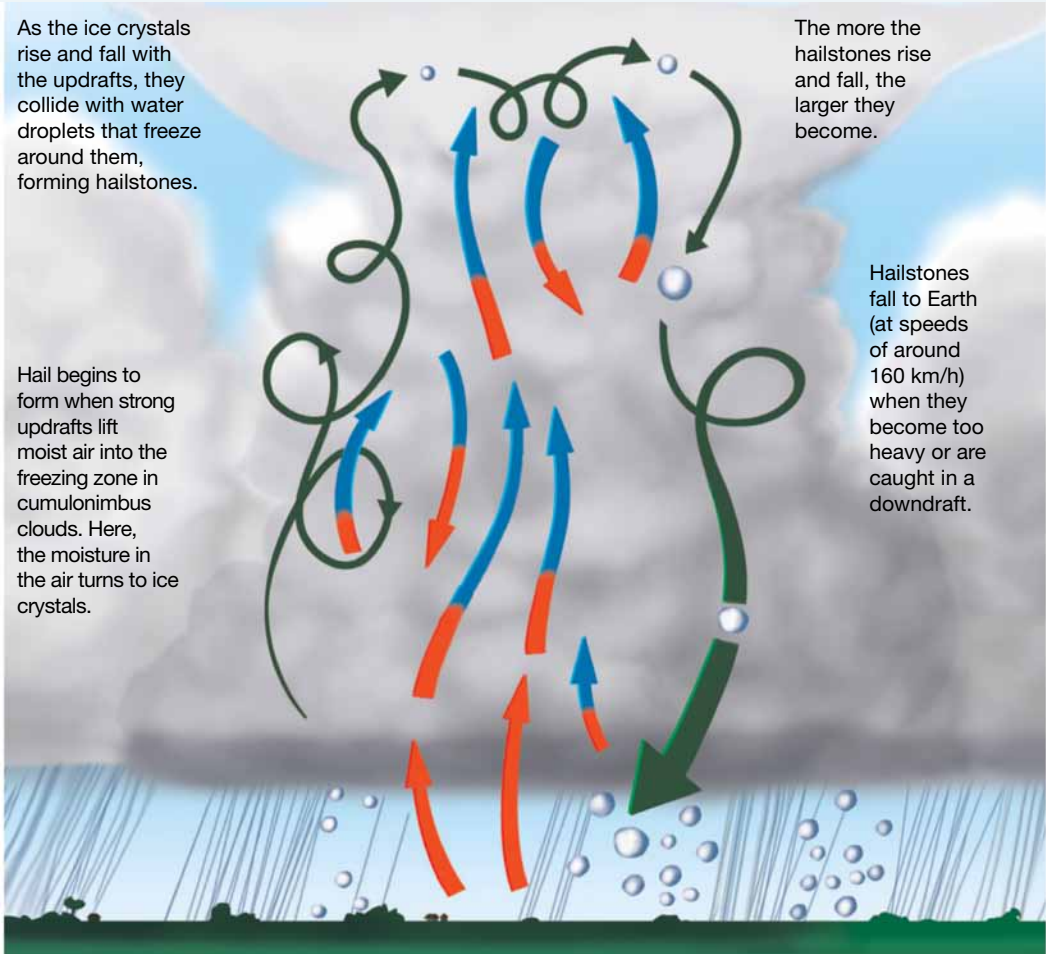
FIGURE 7 How a supercell hailstorm forms



A supercell storm has extremely strong updrafts. These keep hailstones suspended longer than regular storms, allowing hailstones to grow bigger. To form cricket-ball sized hailstones, there must be updrafts of around 160 km/h.

On 16 January, Townsville recorded 91 millimetres of rain in 30 minutes, resulting in flash flooding that left many motorists stranded. The rain continued to fall, with 181 millimetres recorded in two hours. Wind gusts of more than 100 kilometres accompanied the massive storm that has been described as a once-in-a-100-year event.

Unfortunately, while large areas were inundated, the rain had little impact on the region's water storages.

Both Adelaide and Sydney were pummelled by supercell storms on January 22. The worst hit areas were in the Adelaide Hills and Fleurieu Peninsula where 20 000 homes lost power and the SES responded to 61 calls for help.

In 30 minutes, 35 millimetres of rain was recorded, resulting in flash flooding, while hailstorms measuring two centimetres in diameter carpeted parts of the city. Wind gusts of up to 90 kilometres per hour were recorded at the airport.

Meanwhile, Sydney was warned to prepare for the worst, to secure vehicles and loose items, unplug electronic equipment and to stay indoors as the city braced itself for more storms, following from those experienced in previous days.

The intense storm activity was the result of the large number of hot days. Flash flooding, damaging winds, hail and lightning were set to continue.

On 29 January, the tourist hot spots around the Gold Coast and Sunshine Coast were lashed by severe storm activity. Wind gusts of more than 100 kilometres per hour were recorded.

FIGURE 8 The force of a storm tore this tree from the ground.

FIGURE 9 In June 2016, another supercell storm hit Sydney. Waves up to eight metres high crashed into the shoreline at Collaroy Beach and caused extensive damage.

on Resources

Weblink The Gap storm

3.10.5 What is a blizzard?

Periods of intense snowfall characterised by high winds and snow are known as snowstorms. These can be just as deadly as any other storm. The most dangerous snowstorm of all is the blizzard.

The difference between a snowstorm and a blizzard is the strength of the wind. A snowstorm is officially recognised as a blizzard when wind speed is sustained above 56 kilometres per hour or has frequent gusts in excess of this speed for more than three hours. Visibility in a blizzard is also reduced to less than 400 metres. In the most extreme cases, it may be difficult to see beyond a metre ahead. Often snow does not fall during a blizzard, but is blown into snowdrifts capable of burying people and objects. Variations in air pressure cause strong winds when warm air and cold air meet. It is these strong winds and cold conditions that cause a blizzard to develop.

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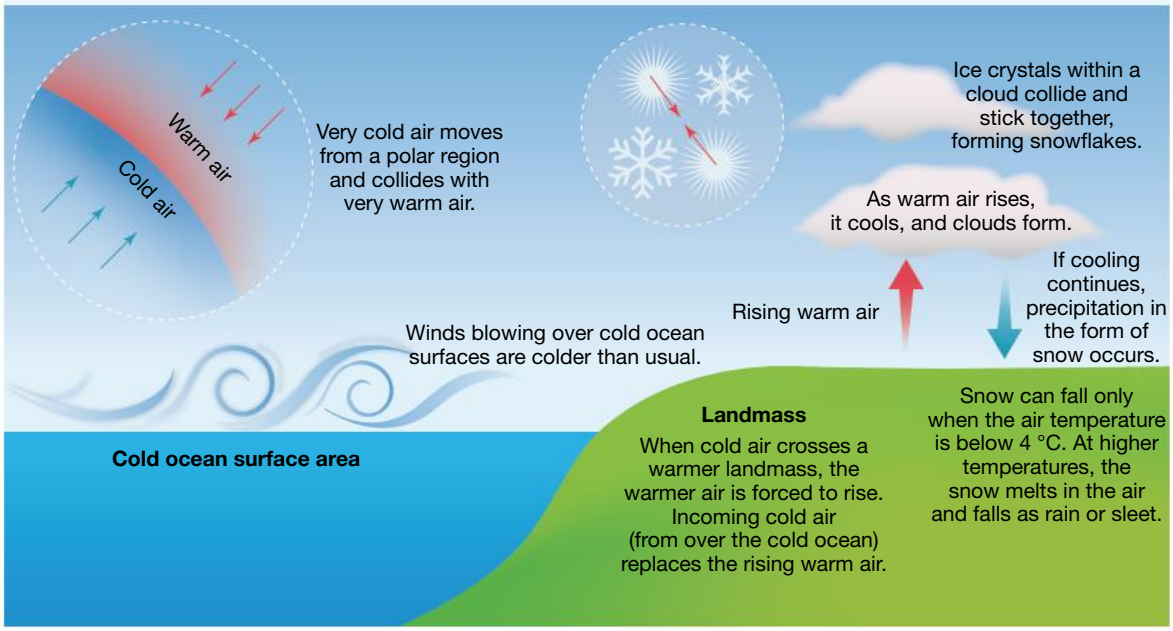
FIGURE 10 How a blizzard forms



Why are blizzards dangerous?

During snowstorms, snow can pile up and it can become impossible to know the depth of the snow, making it difficult to move about. The risk increases of falling through thin ice or into deep **crevasses**. Snow also tends to pile up on slopes. Where the snow load is greater than can be supported by the slope, the risk of **avalanches** develops (see **FIGURE 11**). An avalanche can be triggered by an earthquake or loud noises such as those produced by a gunshot or by animals. During blizzards a condition known as a **whiteout** can occur. This means there is so much snow that visibility is severely affected and may be limited to just one metre. People and animals cannot tell the difference between the Earth and the sky, and quickly become disoriented, lose their way and risk freezing to death.

In the extreme cold associated with snowstorms and blizzards, people are at increased risk of **hypothermia**, **frostbite** and suffocation.

Researchers in Antarctica have to contend with snow build-up in some parts of the continent. The Halley VI Research Station (**FIGURE 12**) has been built on steel legs that can be raised. Skis have been attached to these legs, so that the entire station can be moved in order to eliminate the dangers associated with accumulating snow.

crevasse a deep crack in ice

avalanche rapid movement of snow down a slope, usually under the influence of gravity; can also be triggered by animals, skiers or explosions

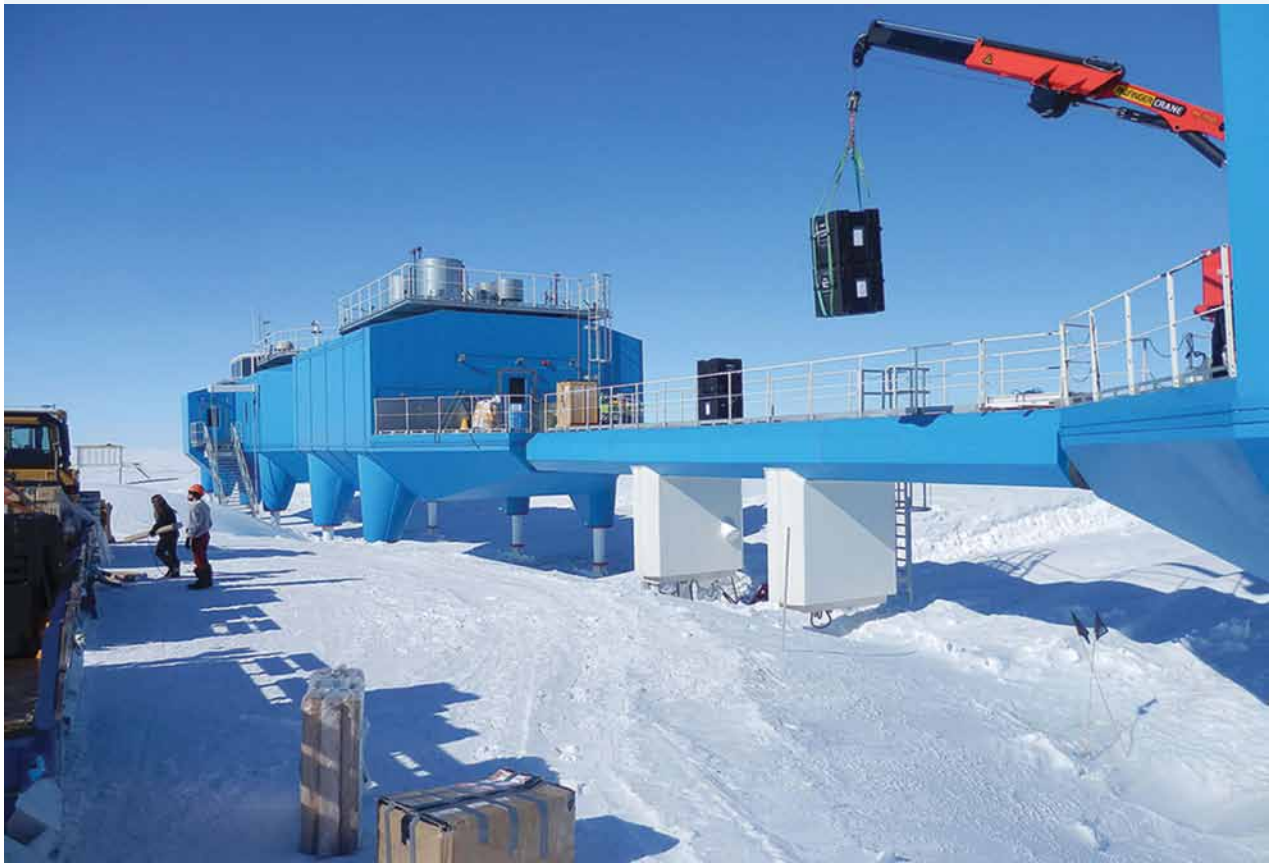
whiteout a weather condition where visibility and contrast is reduced by snow; individuals become disoriented because they cannot distinguish the ground from the sky

hypothermia when a person's core body temperature falls below 35 °C and the body is unable to maintain key systems; risk of death without treatment

frostbite damage caused to the skin when it freezes, brought about by exposure to extreme cold; extremities such as fingers and toes are most at risk, along with exposed parts of the face

FIGURE 11 An avalanche

FIGURE 12 The Halley VI Research Station in Antarctica



3.10 SKILL ACTIVITY: Communicating

Use the diagrams in this lesson to **create** your own sketch of a supercell storm. Using words such as evaporation, condensation and precipitation, annotate your diagram to **explain** how storms develop.

3.10 Exercise

learnon

3.10 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 7, 8	3, 4	5, 6, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. **Identify** three features associated with thunderstorms.
   - A. Massive cloud build-up
   - B. Thunder
   - C. Lack of clouds
   - D. Silence
   - E. Lightning
2. a. **List** the changes to the environment and types of damage that might result from thunderstorm activity.
   b. Next to each type of damage indicate:
   - whether the damage is caused predominantly by wind or water
   - whether the damage tends to occur to the natural or built environment.
3. Study **FIGURE 7.** Number each step in the provided table in order to **illustrate** how hailstones are formed.

Ice crystals rise and fall with updrafts; water droplets freeze around them.	_____
Hailstones grow in size with each updraft.	_____
Strong updrafts lift moisture to the freezing zone.	_____
Hailstones fall to Earth when they are too heavy to remain suspended.	_____
Moisture freezes and turns into ice crystals.	_____

4. **Suggest** reasons people in earlier civilisations assumed weather events were the work of the gods.
5. **Explain** why thunderstorms can cause so much damage to the natural and human environments.

Apply your understanding

Interpreting and analysing

6. Study **FIGURE 7**, which shows a supercell storm. **Write** a paragraph **explaining** why hailstones can vary so much in size.
7. During which seasons of the year are thunderstorms more likely? **Justify** your answer.
8. Study **FIGURE 5**. **Identify** which hours of the day most severe thunderstorms occur. Why?
9. Think of three actions you could do to protect yourself in a thunderstorm. **Explain** the rationale behind the actions you have chosen.
10. **FIGURES 8** and **9** show damage that resulted from thunderstorm activity. Refer to the Beaufort scale (**FIGURE 10** in lesson 3.9) and **predict** the wind speeds that might have been associated with this thunderstorm.

LESSON
3.11 What causes cyclones, hurricanes and typhoons?

LEARNING INTENTION

By the end of this lesson you should be able to explain the nature of cyclones and describe the impacts they can cause to environments and communities.

TUNE IN

Some areas around the world are particularly prone to cyclones, hurricanes and typhoons.

In 2022, the countries that were most exposed to tropical cyclones included Japan, the Philippines and the Bahamas.

1. Consider what you might do if you lived in a place where these extreme weather events were more common.
2. Discuss with your class the impact these weather events may have on the community and the environment in these locations.

FIGURE 1 The aftermath of a typhoon in Iwaizumi, Japan 2016

3.11.1 What is a cyclone?

Tropical cyclones (called hurricanes in the Americas and **typhoons** in Asia) can cause great damage to property and significant loss of life. Some 80 to 100 tropical cyclones occur around the world every year in tropical coastal areas located north and south of the equator. Australia experiences, on average, about 13 cyclones per year.

Cyclones form when a cold air mass meets a warm, moist air mass lying over a tropical ocean with a surface temperature greater than 27 °C. Cold air currents race in to replace rapidly rising, warm, moist air currents, creating an intense low-pressure system. Winds with speeds over 119 kilometres per hour can be generated. Cyclones are classified using the scale in **TABLE 1**.

typhoon the name given to cyclones in the Asian region

TABLE 1 Classification of cyclones using the Saffir–Simpson Scale

Category	Wind gust speed/ocean swell	Damage
1	Less than 125 km/h, 1.2–1.6 m	Mild damage
2	126–169 km/h, 1.7–2.5	Significant damage to trees
3	170–224 km/h, 2.6–3.7 m	Structural damage, power failures likely
4	225–279 km/h, 3.8–5.4 m	Most roofing lost
5	More than 280 km/h, more than 5.4 m	Almost total destruction

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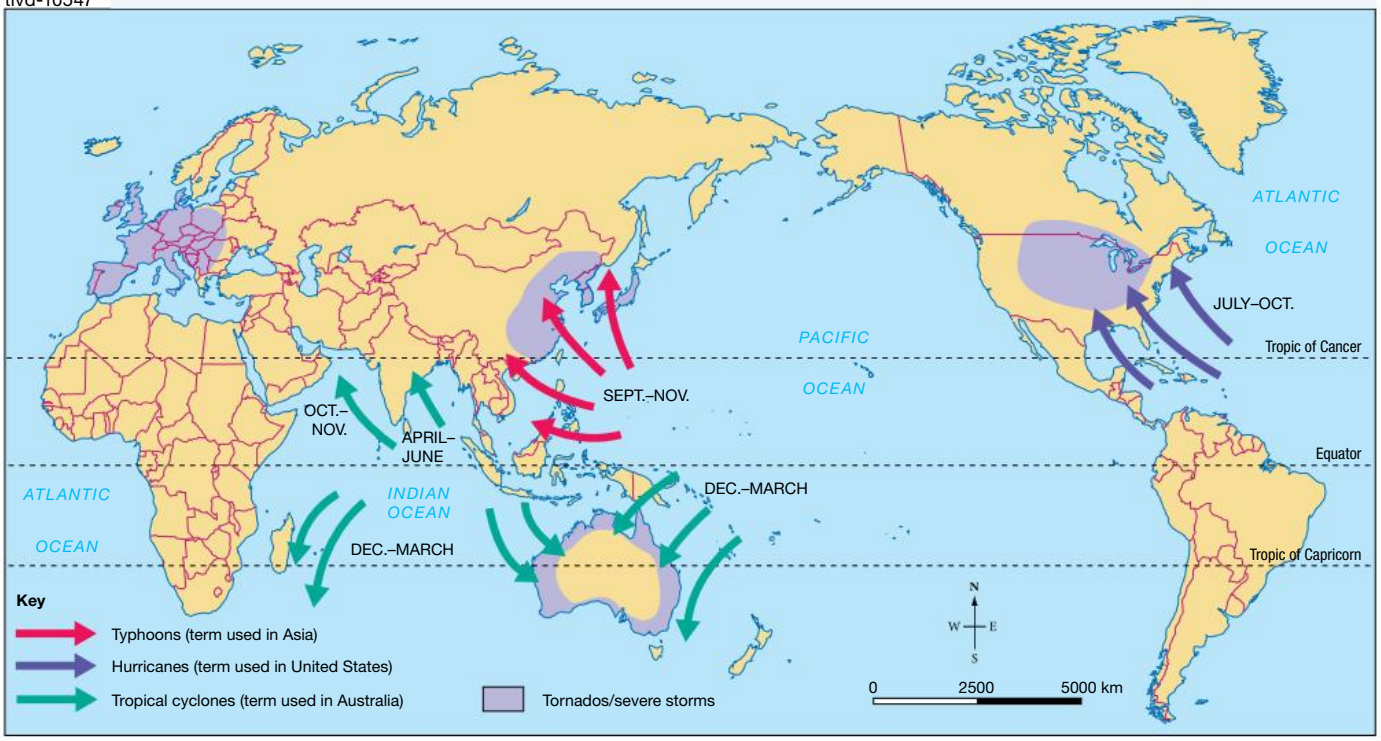
FIGURE 2 World distribution of tropical cyclones by names used in different regions



Source: Spatial Vision

FIGURE 3 shows the continuous cycle of evaporation, condensation and precipitation associated with cyclones. At first, the winds spin around an area about 200 to 300 kilometres wide. As the winds gather energy by sucking in more warm moist air, they get faster. In severe cyclones, winds may reach speeds of 295 kilometres per hour. The faster the winds blow, the smaller the area around which they spin; this is called the eye. The eye might end up being only about 30 kilometres wide. Around the edge of the eye, winds and rain are at their fiercest. However, in the eye itself, the air is relatively still, and the sky above it may be cloudless.

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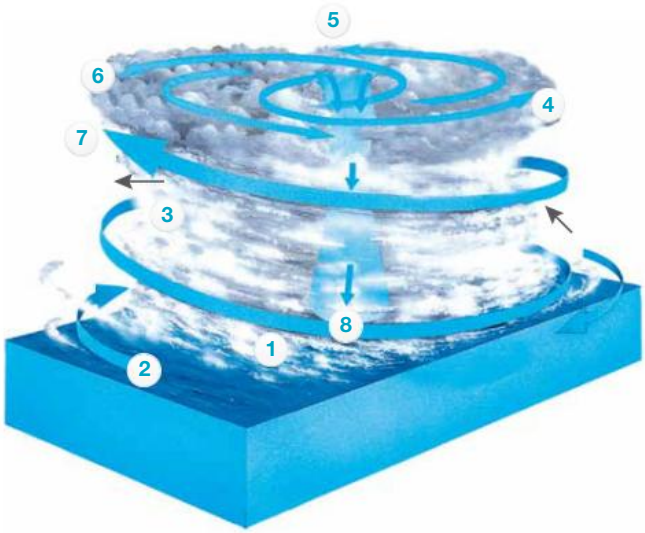
FIGURE 3 How a cyclone forms



1. Warm sea water evaporates and rises.
2. Low pressure centre creates converging winds, which replace rising air.
3. Warm air spirals up quickly.
4. Warm moist air is drawn in, providing additional energy.
5. Water vapour fuels cumulus clouds.
6. In the upper atmosphere, the air moves away from the eye.
7. Storm moves in direction of prevailing wind.
8. Descending air in the eye of cyclone.

What damage is caused by tropical cyclones?

Tropical cyclones can cause extensive damage if they cross land. **Gale force winds** can tear roofs off buildings and uproot trees. **Torrential rain** can often cause flooding, as can **storm surges**.

When a tropical cyclone approaches or crosses a coastline, the very low atmospheric pressure and impact of strong winds on the sea surface combine to produce a rise in sea level, as shown in **FIGURE 4**.

gale force wind wind over 62 kilometres per hour

torrential rain heavy rain often associated with storms, which can result in flash flooding

storm surge a sudden increase in sea level as a result of storm activity and strong winds; low-lying land may be flooded

FIGURE 4 Flooding caused by storm surges

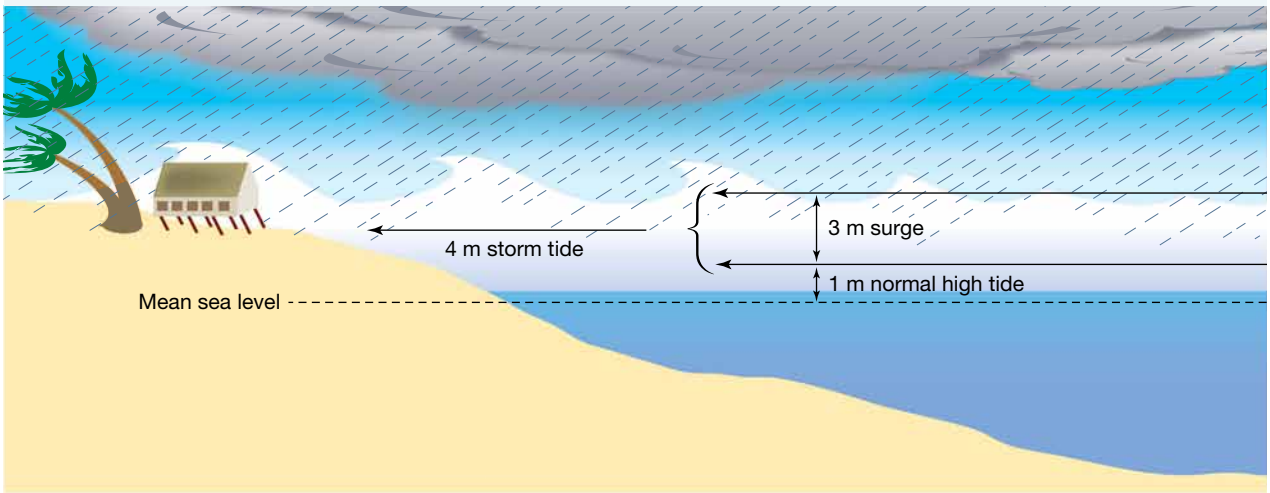


FIGURE 5 Satellite image of Hurricane Katrina, which caused massive damage in New Orleans, United States, in 2005

3.11.2 CASE STUDY: How did Cyclone Winston affect Fiji?

On 7 February 2016, a tropical disturbance was noted north-west of Port Vila, Vanuatu, tracking in a south-easterly direction. By 11 February, it had acquired gale-force winds. Over the next few days, Cyclone Winston went through a cycle of intensifying, weakening and stalling until finally developing into a category 5 cyclone on 19 February.

The following day, shortly before making landfall on Viti Levu, Fiji, Cyclone Winston reached its peak intensity. Sustained winds of 230 kilometres per hour, with gusts of up to 285 kilometres per hour and a central pressure reading of 915 millibars, were recorded.

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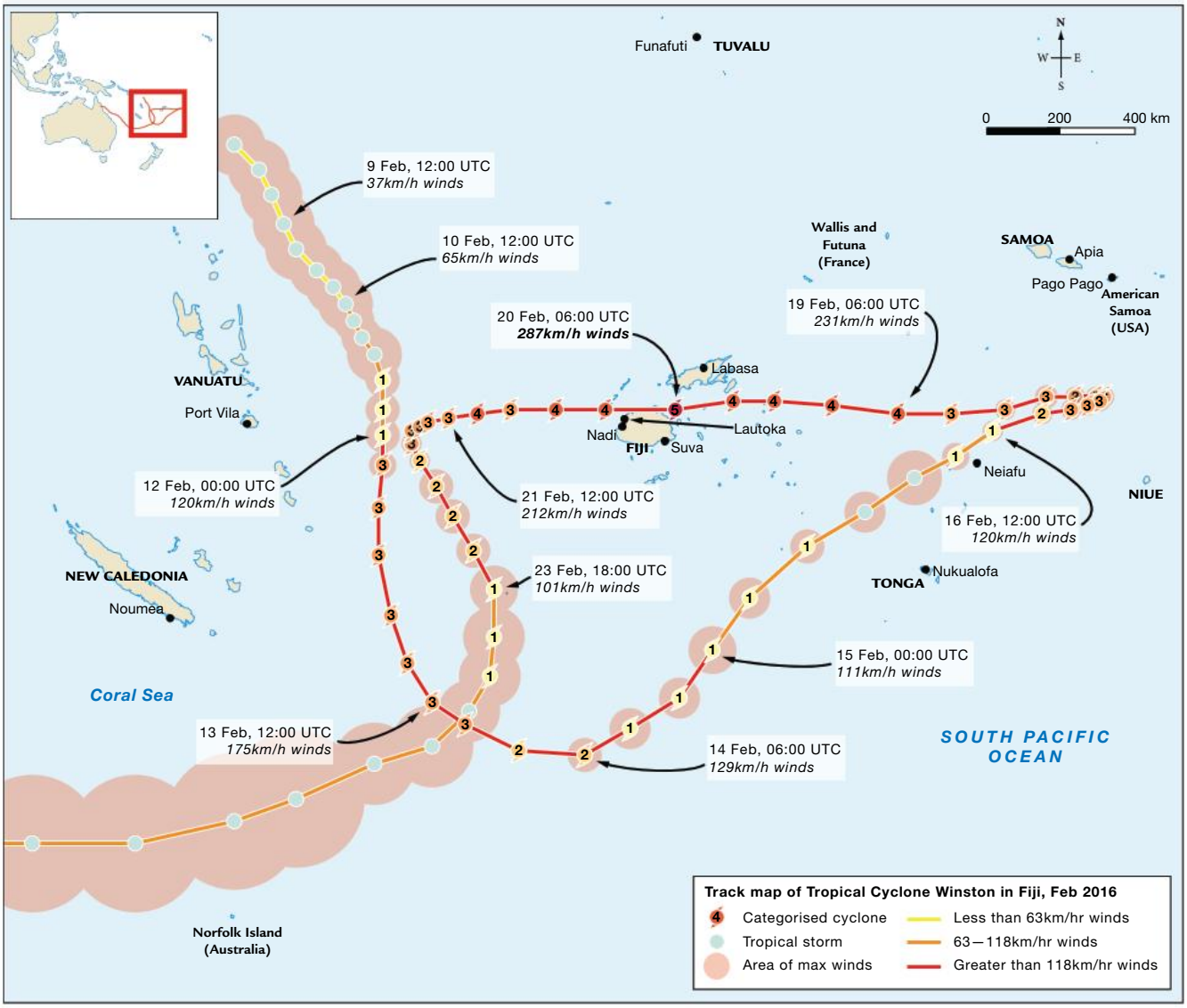
FIGURE 6 A track map of Cyclone Winston



Source: National Hurricane Center, National Oceanic and Atmospheric Administration

FIGURE 7 The power of a cyclone

How much damage was caused?

Cyclone Winston has been described as the most powerful storm to strike in the southern hemisphere. Strong winds battered the island nation of Fiji, with damage multiplied by a 4-metre storm surge.

The damage bill has been estimated at more than US$650 million. More than 40 people were killed and communication was cut, leaving at least six outer islands isolated for days. In the years prior to Cyclone Winston, the Fijian government had invested heavily in infrastructure, much of which was washed away. Homes and community facilities were flattened in many communities, with some villagers losing all their possessions (see **FIGURES 8** and **9**). Large regions were left without electricity and water. A week after the cyclone, around 45 000 people were still living in evacuation centres.

Fiji's largest industries are sugar cane and tourism. The sugar cane industry suffered around US$83 million worth of loss. This figure does not take into account the more than 200 000 people who depend on this industry for their livelihood. Additionally, thousands of acres of root crops were lost. The damage to the tourism industry was mixed. While Denaru Island resorts were still able to operate, this was not the case on some of the outer islands. Despite their losses, many of the local villages that depend on tourism were encouraging tourists to return and they were still operating.

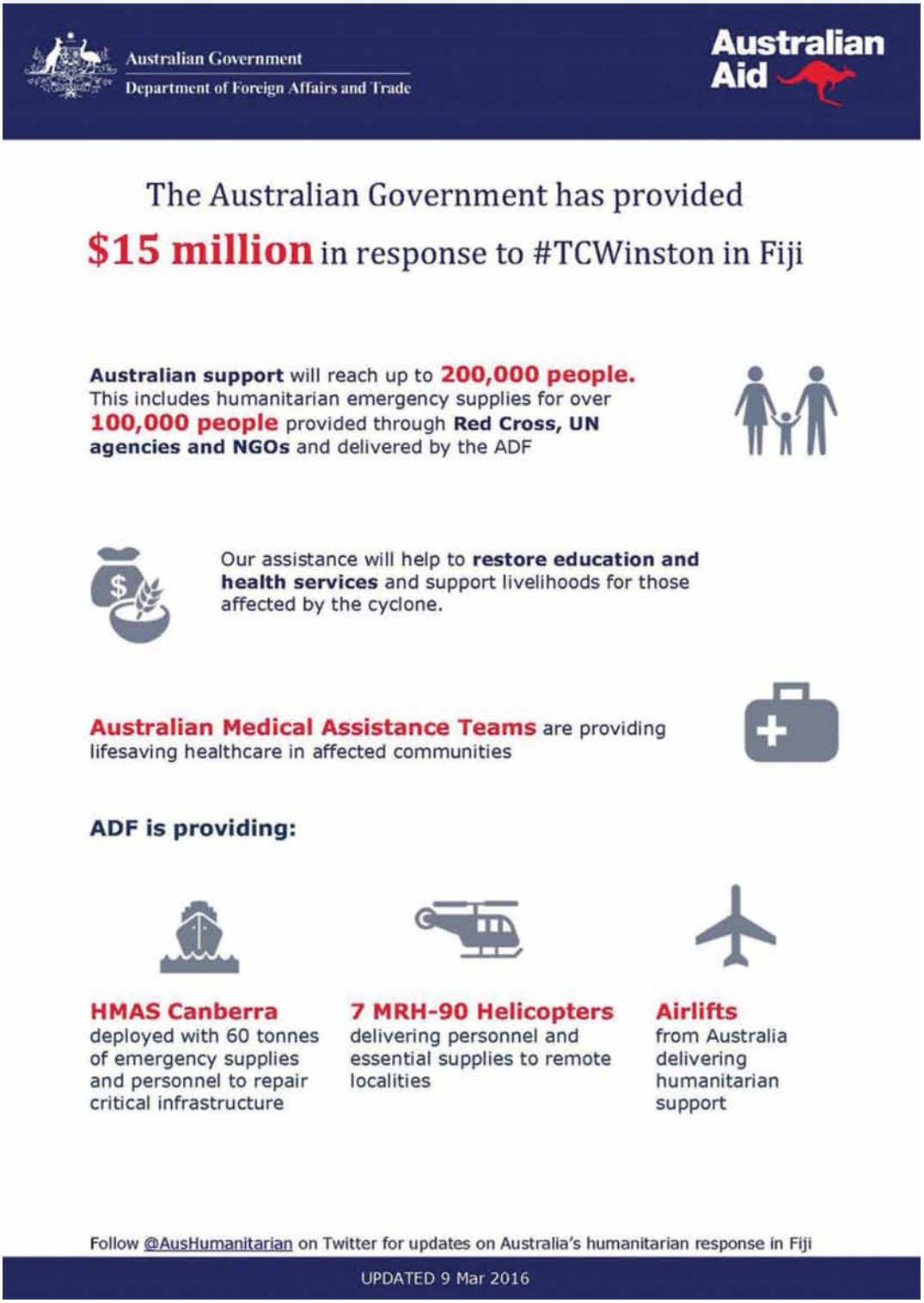
FIGURE 8 Whole communities were left devastated by Cyclone Winston.

FIGURE 9 Additional damage was caused by a 4-metre storm surge.

What aid did Australia provide?

Both Australia and New Zealand were quick to aid Fiji. Australia worked not only with the Fijian government (see **FIGURE 10**), but also with the island nation of Tonga, which was also affected by Cyclone Winston.

FIGURE 10 Australia's aid operation following Cyclone Winston



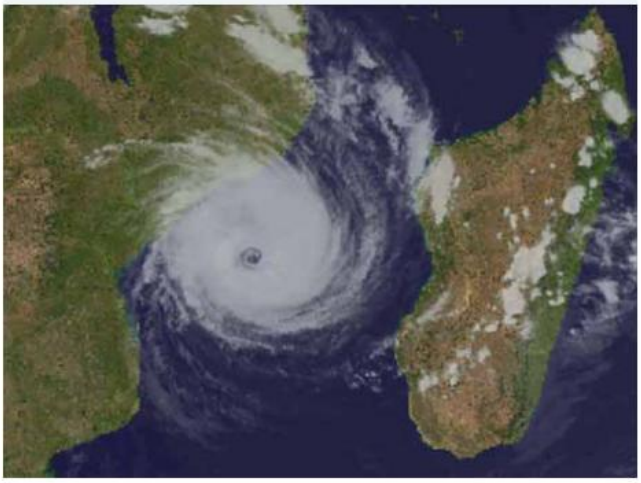
Were other areas affected?

The east coast of Australia experienced large waves in the wake of Cyclone Winston, forcing the closure of some popular tourist beaches. Despite warnings from authorities, surfers risked serious injury and even death to take advantage of the huge swells created along the New South Wales and Queensland coastlines. Beaches were still closed a week after Fiji was devastated.

3.11.3 CASE STUDY: Impacts of Tropical Cyclone Idai

In general, the African continent does not experience as many cyclones or extreme storms as other places in the world. While cyclones may be infrequent, they have been no less disastrous. Tropical Cyclone Idai was not only the worst cyclone to affect Africa, but also one of the deadliest cyclones in the entire Southern Hemisphere, killing 1300 people.

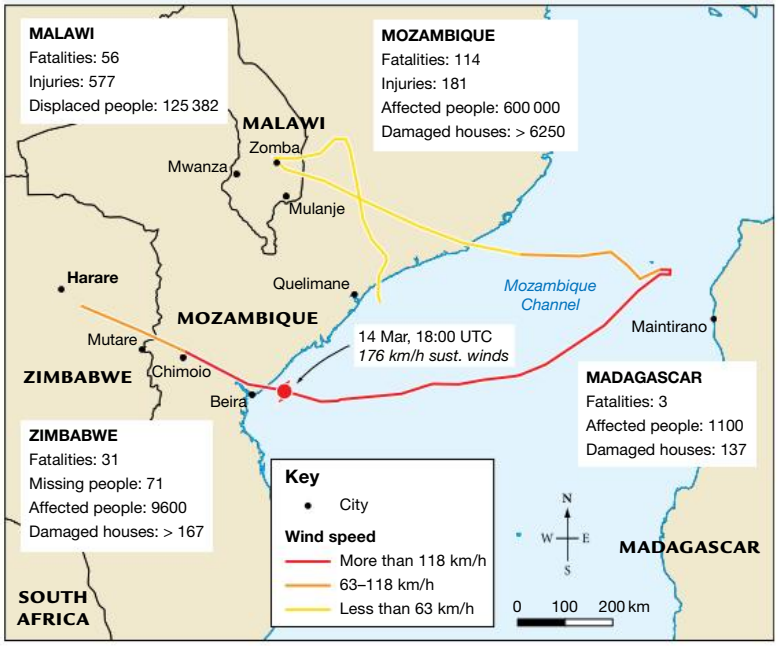
FIGURE 11 Cyclone Idai off the coast of Mozambique



Cyclone Idai began as a tropical depression off the coast of Mozambique on 4 March 2019. The storm made landfall the following day and, for a brief while, showed signs of weakening. However, the cyclone then strengthened, reaching its peak on 14 March 14 with winds of 190 kilometres per hour. Over the next week, Cyclone Idai weakened but stayed active in the area for an unusually long period time.

As Cyclone Idai travelled south, it caused severe flooding in Mozambique, Malawi, Zimbabwe and Madagascar. These countries are all relatively poor, so the impacts of Cyclone Idai were devastating for the region. Even a year after the initial disaster, more than 100 000 people were still living in resettlement sites in Mozambique.

FIGURE 12 The impacts of Cyclone Idai



Source: Map redrawn by Spatial Vision based on the map © European Union, 2019. Map produced by JRC. The boundaries and the names shown on this map do not imply official endorsement or acceptance by the European Union.

What damage was caused?

As well as the 1300 recorded fatalities, an estimated 3 million people were affected by Cyclone Idai. In Mozambique alone, Cyclone Idai is estimated to have caused US$773 million in damages. As the people of the region struggled to deal with the initial impacts of the cyclone, they soon encountered secondary impacts. Much of this region is extremely low-lying, making it susceptible to flooding. Water-borne diseases such as cholera swept through the region, causing further deaths and suffering for already affected communities. Due to the initial damage to infrastructure, it was extremely difficult for authorities and non-government organisations to provide effective relief to suffering communities and individuals. Valuable agricultural land was also destroyed by Cyclone Idai.

FIGURE 13 Flooding in Mozambique after Cyclone Idai

FIGURE 14 Workers providing assistance to people affected by Cyclone Idai

What relief was provided?

Due to the scale of the disaster, local aid agencies were quickly overwhelmed by the impacts of Cyclone Idai. The presidents of both Malawi and Zimbabwe soon declared respective states of emergency and immediately requested international assistance. The United Nations was quick to respond, making U$20 million available in emergency funds. The United Nations World Food Program was particularly concerned about the availability of food and safe drinking water. Foreign governments as well as non-government organisations also provided assistance to people in the affected regions. South Africa, the United Kingdom, Canada and the European Union were among the key providers of financial aid and 'on-the-ground' assistance.

3.11 SKILL ACTIVITY: Questioning and researching

Using the information in this lesson **create** a comparison table that details the key similarities and differences between Cyclone Winston and Cyclone Idai.

3.11 Exercise

learnon

3.11 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
3, 4, 6, 7	1, 2, 8	5, 9, 10

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Check your understanding

1. **Identify** why a tropical cyclone dies out if it moves inland.
   - **A.** It has run its course.
   - **B.** It loses its supply of moisture.
   - **C.** This is the natural cycle of storms.
   - **D.** It doesn't; it merely changes its name.

2. How does the scale of a cyclone vary?
   A. According to the wind speeds generated
   B. According to the time of the year they develop
   C. Depending on which hemisphere they form in
   D. All of the above
3. What conditions do tropical cyclones need in order to develop?
4. In other places tropical cycles are called hurricanes or typhoons. True or false?
5. **Explain** the changes that a storm surge can cause to a coastal area.

Apply your understanding

Communicating

6. **Describe** how the damage would differ between a category 1 and category 5 cyclone.
7. **Propose** why people are more likely to be killed or injured after the eye of the cyclone has passed.
8. Cyclones are associated with destructive winds and the displacement of large volumes of water. Which of these events do you think would cause the most damage to the natural and built environment? **Justify** your answer.

Interpreting and analysing

9. Refer to **FIGURE 2**, which shows the world pattern of tropical cyclones over space.
   a. **State** the time when most cyclones occur north of the equator. When do most cyclones occur south of the equator? **Suggest** a reason for this difference.
   b. **Identify** the parts of Australia most at risk from cyclone activity.
10. If the water source for cyclones is the ocean over which they form, **analyse** why strong winds and flooding occur in places inland from the coast.

LESSON
3.12 INQUIRY: How do people around the world access water?

LEARNING INTENTION

By the end of this lesson you should be able to research how different characteristics of a country influence the availability of and access to water, and communicate your findings.

Background

The world's natural resources are not distributed equally. Some countries have an abundance of natural resources and fertile land, while other countries are entirely composed of desert biomes. The same can also be said for the distribution of water resources.

Countries that have rivers that are fed by melting glaciers (such as India and Bangladesh) have a steady supply of water. Countries that rely on rainfall to fill rivers, streams and lakes are often at the mercy of prevailing weather patterns. And then there are countries that receive plenty of rain, but their people have poor access to water resources. In these situations, both natural and human factors are causing poor water access.

FIGURE 1 People in different countries have varying availability of water and access to water.

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

Consider the following:

a. What do you know about the ways that people in countries other than Australia access water? What about for people living in remote and isolated locations? Or those living in desert locations?
b. How could water access be improved for these people?
c. What are the differences between countries with poor water access and countries with good access to water?

Step 1: Write your inquiry question

In this inquiry, you will be exploring access to water around the world.

Step 2: Questioning and researching using geographical methods

Research your inquiry question. For example:

- How can both the human and natural characteristics of a country influence the availability of, and access to, water?

Step 3: Interpreting and analysing

Choose two countries that have poor access to fresh water. The countries you chose for your report must have different key factors that cause their poor water access. For example, you need to choose one country that has poor fresh water access caused by natural factors and one country that has poor fresh water access caused by human factors. Although a degree of overlap always exists between these factors, you should be able to distinguish between the two categories.

Step 4: Concluding and decision-making

Create a comparison table. You don't need to include all the information you collected. Instead, read through your research notes and decide what parts of research are *the most relevant* to a discussion of access to water. For example, the climate of a country is directly related to water access, but the main religions followed is not relevant to water access.

Step 5: Communicating

Communicate your findings about how both the human and natural characteristics of a country influence the availability of, and access to, water.

Complete your self-assessment using the **Inquiry rubric**, or access the 3.12 exercise set to complete it online.

on Resources

Digital document Inquiry rubric (doc-39376)

LESSON
3.13 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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3.13.1 Key knowledge summary

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

3.2 What is the difference between weather and climate?

- The Earth's atmosphere protects us from the extremes of the sun's heat, creating conditions that support life.
- Our weather is the result of constant changes to the air in the troposphere. These changes sometimes cause extreme weather events.
- All weather conditions result from different combinations of three factors: air temperature, air movement and the amount of water in the air.
- Weather is the day-to-day, short-term change in the atmosphere at a particular location.
- Climate is the average of weather conditions that are measured over a long time.

3.3 What are natural hazards and natural disasters?

- Australia has a wide range of environments and a diverse array of weather conditions.
- Natural hazards are common in Australia, including drought, floods and bushfires.
- A hazard is an event that is a *potential* source of harm to a community.
- A disaster occurs as the result of a hazardous event that dramatically affects a community.
- The four broad types of natural hazard are atmospheric, hydrological, geological and biological.

3.4 What is the impact of water variability, availability and accessibility?

- The amount of rainfall a location receives can vary significantly, and depends on a number of seasonal and environmental factors.
- Locations can often see inconsistency in the amount of rain received across a range of time frames.
- The unique characteristics of Australia's rainfall patterns are largely due to the influence of two equally unique climate events — El Niño and La Niña.
- When an El Niño event occurs, winds and surface ocean currents reverse their direction. Warm, moist air is pushed towards South America. This produces rain in South America and drought in Australia.
- A remarkably small percentage of water is available for direct human consumption.
- For some countries, water *accessibility* is a greater concern than *availability.*

3.5 What causes droughts and how do we manage them?

- A drought is a prolonged period of below-average rainfall, when not enough water is available to supply our normal needs. No universal amount of rainfall defines a drought.
- Sustained periods of drought can have varied and significant impacts on environments and communities.
- Effective management and preventative strategies can reduce the impacts of droughts. Since drought management often requires financial investment, the ability of poorer countries to withstand the pressures of drought are not as high as more wealthy countries.
- Individuals can help prevent and manage the impacts of drought through responsible personal water usage.

3.6 What are the causes and impacts of floods?

- A floodplain is an area of relatively flat land that borders a river and is covered by water during a flood. Floodplains are formed when the water in a river slows down in flat areas.
- These fertile, flat areas are used for farming and settlement around the world.
- The three types of floods are slow-onset, rapid-onset and flash floods.

3.7 How are floods managed?

- Managing the effects of floods is important if the amount of damage caused is to be minimised. Unfortunately, not all countries or communities have the same resources to tackle this problem.
- The most common form of flood management is to build a barrier that prevents excess water from reaching areas that would suffer major damage. Levees, dams and floodgates are all examples of such barriers.

3.8 Investigating topographic maps — potential flooding on Sydney's northern beaches

- Topographic maps can help us identify places that are likely to be affected by flooding.

3.9 Why does the wind blow?

- Earth's atmosphere protects us from the extremes of the sun's heat and the chill of space, making conditions right to support life.
- Wind is caused by air moving from areas of high pressure to areas of low pressure.
- The direction in which winds circle depends on whether you are in the northern or southern hemisphere. As the air moves from an area of high pressure to an area of low pressure, winds circle in the opposite direction in each hemisphere.

3.10 What causes thunderstorms and extreme weather?

- Thunderstorms, also referred to as electrical storms, form in unstable, moist atmospheres where powerful updrafts occur, which happens when a cold front approaches.
- Severe thunderstorms occur when a storm has one or more of the following features: flash flooding, hailstones, or wind gusts of 90 kilometres per hour or more.
- Thunderstorms can occur at any time of the year, but are more likely to occur during spring and summer.
- A snowstorm is officially recognised as a blizzard when wind speed is sustained above 56 kilometres per hour or has frequent gusts in excess of this speed for more than three hours.

3.11 What causes cyclones, hurricanes and typhoons

- Cyclones form when a cold air mass meets a warm, moist air mass lying over a tropical ocean with a surface temperature greater than 27 °C. Cold air currents race in to replace rapidly rising, warm, moist air currents, creating an intense low-pressure system.
- Cyclonic wind strength is measured by the Saffir–Simpson Scale.
- When a tropical cyclone approaches or crosses a coastline, the very low atmospheric pressure and impact of strong winds on the sea surface combine to produce a rise in sea level.

3.12 INQUIRY: How do people around the world access water?

- The distribution of water resources across the world is not equal, and both natural and human factors can cause poor water access.
- The different ways that water is accessed in different locations affects people's lives.

3.13.2 Key terms

alluvium the loose material brought down by a river and deposited on its bed, or on the floodplain or delta

avalanche rapid movement of snow down a slope, usually under the influence of gravity; can also be triggered by animals, skiers or explosions

barometer an instrument used to measure air pressure

catchment area the area of land that contributes water to a river and its tributaries

crevasse a deep crack in ice

cumulonimbus clouds huge, thick clouds that produce electrical storms, heavy rain, strong winds and sometimes tornadoes; they often appear to have an anvil-shaped flat top and can stretch from near the ground to 16 kilometres above the ground

cyclones intense low-pressure systems producing sustained wind speeds in excess of 65 km/h; they develop over tropical waters where surface water temperature is at least 27 °C

drought a long period of time when rainfall received is below average

El Niño the reversal (every few years) of the more usual direction of winds and surface currents across the Pacific Ocean; this change causes drought in Australia and heavy rain in South America

evaporate to change liquid, such as water, into a vapour (gas) through heat

flood inundation by water, usually when a river overflows its banks and covers surrounding land

frostbite damage caused to the skin when it freezes, brought about by exposure to extreme cold; extremities such as fingers and toes are most at risk, along with exposed parts of the face

gale force wind wind over 62 kilometres per hour

hailstone an irregularly shaped ball of frozen precipitation

hailstorm any thunderstorm that produces hailstones large enough to reach the ground

hypothermia when a person's core body temperature falls below 35 °C and the body is unable to maintain key systems; risk of death without treatment

incentive encourages a person to do something

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

inundate to cover with water, especially floodwater

isobars lines on a map that join places with the same air pressure

meteorologist a person who studies and predicts weather

monsoon rainy season accompanied by south-westerly summer winds in the Indian subcontinent and South-East Asia

natural disaster an extreme event that is the result of natural processes and causes serious material damage or loss of life

natural hazard an extreme event that is the result of natural processes and has the potential to cause serious material damage and loss of life

precipitation rain, sleet, hail, snow and other forms of water that falls from the sky when water particles in clouds become too heavy

rebate a partial refund on something that has already been paid for

southern oscillation a major air pressure shift between the Asian and east Pacific regions; its most common extremes are El Niño events

storm surge a sudden increase in sea level as a result of storm activity and strong winds; low-lying land may be flooded

torrential rain heavy rain often associated with storms, which can result in flash flooding

troposphere layer of the atmosphere closest to the Earth, extending about 17 kilometres above the Earth's surface, but thicker at the tropics and thinner at the poles; where weather occurs

typhoon the name given to cyclones in the Asian region

vulnerability the state of being without protection and open to harm

water vapour water in its gaseous form, formed as a result of evaporation

weir a barrier across a river, similar to a dam, which causes water to pool behind it; water is still able to flow over the top of the weir

whiteout a weather condition where visibility and contrast is reduced by snow; individuals become disoriented because they cannot distinguish the ground from the sky

3.13.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

How does weather and climate, including severe weather events, influence the distribution and wellbeing of human populations?

What impact could the lack of water resources have on communities and how can it be improved?

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 you view? If so, how?
2. Write a paragraph in response to the inquiry question, outlining your views.

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-13433)
Reflection (ewbk-10527)
Crossword (ewbk-10687)

Interactivity Water variability and natural hazards crossword (int-8949)

3.13 Review exercise

Multiple choice

1. Our weather is the result of changes in what?
   - A. The distance of the Earth from the Sun
   - B. The composition of gases in the Earth's atmosphere
   - C. The numbers of hours in a day
   - D. The constant changes to the air in the troposphere
2. Weather describes day-to-day observations. What does climate refers to?
   - A. The average weather conditions over a long period of time
   - B. The average weather conditions between places
   - C. The average weather conditions for an entire country
   - D. Nothing; weather and climate are interchangeable terms.
3. A hazard is an event which is a _____ source of harm to a community.
   - A. definite
   - B. potential.
   - C. small
   - D. large
4. A disaster occurs when a hazardous event _____ a community.
   - A. occurs in
   - B. overwhelms
   - C. threatens
   - D. involves
5. What is the risk a hazard poses to a community determined by?
   - A. The type of hazard and the vulnerability of the community
   - B. The type of hazard and the size of the community
   - C. The type of hazard and the demographics of the community
   - D. The type of hazard and the location of the community
6. Which of these statements provides the most accurate definition of a drought?
   - A. A prolonged period with no rainfall
   - B. A prolonged period with average rainfall
   - C. A prolonged period with below-average rainfall
   - D. A prolonged period with inconsistent rainfall

7. What are Australia's weather patterns heavily influenced by?
   - **A.** El Niño and La Niña
   - **B.** Our extreme southerly location
   - **C.** The relative dryness of our country
   - **D.** Our lack of mountainous regions
8. Floodplains provide what benefits to human civilisations?
   - **A.** Reliable access to water
   - **B.** High-nutrient soil
   - **C.** Enabling agricultural activity
   - **D.** All of the above
9. What are the three main types of floods?
   - **A.** Slow-onset, deep floods, flash floods
   - **B.** Slow-onset, rapid-onset, flash floods
   - **C.** Slow-onset, large area, flash floods
   - **D.** Slow-onset, regional, flash floods
10. What is the effect of differences in air pressure on the wind?
    - **A.** Changes its direction
    - **B.** Changes its temperature
    - **C.** Changes its strength
    - **D.** All of the above

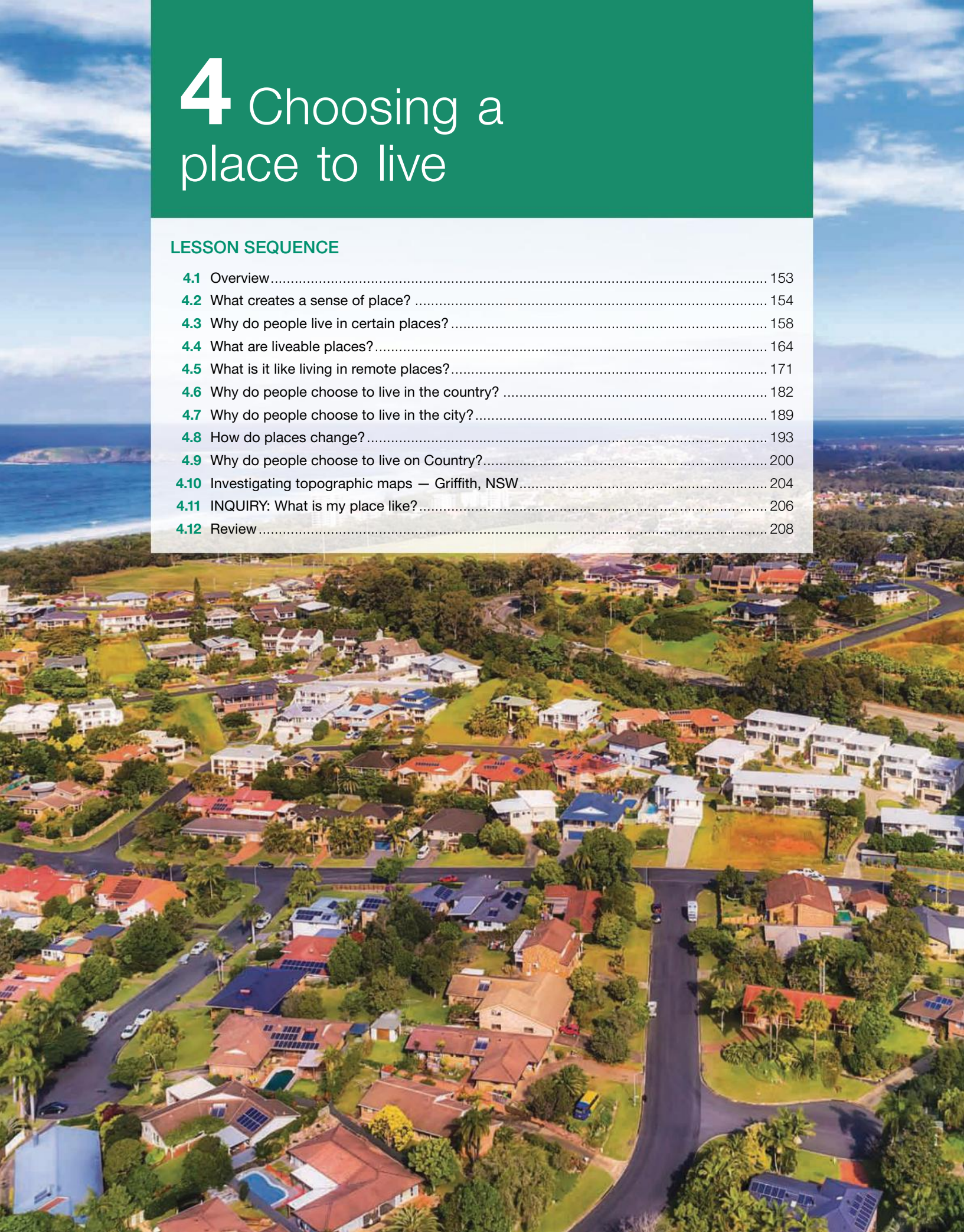
Short answer

Communicating

11. **Explain** the difference between the terms 'water variability', 'water accessibility' and 'water availability'.
12. Increased population growth will cause more water scarcity around the world. **Discuss** how this connection is possible.
13. Drought presents a far greater risk to communities than floods. Do you agree or disagree with this statement? **Explain** your opinion in detail.
14. **Explain** how climate change is increasing the risk of hazards becoming disasters.
15. **Determine** what kind of response provides the best assistance to communities affected by disasters — government support, foreign aid or the work of non-government organisations.

4 Choosing a place to live

LESSON SEQUENCE



LESSON
4.1 Overview

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What do people consider when choosing a place to live?

4.1.1 Introduction

We all live in different places. Places are important to people, whether the places are regional or metropolitan, remote or central. No two places are alike; they differ in appearance, size, features and access. In your mind's eye, try to picture the difference between your place and a city in Sweden (you may need Google to help you with that one). Perhaps even picture what the school down the road looks like compared to yours — what are the differences? Why did you choose to go to your current school instead of that one? You probably have a list of the similarities and differences between these places, and you're probably already deciding which place you prefer.

When people move, they ask themselves similar questions. Why does your family live in the place that it does? Why do many Australians live in big cities near the coast? Have you thought about the reasons your parents chose the place or environment in which you now live? When making these choices, people consider the cost, proximity to family and friends, and access to facilities and resources. This topic will take you through why people choose to live where they live.

FIGURE 1 Where would you choose to live?

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-13434)

Video eLesson Choosing a place to live (eles-1619)

LESSON
4.2 What creates a sense of place?

LEARNING INTENTION

By the end of this lesson you should be able to define the geographical concept of place, describe how places are similar and different, and explain how places are viewed differently by people.

TUNE IN

Think of your favourite place — it could be your house, your city, your local park or the cinema. Create a mind map listing all the things about that place that make it special. An example has been provided for you in **FIGURE 1**.

FIGURE 1 Features that make Adelaide special

4.2.1 A sense of place

Places are central to the study of Geography. This is because geographers are interested in where things are found on Earth and why they are there. But what exactly is a place?

To understand what a place is, think about **location** and **region**. Each place has a unique identity that makes it different from other places. A combination of characteristics is specific to that place, making it individual. A sense of place comes from being aware of what makes that location significant and seeing its special qualities.

place specific area of the Earth's surface that has been given meaning by people

location a point on the surface of the Earth where something is to be found

region any area of varying size that has one or more characteristics in common

The characteristics of a place can come from:

1. natural features
2. human features — that is, features built by people
3. a combination of natural and human features.

Eventually, one or more of these features becomes a symbol of that place.

FIGURE 2 Christ the Redeemer statue, Rio de Jeneiro, Brazil

FIGURE 3 Disney World, Orlando, Florida, United States

FIGURE 4 The Taj Mahal in Agra, India

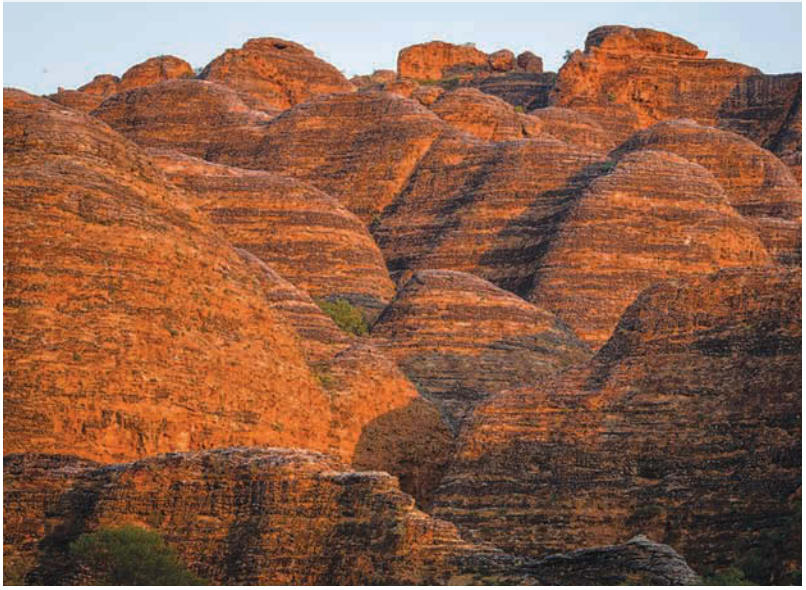
FIGURE 5 The Grand Canyon, Utah, United States

FIGURE 6 Table Mountain, Cape Town, South Africa

FIGURE 7 Golden Gate Bridge, San Francisco, California, United States

FIGURE 8 The Great Wall of China

FIGURE 9 Purnululu in Western Australia



on Resources

Google Earth Taj Mahal
Grand Canyon
Disney World
Table Mountain
Purnululu

4.2 SKILL ACTIVITY: Concluding and decision-making

1. Using the images included in this lesson, **list** all the **natural** features, **human** features and any **combinations** in a table similar to the one provided.

	Natural	Human	Combination
Rio de Janeiro, Brazil			
Disney World, USA			
The Taj Mahal, India			
The Grand Canyon, USA			
Table Mountain, South Africa			
Golden Gate Bridge, USA			
The Great Wall of China, China			
Purnululu, Australia			

2. Which, in your opinion, is the most liveable of these places? **Explain** your answer.
3. Using the mind map you created at the start of this lesson, **write** a short advertisement to entice someone to move to this place. Make sure you mention a **natural**, **human** and **combination** of features in your writing.

4.2 Exercise

learnon

4.2 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3	4, 6, 7	5, 8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
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Check your understanding

1. **Identify** the correct definition of the term 'location'.
   - A. A specific area on the Earth's surface that has been given meaning by people.
   - B. A point on the surface of the Earth where something is to be found.
   - C. Any area of varying size that has one or more characteristics in common.
   - D. Any place that can be visited.
2. **Identify** the correct definition of the term 'place'.
   - A. A specific area on the Earth's surface that has been given meaning by people.
   - B. Any area of varying size that has one or more characteristics in common.
   - C. A point on the surface of the Earth where something is to be found.
   - D. Any location that is being used by humans.
3. **Identify** the correct definition of the term 'region'.
   - A. A point on the surface of the Earth where something is to be found.
   - B. A specific area on the Earth's surface that has been given meaning by people.
   - C. Any area of varying size that has one or more characteristics in common.
   - D. A country or continent only.
4. Study the images in **FIGURES 2** to **9**. **Describe** five characteristics in the environment of each feature that create its individual sense of place.
5. Of all these characteristics, **state** which one you believe to be the most important in creating an identity for that place in the minds of people.

Apply your understanding

Interpreting and analysing geographical data and information

6. Do you think that people's favourite places would vary with the age of the individual? Explain your answer.
7. Study the images in **FIGURES 2** to **9**. **Suggest** reasons these places have become famous around the world.

Communicating

8. **Name** and **describe** a place you have visited and enjoyed that is predominantly made up of natural characteristics.
9. **Name** and **describe** a place you have visited and enjoyed that is predominantly made up of human characteristics.
10. No matter where we live, we all live in the one place: Earth. From what you have learned so far, **define** what a place is in your own words. What do you think would be the characteristics of a place that would appeal to anyone, wherever they come from? (*Hint:* What feelings do you have when you are in a place that you like?)

LESSON
4.3 Why do people live in certain places?

LEARNING INTENTION

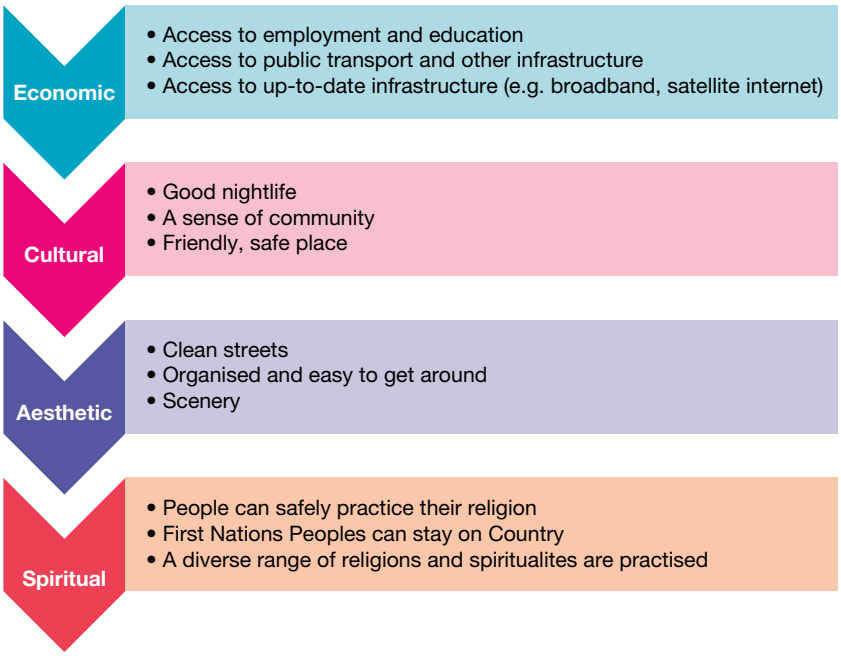
By the end of this lesson you should be able to explain the reasons people choose to live in certain areas, explain the objective and subjective measures people use when evaluating a place to live, and describe how places change over time.

TUNE IN

Why would someone choose to live in a busy city, or a rural town with only a couple of stores? We choose places to live for many reasons, and **FIGURE 1** shows the four factors that guide these decisions.

Imagine you had to select a new place for your family to live. Refer to the four factors in **FIGURE 1** and, in pairs, discuss the features you'd be looking for in each factor.

FIGURE 1 Economic, cultural, aesthetic and spiritual factors influence where you live.



4.3.1 Push and pull factors

People choose to live in specific places for a wide range of reasons. These reasons can be broadly divided into **pull factors** and **push factors**. Pull factors are those that attract or 'pull' a person to a place, whereas push factors are those that discourage or 'push' people away from a place. The combination of reasons varies from person to person, and what one person may see as an advantage, another person may see as a negative.

pull factors positive aspects of a place; reasons that attract people to come and live in a place

push factors reasons that encourage people to leave a place and go somewhere else

It is also true, though, that the reasons people choose to live in a place often change over time. Sometimes, these reasons might even be connected to the very existence of the place — or its changing nature.

Four factors influence the liveability of places or why people decide to live there:

1. available financial resources (money)
2. employment
3. relationships with other people (for example, wanting to be near family or moving for a partner's job)
4. lifestyle.

Many of these factors change throughout a person's life. For example, where a 20-year-old single person wants to live is often quite different from where someone in their forties or someone with a partner and two teenage children may want to live.

In other situations, the reason for living in a place may disappear; this is the case for a number of towns throughout regional Australia. In Western Australia, for example, the township of Kanowna is situated 22 kilometres east of Kalgoorlie, and was established after gold was discovered in 1893. Within a short period of time, the population had grown to over 12 000, and **infrastructure** such as a hospital, railway line, school, post office and at least ten hotels had been constructed.

As the gold discoveries eventually dried up, the population drifted away. The township was abandoned by the mid-1950s. Interest in the geology of the area returned in the 1970s and after new deposits were uncovered in the late 1980s, the Kanowna Belle Gold Mine began operation in 1993. With the mine located only 19 kilometres from Kalgoorlie, the majority of workers choose to live there, unless they are **fly in, fly out (FIFO)** employees. As of the 2016 census, only ten people still lived in the original gold mining township of Kanowna.

Cossack has a similar story to Kanowna. Established in the late 1860s around 200 kilometres west-south-west of Port Hedland, it was renamed after the HMS Cossack in 1871 and became a base for the pearling industry in Western Australia. The development of the pastoral industry in the Pilbara region and the discovery of gold also attracted people to the port town.

In 1898, a cyclone destroyed a significant portion of the town and, as the size of pearling and transport ships began to increase in the early 1900s, the harbour was no longer suitable to accommodate these. In light of these challenges, the pearling industry was relocated to Broome, a new port was opened at Port Samson, and the town of Cossack was eventually abandoned in the 1950s. Most of the historic buildings in the town were built in the 1880s and have been redeveloped as tourist attractions; tourists can either walk or drive the 5-kilometre Cossack Heritage Trail.

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

fly in, fly out (FIFO) workers who fly to work in remote places, work 4-, 8- or 12-day shifts and then fly home

FIGURE 2 The restored courthouse is one of the attractions on the Cossack Heritage Trail.

FIGURE 3 The Customs House and Store is another attraction on the Cossack Heritage Trail.

Many of the towns in the north-eastern United States were established as manufacturing towns. At first they were located near major ports or iron ore and coal deposits, and some closed down when these resources ran out. In more recent times, factories such as the one shown in **FIGURE 4**, which is near Baltimore, have closed down because the owners could no longer compete with the goods produced at a lower cost in China and other South-East Asian countries. With no other jobs available, people left the area, and it fell into a state of urban decay. By 2018, however, Baltimore is once again thriving, especially with many STEM jobs.

FIGURE 4 A disused factory near Baltimore

4.3.2 Economic, cultural, aesthetic, and spiritual factors

Push and pull factors are the broad factors associated with where people choose to live. These factors can then be drilled down into to look at more specific factors. People may be pulled to a place — because of their work, for example — but they will end up staying in a place because of a range of reasons. These reasons are broken into **economic**, **cultural**, **aesthetic** and **spiritual** factors. A brief outline of each of these factors is provided in **FIGURE 1** at the start of this lesson.

Some examples of these different liveability factors are illustrated in **FIGURES 5** to **8**. Each example represents a different part of the world, highlighting that people are drawn to all kinds of different places, and then stay there for a range of reasons.

FIGURE 5 Economic factor: London's famous double-decker buses, a key feature of the city's public transport system

FIGURE 6 Cultural factor: celebrating the Holi Festival in India

FIGURE 7 Aesthetic factor: driving through the Grampians National Park near Dunkeld in Victoria

FIGURE 8 Spiritual factor: St Peter's Cathedral in Adelaide, South Australia

4.3.3 Objective and subjective measures

When moving somewhere, most people hope that each location has something from all four of these factors. This doesn't happen all the time. For example, Shaun may move from Perth to Darwin for work (an economic factor) but when he gets there, may realise Darwin doesn't have the nightlife he really wanted (a cultural factor). This is an example of an **objective** and a **subjective** reason for living somewhere.

Shaun's job is an objective reason for moving to Darwin — work is available there so he must go. The lack of nightlife is subjective for Shaun, because while it may not be his vibe, a whole lot of people who live in Darwin love the nightlife. Some more objective and subjective measures are listed in **FIGURE 9**.

FIGURE 9 Objective and subjective reasons are also behind living somewhere.

Objective	Subjective
☐ Access to transportation	☐ Places of worship
☐ Access to clean water	☐ Access to different forms of entertainment
☐ Access to education and employment	☐ The scenery and the look of the place

4.3 SKILL ACTIVITY: Interpreting and analysing geographical data and information, Concluding and decision-making

1. **Rank** your order of preference for the liveability factors listed (1 = most important; 4 = least important) and **explain** why you gave each its ranking.

Economic	Cultural	Aesthetic	Spiritual

Ranking	Reason

2. Conduct a survey of five of your classmates on why they live where they do.
   a. Ask your classmates to ask their parents or caregivers why they chose to move to this location.
   b. Gather their responses in the table provided.

Classmates	Why did your parents or caregivers move here?
Classmate 1	
Classmate 2	
Classmate 3	
Classmate 4	
Classmate 5	

3. **Classify** your own parent or caregiver answer and the answers from your five classmates into **economic**, **cultural**, **aesthetic** and **spiritual** categories.

Responder	Economic	Cultural	Aesthetic	Spiritual
Own parents or caregiver				
Classmate 1				
Classmate 2				
Classmate 3				
Classmate 4				
Classmate 5				

4. **Present** the answers using a column graph, correctly and fully labelled.
5. As a class, **discuss** the pattern of reasons shown by each graph, and the possible explanations for this. For example, how important is culture to people?
6. a. Use Google Earth to look up the location of the current settlement of Cossack in Western Australia.
   b. **Calculate** the distance between Cossack and the nearby town of Wickham, and Port Samson.
   c. **Study** the land use and features of the environment around all three locations. **Identify** the economic, cultural, aesthetic and spiritual uses of the land. **Label** these uses as possible push or pull factors.

on Resources

Interactivity Push/pull factors (int-3089)

Google Earth Baltimore, USA
Kanowna
Cossack

4.3 Exercise

learnon

4.3 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
2, 3, 4, 5	1, 6, 7	8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. **Define** each of the following terms in your own words.
   a. Cultural
   b. Aesthetic
   c. Spiritual
   d. Economic
2. **Select** the correct option. When choosing a place to live, **employment** / **religion** / **education** is a subjective factor.
3. **Select** the correct option. When choosing a place to live, **spirituality** / **the nightlife** / **employment** is an objective factor.
4. **Determine** whether the following statements are true or false.
   a. Pull factors are negative aspects of a place; they don't attract people to come and live in a place.
   b. Push factors are reasons that encourage people to leave a place and go somewhere else.
   c. Access to employment and education are cultural factors.
5. Briefly **explain** what happened in Cossack, Western Australia.

Apply your understanding

Communicating

6. **Identify** and **justify** the push and pull factors that exist for people thinking about whether they should move to Baltimore today.
7. **Define** the term 'urban decay' in your own words.
8. **Suggest** reasons some people continue to live in decaying urban environments, and why others might choose to move.

Interpreting and analysing geographical data and information

9. Study **FIGURE 4**. **Identify** some of the specific signs that indicate an area is in urban decay.

Concluding and decision-making

10. Consider the information on Kanowna and imagine that you have been employed at the Kanowna Belle Gold Mine. You have been given the option of housing within Kalgoorlie or within the original Kanowna township. Consider the potential advantages and disadvantages of both options and **explain** what your final decision would be.

LESSON
4.4 What are liveable places?

LEARNING INTENTION

By the end of this lesson you should be able to create a mind map of your neighbourhood and compare it with a Google map to analyse the similarities and differences between the two maps.

TUNE IN

Each suburb or town can be very different from its neighbouring areas. You might enjoy some things about your neighbourhood that others might never have noticed. Let's explore what you might include in your perfect place.

1. Make a list of the ten 'must-haves' for your perfect place.
2. Uh-oh! You only have enough money for five things! To help with your decision-making, rank your must-haves on a continuum from least important to most important.
3. Now you have ranked your top five, pick one of these and explain why it's important and how it makes your place perfect.

FIGURE 1 The beauty of a place may be important to you.

4.4.1 My place

What is your **neighbourhood** or local place like? All of us live in a **community**, and these are often centred on the place where we live, or go to school or work.

Teenagers have different types of local places that have special meaning for them, each one at a different scale: their bedroom, home and neighbourhood.

When you live in a neighbourhood, you become familiar with all the things that help to create the character of the place. Sometimes a neighbourhood is made up of people who have similar interests and beliefs, whether these be cultural, sporting, environmental or job-related. Other neighbourhoods have a mixture of people from different backgrounds, creating a vibrant, multicultural community identity. The fact that Australian neighbourhoods can be so different is what makes Australia such an interesting place to live in.

Neighbourhoods have always existed in Australia. The **Country** that is special to many First Nations Australians is often based on language. For instance, the Noongar people consists of 14 First Nations Australian communities who lived in what is now the south-west region of Western Australia before Europeans arrived. Each community spoke its regional dialect and controlled a territory that had definite boundaries. This means these people saw, and often still see, their neighbourhood as the region in which people spoke the same language and had the same customs, such as marriage rituals. People were, and are, socially connected.

neighbourhood a region in which people live together in a community

community a group of people who live and work together, and generally share similar values; a group of people living in a particular region

Country the place where a First Nations Australian comes from and where their ancestors lived; it includes the living environment and the landscape

Because nearly 90 per cent of Australians live in towns and cities, most people likely live in a street that is part of a suburb, town or city, and which itself is part of a state or territory. On the other hand, some Australians do not live in urban areas, but still live in their own communities that are just as distinctive as neighbourhoods in towns and cities. How can we describe where our local place is and what it is like? Sometimes, people try to use words to do this, but it is not an easy task. Geographers have no such trouble, however; they can use maps.

FIGURE 2 First Nations groups of South West Western Australia

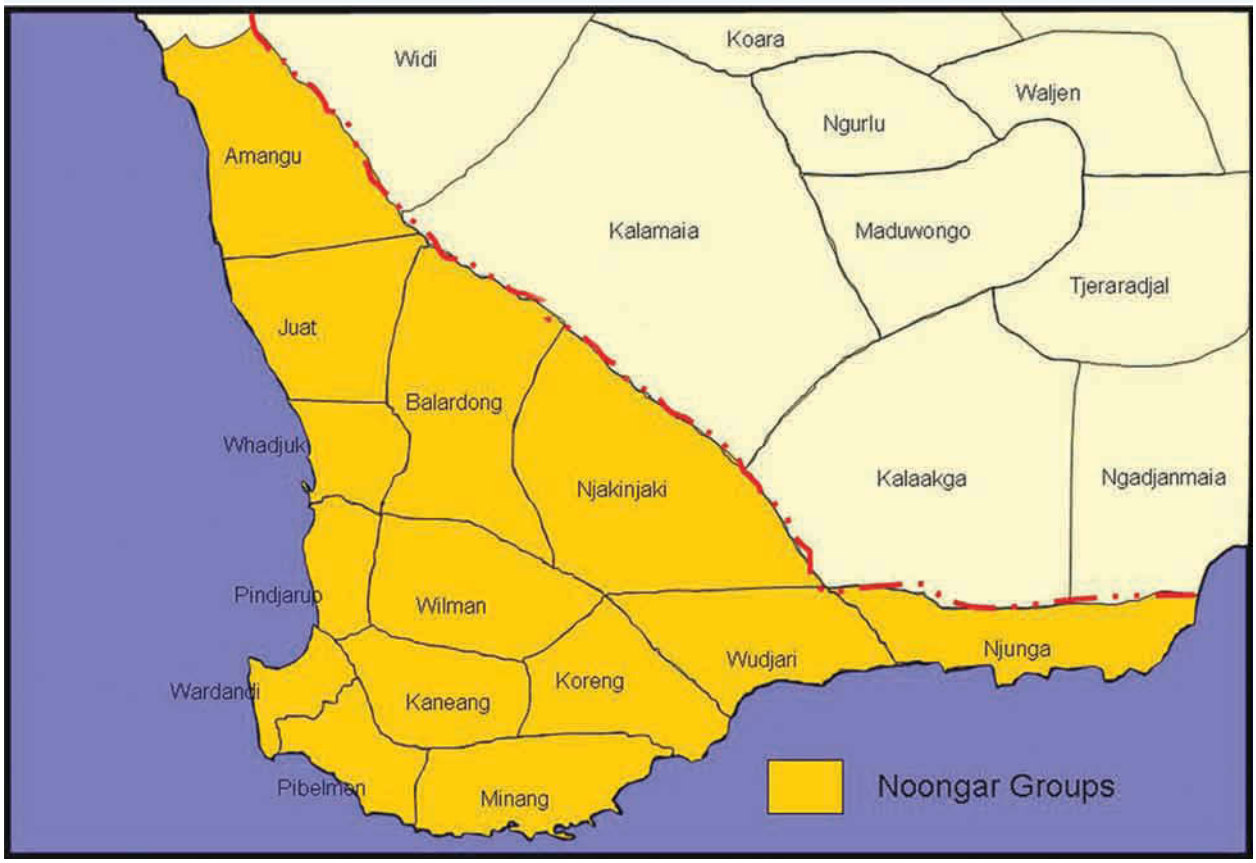
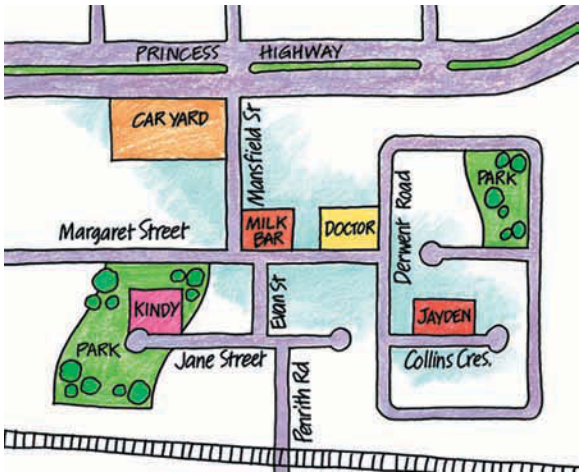


FIGURE 3 Mental map of Jayden's local place (a) by Jayden and (b) by Annette, Jayden's mother

(a)

(b)



4.4.2 What makes Australia so liveable?

Where is your favourite place in Australia? Have you been to a holiday paradise, one that you think would be the perfect place to live? Is the climate perfect, the scenery spectacular? Is it safe, fun and the place for adventure? Is this place in a city, in the **wilderness** or in the next street? Is it paradise because your friends or family live there or because of the natural or **built environment**?

Among the most popular and beautiful tourist destinations in Australia are the Great Barrier Reef, Uluru, Melbourne, Sydney, the Gold Coast, the Great Ocean Road, Monkey Mia, Kakadu, the Tasmanian Wilderness, the Blue Mountains, Port Arthur, Byron Bay, Kangaroo Island and Ningaloo Reef. Many of these places have unique landscapes, located within naturally stunning environments. Four of these are predominantly built environments: Sydney, Melbourne, the Gold Coast and Port Arthur. The remaining ten places are best known for their natural, often **remote**, and almost wilderness environments.

Some of these wonderful places are found in or close to cities and large towns; some have significant local populations; and some are quite remote. They are all places that attract large numbers of visitors every year. People come to see or experience an **aspect** of the local environment that brings them pleasure.

FIGURE 4 shows the location of five of Australia's most popular places for tourists.

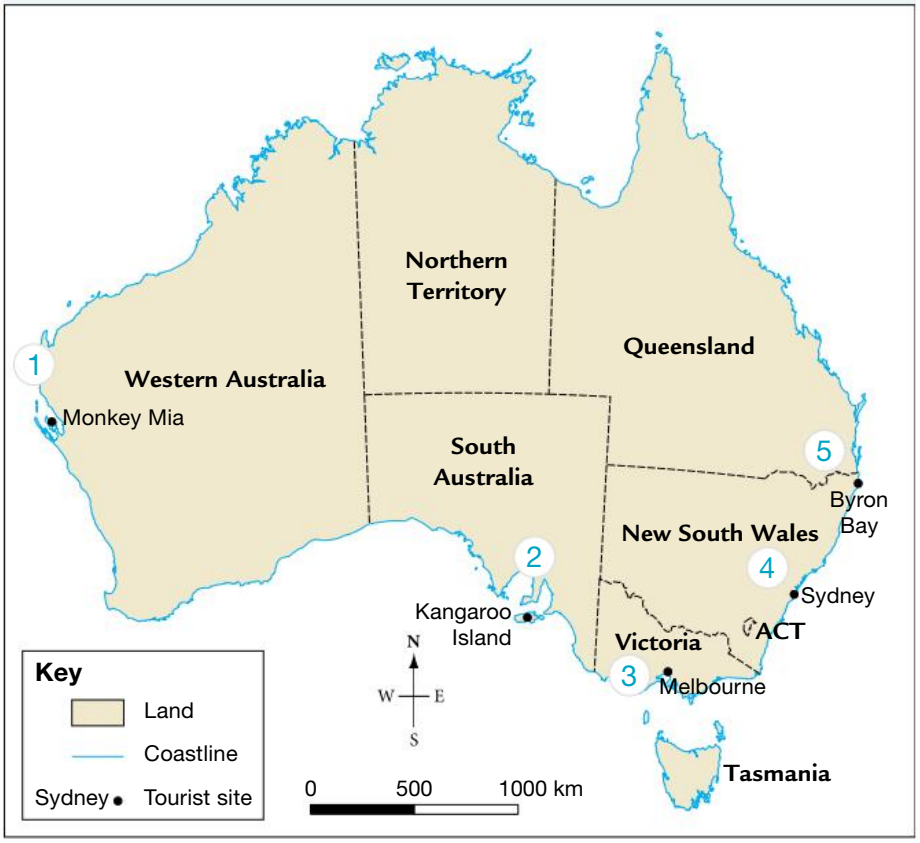
wilderness a natural place that has been almost untouched or unchanged by the actions of people

built environment a place that has been constructed or created by people

remote a place that is distant from major population centres

aspect feature or quality, or the direction something is facing

FIGURE 4 Five of Australia's most popular places for tourists



Source: Spatial Vision

These places are often perfect for a holiday but they may also be a place to live. Is it mostly the excitement of a big city, the natural beauty, or some other factor that makes you decide which place is the most liveable? The following provides some further information on the five locations from **FIGURE 4**.

1. Monkey Mia is an environment where you can experience natural wildlife by interacting with dolphins. It is located in Shark Bay on the coast of Western Australia, 850 kilometres north of Perth. For over 40 years, a small pod of dolphins has come ashore to connect with beachgoers. The Department of Environment and Conservation provides staff who supervise the feeding of fish to these dolphins each day. It is an unusual opportunity for people to see wild dolphins up close, quite near to the shore. Monkey Mia is a place of great natural beauty without a huge tourist resort attached. Most visitors camp. It is an important stop on the around-Australia tourist trail. At the 2016 census, fewer than 800 residents lived near the Monkey Mia Resort.

FIGURE 5 Seeing wild dolphins up close is an attraction for tourists to Monkey Mia.

2. Kangaroo Island is a place of natural beauty. It is Australia's third largest island, found about 160 kilometres south of Adelaide. It is a wildlife lover's paradise, being home to many native Australian animals in their natural habitats, including koalas, kangaroos, seals and penguins. It has remote, unspoiled beaches and interesting rocky outcrops. Although first settled in the late 1830s, its present population of over 4200 is the highest it has ever been. It was originally settled as a fishing and farming community but today is better known as a tourist destination.

FIGURE 6 Kangaroo Island is known for its abundance of wildlife.

3. Melbourne is the second-largest and often ranked as the most **liveable city** in Australia. (Ranked most liveable city in the world 2011–2017, second to Vienna in 2018 and 2019 and pushed to eighth spot in the 2021 rankings, according to the *Economist* magazine.) It is the capital of Victoria and home to over five million residents in 2022. It is an attractive destination for tourists, who enjoy visiting its major sporting and cultural events, shops, restaurants and theatres. Melbourne is located beside Port Phillip Bay and on the Yarra River. It is not a city known for its beautiful natural environment, but it has become known for its distinctive laneways, bars and café culture.

liveable city a city that people want to live in, which is safe, well planned and prosperous and has a healthy environment

FIGURE 7 Melbourne is attractive for both residents and tourists.

4. Sydney is a built environment in a beautiful setting and is Australia's largest and oldest city. It is often called the 'Harbour City'. Sydney is popular with both domestic and international tourists and is home to nearly 5.5 million residents in 2022. It has many attractions, including restaurants, beautiful beaches, theatres, galleries and iconic landmarks. It has a beautiful natural environment with varied experiences provided by the built environment. This makes it an extremely popular destination for everyone.

FIGURE 8 Sydney has many cultural and environmental attractions.

5. Byron Bay is a beachside town in northern New South Wales, located 160 kilometres south of Brisbane. It is a very relaxed place with a local community that includes many artists and retired hippies. It is an important surfing place, with easy access to offshore reefs and stunning beaches. It has become a popular place for 'schoolies' end-of-year celebrations. In 2022, Byron Bay Shire had a population of nearly 35 000 people in (9500 in the township of Byron Bay), who rely heavily on tourism and agriculture for their income.

FIGURE 9 Byron Bay's natural beauty and laidback atmosphere attract residents and tourists.

on Resources

Interactivity How did they live here? (int-8950)
Weblink Nothing like Australia

4.4 SKILL ACTIVITY: Interpreting and analysing

1. **Create** a mental map of your neighbourhood or local place. A mental map is a drawing or map that contains your memory of the layout and distribution of features in a place. Locate your house in the centre of the sheet and work outwards from there. The map should be as detailed as possible. Include features such as:
   - streets and their names
   - houses of friends or family
   - shops, parks, trees, post boxes, telephone poles, pedestrian crossings, railway lines and stations
   - anything you can remember, but the map must be drawn from memory.
2. **Present** the map using geographical rules (BOLTSS). Since you are not drawing the map to a scale, write 'Not to scale' in the correct position. Remember to use conventional colours and symbols as far as possible.
3. **Compare** your map to an actual map of your neighbourhood.
   a. In what ways was your map accurate?
   b. Which features did you not mark on your map?
   c. Which parts of your neighbourhood did you know well and which did you not know well?
   d. Think of reasons to explain your answers to (c).
4. **Design** a map of your most liveable place. Consider the natural and built environments; distance to a city, services, job and recreational opportunities; climate; and lifestyle. **Annotate** your map to **explain** why this is where you would like to live. Use the **Nothing like Australia** weblink in the Resources panel to help find your ideal location.

4.4 Exercise

learnon

4.4 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 10	4, 5, 6, 7	8, 9

Check your understanding

1. A neighbourhood is a region in which people live together in a community. True or false?
2. **Select** the correct option. Approximately **10** / **30** / **60** / **80** / **90** per cent of Australians live in towns and cities.
3. **Identify** which city was named the 'most liveable city' in the world in 2018.
   - **A.** Melbourne
   - **B.** Vienna
   - **C.** Vancouver
   - **D.** Sydney
4. In your own words, **define** the term 'liveable city'.
5. Study **FIGURE 3**, which shows two mental maps of the same neighbourhood place. One is drawn by Jayden, a seven-year-old boy, and the other is drawn by his mother.
   a. **Compare** the two maps by drawing up a table similar to the following and filling in the spaces.

	Features that are different	Features that are similar
Land use		
Transport		
Street layout		
Relative sizes		
Names of places		
Other		

   b. **Identify** reasons to explain the major similarities and differences between the maps drawn by Jayden and his mother. Think about factors such as age, duties during the day, transport and friendships.

Apply your understanding

Concluding and decision-making

6. After reading about the five places described in section 4.4.2, which of these places is most similar to your most liveable place? **Explain** your answer.
7. If you wished to work as a national park ranger, **identify** which of the places in **FIGURE 4** would be best?
8. If you were planning a career in the theatre, which of the places in **FIGURE 4** would be best? **Justify** your response.
9. If you wished to live in a relaxed coastal environment close to a capital city, which of the places in **FIGURE 4** would be best? **Justify** your response.

Communicating

10. Consider **FIGURE 3**. **Explain** why you think people might describe the same place in different ways.

LESSON
4.5 What is it like living in remote places?

LEARNING INTENTION

By the end of this lesson you should be able to explain why people move to remote or rural places, and discuss strategies that could be used to ensure the sustainable survival of rural and remote places.

TUNE IN

Deciding to move can be a big decision, especially if you are moving to somewhere that is very different from your current home. This could mean making the move from an urban city area to a remote or rural area.

1. What do you think of when you hear 'remote' and 'rural'?
2. What would make someone move from the inner city to somewhere remote or rural?

FIGURE 1 Would you move to a rural area?

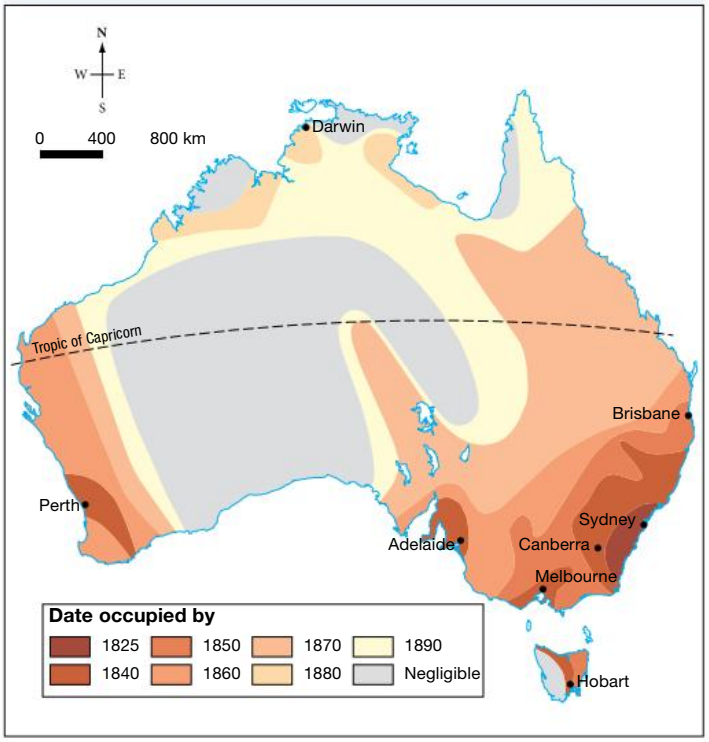
4.5.1 Settling inland Australia

int-7797

For over 100 years, a small percentage of Australians have been moving away from large cities and coastal regions to live in more remote locations. They are often searching for new farmland or the mineral resources of the inland. Why do some people choose to live in places where their nearest neighbour is 50 kilometres away and it takes six hours to get to the closest supermarket? Why do they find remote places more liveable?

The potential to relocate people inland has never been faster or easier. The interconnection provided by modern transport and the high-speed communication provided by phone and internet should mean that technology has reduced remoteness. However, the general shift of Australia's population for the last 100 years has been towards the major cities and away from the country. In 2016, the average age of farmers in Australia was 56 years and getting older (this was up 17 years from 2010). Most children of farmers leave the country and seek education and work opportunities in large cities.

FIGURE 2 Stages in European land occupation in Australia



Source: © Spatial Vision

Over the past 100 years, governments and private industry have made many attempts to encourage people to occupy the more remote places of Australia. Soldier settlement programs and mining developments are two such schemes.

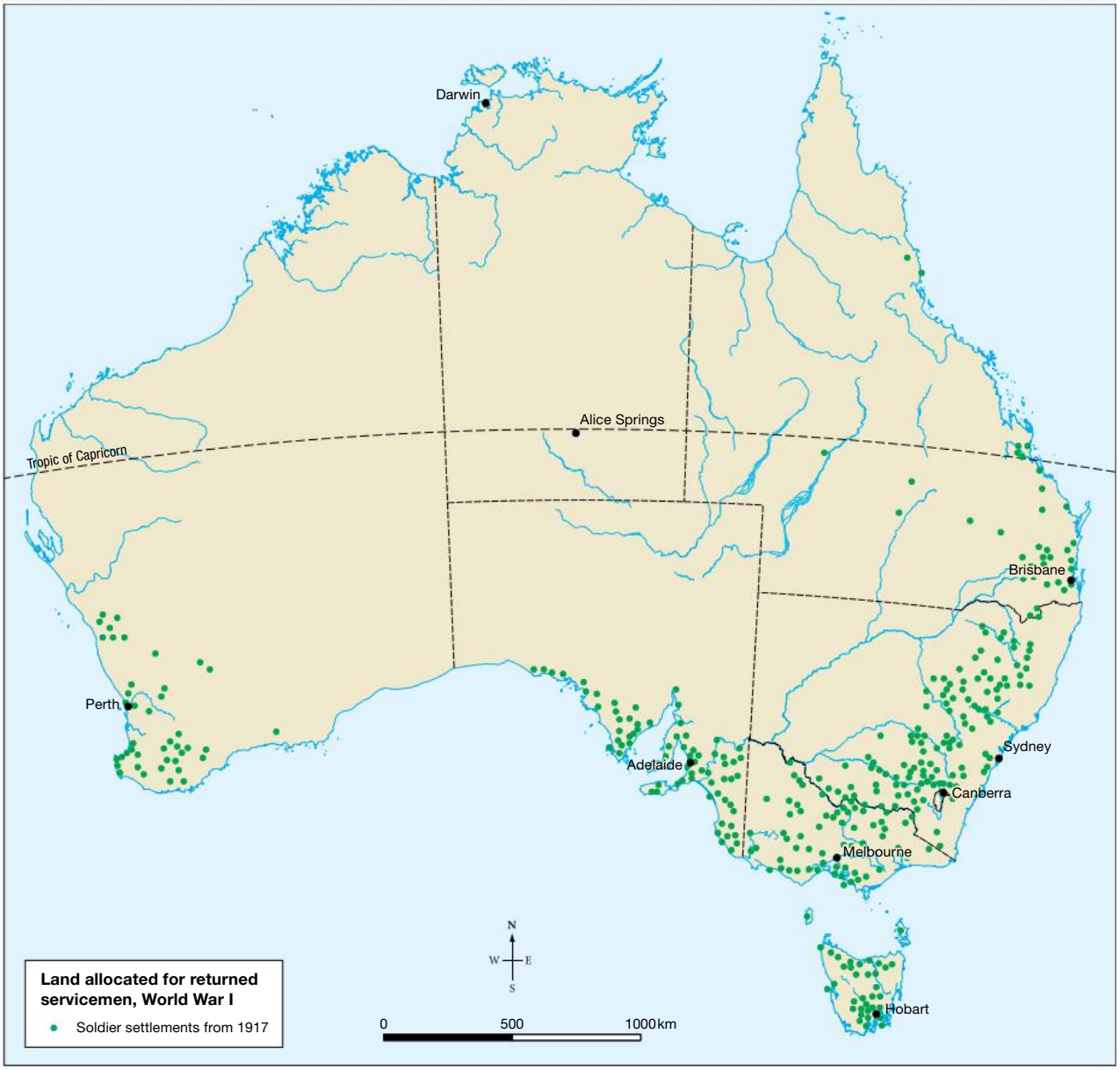
Soldier settlement schemes

After both World War I and World War II, the state and federal governments of Australia began a program of providing land to returned soldiers. This was to give these soldiers work, but it was also seen as a way of attracting people to otherwise sparsely inhabited places.

After World War I, more than 25 000 soldiers were resettled in places such as the Wheatbelt and south-west region in Western Australia, Merbein and Mortlake in Victoria, Griffith and Dorrigo in New South Wales, Murray Bridge and Kangaroo Island in South Australia and the Atherton Tableland in Queensland. The settlers were expected to stay on their land for at least five years and to improve the quality of the land they were farming. Many of these settlements were not successful because the soldiers were not always suited to farming, the farms were often too small, and farmers did not have enough money to invest in stock or equipment.

After World War II, a similar scheme was much more successful, because farms offered were bigger, and roads, housing and fences were supplied.

FIGURE 3 Location of soldier settlement areas, 1917



Source: Spatial Vision

Remote mining communities

Karratha, Broken Hill and Tom Price are examples of current mining towns that are just as remote as the goldrush towns of Bathurst and Ballarat were in the 1850s and 1860s.

Today, flying from Perth to Tom Price in Western Australia only takes one and a half hours, yet it can be difficult to attract workers to mines in this region. Wages are high; workers in the mining and construction industry in these locations can earn between $90 000 and $120 000 per year. Fewer jobs are now available because the mining boom has passed, but skilled workers are still attracted to these remote places.

FIGURE 4 Mount Tom Price mine and Tom Price township

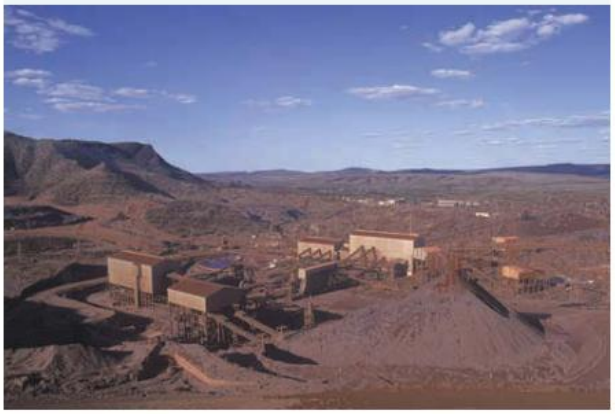
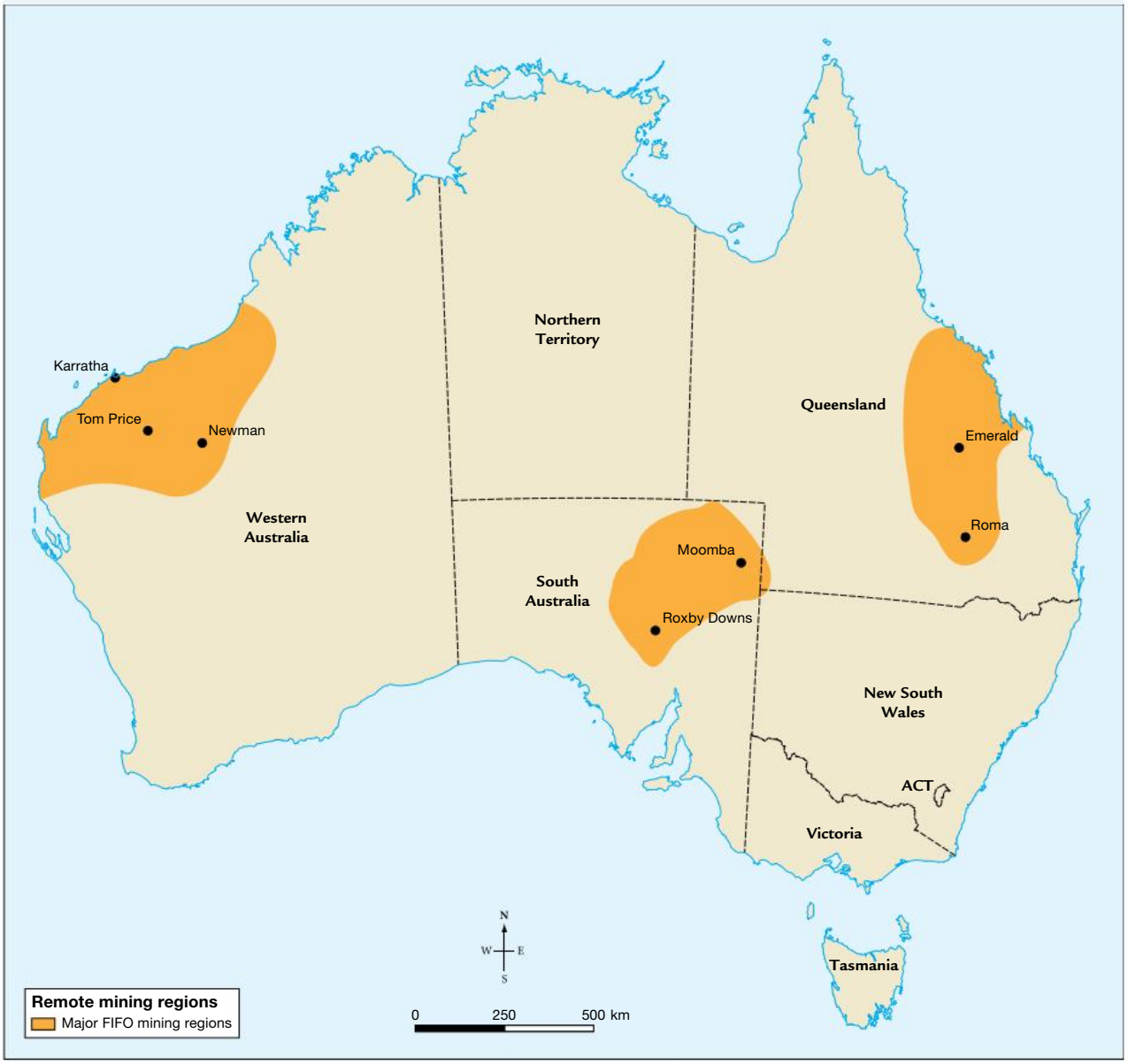


FIGURE 5 Location of remote mining regions



Source: Spatial Vision

Some workers fly in and fly out (FIFO) for their shifts. In 2017, experts estimated that between 75 000 and 90 000 Australians fly in for a shift that may last several weeks, eventually flying home for their days off.

4.5.2 Moving for more space

During the COVID-19 pandemic, many Australians decided to leave the hustle and bustle of the big cities and move to regional and rural areas. One reason for this move was the series of lockdowns that were needed to stop the spread of the virus. Some people argued, if they must stay home, why not stay somewhere with a big backyard and a view? Another reason was because the pandemic brought about new ways of learning and earning.

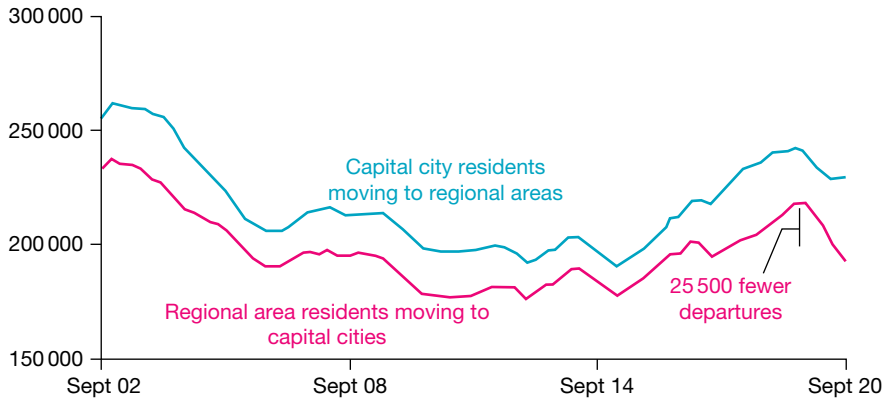
Because the internet was now fast enough and stable enough in most areas to allow students to learn from home and for their parents to work from home — via Zoom meetings and various other face-to-face communication platforms — some people opted for the laid-back lifestyle afforded to them by country living. Following the extended lockdowns in Melbourne and Sydney, a population shift occurred from the city to the country. The Australian government's Centre for Population studied this phenomenon and in late 2020 released a report highlighting that in the year to September 2020, regional areas had a net gain of 36 200 people.

FIGURE 6 Most students switched to remote learning during the COVID-19 pandemic.

FIGURE 7 Working from home also became the norm during the COVID-19 pandemic.

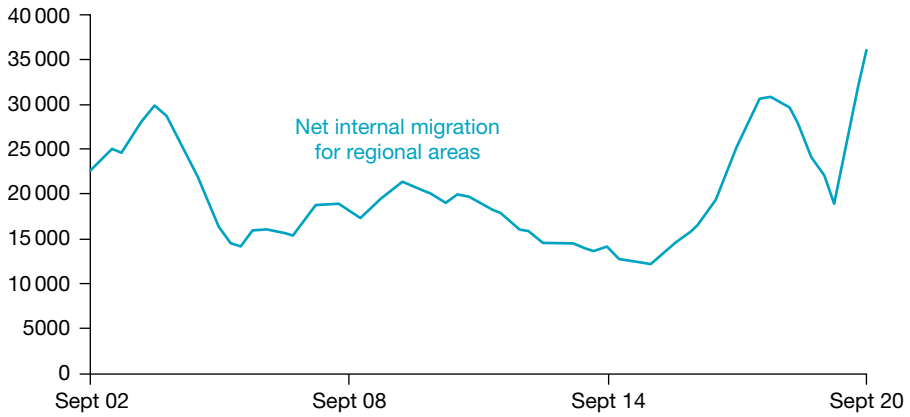
tlvd-10517

FIGURE 8 Movements between capital cities and regional areas in 2020



Source: Migration between cities and regions: A quick guide to COVID-19 impacts, Centre for Population, 2020.

FIGURE 9 Net internal migration for regional areas in 2020

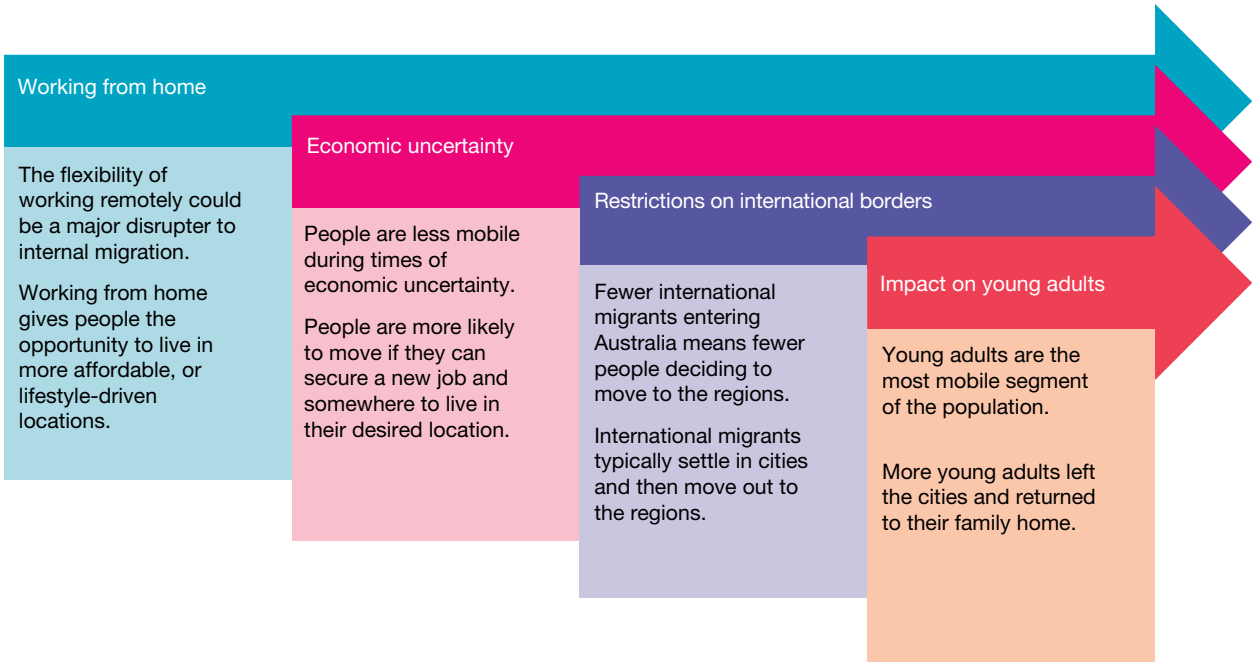


Source: Migration between cities and regions: A quick guide to COVID-19 impacts, Centre for Population, 2020.

The Centre for Population identified four key drivers that influenced internal migration in Australia during the COVID-19 pandemic. These drivers are shown in **FIGURE 10**.

int-8934

FIGURE 10 Four key drivers influenced internal migration in Australia during the COVID-19 pandemic.



Source: Migration between cities and regions: A quick guide to COVID-19 impacts, Centre for Population, 2020.

4.5.3 Rural settlement

Some people live in rural areas because they are involved in primary industries. Others provide services. Griffith is a large town (population 17 000) in the Murrumbidgee Irrigation Area in New South Wales. The climate in this area is semi-arid (warm, with unreliable rainfall). The land became productive farmland after **irrigation** was provided in 1912. Reliable water and available farmland attracted many people to this area.

irrigation water provided to crops and orchards by hoses, channels, sprays or drip systems in order to supplement rainfall

Two main types of farm are in this area.

- Type A farms are usually about 220 hectares in size (a hectare being 10 000 square metres). Each year they grow a combination of rice, corn, wheat, vegetables and pasture, and graze beef cattle. Irrigation water is usually used.
- Type B farms are **horticulture** farms, and are usually about 20 hectares in size. They grow a combination of permanent crops that may include grapes, peaches, plums, and citrus fruit such as oranges. Many of these plants last for many years, and irrigation is always needed.

FIGURE 11 Farms in the Griffith area support businesses in the town.

4.5.4 Are rural communities sustainable?

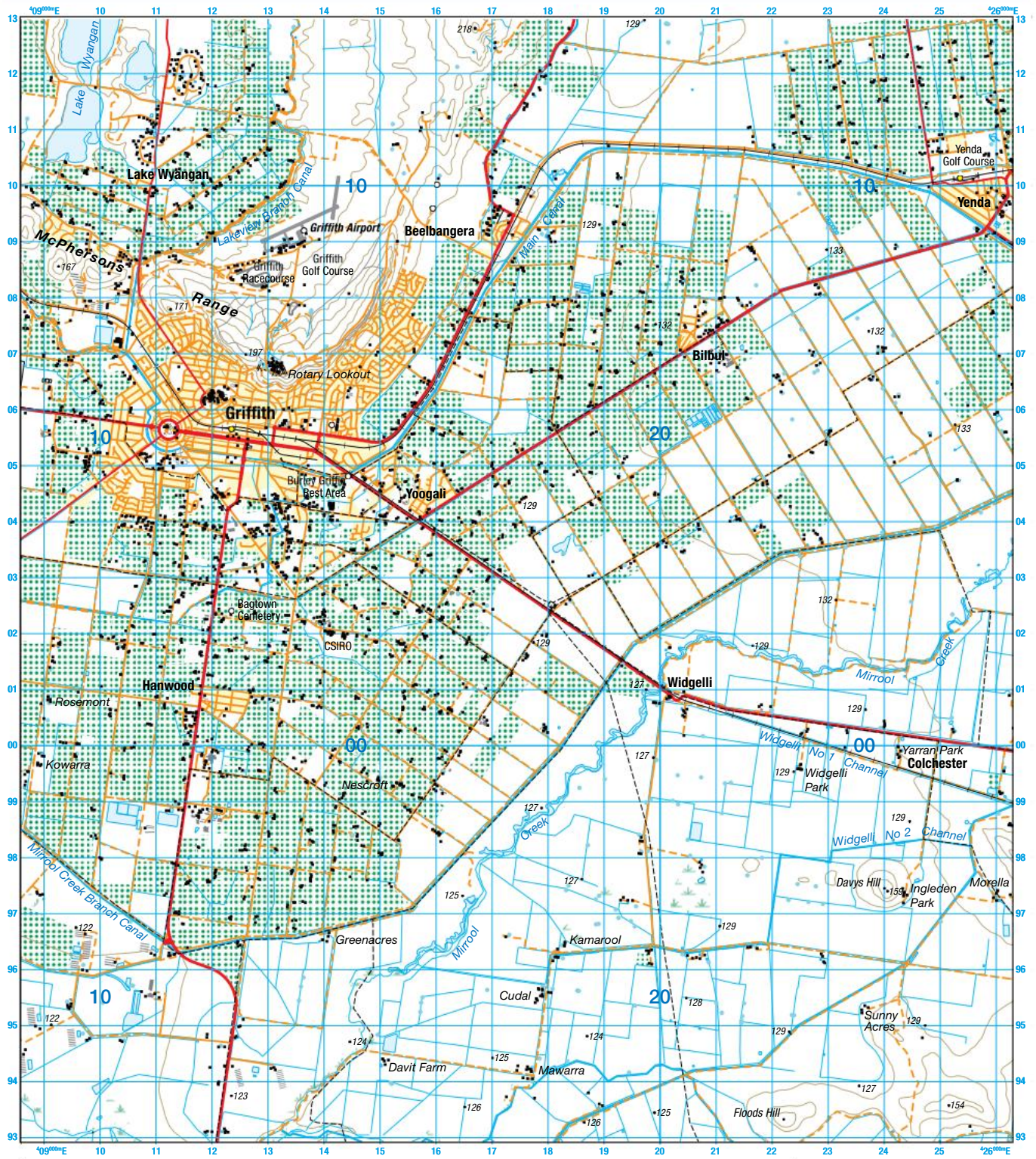
Rural communities are an important part of Australia's social identity, but (based on long-term trends) they are facing significant change and challenges in maintaining their population. Many are experiencing a decline because young people are leaving in search of education and employment. Some rural communities are able to alter this trend, and are surviving against the odds. Others have not fared so well.

Coober Pedy is a vibrant multicultural town in the far north of South Australia, 850 kilometres north of Adelaide and 700 kilometres south of Alice Springs. The town is located in one of the most **arid** environments of Australia. The traditional custodians of the land are the Antakirinja people. The town's name may have come from the name Kupa Piti, meaning 'white man's hole'. Opal was discovered in February 1915 and, after several cycles of boom and bust, the town expanded rapidly during the 1960s. Opal developed into a multi-million dollar industry, and the town is sometimes called the 'Opal Capital of the World'.

horticulture the growing of garden crops such as fruit, vegetables, herbs and nuts

arid lacking moisture; especially having insufficient rainfall to support trees or plants

FIGURE 12 Topographic map extract of Griffith

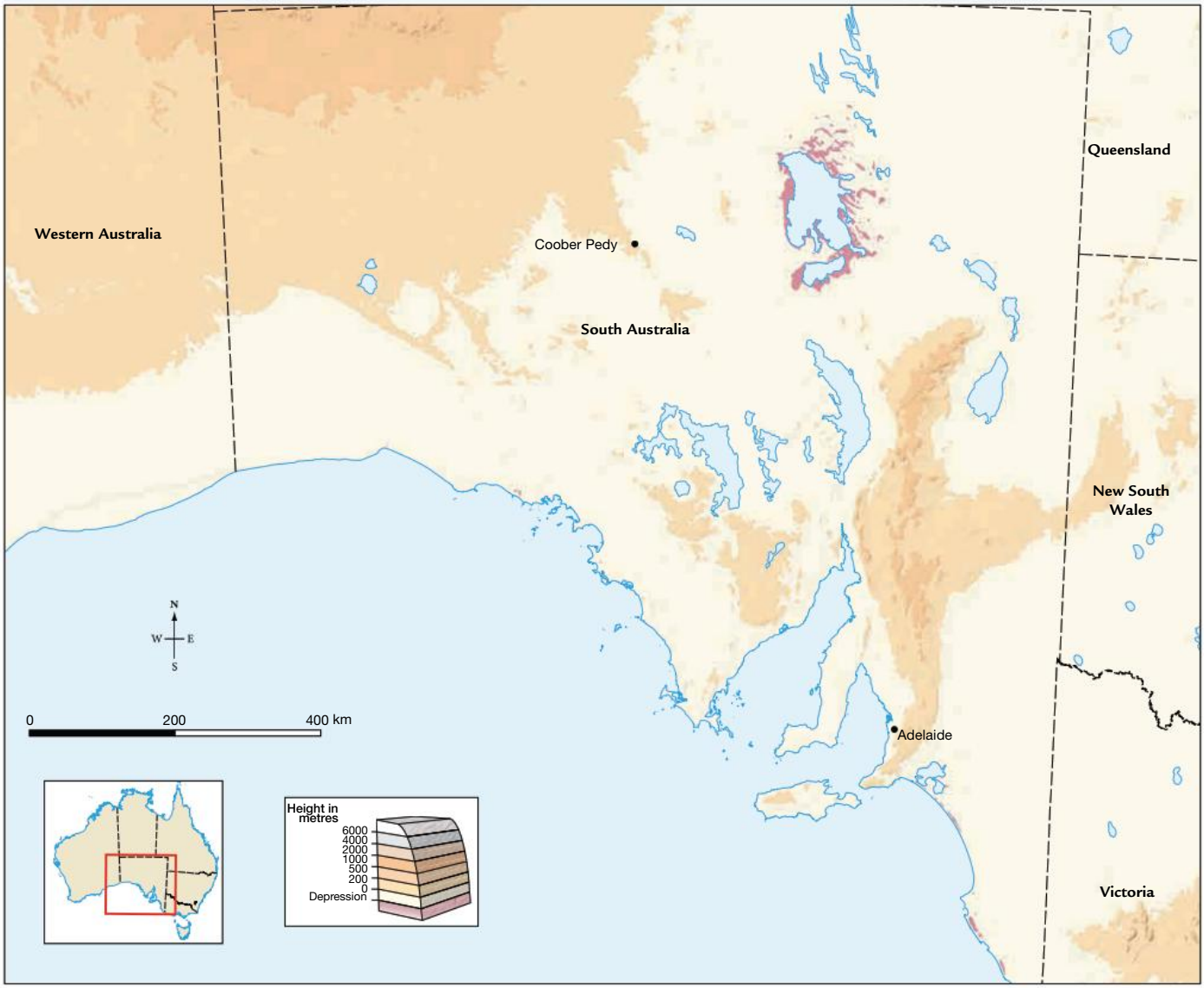


Key

Water area	388 Spot height (metres)	Highway sealed	Railway
Swamp	Orchard or vineyard	Secondary road sealed	Railway station
Area subject to inundation	Built up area	Minor road unsealed	Racetrack
Watercourse or canal	Airport or runway	Track	
Contour	Building	Tower	
Transmission line	Waterpoint	Landmark point	

Source: Spatial Vision

FIGURE 13 Coober Pedy location map



Source: Spatial Vision

Opal continues to be important to Coober Pedy's identity and economy, but the town now draws its income from mining services, tourism and public services. Coober Pedy has a large Antakirinja community, and the town's population has now declined, with an estimated 1762 people in the 2016 census.

What does the future hold for Coober Pedy?

Coober Pedy is widely known for its underground housing (see **FIGURE 16**), an effective and environmentally friendly response to the town's searing summer heat and chilly desert evenings. Recent exploration has revealed significant deposits of iron ore, copper, gold and coal in the area, along with platinum, palladium and rare earths.

Yet in 2014, the Cairn Hill iron ore/copper/gold mine 55 kilometre south-east of Coober Pedy was closed due to low iron ore prices.

int-5292

The location of the town makes it an ideal centre for mining services, and a base for the delivery of state and federal government services in the region. This presents an opportunity for the town to reverse its steady population decline and again see growth in its economy and population.

Coober Pedy has good hospital and medical services, primary and secondary schooling, a TAFE campus, childcare services and police.

However, these services are under some pressure, and the recruitment and retention of medical professionals continues to be a problem.

This rural environment is extremely remote, so many of the pastoral properties in the region have been linked to telecommunication services since 1987. The Stuart Highway provides the main transport and service route for the town.

FIGURE 14 Climate graph for Coober Pedy, South Australia

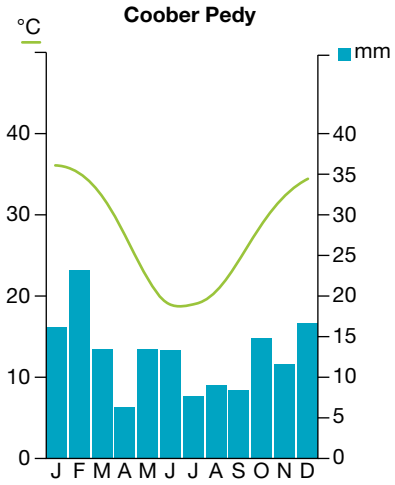


FIGURE 15 Along with other South Australian fields, Coober Pedy produces most of the world's opal. Mullock heaps create Coober Pedy's distinctive landscape.

FIGURE 16 Much of Coober Pedy's population lives underground to take advantage of the cooler and more stable underground climate.

DISCUSS

Discuss strategies that could be implemented to entice more people to live in Coober Pedy and reverse its population decline. Develop a list of possible strategies that could be implemented.

4.5.5 A question of survival

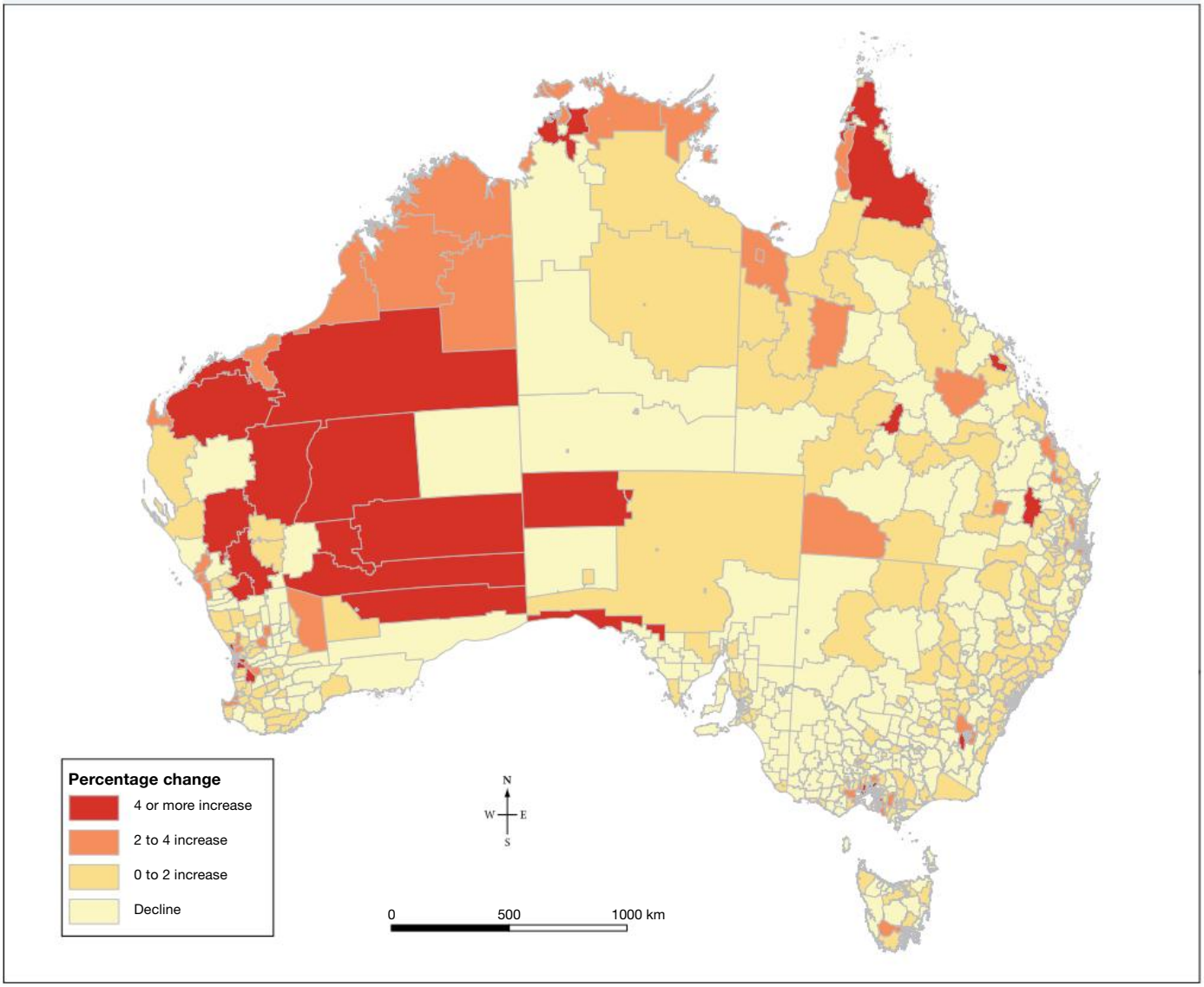
Many rural communities are facing global pressures, such as more overseas competition and fluctuations in the Australian dollar, which can affect the prices of commodities (such as minerals, wool and beef). Climate change and resultant droughts and floods also affect these rural communities. The rural communities that are not experiencing the trend of people moving to urban areas (see **FIGURE 17**) all have one thing in common: they have discovered another source of income. They may have shifted their focus to growing olives or grapes, or perhaps made use of a natural environmental resource such as a nearby national park.

In some cases, a rural community is unable to reinvent itself or tackle the problem effectively. The loss of an industry such as mining may have terrible effects on employment, leaving the resident population with lower incomes and few job prospects.

int-8935

tlvd-10518

FIGURE 17 Australia's population increase and decrease 2011–2016



Source: Spatial Vision

SkillBuilders to support skill development

- 1.8 Using topographic maps
- 1.14 Interpreting diagrams

on Resources

Digital document	Topographic map extract — Griffith (doc-17952)
Interactivity	Remote living (int-3090)
Weblink	Soldier settlement
Google Earth	Tom Price township
	Griffith

4.5 SKILL ACTIVITY: Questioning and researching using geographical methods

1. Do you think the population shifts caused by the COVID-19 pandemic and lockdowns are permanent or just an immediate reaction to the pandemic? In small groups, **decide** where you stand and then **conduct research** into this trend.
2. **Report** your findings back to the class. Your report must include up-to-date data, graphs and charts, and be multimodal (using PowerPoint, Prezi or Google Slides, for example).

4.5 Exercise

learnon

4.5 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 4	6, 7	5, 8

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

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Check your understanding

1. **Define** what makes a place remote.
   - A. It is close to a city centre.
   - B. It is in the countryside.
   - C. It is a long way from major population centres.
   - D. It has a population of fewer than 1000.
2. **Determine** whether the following statements are true or false.
   - a. FIFO reduces remoteness.
   - b. During 2020, the number of people moving to the regions increased.
3. Which of the following is *not* an incentive to leave the hustle and bustle of the city and move to a remote location?
   - A. Good internet access
   - B. The ability to work from home
   - C. Busy streets
   - D. Increased variety and number of cultural events
4. **Identify** which of the four key drivers identified by the Centre for Population caused an increase of internal migration during the COVID-19 pandemic.

Apply your understanding

Interpreting and analysing geographical data and information

5. Refer to **FIGURE 12**.
   - a. **Determine** the main use for farmland in the area surrounding Griffith.
   - b. **Sketch** the symbol of this land use.
   - c. Is this an example of farming type A or type B?
   - d. **Identify** two natural factors and two human factors in **FIGURE 12** that might have influenced people to choose to live in the Griffith area.
6. **Describe** why rural communities are under threat.
7. **Describe** the change in the speed of settlement of inland Australia that is illustrated by **FIGURE 17**.
8. Study **FIGURE 3**. Use your atlas to **compare** the location of soldier settlements with a rainfall map of Australia. Were soldier settlements located in places that receive good rainfall for farming?

LESSON
4.6 Why do people choose to live in the country?

LEARNING INTENTION

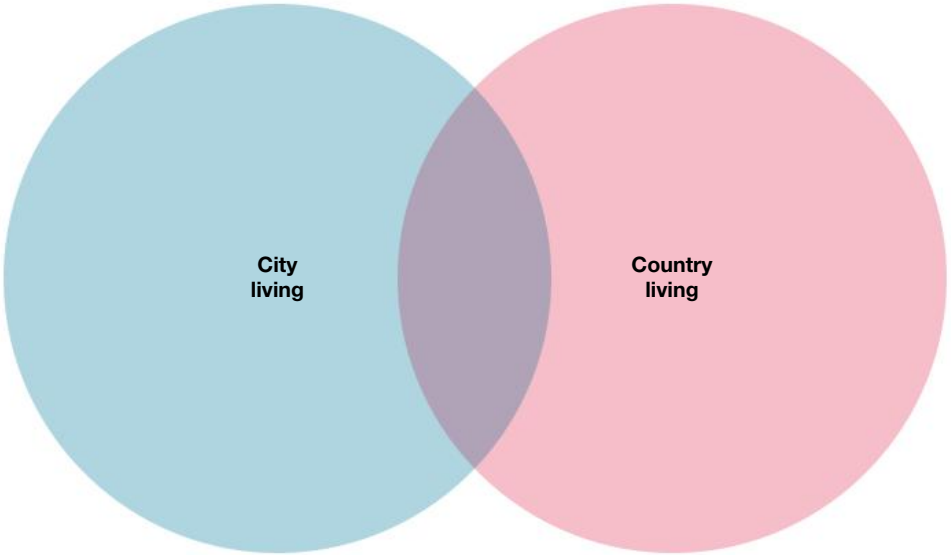
By the end of this lesson you should be able to identify the characteristics of a country town, and explain why country towns are becoming more popular.

TUNE IN

City living and country living share some similarities, but also have quite a few differences. Think about your experience living where you do to help you complete this task.

Create a Venn Diagram similar to the example in **FIGURE 1** to list the similarities and differences between city living and country living.

FIGURE 1 City living versus country living



4.6.1 The attraction of the country

Country towns come in all shapes and sizes. They can be small centres with only a post office and general store or they can be substantial towns. Because most of Australia's population and businesses are concentrated in the capital cities, even people who live in quite large towns outside the capital cities see themselves as living in the country.

Even though most Australians live in large urban centres, the rural or country regions are very important because this is where food is grown, **natural resources** are extracted and ecosystems can flourish. Many Australians travel to country places for holidays and many dream of moving to the country. The attractions of country places include cheaper housing, less traffic, a greater sense of safety, and the allure of living within and around natural environments.

natural resources resources (such as landforms, minerals and vegetation) that are provided by nature rather than people

DISCUSS

How do you feel about living in different places? The following nine statements refer to different opinions about living in rural areas or cities.

- Rural areas are peaceful, have lots of space and clean air.
- Cities provide more choice in activities and places to live.
- I feel isolated in cities.
- Pollution and noise in big cities impair living conditions.
- I don't feel safe in big cities because of crime.
- Rural areas have great communities with people supporting one another.
- The natural environment in many rural areas is very attractive.
- I feel isolated in rural areas.
- Jobs and transport are more accessible in cities.

Complete a diamond ranking diagram by writing the statement you most agree with at the top and the one you most disagree with at the bottom. Then choose the next two top and bottom statements and the final three in the middle of the ranking. Explain your ranking to another person. How might these rankings change if they were completed by people who live in places different from where you live? Can you test this hypothesis?

4.6.2 Demography

The **demographic** characteristics of country places are influenced by location and activities in the surrounding area. For instance, Leongatha is located on the South Gippsland Highway, 135 kilometres south-east of Melbourne, Victoria. Reliable rainfall and good soil make the area one of the most productive in Victoria. Dairy farming is the main type of farming, and the milk-processing factory is the largest single employer in town. Another town, Coleraine, is located on the Glenelg Highway, 350 kilometres west of Melbourne. The farms in this region are generally large. Sheep and cattle grazing are the main types of farming, and no major business is located in the town.

TABLE 1 Predicted population for selected Victorian places

Local government area	2011		2031	
Municipality	% aged under 20	% aged over 65	% aged under 20	% aged over 65
Melbourne (urban)	24.3	23.8	13.0	17.1
South Gippsland Shire (rural includes Leongatha)	24.8	21.9	19.5	28.1
Southern Grampians Shire (rural includes Coleraine)	25.8	21.6	19.6	30.3

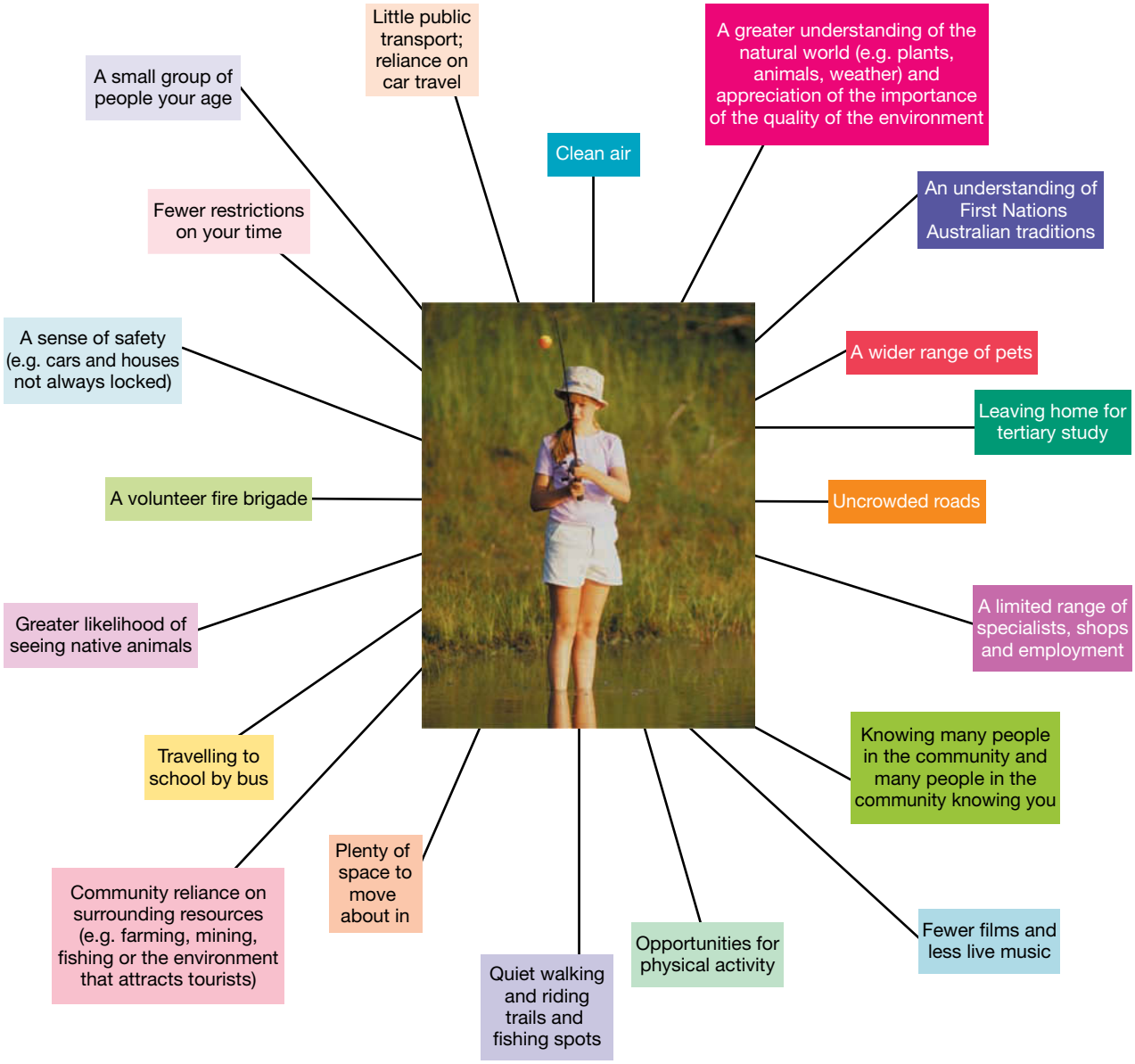
A sense of belonging

Living in the country provides opportunities to be involved in a wide range of community activities. Activities might have an economic focus (such as fundraising), an environmental focus (such as Landcare) or a social focus (such as youth groups). A common outcome of all activities is the way they contribute to a sense of connectedness or belonging.

Even small towns commonly provide a range of sports. Sports provided in a town as large as Leongatha might include Australian Rules football, cricket, Little Athletics, tennis, equestrian events, bowls, fishing, cycling, croquet, skateboarding, golf, swimming, basketball, netball, table tennis, badminton, karate, gymnastics, squash and taekwondo. Also likely available are cultural activities and entertainment, such as films, brass bands, Guides, Scouts, art galleries, dancing and theatre groups.

demographic describes statistical characteristics of a population

FIGURE 2 Growing up in country town might mean . . .

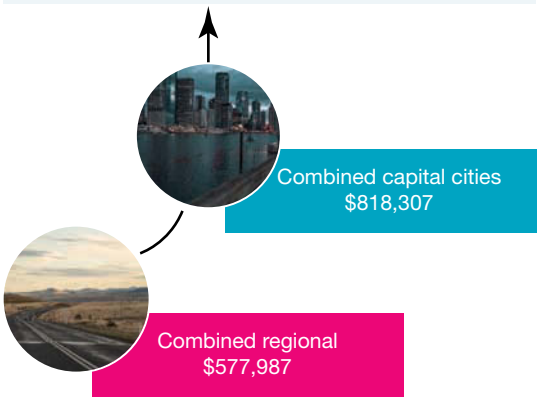


4.6.3 Access to services

Living in the city undoubtedly has its advantages when it comes to accessing all the services people need. Cities provide ample public transport, and medical, education and employment services.

People who live in the city are spoiled for choice. However, ready access to these services comes at a hefty price tag. **FIGURE 3** highlights the combined median house price for Australian cities versus the combined median house price for regional Australia.

FIGURE 3 The median house price in capital cities versus regional Australia



With the internet becoming more and more a part of everyday life, and with increasing demand for faster speeds and more reliable technology across Australia (including in the regions), the advantage of cities when it comes to access to services is slowly eroding. People now have access to the same sort of services, sometimes from the comfort of their own home.

Transport — road and rail

Transport is one of the most important aspects that people consider when deciding where to move. After all, you can't move somewhere if you can't get there. One of the most common ways of travelling across Australia is by using the roads and highways, and the rail network. Regional centres are connected to capital cities via a vast network of roads, highways and railways. These move not only people to places, but also goods and services.

All of Australia's regional centres are connected to their capital cities or other capital cities via the National Land Transport Network (see **FIGURE 4**). On top of this, the rollout of the National Broadband Network has connected more people to the information superhighway. So while distance remains a challenge, access to new communications technology has meant that distance doesn't seem so far.

FIGURE 4 National Land Transport Network, including road and rail

Source: Department of Infrastructure, Transport, Regional Development and Communications

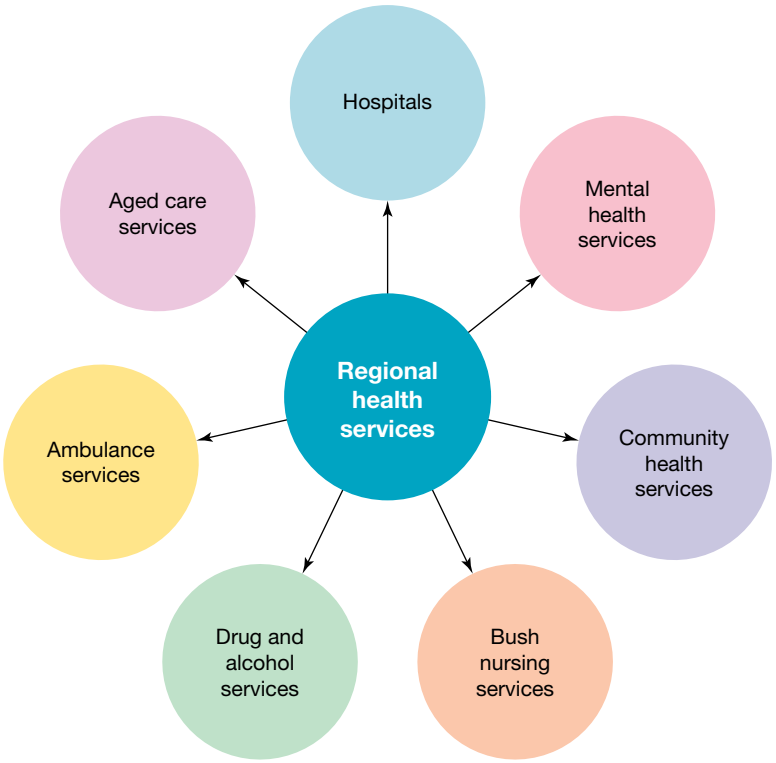
Medical

As with their city counterparts, a range of health services are available to people in regional locations across Australia.

Due to factors such as smaller populations and reduced local demand, the availability of resources and the need to provide high-quality healthcare, not all health services are available in all regional areas. This is a challenge for people living in these regional areas but, again, the internet has come to the rescue.

Telehealth has become a popular and efficient means for people living in remote and rural areas to access high-quality healthcare. Between March 2020 and February 2022, approximately 96 million telehealth services were delivered to almost 17 million patients. On top of telehealth, numerous state government initiatives are available to residents in rural areas that can help with accessing important medical services, including assistance with transport.

FIGURE 5 A range of regional health services are available.



Education

Undoubtedly, the number of metropolitan schools is greater than the number of regional schools. However, rural and regional areas offer many opportunities for students. Schools, universities and TAFEs are all available in the regional centres of Australia. However, students in regional and rural areas face additional challenges accessing high-quality education.

Again, though, the development of the internet and other technology has led to increased investment in online teaching and learning, with a lot of schools, universities and TAFEs offering purely online courses. This allows for people to work from home (say, on their farm) and continue their education. Maximising the potential for students to study online can also contribute to increasing the number of students in regional and rural areas completing study at university or TAFE.

FIGURE 6 Telehealth offers many benefits.

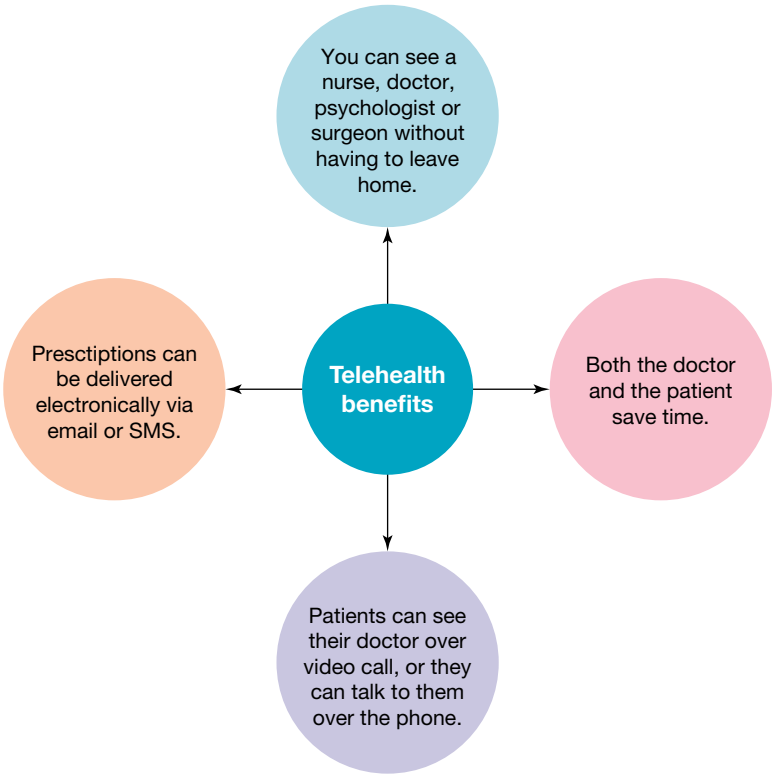


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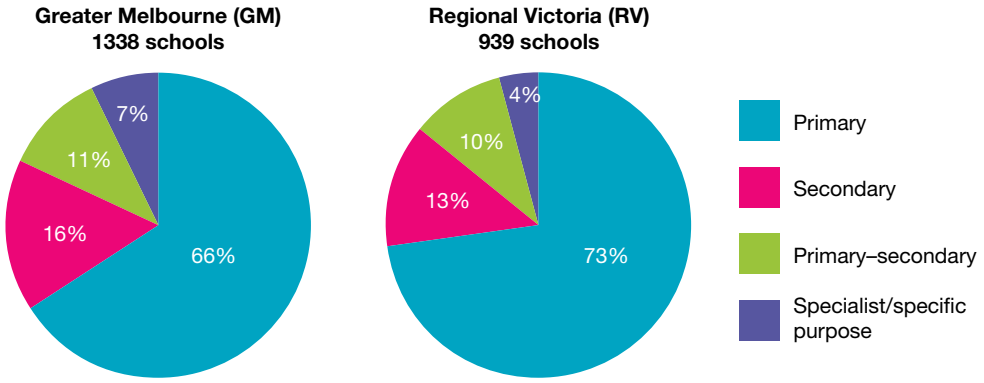
FIGURE 7 Breakdown of metropolitan and regional schools in Victoria



Source: Victorian Registration & Qualifications Authority

While the internet has helped counter some of the barriers to getting a high-quality education in regional and rural settings, a range of reasons remain as to why education in regional Australia is both beneficial and challenging. These are outlined in **FIGURE 8**.

FIGURE 8 Advantages and challenges of education in regional Australia

Advantages	Challenges
Smaller class sizes	Fewer resources
Teacher knows all of their students	Fewer subjects offered
Smaller schools	Specialist teachers difficult to find
A strong sense of community. The school can become the heart of the town	Post-school employment opportunites can be limited

4.6 SKILL ACTIVITY: Questioning and researching using geographical methods

Some rural areas have been growing over recent years. Working in small groups, your task is to investigate why.

1. Visit the **ABS Regional Population** interactive map on your Resources tab.
2. Zoom into your state and then **choose** one of the regional local government areas (LGAs) that is showing some growth.
3. Hover over the LGA to access the Components of Population Change. Note them down.
4. **Research** the LGA, exploring the towns and cities within it, along with tourist attractions, and access to services, employment and education.
5. **Create** a presentation (for example, poster, PowerPoint or YouTube video) for the class that communicates your findings and outlines why you think this LGA has been growing.

on Resources

Weblink ABS Regional Population interactive map

4.6 Exercise

learnon

4.6 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 4	5, 6, 7	8, 9, 10

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- Receive immediate feedback
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Check your understanding

1. **Determine** which of the following opinions is about living in rural areas.
   - A. Rural areas are peaceful, have lots of space and clean air.
   - B. People feel isolated in cities.
   - C. Rural areas have great communities with people supporting one another.
   - D. All of the above.
2. **Select** the best answer from the list provided to fill in the gaps.

capital	substantial	Australia's	large	Country

_____ towns come in all shapes and sizes. They can be small with only a post office and general store, or they can be _____ towns. Because most of _____ population and businesses are concentrated in the _____ cities, even people who live in quite _____ towns outside the capital cities see themselves as living in the country.

3. **Determine** whether the following statements are true or false.
   - a. People who live in country centres have a strong sense of identity, connectedness and belonging.
   - b. It is predicted that in 2031, 13 per cent of Melbourne's urban population will be under the age of 20.
4. **State** the common outcome of community activities.

Apply your understanding

Communicating

5. **State** three opportunities in your community for young people to feel socially connected
6. **State** three ways that country and regional centres can overcome access to essential services such as education and medical care.

Interpreting and analysing

7. In Australia, the trend is for people to move away from the country to the major cities. **State** three reasons you think this happens.
8. Country towns are critical to the rest of Australia. **Explain** what role country towns can play on a national scale.
9. **Identify** the characteristics in **FIGURE 2** that are attractive to you. Are most of these characteristics social, economic or environmental?

Communicating

10. **Describe** how governments might use demographic information from country towns.

LESSON
4.7 Why do people choose to live in the city?

LEARNING INTENTION

By the end of this lesson you should be able to explain the interconnection between push and pull factors and the growth of cities, and identify places in Australia that are growing at the fastest rate.

TUNE IN

People have very different opinions about where they like to live. Some people choose to live in a city. Using the images in **FIGURES 1** and **2** as inspiration, brainstorm a list of all the good and bad things about city living.

FIGURE 1 View of Manhattan from the Rockefeller Centre

FIGURE 2 New York's Times Square at night

4.7.1 The growth of the suburbs

Which place in Australia is growing the fastest? If a place is liked by lots of people, does that make it the best? What makes a suburb the most popular? Coastal areas have always been a popular place for Australians to relax and holiday. Is the fastest growing place in Australia near the coast?

People might move to a new place for many different reasons. As outlined in lesson 4.3, the attractions that entice people to live somewhere are called its pull factors. Pull factors include cheaper housing, better climate, more job opportunities and improved lifestyle. People can also be forced to leave their home and move to a new place. These reasons are known as push factors. Loss of your job or business, poor school or health facilities, and a natural disaster, such as flood or fire, are examples of push factors.

After the 2016 Census, the Australian Bureau of Statistics, which collects information for the Australian government, highlighted that four of the five fastest growing suburbs in Australia were in Melbourne. The other suburb was in Perth. Over recent years, Melbourne has been Australia's fastest growing capital city (although this growth slowed during the COVID-19 pandemic and resulting lock downs). It is not surprising that Melbourne often tops tables as the world's most liveable city.

In Western Australia, the areas that experienced the highest growth rates across 2018–2019 were the Alkimos–Eglinton region in Perth's outer north-west (which increased by 12 per cent), North Coogee (9.6 per cent) and the Casuarina–Wandi region in Perth's south-west (9.2 per cent).

What makes the Gold Coast such a great place to live?

The Gold Coast's warm weather, beach culture and holiday lifestyle have attracted many new residents.

FIGURE 3 Net migration to the Gold Coast between 2011 and 2016

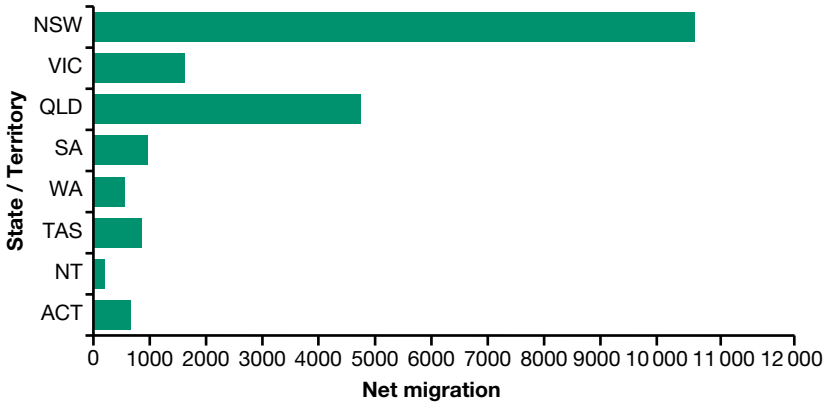
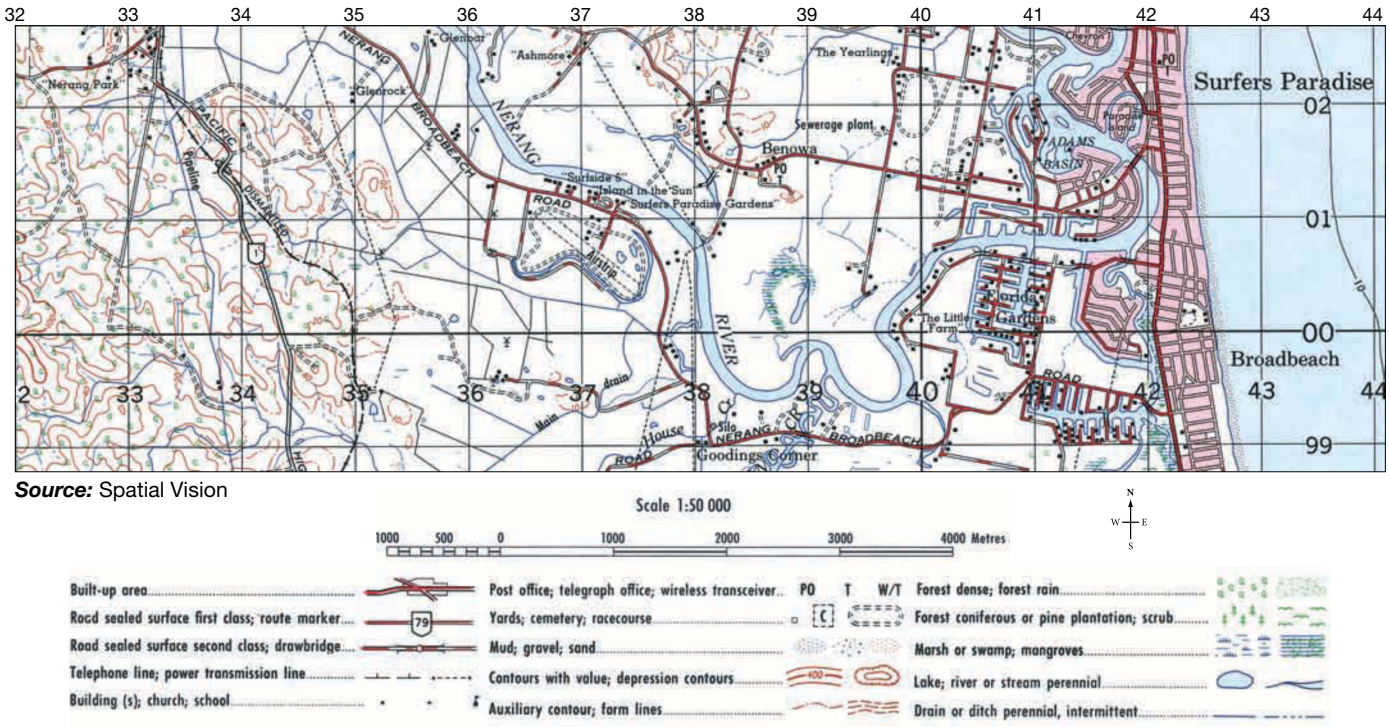


FIGURE 3 shows that most of the new arrivals came from New South Wales. Many were attracted to the place their family visited on holiday, and they later decided to make it their permanent home. The Gold Coast is now the sixth-largest urban area in Australia. It is a major tourist destination, offering a wide range of work opportunities, community facilities and intercity and interstate transport links by road, rail and air. Many new residents are older Australians who have retired to this place. The increased population has placed pressure on the coastal environment, as well as on the existing infrastructure of schools, hospitals, roads and housing.

Use Nearmap or Google Maps to access an **aerial photograph** of the Gold Coast region today. Compare this to **FIGURE 4**, showing the changes that have occurred to the land use here over the past 55 years.

aerial photograph a photograph taken of the ground from an aeroplane or satellite

FIGURE 4 Topographic map extract of the Gold Coast region in 1967



Source: Spatial Vision

An AFL expansion team, and the Commonwealth and Olympic Games

The main Australian Rules football states are Victoria, South Australia, Western Australia and Tasmania along with the First Nations Australian communities of the Northern Territory. In March 2009, the Gold Coast Football Club, now named the Gold Coast Suns, was established, supported financially by the Australian Football League (AFL). The club's establishment on the Gold Coast has seen a rise in youth participation in AFL in the region.

FIGURE 5 Official destination logo for Brisbane

brisbane
australia

The Gold Coast was also chosen to host the 2018 Commonwealth Games. Metricon Stadium at Carrara, the home of the Gold Coast Suns, was temporarily transformed and increased in capacity to host the athletics events as well as the opening and closing ceremonies for the Commonwealth Games. Australia has hosted five Commonwealth Games, but this was the first time they were not held in a state capital city.

The Gold Coast isn't the only city in Queensland to play host to major international sporting events. In 2032, Brisbane will host the Games of the 35th Olympiad — also known as the 2032 Summer Olympics. Brisbane was chosen because of its high percentage of existing venues (thanks, 2018 Commonwealth Games!) and its experience in organising major events. The city plans to use approximately 84 per cent of its existing venues, with the Brisbane Cricket Ground, commonly known as the Gabba, set to be rebuilt to become the lead venue.

FIGURE 6 Brisbane's Story Bridge

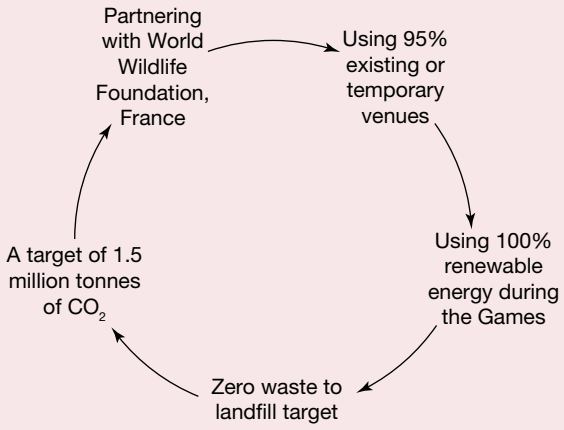
CASE STUDY: Paris 2024 Summer Olympic Games

The 2024 Summer Olympic Games were held in Paris — a truly global city steeped in history. Millions of athletes and spectators descended on the 'City of Love' (as its known), creating a big environmental impact. As part of their bid to host the Games, Paris committed to a raft of environmental measures to make their Olympic Games as sustainable as ever.

The Summer Olympic Games is one of the biggest sporting events held globally. The Games create a huge financial cost and a large cost to the environment — think about all the travel (by athletes and spectators), all the food, all the cameras and all the lights. These factors create a lot of emissions.

The goal of the organisers of the Paris Olympic Games and Paralympic Games was to advance the sustainability agenda by being the first climate positive Games.

FIGURE 7 The 2024 Paris Olympics focused on being sustainable.



Resources

Weblink Paris 2024: Delivering Carbon Neutral Games

4.7 SKILL ACTIVITY: Interpreting and analysing geographical data and information

Compare FIGURE 4 with the Nearmap or Google Maps aerial image of the same place today.

1. Study the map and photo in small groups. **Identify** the changes to the environment, both built and natural, between the map and the photo.
2. **Collate** this information in a table.
3. Write one sentence to **describe** the change to the built environment.
4. Write one sentence to **describe** the change to the natural or physical environment.
5. The population of the Gold Coast is predicted to double to 1.2 million people by 2050. Is much space left in this area of the Gold Coast for housing? **Propose** where new suburbs could be established.

4.7 Exercise

learnon

4.7 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 4	5, 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

1. What features of the Gold Coast have made it grow so quickly? **Select** all possible answers from the options provided.
   - **A.** Warm weather
   - **B.** Cooler weather
   - **C.** Beaches
   - **D.** Holiday lifestyle
2. **Select** the correct answer to complete the following sentence. Most new residents of the Gold Coast have moved from **Victoria** / **New South Wales** / **South Australia** / **Tasmania** / **Western Australia** / **Northern Territory** / **Queensland** / **Australian Capital Territory.**
3. Push factors are attractions that entice people to live in a certain place. True or false?
4. **Define** push factors. Give an example.
5. Push and pull factors result in the rise or fall of the population for a place. Use examples to **explain** the differences in environment, services and facilities between a place with push factors and a place with pull factors.

Apply your understanding

Communicating

6. Imagine you are a town planner. **Identify** two new features that you can add to your suburb that would make it a more appealing place to live.
7. The Paris 2024 Summer Olympic Games aimed to be the greenest Olympic Games ever staged. **Identify** three things they did to achieve this.
8. **Describe** what was significant about the Gold Coast hosting the 2018 Commonwealth Games.

9. **Select** which question this answer relates to:
Many of Australia's towns and cities are growing so quickly because global human populations are also rapidly increasing. People are living longer than ever before and people in more developed countries, such as Australia, have access to health services.
   A. What is behind the growth of Australia's regional centres?
   B. What are some of the reasons for Australia's growing cities?
   C. Australia's population is growing, why?
10. **Consider** the push and pull factors that you've identified and discussed already. Which do you believe is the most important factor people consider when deciding where to live? **Justify** your response.

LESSON
4.8 How do places change?

LEARNING INTENTION

By the end of this lesson you should be able to explain why places change over time, describe the changes that might occur in a place over time and predict how a place might look in the future.

TUNE IN

Think of a place familiar to you (such as your neighbourhood, your school or your city) and draw an image of what it may look like in 5 years, in 10 years, and again in 20 years. Consider the current trends in transport, sustainability, employment and education.

Explain the changes you've predicted for your place and why you drew them. Do these changes improve or deteriorate your place?

4.8.1 On the move

A town will change over time if the factors influencing people's decision-making about living there also change. Change may be due to government plans, the perception of the natural environment, the economic activities that are carried out in the place, and access to resources and other places.

FIGURE 1 A Tallangatta house being moved to the new town site

The original buildings in Tallangatta, in north-east Victoria, about 40 kilometres from Albury and Wodonga, can be seen only when the water level in Lake Hume is very low. The current town was moved from its original location in 1956. Houses were lifted onto trucks (with parts of the buildings often falling off during the journey) and moved about eight kilometres (see **FIGURE 1**). The original site, in a valley beside the Mitta Mitta River, was flooded when the size of Lake Hume was increased.

4.8.2 Town closed

In 1917, it was decided that a town was needed on the dry and hot Nullarbor Plain to provide services for the Indian Pacific railway (see **FIGURE 2**). With a population of 300, the town of Cook was once big enough to have a school, hospital, shop and accommodation for train drivers. When the railways were privatised in 1997, the town was closed. Cook currently has no known residents and it has effectively become a ghost town.

FIGURE 2 The location of Cook

Source: Spatial Vision

Resources

- **Interactivity** Country town services (int-3092)
- **Google Earth** Kellerberrin

4.8.3 Access to resources

Resource depletion

Silverton, 25 kilometres north-west of Broken Hill, was once home to 3000 people who mainly worked in mining. Most people left, often taking their homes with them, when richer mines opened at Broken Hill. According to the 2016 census, the population of Silverton is 50, although the town is now visited by many tourists.

Silverton has reinvented itself as a unique location for the filming of TV and movie productions. The town and its semi-arid surroundings have been used as the setting in many films, such as *Mad Max 2*, *Dirty Deeds*, *Strangerland*, *Mission Impossible 2* and *The Adventures of Priscilla, Queen of the Desert*. In the coming years, we may see another change in Silverton's population with the construction of the Silverton Wind Farm. After years of delays, construction of the renewable energy project commenced in 2017, with the first generation of electricity occurring in 2018. All 58 wind turbines have now been constructed, making it the seventh largest wind farm in Australia.

FIGURE 3 Silverton wind farm

FIGURE 4 Silverton has reinvented itself as a tourist destination.

Resource discovery

Karratha is a hot, dry place 1600 kilometres north of Perth. It was founded in the 1960s for workers on the growing iron ore mines in the Pilbara region. In the 1980s, the development of the natural gas industry encouraged further growth. The town currently supports about 22 000 people and is expected to support up to 40 000 by 2030.

DISCUSS

Discuss the following statement with a partner: *'Environmental factors are the main reason towns change'.* Compose a clear paragraph to express your opinion. The first sentence will clearly state your view. The rest of the paragraph should contain at least two pieces of evidence to support your view.

FIGURE 5 The planned town of Karratha

4.8.4 Sea change

Margaret River, 270 kilometres south of Perth, has become popular because it offers a rural lifestyle and is accessible to the capital city. People who move from the city to the coast are said to have made a **sea change**. Those who move to an inland location are said to have made a **tree change**.

Change over time

Many people now recognise that the Margaret River region has many attractions, such as beaches, waterways, caves, wineries, national parks and mild weather that suits farming and tourism.

However, what people have thought about the region has changed over time. Before 1830, the Noongar people, including the Wardandi Nation, valued the natural characteristics (such as flora, fauna, weather, sea and rivers) and made few changes to the natural environment. In 1830, white settlers arrived to cut down trees and sell timber. In 1950, they began using the cleared areas for dairy cattle and beef cattle.

Tourists also began to value and visit the region's natural features, such as beaches, rivers and caves. By 1970, people were moving from the city to enjoy the quiet country atmosphere and, by 1990, the area had become popular as a sea change destination.

FIGURE 6 The Bussell Highway — the main street in Margaret River — in 1991

TABLE 1 Origin of people who moved to Margaret River, 2006–2011

Previous place of residence	Number
New South Wales	83
Victoria	35
Queensland	44
South Australia	30
Western Australia	1004
Tasmania	13
Northern Territory	20
Overseas	365

4.8.5 Tourism

Port Douglas, 60 kilometres north of Cairns, was a busy port in the 1870s and had a population of more than 10 000. The mining that had attracted people to this hot, wet area did not last. By the 1960s, the population was only 100. In the 1980s, road and air access to the town improved. People were prepared to travel long distances from within Australia and from overseas to enjoy the warm weather, stunning beaches and the World Heritage areas of the nearby Great Barrier Reef and Daintree rainforest. The permanent population is now about 3500. During the peak holiday season (May to November) the population of Port Douglas can increase to more than double its regular size.

sea change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small coastal town

tree change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small country town, in the bush, or on the land as a farmer

FIGURE 7 Port Douglas in 1971, before the tourist boom

FIGURE 8 Port Douglas in 2007

DISCUSS

Many places change over time. Study the two photographs of Port Douglas in 1971 and in 2007. Discuss how the following people might respond to change that has taken place here.

- A resident whose family has lived in Port Douglas for three generations
- A shop owner
- A travel agent
- A tourism company owner
- A fisherman
- A painter or photographer

4.8.6 Change in the future

Even in a small state such as Victoria, predicted population growth varies across the state. Towns relying on big farms are predicted to lose population. The use of machinery and the closure of processing plants have reduced employment opportunities.

Towns in regions very close to Melbourne are predicted to grow. People who live in these places still have access to jobs and entertainment in Melbourne even though they live in regional Victoria. More people creates a need for more businesses and infrastructure.

The population of Perth is predicted to grow by over 34 per cent between 2020 and 2036. This is likely to place pressure on urban infrastructure such as roads and CBD transport options, but also provides opportunities for inner-city services such as cafés and restaurants.

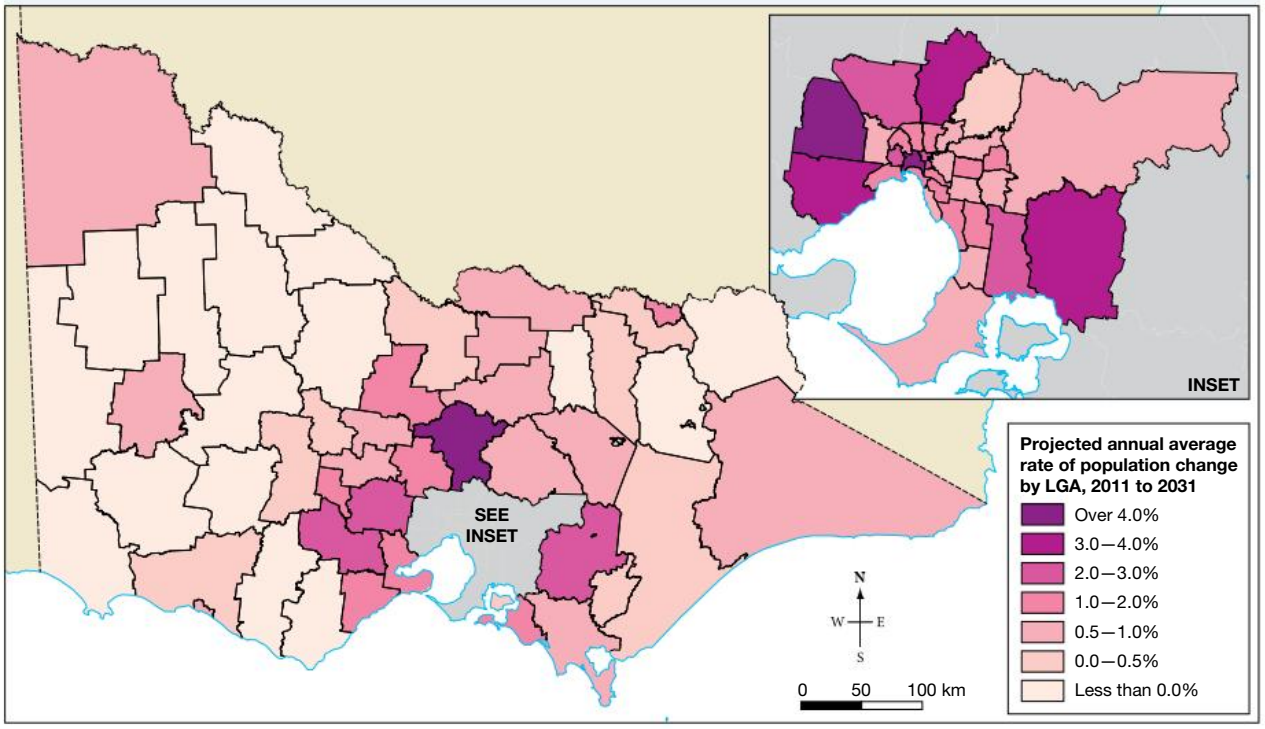
on Resources

Google Earth Tallangatta
Silverton
Karratha
Margaret River

int-8937

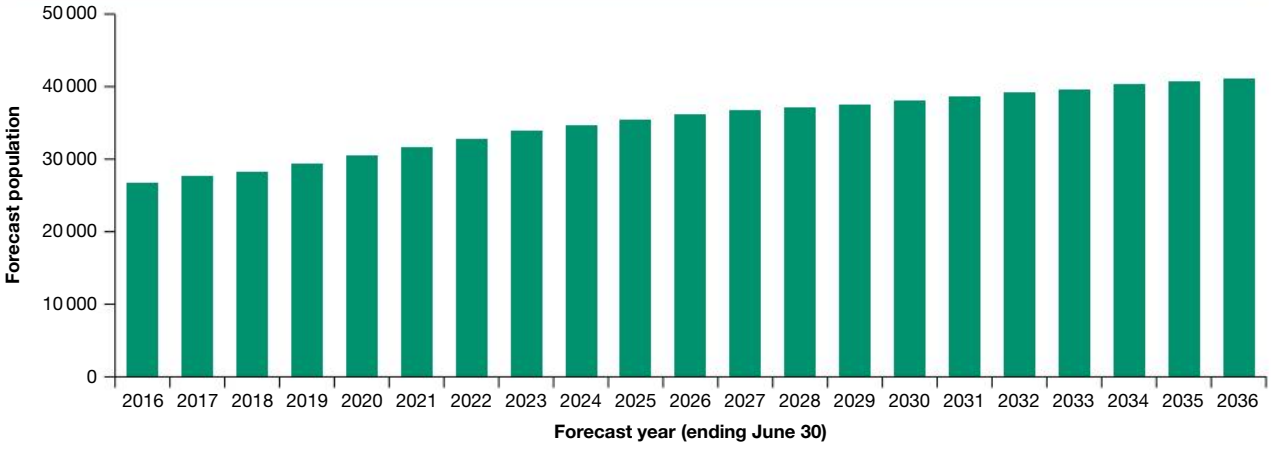
tlvd-10519

FIGURE 9 Projected population change for regional Victoria, 2011–2031



Source: The Department of Environment, Land, Water and Planning.

FIGURE 10 Forecast population growth for Perth



SkillBuilders to support skill development

- 1.5 How to read a map
- 1.6 Reading a weather map
- 1.9 Using alphanumeric grid references
- 1.11 Creating and analysing overlay maps

4.8 SKILL ACTIVITY: Interpreting and analysing geographical data and information

1. Find maps of Victoria that provide information about landform and climate. Refer to your maps and **FIGURE 9** to complete the following.
   a. Think about landform and population change. Are most areas of declining population in places that are not mountainous? Are most areas of increasing population on the coast side of the mountains?
   b. Think about climate and population change. Are most of the highest growth population areas in places where rainfall is over 600 millimetres per year? Are most areas of declining population in places where the rainfall is lower?
   c. What might be the reasons for your findings in (a) and (b)?

4.8 Exercise

learnon

4.8 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 4	5, 6, 7	8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. **Identify** the water storage that drowned old Tallangatta.
   A. The Ocean
   B. Lake Hume
   C. One month of heavy rain
   D. The Murray River
2. People are now drawn to Silverton to see the town in its isolated, dry setting, which is a location for many film sets. True or false?
3. **Select** the correct answer to complete the sentence. During the peak season, the population of Port Douglas is **the same as** / **double** / **triple** / **half** its permanent population.
4. Refer to **TABLE 1**. **Identify** the three main places new residents came from to settle in Margaret River between 2006 and 2011.
5. **Describe** why May to November is the peak holiday season in Port Douglas.

Apply your understanding

Communicating

6. **Explain** why population changes are expected in regional Victoria in the coming years.
7. What would be the advantages and challenges of living in a town such as Port Douglas, which relies on tourism? **Justify** your response.
8. Read the description of the change over time for Margaret River. **Create** a timeline to show the changing view of Margaret River.

Interpreting and analysing geographical data and information

9. Refer to the map in **FIGURE 9.**
   a. **Describe** the location of the areas predicted to grow by more than 3 per cent. For example, are they inland or by the coast? Are they in the north, south, east or west of the state? Are they clustered together or spread out? Are they close to Melbourne?
   b. **Predict** what will happen to towns in regional Victoria.
   c. **Identify** the proportion of Victoria that is predicted to increase its population and the proportion that is predicted to decrease its population.
10. Factors that cause change can be categorised as social (related to people), economic (related to money) or environmental (related to setting or surroundings). **Consider** all the reasons for change provided in this lesson and **list** each in its correct category.

LESSON
4.9 Why do people choose to live on Country?

First Nations Australian readers are advised that this lesson may contain images of and references to people who have died.

LEARNING INTENTION

By the end of this lesson you should be able to explain why some First Nations Australians choose to live on Country, and explain the importance of Country and place to First Nations Australians.

TUNE IN

First Nations Australians have a deep connection and responsibility to Country. Read the excerpt provided in **FIGURE 1** from *The Lost Girl* to learn more about the importance of Country.

aud-0427

FIGURE 1 Excerpt from *The Lost Girl* by Ambelin Kwaymullina (illustrated by Leanne Tobin)

The girl had lost her way. She had wandered far from the Mothers, the Aunties, and the Grandmothers, from the Fathers and the Uncles and the Grandfathers. She had hidden in the shadow of a rock and fallen asleep while she waited for her brothers and sisters to find her. Now it was night, and no one answered when she called, and she could not find her way back to camp.

The girl wandered, alone. She grew thirsty, so she stopped by a waterhole to drink, and then hungry, so she picked some berries from a bush. Then the night grew colder, so she huddled beneath an overhanging rock, pressing herself into a hollow that had trapped the warm air of the day. Finally, she saw a crow flying in the moonlight, flapping from tree to tree and calling 'Kaw! Kaw! Kaw!'. The girl followed the crow. She followed him through the trees and over the rocks and up the hills, until at last she saw the glow of her people's campfires in the distance.

The people laughed and cried at once to see the girl was safe. They growled at her for her foolishness, and cuddled her, and gave her a place by the fire. Her little brother asked if she had been afraid; but the girl said, 'How could I be frightened? I was with my Mother. When I was thirsty, she gave me water; when I was hungry, she fed me; when I was cold, she warmed me. And when I was lost, she showed me the way home'.

1. What does the story The Lost Girl highlight about the importance of the land and Country to the First Nations Peoples of Australia?
2. Highlight any phrases that indicate a spiritual connection, a cultural connection and a familial connection to Country.

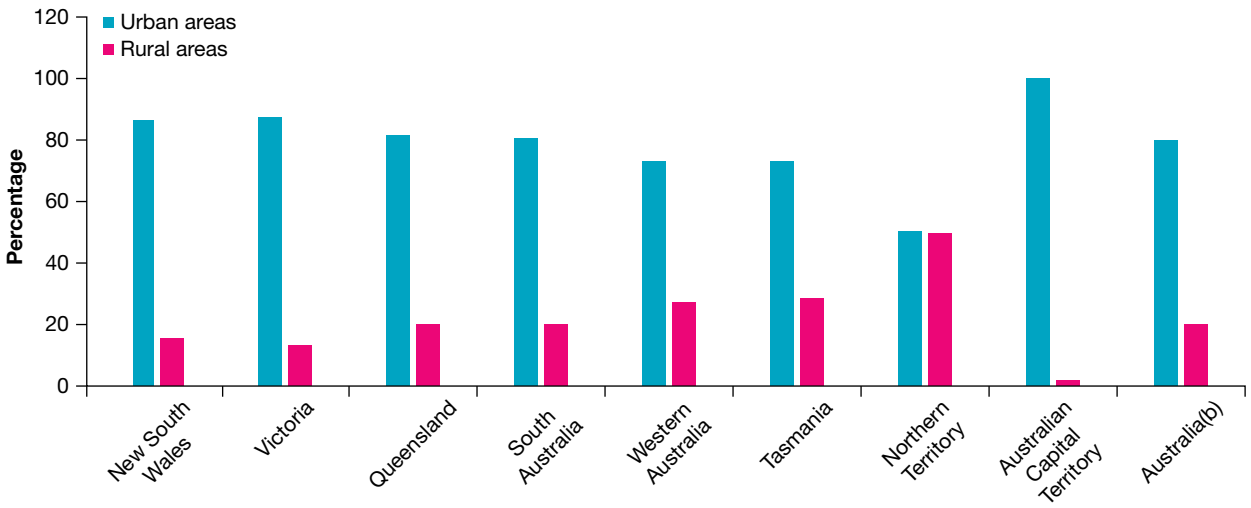
4.9.1 A connection to Country

For many First Nations Australians, land is much more than soil, rocks or minerals. It is Country. Country is home. Country is family. And just like you have responsibilities to your family, so too do First Nations Australians have deep responsibilities, developed over 65 000 years, to live on and care for their traditional Countries. Despite this, the First Nations Australian population is becoming increasingly urbanised. Since the 1996 Census, the proportion of First Nations Australians living in urban areas has increased from 73 to 79 per cent.

For First Nations Australians, Country is multi-dimensional. It consists of people, animals, plants, Dreamings, earth, soils, minerals, waters and air. First Nations Australians speak to Country, sing to Country, visit Country, worry about Country, feel sorry for Country, celebrate Country and long for Country. It is intrinsic to their very being. Because of this, understanding why some First Nations Australians would choose, or prefer, to live on Country is important.

Much like you consider your home to be special and unique, so too do First Nations Australians. The connection to Country isn't just the land in general; it's to a specific area of land. They feel a long, enduring history. Connection to Country is achieved through very specific local knowledge of a region's natural history, coupled with complex layers of past personal and family experiences. So living remotely isn't the same as living on Country. A relationship with the land must exist.

FIGURE 2 First Nations Australians living in urban and rural areas by state, 2016



Source: ABS Census of Population and Housing, 2016

on Resources

Weblink Connect to Country

4.9.2 'Healthy Country, healthy people'

The land sustains First Nations Australians in every aspect of their lives: spiritually, physically, socially and culturally. Connection to Country runs so deep for many First Nations Australians that often their mental and physical health and wellbeing are reflected in the Country. For example, First Nations Australians in the Murray River region attributed aspects of their own poor physical and mental health to the poor health of the Murray River. Due to environmental degradation and legal restrictions on access, First Nations Australians were unable to pass on traditional knowledge or pursue traditional activities that were closely connected to the river system and this impacted their wellbeing, as well as the health of the river system.

Understanding the need for First Nations Australians to go on Country is, therefore, important. As well as this, they may choose to permanently live on Country. For First Nations Australians, this choice is in part about their own health. When on Country, First Nations Australians can engage in traditional practices. One of the most common reasons for going on Country is to gather traditional foods, which involves lots of walking (see **FIGURE 3**), digging and chopping. In addition to this, the traditional methods of gathering food and resources along the beach have even larger health benefits.

As well as the health benefits derived from activities on Country, mental health and wellbeing benefits also come with being on Country. For many First Nations Australians, a sense of wellbeing comes from maintaining

or re-establishing connections with Country. By returning to Country, and serving Country, First Nations Australians can reaffirm their identity and thus improve their mental wellbeing.

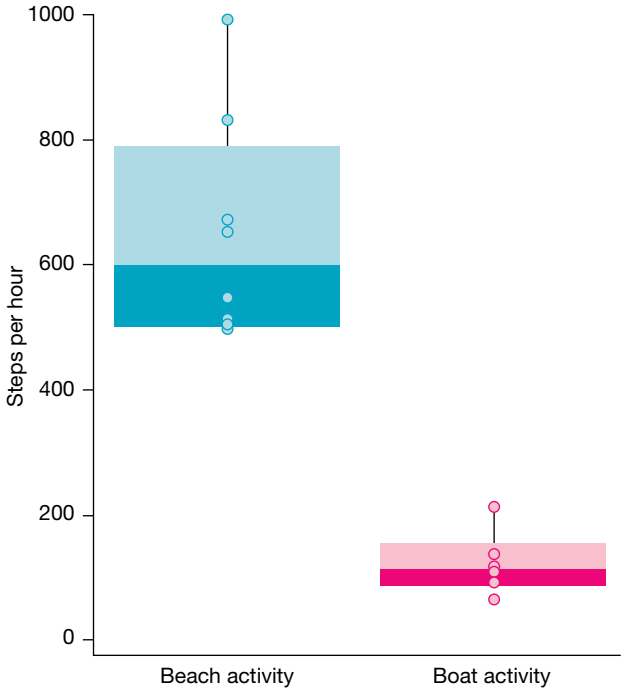
4.9.3 Sustainability

For tens of thousands of years, First Nations Australians have managed the land and its resources to ensure environmental harmony and sustainability. Maintaining a balance in the environment is central to First Nations Australian ways of thinking and being. Because of this, caring for Country, by living on Country, has substantial environmental benefits.

Through practising their traditional land management techniques on Country, First Nations Australians provide a wide range of environmental services. Some of these are outlined in **FIGURE 4**.

A well-recognised environmental benefit of caring for Country is when First Nations Australians choose to declare an Indigenous Protected Area (IPA) on their land. Through this arrangement, First Nations Australians manage their land to meet international conservation standards in exchange for funding to do so their way. Research into the effectiveness of this arrangement found IPAs were extremely cost-effective in helping Australia work towards national and international biodiversity and conservation goals.

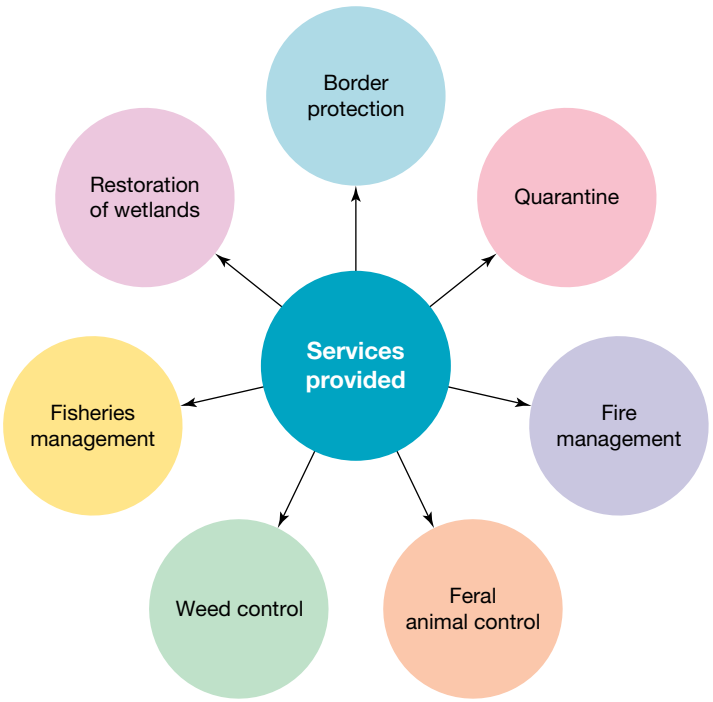
FIGURE 3 Steps taken when on Country



Overall steps taken per hour of self-initiated activity when on Country

Boxplots illustrate the average number of steps taken per hour of activity across three days (where date available) for each participant (open circles: beach, $n = 8$; boat, $n = 6$).

FIGURE 4 Environmental services provided by First Nations Australians



4.9 SKILL ACTIVITY: Investigating and Communicating

1. **Research** the local Country of First Nations Australians where you live, and find out more about their culture (including language, laws, spiritual beliefs, important places and important landmarks).
2. **Create** a poster for display in the class.
3. **Write** a letter to the local council asking for them to allow for more First Nations Australian activity on Country. Make sure you include your research into the local Country, including maps, diagrams and potential activities that First Nations Australians can conduct.

4.9 Exercise

learnon

4.9 Exercise

Learning pathways

■ LEVEL 1	■ LEVEL 2	■ LEVEL 3
1, 2, 3, 4	5, 6, 7	8, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. **Select** the most appropriate answer. What is Country to the First Nations Peoples of Australia?
   - A. Land, sea and sky
   - B. Animals, rocks and water
   - C. Family
   - D. Land they own
2. **Determine** if the following are true or false.
   - a. First Nations Peoples of Australia have a deep, longstanding responsibility to care for Country.
   - b. More First Nations Australians live on Country than in urban areas.
3. Study **FIGURE 3**. **Explain** what it is highlighting about beach activities versus boat activities.
4. **Select** the most appropriate words to fill in the gaps and complete the sentence.

physically	wellbeing	First Nations Australians	mental	Country

The land sustains _____ in every aspect of their lives: spiritually, _____, socially and culturally. Connection to _____ runs so deep for many First Nations Australians that often their _____ and physical health and _____ are reflected in the Country.

5. **Explain** why it is important that First Nations Australians live on the Country they have a connection to?

Apply your understanding

Interpreting and analysing

6. Using **FIGURE 2**, **determine** which state or territory has the highest percentage of First Nations Peoples living in rural areas and which state has the least.
7. **Explain** how connection to Country is established for First Nations Australians.
8. Answer the following.
   - a. Why do you think the number of First Nations Australians living in urban areas has steadily increased?
   - b. **Describe** methods that might encourage First Nations Australians to stay on Country.
9. Look at **FIGURE 3** and **create** a list of reasons that **explains** the difference between beach activity and boat activity. **Discuss** why you think this is.
10. **Evaluate** the traditional First Nations Australian way of land management. Which do you think is of greatest benefit to sustainability? **Justify** your response.

LESSON
4.10 Investigating topographic maps — Griffith, NSW

LEARNING INTENTION

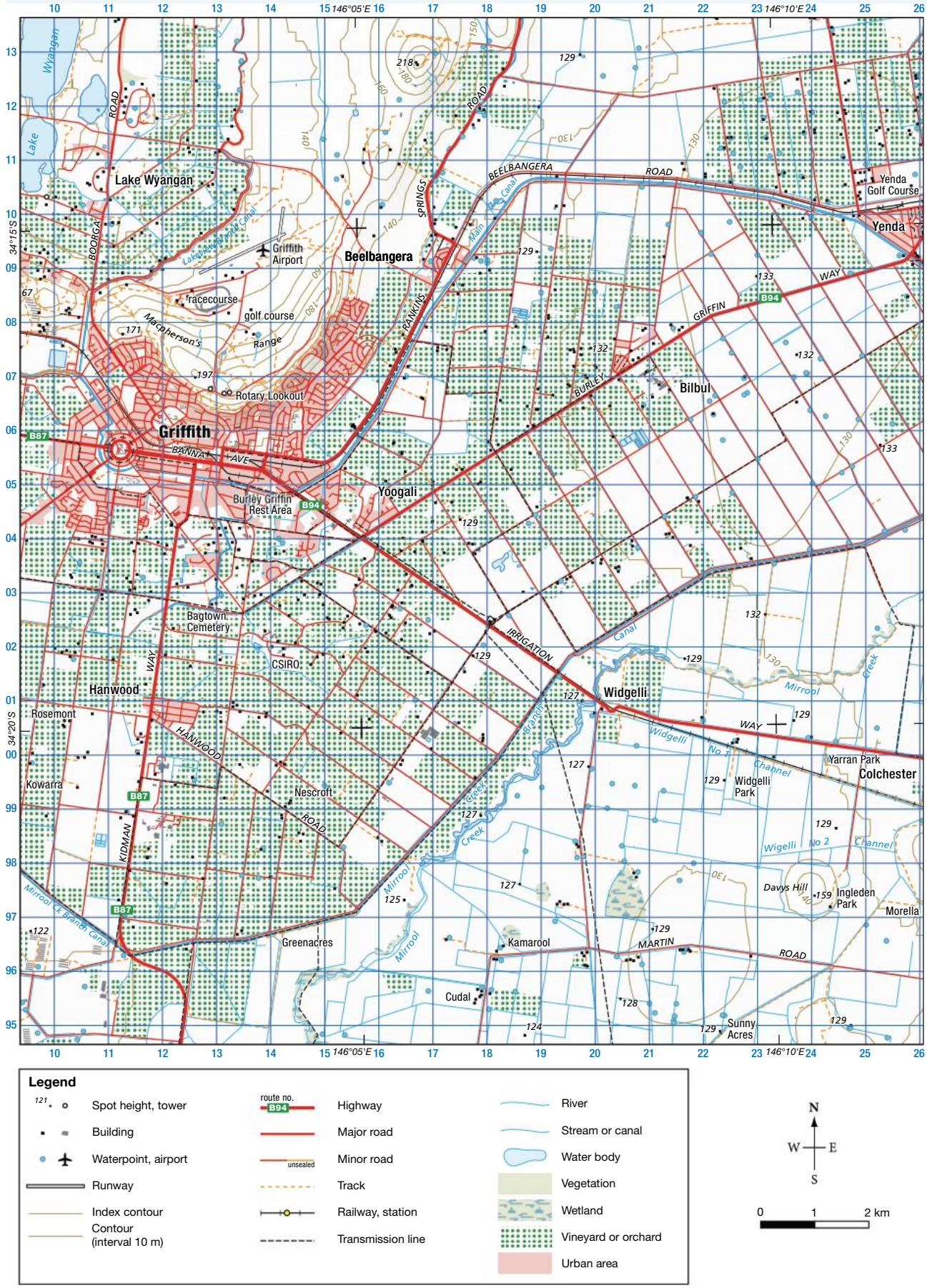
By the end of this lesson you should be able to identify key features of the Griffith area on a topographic map, and discuss how these features affect liveability.

4.10.1 Griffith and surrounding region

Griffith is located within rich farming lands of the Murrumbidgee Irrigation Area in New South Wales. The climate in this area is semi-arid (warm, with unreliable rainfall) and the area supports a variety of agricultural industries such as viticulture, fruit growing and rice production. The picking, processing and distribution of locally grown rural products provides employment and training opportunities for seasonal workers and the local population during harvesting periods.

FIGURE 1 Griffith is home to Spring Fest, featuring sculptures made from local fruit.

FIGURE 2 Topographic map extract of Griffith



Source: Data based on Spatial Services 2019

Resources

eWorkbook	Investigating topographic maps — Griffith, NSW (ewbk-10547)
Digital document	Topographic map of Griffith, NSW (doc-39383)
Video eLesson	Investigating topographic maps — Griffith, NSW — Key concepts (eles-6013)
Interactivity	Investigating topographic maps — Griffith, NSW (int-8960)
Google Earth	Griffith

4.10 Exercise

learnon

4.10 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 5	2, 6	3, 4

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. What land use is found at the following?
   a. AR1297
   b. AR1105
2. **Identify** the direction of the town of Widgelli (AR2000) from Griffith Airport (AR1409).
3. Use the scale on the map to **calculate** the number of square kilometres covered by the map.
4. **Determine** the types of transport that would be available to people living in Griffith based on the features shown in this map.

Apply your understanding

Interpreting and analysing

5. Based on the features shown on this map, do you think you would find Griffith a good place to live? **Explain** your answer, with reference to the features shown on the map.
6. Based on the services shown on this map, do you think Griffith is a well-connected town? **Justify** your answer, with reference to the features shown on the map.

LESSON
4.11 INQUIRY: What is my place like?

LEARNING INTENTION

By the end of this lesson you should be able to research different demographic characteristics of your chosen place, and communicate what these characteristics indicate.

Every person has their own idea of what their local place is like. For some people, this area can be very large; for others, it can be quite small. It really depends on where you go in your everyday life — for example, homes of relatives or friends, sports clubs, shops and parks. This means that it does not matter if your map representing your place is a different size or shape from those of friends who live in the same areas. The differences simply reflect what you do and think as an individual.

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

In pairs or small groups, **create** a blog that presents the demographic characteristics of your place. This place can be your neighbourhood, your Country, your state's capital city, or anywhere in Australia you want to live. This is *your* place.

The Australian Bureau of Statistics (ABS) provides a pathway for you to find out the demographic characteristics of your place. In your team, develop inquiry questions for three different demographic characteristics that you wish to have mapped. You will then develop blog entries for these three characteristics, and produce those maps and publish them, for further discussion.

Step 1: Questioning and researching using geographical methods

For this inquiry, you will need Census data, which is available via the **Australian Bureau of Statistics** weblink in the Resources panel.

- Go to the ABS website and select the 'Census' page from the drop-down menu and then click the 'Find Census Data' button.
- Select 'Search Census data'. Enter the postcode of your place.
- In the 'Search results' window select 'All persons' under View QuickStats.
- You're taken to the QuickStats page, where you will be able to access the information needed for your blog posts.
- **Compare** the changes to your place by exploring the 'Historical Census data' page (after clicking the 'Find Census Data' button.

Step 2: Interpreting and analysing geographical data and information

For each of the three areas your team is investigating:

- **Describe** the pattern of distribution. How does your place compare with the neighbouring places?
- What do the combination of characteristics you have chosen tell you about the community in your place?
- Looking at the historical Census data for your place, what changes have you noticed?

Step 3: Concluding and decision-making

- What does this data tell you about your place that you didn't know before?
- Considering the historical Census data and the changes you noticed, what reasons can you suggest to **explain** these changes?

Step 4: Communicating

- Use an online blogging site to set up your group's blog and then enter all of the required blog entries. Be sure to **create** a headline for your article and add relevant tables, graphs, maps, images and videos. Your article should emphasise the important facts and how and why your place has changed over time.

Complete your self-assessment using the **Inquiry rubric** or access the 4.11 exercise set to complete it online.

on Resources

Digital document Inquiry rubric (doc-39377)

Weblink Australian Bureau of Statistics

LESSON
4.12 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**

Find all this and MORE in jacPLUS

4.12.1 Key knowledge summary

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

4.2 What creates a sense of place?

- A sense of place is personal and varies from person to person.
- Natural and human features influence a sense of place.

4.3 Why do people live in certain places?

- Push and pull factors influence where people choose to live.
- These factors include economic, spiritual, aesthetic and cultural aspects.

4.4 What are liveable places?

- Local neighbourhood can have special meaning to some people.
- First Nations Australians often identify with their local Country.
- Holiday and tourism locations often promote a positive sense of place.
- Identifying the most liveable places differs from person to person.

4.5 What is it like living in remote places?

- Mining and farming are the main activities in remote areas in Australia.
- Australians are generally moving towards cities and major towns.
- Some Australians have left the city for more space, and they can do this because of the development of high-speed internet.
- In general, many rural communities have been in population decline in Australia.

4.6 Why do people choose to live in the country?

- Country communities, though smaller in size, are crucial to Australia's economy because of the agricultural activity that take place in these areas.
- Because country communities are small, they often have an increased sense of belonging.

4.7 Why do people choose to live in the city?

- The places people choose to live are determined by push and pull factors.
- The number of people living in urban areas continues to rise.

4.8 How do places change?

- Significant changes can occur in towns over time. Often, these changes are related to external factors such as government decisions and land management issues.
- Changes in tourism patterns can also significantly affect smaller communities.

4.9 Why do people choose to live on Country?

- First Nations Australians have a significant connection to the land.
- They treat the land like a member of their family; it is a living person to First Nations Australians.
- First Nations Australians and their traditional land management skills help achieve sustainability goals.

4.10 Investigating topographic maps — Griffith, NSW

- Topographic maps can help you understand the liveability of a place.

4.11 INQUIRY: What is my place like?

- Everyone has their own ideas of place.
- Data can help you understand and describe the demographic characteristics of your place.

4.12.2 Key terms

aerial photograph a photograph taken of the ground from an aeroplane or satellite
arid lacking moisture; especially having insufficient rainfall to support trees or plants
aspect feature or quality, or the direction something is facing
built environment a place that has been constructed or created by people
community a group of people who live and work together, and generally share similar values; a group of people living in a particular region
Country the place where a First Nations Australian comes from and where their ancestors lived; it includes the living environment and the landscape
demographic describes statistical characteristics of a population
fly in, fly out (FIFO) workers who fly to work in remote places, work 4-, 8- or 12-day shifts and then fly home
horticulture the growing of garden crops such as fruit, vegetables, herbs and nuts
infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines
irrigation water provided to crops and orchards by hoses, channels, sprays or drip systems in order to supplement rainfall
liveable city a city that people want to live in, which is safe, well planned and prosperous and has a healthy environment
location a point on the surface of the Earth where something is to be found
natural resources resources (such as landforms, minerals and vegetation) that are provided by nature rather than people
neighbourhood a region in which people live together in a community
place specific area of the Earth's surface that has been given meaning by people
pull factors positive aspects of a place; reasons that attract people to come and live in a place
push factors reasons that encourage people to leave a place and go somewhere else
region any area of varying size that has one or more characteristics in common
remote a place that is distant from major population centres
sea change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small coastal town
tree change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small country town, in the bush, or on the land as a farmer
wilderness a natural place that has been almost untouched or unchanged by the actions of people

4.12.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

What do people consider when choosing a place to live?

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 you 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-13434)
Reflection (ewbk-10549)
Crossword (ewbk-10548)

Interactivity A world of people and places crossword (int-8938)

4.12 Review exercise

Multiple choice

1. What are push factors defined as?
   - A. The positive aspects of a place, and the reasons that attract people to live there
   - B. The reasons that encourage people to leave a place and go somewhere else
   - C. The natural and human features of a location
   - D. A combination of reasons for where somewhere lives, mainly positive
2. Which two of the following facilities would you expect to find in Monkey Mia?
   - A. High-rise apartments
   - B. A general store and service station
   - C. Theme parks
   - D. Takeaway food stores
3. What are two reasons people want to live in remote locations?
   - A. Becoming very lonely living in remote locations
   - B. Opportunities for new farming enterprises
   - C. Fewer employment opportunities
   - D. Wages are quite high in remote locations
4. What is a tree change defined as?
   - A. Leaving a fast-paced urban life for a more relaxing lifestyle in a small country town, in the bush or on the land as a farmer
   - B. Planting trees to improve the vegetation of your community
   - C. Leaving a fast-paced urban life for a more relaxing lifestyle in a small coastal town
   - D. Moving to a seaside suburb
5. Generally speaking, which three of the following 'pull factors' would university students regard as reasons to live in a country town?
   - A. A tertiary institution
   - B. High unemployment rate
   - C. Effective public transport
   - D. Inexpensive student accommodation

6. The early settlers in Australia chose to live on the coast and along rivers for a number of reasons. Which of the following would *not* have been a factor?
   - **A.** Good access to sea transport
   - **B.** Milder climate
   - **C.** More scenic landscapes than further inland
   - **D.** Bays and rivers providing safe ports for ships, their main form of transport
7. Which of the following are correct in regards to the services and facilities available in country towns?
   - **A.** There are sporting activities.
   - **B.** There are no cultural activities.
   - **C.** There are no environmental groups.
   - **D.** There are social groups.
8. What does the term 'sea change' refer to?
   - **A.** Moving from the city to the coast
   - **B.** Moving to an inland location
   - **C.** Changing the natural environment
   - **D.** Changing jobs and careers
9. What factors contributed to the growth of tourism in Port Douglas?
   - **A.** Mining and population growth
   - **B.** Decreased population and stunning beaches
   - **C.** Improved road and air access, warm weather, and nearby World Heritage areas
   - **D.** High-rise buildings and city infrastructure
10. What is 'Country' for many First Nations Australians?
    - **A.** Soil, rocks and minerals
    - **B.** Cultural traditions and practices
    - **C.** Home and family
    - **D.** Urban areas

Short answer

Communicating

11. **Construct** a detailed list of factors (reasons) that influence where people live.
12. What services allow FIFO settlements such as Tom Price to exist?
13. **Explain** how the quality of the environment might differ in the following places: Sydney, Monkey Mia, Byron Bay and Melbourne.

5 Liveable places

LESSON SEQUENCE

LESSON
5.1 Overview

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What effect does the distribution of resources and services have on our concept of liveability over place and time?

5.1.1 Introduction

Your quality of life is influenced by many factors, such as climate, landscape, community facilities, the location of your home, the sense of community identity and links to other settlements. You probably have an idea of a street, town, city or suburb where you would like to live, and your opinion may be quite different from those of others. This is because other people see different factors as important. This topic looks at how people define and improve liveability.

FIGURE 1 Kolkata is one of the world's mega cities.

on Resources

eWorkbook	Customisable worksheets for this topic (ewbk-13435)
Video eLesson	Making places liveable for young people (eles-1621)
Google Earth	Kolkata

LESSON
5.2 What is liveability?

LEARNING INTENTION

By the end of this lesson you should be able to define the term 'liveability' and suggest reasons people's perceptions of liveability differ.

TUNE IN

How liveable a place is relates to a range of criteria. People place a different level of importance on varying factors, including access to healthcare and education.

FIGURE 1 Living in Bangladesh

1. Describe what you can see in **FIGURE 1**.
2. Do you think this is a liveable place? Give reasons for your answer.
3. What would you change to make this place more liveable?

5.2.1 What do people think about liveability?

If you were told that Vancouver or Melbourne was the world's best place to live in, or the world's most liveable city, what would you think this means? Do city councils just brag about how good their city is, or can liveability be measured? Is liveability the quality of life experienced by a city's residents?

Here are some examples of what fictional people think about the liveability of their community. They come from different places and they are all trying to explain what liveability means to them.

'I think a liveable city is a city where I can have a healthy life and where I can safely and quickly get around on foot or by bicycle or public transport, or even by car — as a last resort. A liveable city is a city for everyone, including children and old people, rich and poor, and people of different religions, races and fitness levels. A liveable city should be attractive, and have good schools, a choice of things to do and fresh air.'
John from Perth

‘I think that a place is liveable if I have food every day, I do not have to walk more than ten minutes to collect water for cooking and my father has work close by, so he is home for dinner. Liveability means warm weather, enough rain and being able to go to school every day.’
Nafula from Kenya

‘Liveability is all about the **natural environment**. I think a place is liveable if the air is clean, there is plenty of water in the river and there is a healthy forest nearby. Being able to grow your own food, use renewable energy and live a simple life are all a part of what is important to me and can make a place liveable.’
Joy from Huon Valley, Tasmania

natural environment elements — such as wind, soil, flowing water, plants and animals — that influence the characteristics of an area

‘Liveable cities have housing that is close to jobs, services and transport, and is available for all income levels. Neighbourhoods are pedestrian-friendly with green spaces and lively retail sectors. They are mostly car-free, and have good schools and public buildings. A liveable city needs lots of different choices, including choices in ways to live, places to work, shop and eat, and locations to linger in — whether alone or with other people.’
Alex, property developer from New York

‘A liveable place is somewhere I can have a computer and a television and a bed of my own in my own room. I would like a bike to get to school, three meals a day and two sisters. A liveable place would be clean, safe and modern. My grandmother and aunty would also live with us.’
Jing from a village in rural China

‘Liveability means that I have a good job, good food, a nice house, a newish car, nice neighbours and a **community** that cares about my family and me.’
Oscar from western suburbs of Sydney

community a group of people who live and work together and share similar values; a group of people living in a particular region

‘A liveable community offers many activities, celebrations and festivals that bring all of its residents together. Every year at Carnevale, my whole neighbourhood comes together to dance the samba. I would never wish to live anywhere else.’
Raul from Rio de Janeiro

‘The place that I think would be the most liveable is Darwin. It has great footy grounds, public transport, good food, good houses, good shops and good schools. Where I live, my house is isolated and I cannot get anywhere unless I walk. I would like to live in Darwin and play football.’
Sam from near Alice Springs

‘The community is what makes a place liveable. Being connected with my neighbours through the community gardens, food co-op, volunteer network at our kids’ school and the car-share scheme all make me feel a valued member of my community. I like knowing people who care and that we all care for each other.’
Laura from Bristol, United Kingdom

5.2 SKILL ACTIVITY: Questioning and researching

1. Ask a much older person to describe the living conditions in the community they lived in as a teenager. Record or write down their memories.
2. Ask this older person how they would have measured liveability when they were young.
3. Ask if they would describe the place they described to you in question 1 as liveable, and why (or why not). Would they have changed anything?
4. **Reflect** on what you have learnt through your conversation with an older person.
5. Do you think the current liveability of your community is better than that described by the older person? Provide examples to support your view.

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5.2 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4	3, 5, 6	7, 8, 9, 10

Check your understanding

1. Liveability means the same thing to different people. True or false?
2. Select the correct term to complete the sentence.

combine	community	complex

A _____ is a group of people who live and work together, and generally share particular values.

3. **Identify** the elements that contribute to liveability.
   - A. Community
   - B. Housing
   - C. Transport
   - D. Food and water
   - E. Education
   - F. All of the above
4. Which of the following are most likely to be important aspects of liveability for a woman in Kenya? **Select** all that apply.
   - A. Having choices in places to eat and shop
   - B. Having food every day
   - C. Being able to go to school every day
   - D. Having a good job and a nice car
   - E. Being near clean water
5. **Identify** at least three aspects of liveability that would be important for a person living in a city such as New York or Melbourne.

Apply your understanding

Communicating

6. Write a statement, similar to those in section 5.2.1, about the community that you live in that **explains** what makes it liveable.
7. Liveability means different things to different people depending on their situation.
   Consider how your liveability statement might be if you were blind, unemployed, elderly or unable to speak English. **Create** community liveability statements that reflect two of these residents.
8. Carefully read the different opinions about what makes a place liveable in this lesson.
   a. Make a list of the common themes mentioned by these people.
   b. **Identify** a shared common definition of what makes a place liveable.
   c. **Consider** the location of each place mentioned in this lesson. Does the place in which each person lives appear to influence their definition of the term liveability?
9. Sometimes living conditions can change quite quickly. **Discuss** at least one example of how natural events, political events or economic events can influence living conditions.
10. Think about your community 50 years from now. **Predict** how the characteristics of your community might be different. Include your thoughts on aspects such as housing, traffic, number of people, age of the population and the types of facilities.

LESSON
5.3 Where are the most liveable cities?

LEARNING INTENTION

By the end of this lesson you should be able to identify factors that are considered when determining a city's liveability ranking and describe the location of the most liveable and least liveable cities. You should also be able to make connections between places based on liveability factors.

TUNE IN

Did you know that the Economist Intelligence Unit publishes rankings of the world's most liveable cities? **TABLE 1** shows the rankings for 2021, where Melbourne dropped to eighth on the list — down from second in 2019. But how do they decide which cities are the most liveable?

TABLE 1 Most liveable cities, 2021

City	Rank	Country	Index	Country COVID deaths
Auckland	1	New Zealand	96.0	26
Osaka	2	Japan	94.2	13 705
Adelaide	3	Australia	94.0	910
Wellington	4	New Zealand	93.7	26
Tokyo	5	Japan	93.7	13 705
Perth	6	Australia	93.3	910
Zurich	7	Switzerland	92.8	10 844
Melbourne	8	Australia	92.5	910
Geneva	9	Switzerland	92.5	10 844
Brisbane	10	Australia	92.4	910

Source: The Economist Intelligence Unit

Brainstorm seven criteria you would choose to measure liveability. For example, your first criterion for the most liveable city could be access to clean water.

5.3.1 What is liveability?

Everyone likes to be able to tell you they are the best, or in the top 10 of some category. Cities are no different. If you look at the official websites for many international cities, they will likely tell you that they are the safest, wealthiest, fastest growing or have the best events calendar. Being able to boast that a city is the world's most liveable is great publicity.

Liveability can be defined as 'the features that create a place that people want to live in and are happy to live in'. It is usually measured by factors such as safety, health, comfort, community facilities and freedom.

5.3.2 Who says which city is the most liveable?

Several international organisations have created lists of the world's most liveable cities. These organisations each compare data and produce a table that ranks the liveability of cities. This information is collected for workers considering overseas transfers or for companies that may need to compensate workers who are transferred to a low-ranked city. The rankings can also be used to attract migrants, tourists or investment. The various rankings compare a large number of cities; however, not all cities in the world are included in each survey.

The criteria used to produce the rankings include:

- stability or personal safety (crime, terror threats and civil unrest)
- healthcare
- culture and environment (religious tolerance, corruption, climate and potential natural disasters)
- education
- infrastructure (transport, housing, energy, water and communication)
- economic stability
- recreational and sporting facilities
- availability of consumer goods (food, cars and household items).

FIGURE 1 shows the top 10 and bottom 10 in the global cities liveability rankings, as released by the Economist Intelligence Unit (EIU) in 2021. These rankings are released each year, so it is possible for you to log on (use the **Economist Intelligence Unit** weblink in your online resources) to get the most recent update to the rankings. This survey ranks 140 cities; a score of 100 equates to the perfect or ideal city. In previous years, Vienna, Melbourne and Vancouver have shared the top ranking as the world's most liveable city. In 2019, Vienna took out the number one ranking, with Melbourne pushed to second and Vancouver's ranking falling to sixth. In 2021, however, Auckland took over the top ranking, with Adelaide taking out the second spot. Melbourne fell to equal eighth spot with Geneva, and both Vancouver and Vienna dropped out of the top 10.

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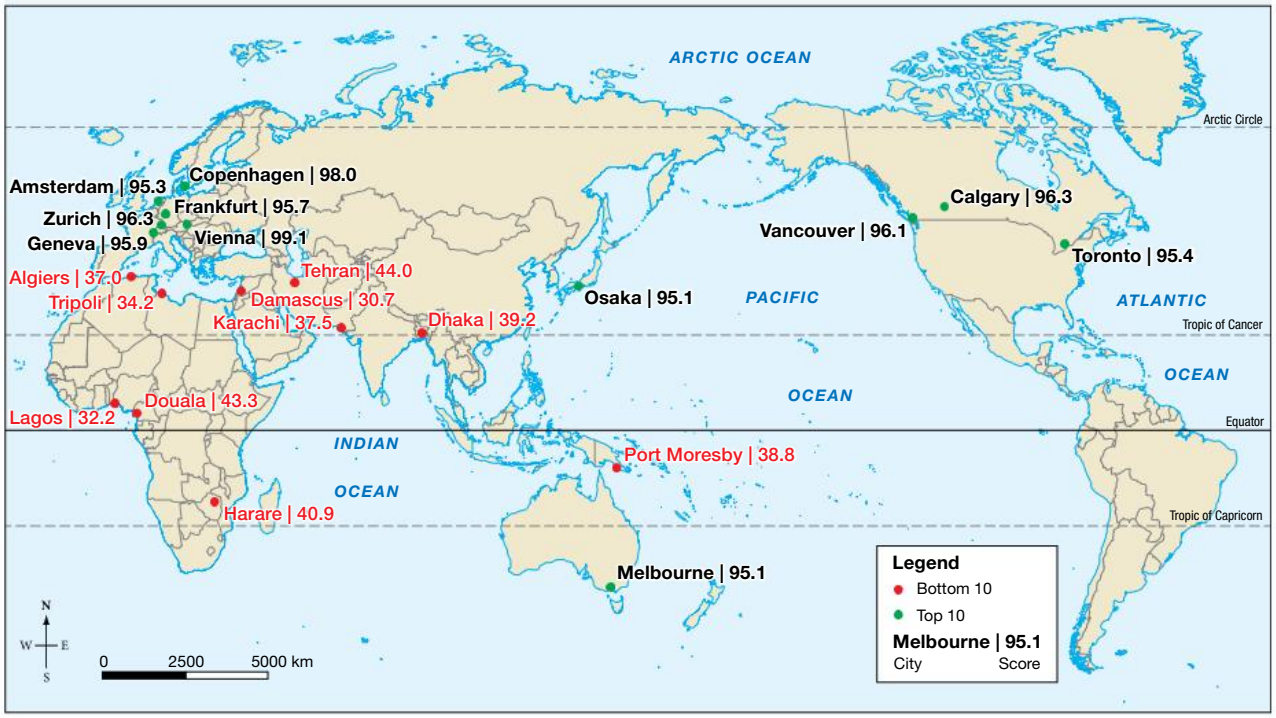
FIGURE 1 City liveability rankings



Source: Economist Intelligence Unit (EIU) 2022

The map shows that many of the world's top cities have scores that are very similar. The difference in score between the top 10 cities is only 3.6 points.

Between 2008 and 2019, the average global liveability score increased by around one percentage point. Of the 140 cities included in the liveability survey, half improved their overall status. However, between 2019 and 2021, we have seen a dramatic shift at the top of the rankings, largely due to the impact of the COVID-19 pandemic. Six cities have been forced out of the top 10 rankings between 2019 and 2021, including Vancouver, Calgary and Toronto, the only places in North America to feature in the top 10 in 2019. Over this period, the average global liveability score has fallen by seven percentage points. See **TABLE 2** for some of the changes in liveability rankings between 2019 and 2021.

TABLE 2 Changes in EIU city liveability ratings from 2019 to 2021

City	2019 ranking	2021 ranking
Vienna	1	12
Melbourne	2	8
Sydney	3	11
Adelaide	10	3
Auckland	12	1
Perth	14	6

What do these top 10 liveable cities have in common?

Looking at the locations of the most liveable cities, you can see many are found in Australia (with four cities) and New Zealand (with two); followed by Switzerland and Japan with two apiece. They are all mid-sized cities, have quite low **population density**, low crime rates and **infrastructure** that copes quite well with the needs of the local community. They are found in places with a **temperate climate**, with seasonal variations.

The top cities also tend to be modern cities, not much more than 300 years old. They have been planned so that people can travel around them by both public and private transport. They are also found in some of the world's wealthiest or most developed nations.

Australian and New Zealand cities perform better than cities in the United States due to US cities' higher crime and congestion rates. The highest ranked US city is Honolulu at 14.

How did COVID influence the rankings?

The EIU's Global Liveability Index was not published in 2020 due to the global pandemic, which made it difficult to collect comprehensive data that was fair and representative of each city. Additional data was collected in 2021 that specifically accounted for the pandemic, responsiveness of cities and their capacity to deal with COVID-19.

In the 2021 EIU rankings, the rankings of European cities fell, whereas places in Australia, Japan and New Zealand managed to remain in the top 10 or move up the rankings. Experts have noted a strong correlation between the responses of countries and individual cities to COVID-19 and their ranking in 2021.

Tough lockdowns and soaring COVID case numbers have been a defining factor in the decline of cities in the liveability rankings, particularly in Europe, where case numbers skyrocketed, and subsequent waves had a greater impact. Island nations were able to move swiftly and minimise case numbers. Lockdowns, restrictions on movement and the strain on healthcare systems have had a greater impact on the rankings than factors such as education, personal safety and infrastructure.

population density the number of people living in a square kilometre

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

temperate climate climate with generally warm summers and cool winters, without extremes

on Resources

Weblink Economist Intelligence Unit

5.3 SKILL ACTIVITY: Interpreting and analysing

1. Use a spreadsheet to collect at least five sets of data to compare the top and ten and bottom ten cities as shown on the map in **FIGURE 1**. Suitable focus areas for your data sets include:
   - population
   - population density
   - number of universities
   - number of hospitals
   - literacy rates
   - recent violence/war/civil unrest, and crime rates
   - traffic issues
   - public transport
   - infrastructure
   - water/sanitation.
2. **Create** a series of graphs to represent the data in your spreadsheet — remember to use geographic conventions and include the source of each data set.
3. **Interpret** your graphs. **Describe** the differences between the most liveable and least liveable cities. Include specific references to places and each set of data.

5.3 Exercise

learnon

5.3 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 3, 4, 7	2, 6, 8, 9	5, 10

Check your understanding

1. **Select** the correct option to complete the sentence. The Economist Intelligence Unit ranks **50** / **99** / **140** / **150** / **200** cities in their liveability rankings.
2. **Identify** the type of climatic region where most of the liveable cities are found.
   - **A.** Hot and dry climate
   - **B.** Cold climate
   - **C.** Wet climate
   - **D.** Mild climate
3. Refer to **FIGURE 1**. **Identify** the three lowest ranked cities in the 2021 liveability ranking.
   - **A.** Port Moresby
   - **B.** Damascus
   - **C.** Dhaka
   - **D.** Algiers
   - **E.** Calgary
   - **F.** Lagos
   - **G.** Adelaide
4. Analyse the information in **FIGURE 1**.
   - **a.** How many of the top 10 most liveable cities are found in each of the following regions?
     - **i.** Australia and the Pacific
     - **ii.** Africa
     - **iii.** Europe
     - **iv.** North America
   - **b.** **Identify** how many of the most liveable cities are found in the Northern Hemisphere.
   - **c.** **Identify** which two continents contain a majority of the 10 least liveable cities.
5. London and New York have a similarly low ranking. **Propose** why these well-known cities are ranked so low.

Apply your understanding

Interpreting and analysing

6. **Predict** why you think a city might suddenly fall down the liveability rankings.
7. **Propose** a strategy to improve a city's liveability ranking.
8. **Summarise** how COVID-19 affected the liveability rankings.
9. **Determine** at least two reasons Auckland might have moved from ranking twelfth in 2019 to first position in 2021.
10. Other than issues related to COVID-19, **identify** two reasons Australian cities outperform cities in the United States in the liveability rankings.

LESSON
5.4 Is Perth a liveable city?

LEARNING INTENTION

By the end of this lesson you should be able to explain why Perth is ranked highly on the liveability rankings and understand why a city's ranking might change over time.

TUNE IN

Into the Economist Intelligence Unit's first global liveability survey since the COVID-19 pandemic, Perth rose from fourteenth to sixth place. Meanwhile, Sydney and Melbourne dropped to lower positions than they held previously, with Sydney dropping out of the top 10.

1. Brainstorm a list of facts that you know about Perth.
2. From this list, highlight any facts that might make it a liveable city.
3. Brainstorm a list of factors that might have helped Perth move into the top 10 most liveable cities.
4. Discuss factors that might have caused Melbourne and Sydney to fall in the rankings.

FIGURE 1 Perth has cracked the top 10 for most liveable city in the world.

5.4.1 Perth — pluses and minuses

What makes Perth such a liveable city? Saying that a city of one of the 'most liveable' gives it a ranking, like those given to cars or restaurants. However, as is the case for Perth, that ranking can change. Why?

For a number of years, Perth was considered to be one of the most liveable cities in the world, according to the global liveability index developed by the Economist Intelligence Unit (EIU). It continues to be ranked in the top 20 in recent years, with a 2019 score of 95.9 out of a possible 100. In 2021, Perth once again found itself in the top 10, moving eight places from fourteenth to sixth with a score of 93.3.

What are some of Perth's positive features, and what are some of its less appealing features?

In 2021, Perth was awarded the maximum score of 100 for the categories of healthcare, education and Infrastructure, a score of 95 for stability, and a score of 78.2 for culture and environment.

FIGURE 2 The balance of good features and not-so-good features for Perth.

5.4.2 Is all of Perth the same?

All cities have some parts that are more liveable than others. In the case of Perth, people may have higher incomes, larger houses, more and better cars, a view of the sea or the Swan River, and better shops and entertainment facilities in certain suburbs. And even the highly liveable inner suburbs of Perth have pockets of poorer housing or homelessness; they just have fewer of them.

Like most large cities, Perth has distinct regions, with a clear north–south divide. The far northern suburbs offer the opportunity to experience a coastal community lifestyle on generous blocks of land, with improved road and rail infrastructure enabling access to the CBD. Places such as Joondalup have wide appeal to students, retirees, families and downsizers due to the range of **amenities** available within the area. Access to the far southern suburbs such as Rockingham has been improved via express train and bus services to the CBD, and these suburbs offer affordability for growing families. While Mandurah is still considered a separate city from Perth, the urban sprawl of Perth has grown so much that the two have formed a **conurbation**.

amenities desirable or useful features of a place that make it more pleasant or attractive

conurbation an extended urban area, usually made up of a town merging with the suburbs of a city

This is where cities have merged to form one continuous urban or industrially developed area. Inner-city suburbs along the north of the Swan River, such as Northbridge, Leederville and Mt Lawley, are popular with professionals, students and young couples who want access to a cosmopolitan lifestyle. Greater diversity of housing choices can be found in these areas, with their mix of heritage buildings, new homes and high-density apartment complexes. Those suburbs along the south banks, such as Como and Applecross, offer easy access to the CBD and contain a range of cafés and restaurants, while still feeling relaxed and close to nature.

FIGURE 3 Perth has a variety of amenities to offer that make it liveable.

Street performers at the annual multi-arts Fringe World Festival

Suburban area serviced by an excellent road network, including a multi-lane highway

Perth Arena is home to the Perth Wildcats; it also hosts netball and tennis, including the ATP Cup.

Optus Stadium is a 60 000 seat multi-purpose venue; it is the home ground of AFL teams West Coast and Fremantle, and hosts international and domestic cricket, soccer and rugby.

Perth and its suburbs are serviced by an excellent public transport system, officially branded as Transperth.

Cottesloe Beach is a favourite among locals for swimming, snorkelling and surfing.

Resources

Weblinks Best things to do in Perth
A tour around my city of Perth

5.4 SKILL ACTIVITY: Concluding and decision-making, Communicating

1. Use the weblinks in the Resources panel, and watch the two videos via the weblinks:
   - **Best things to do in Perth**
   - **A tour around my city of Perth**

   They look at Perth through the eyes of a tourist and a local.
2. While you are watching, take notes on the opinions of the people featured about the positives of Perth.
   - What comparisons can you make?
   - How are the opinions of the tourist and the local similar and how are they different?
   - Do they value different features?
3. **Communicate** your findings using a visual tool such as a Venn diagram.

5.4 Exercise

learnon

5.4 Exercise

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Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4, 8	3, 6, 7	5, 9, 10

Check your understanding

1. What are two ways of **describing** the weather in Perth?
   - A. Hot and dry in summer
   - B. Unreliable
   - C. Mild for most of the year
   - D. Mild in winter
   - E. Reliable and constant
2. **Identify** the organisation that ranks the liveability of cities.
   - A. Economist Intelligence Unit
   - B. United Nations Intelligence Unit
   - C. Global liveability awards
   - D. Economist Ranking Unit
3. **Describe** the difference between Perth's inner and outer suburbs.
4. **Identify** the categories in which Perth received a perfect score in the EIU 2021 global liveability index. Select all that apply.
   - A. Healthcare
   - B. Culture and environment
   - C. Infrastructure
   - D. Stability
   - E. Education
5. Look at the images of Perth in **FIGURE 3**. **Identify** and list ten liveability factors that these images illustrate.

Apply your understanding

Interpreting and analysing

6. **Identify** which of Perth's not-so-good features may have had an impact on its ranking within the culture and environment category.
7. **Propose** reasons that might explain why four of Australia's major cities are ranked in the top 10 liveable cities.
8. **Explain** how Perth's weather can be both a positive and a negative in terms of liveability.
9. In many parts of Perth, high-rise apartments rather than single dwellings on a large block are becoming more common. Suggest reasons for this trend.
10. **Explain** why Perth continues to have a high dependence on private cars, and how this affects liveability.

LESSON
5.5 Is there a connection between liveability and sustainable living?

LEARNING INTENTION

By the end of this lesson you should be able to define what is meant by sustainability and an ecological footprint, and make links between liveability, sustainability and ecological footprints.

TUNE IN

Did you know that sustainable living is linked to our ecological footprint?

FIGURE 1 Our ecological footprint comprises many different elements, including how we power our homes.

1. Brainstorm a definition of the terms 'sustainable living' and 'ecological footprint'.
2. Brainstorm a list of features that help determine our ecological footprint.
3. Categorise each feature as either having a positive or negative impact on ecological footprint.

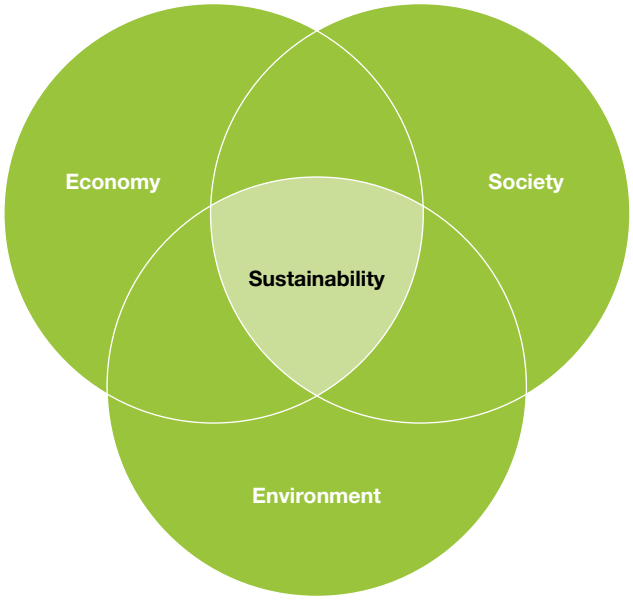
5.5.1 Sustainability

Australia's major cities consistently rate among the most liveable. Liveability, however, is not always the same as sustainability (see **FIGURE 2**). Sustainability considers how well a community is currently meeting the needs and expectations of its population, and how well it will be able to continue providing for its population in the future.

Indicators that a place is sustainable include:

- low working hours to meet basic needs
- easy access to education
- satisfactory and affordable housing
- plenty of recycling and composting
- reliable transport
- low emissions and high air quality
- **biodiversity**
- high renewable energy use and low non-renewable energy use
- good water, forests and marine health
- ability to respond to disasters.

FIGURE 2 To achieve sustainability, a city's environmental, economic and social aspects must all be considered.



Sustainable cities index

The Arcadis Sustainable Cities annual index considers 50 leading cities and ranks each against a range of indicators. These are organised under the headings of people (society), planet (environment) and profit (economy), as shown in **TABLE 1**.

TABLE 1 Top 10 sustainable cities by indicator, 2020*

Ranking	Overall SCI	Planet	People	Profit
1	Osla	Osla	Glasgow	Seattle
2	Stockholm	Paris	Zurich	Atlanta
3	Tokyo	Stockholm	Copenhagen	Boston
4	Copenhagen	Copenhagen	Seoul	San Francisco
5	Berlin	Berlin	Singapore	Pittsburgh
6	London	London	Vienna	Tampa
7	Seattle	Tokyo	Tokyo	Dallas
8	Paris	Antwerp	Rotterdam	Chicago
9	San Francisco	Zurich	Madrid	Baltimore
10	Amsterdam	Rotterdam	Amsterdam	Miami

Source: © Arcadis Sustainable Cities Index 2020, compiled in partnership with Centre for Economics and Business Research
* Most recent data available at time of printing.

Ecological footprint

Everything we do and consume has an impact on the environment. Land is cleared to grow plants and animals; fish are caught in the sea; water is diverted for homes, businesses and farms; and most transport is powered by non-renewable resources. An **ecological footprint** calculates the land area (hectares) that would be needed to

biodiversity the variety of life in the world or in a particular habitat or ecosystem

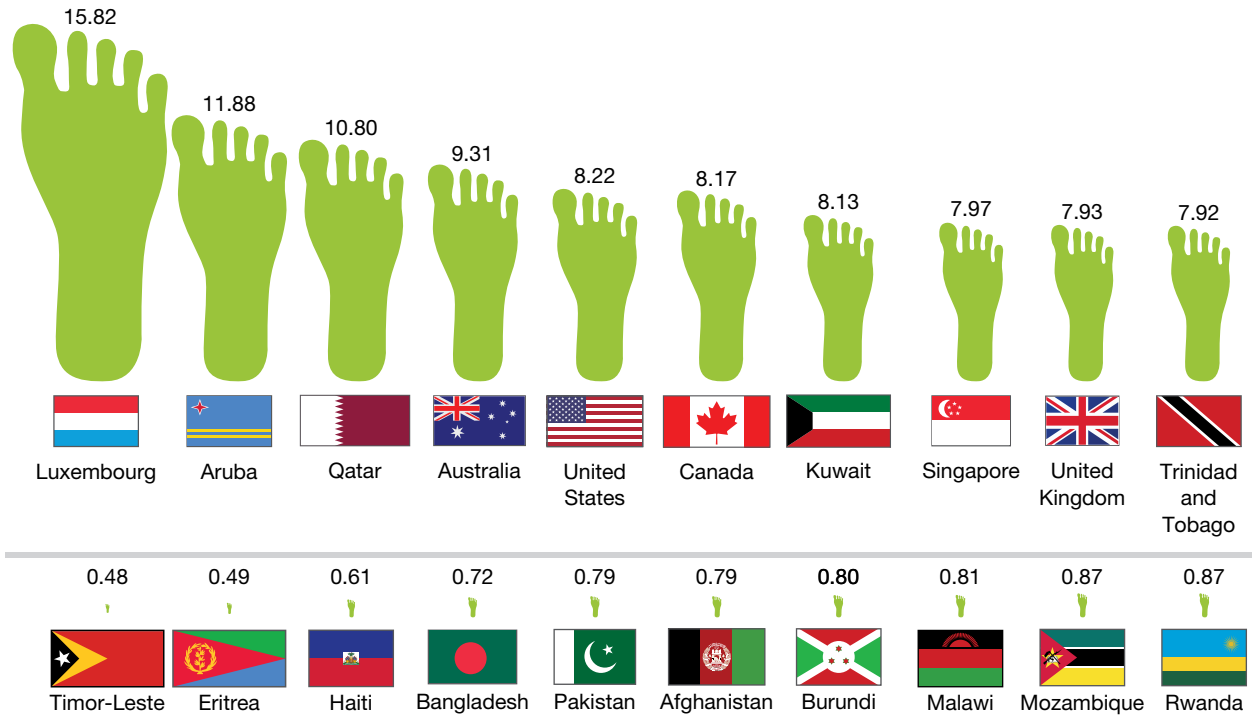
ecological footprint total area of land used to produce the goods and services consumed by an individual or country

sustain an individual (expressed as per capita). It is used to compare the amount of various resources used per capita in countries around the world.

Generally, if you live in a high-income country such as Australia, you are likely to have an ecological footprint that is much larger than a person who lives in a low-income country such as Chad in Africa. The average ecological footprint of all people on Earth is 2.7 hectares, the equivalent of 1.75 planet Earths. The average Australian footprint is about 9.3 hectares. To enjoy a sustainable way of life, the population needs to stay within the Earth's carrying capacity (meaning the maximum number of individuals of a population that the environment can support), and the average footprint should not be more than 1.7 hectares. **FIGURE 3** shows that developed countries such as Luxembourg, Aruba, Qatar, Australia, the United States and Canada far exceed this figure. In Australia, we are using resources and generating waste more than five times faster than the Earth can regenerate and absorb them. As more countries develop industries and improve their standard of living, clever responses will be needed to ensure that everyone can enjoy a high standard of liveability.

tlvd-10552

FIGURE 3 Top 10 countries with the biggest and smallest ecological footprints (hectares per capita) per person, 2022



Government policy can influence the ecological footprint through policies on power generation, transport, water, industry support, rubbish collection and building regulations. Individuals can influence the ecological footprint through what they eat and buy, how they use water and power, whether they recycle and compost, and how they build their houses and travel.

5.5 SKILL ACTIVITY: Concluding and decision-making, Communicating

1. **Conduct research** to find the following images:
   - one that shows living conditions in a country with an ecological footprint over seven hectares per capita
   - one that show living conditions in a country with an ecological footprint of less than one hectare per capita.

   Refer to **FIGURE 3** for examples of countries with large and small ecological footprints.
2. **Annotate** your images to **explain** how living conditions may have an impact on the ecological footprint.
3. Revisit the country you chose with a large ecological footprint. **Propose** a strategy that might assist in reducing the ecological footprint of this country. Make sure you fully **explain** your strategy and how it might lead to a reduction in the ecological footprint.

SkillBuilders to support skill development

- 1.12 Annotating a photograph

5.5 Exercise

learnon

5.5 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4, 6	3, 7, 8	5, 9, 10

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- Receive immediate feedback
- Access sample responses
- Track results and progress

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Check your understanding

1. **Identify** the key term that refers to the variety of life in the world on in a particular habitat or ecosystem.
   - A. Agriculture
   - B. Ecological footprint
   - C. Biodiversity
   - D. Livestock
2. **Identify** three indicators that a place is sustainable.
   - A. Unreliable public transport
   - B. Satisfactory and affordable housing
   - C. Low emissions and high air quality
   - D. Difficult access to education
   - E. Long working hours to meet basic needs
   - F. Good water, forests and marine health
3. **Identify** three aspects that are considered in a definition of sustainability.
   - A. Population
   - B. Society
   - C. Liveability
   - D. Economy
   - E. Environment
   - F. Waste
4. Refer to **TABLE 1** and your atlas and answer the following questions.
   - a. The table includes 23 cities. _____ of these are located in the continent of Europe.
   - b. **Identify** other continents that are represented in the table.
   - c. **Identify** any cities that are represented on all three lists of sustainability indicators.
5. Refer to **FIGURE 3**. **Describe** the distribution of countries with an ecological footprint of seven or more hectares per capita.

Apply your understanding

Interpreting and analysing

6. **Predict** what might happen to the global ecological footprint if liveability improves on every continent.
7. Refer to the list of indicators in section 5.5.1 that indicate that a place is sustainable. Categorise each indicator as applying to economy, society or environment. **Propose** one more indicator for each category.
8. **Consider** the ways in which resources have been used to improve liveability in your area. **Identify** an aspect you would be prepared to change a little so that others might improve the liveability where they live. **Justify** your answer.
9. **Explain** why high-income countries have a much larger ecological footprint than low-income countries.
10. a. **Explain** the term ‘carrying capacity’.
    b. **Compare** the Earth’s carrying capacity to its current ecological footprint.

LESSON
5.6 What makes a city less liveable?

LEARNING INTENTION

By the end of this lesson you should be able to identify factors that lead to a city being described as less liveable, and describe the impact of these factors on people and places.

TUNE IN

Humidity is one aspect of climate. **TABLES 1** and **2** show the humidity levels for Port Moresby in Papua New Guinea and Dhaka in Bangladesh.

TABLE 1 Humidity levels in Port Moresby

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug,	Sep.	Oct.	Nov.	Dec.
Humidity %	76	78	78	81	86	78	76	74	73	76	73	74

TABLE 2 Humidity levels in Dhaka

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Humidity %	54	50	45	56	72	80	80	79	79	73	67	64

Work with a partner to answer the following questions.

1. What is humidity?
2. Do you think the places show in **TABLES 1** and **2**, have high or low humidity? Justify your answer.
3. How do you think humidity affects liveability?

5.6.1 Port Moresby

The United Nations measures people's quality of life using the Human Development Index (HDI). In 2000, Papua New Guinea was ranked 133 in the world; in 2019 its ranking had dropped to 155 (out of 189). Its largest city, Port Moresby, faces many challenges to meet the needs of its people and improve the standard of living.

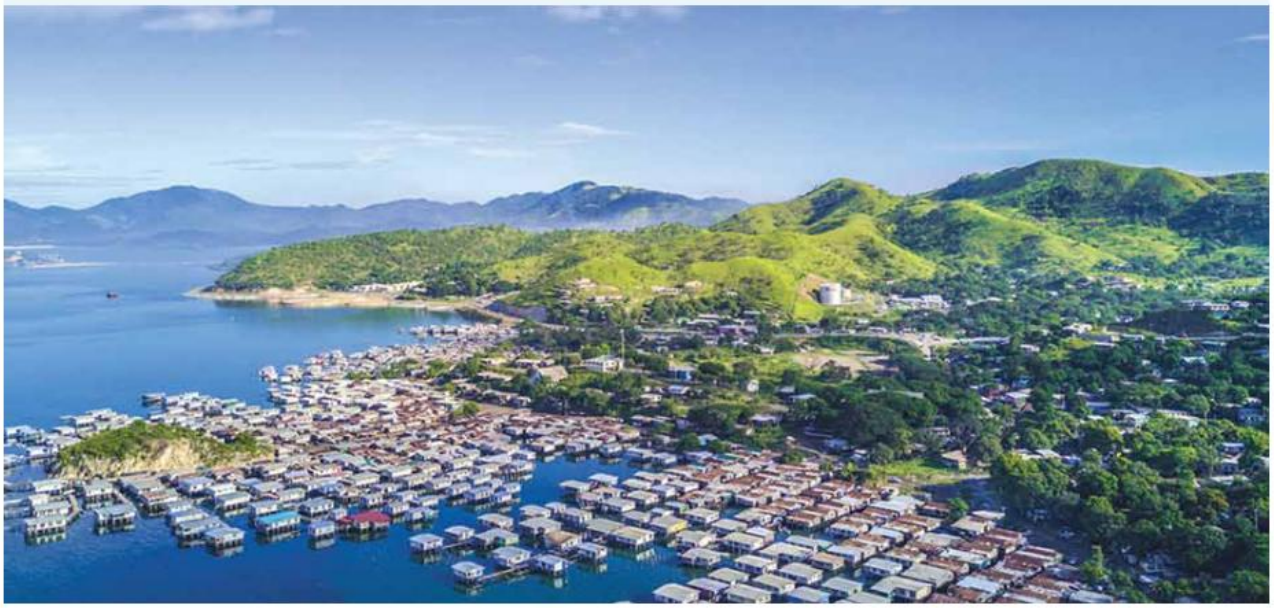
Environment

Port Moresby, the capital of Papua New Guinea (PNG) is located on the south-eastern coastline at latitude 9.44 °S. Its population is approximately 400 000 people. Covering an area of 240 square kilometres, Port Moresby has a population density of 1500 people per square kilometre.

As shown in **FIGURE 3,** Port Moresby has a hot and humid tropical climate with a distinct wet and dry season. More than 1000 millimetres of rain falls annually.

Located 35 metres above sea level, Port Moresby is vulnerable to climate change, where the impact of erosion due to rising sea-levels is evident. Low-lying areas are particularly at risk during tropical cyclone season, especially because these events are predicted to become more frequent and severe.

FIGURE 1 Aerial image of Port Moresby, Papua New Guinea



Safety

The crime rate in Port Moresby is very high, and the city has a reputation as one of the most dangerous in the world. Crimes are often very violent, and gang-based crime is common. Not enough police are available, and many crimes are never solved. Travellers are advised to be very careful, to not wear obviously expensive jewellery and to avoid travelling at night.

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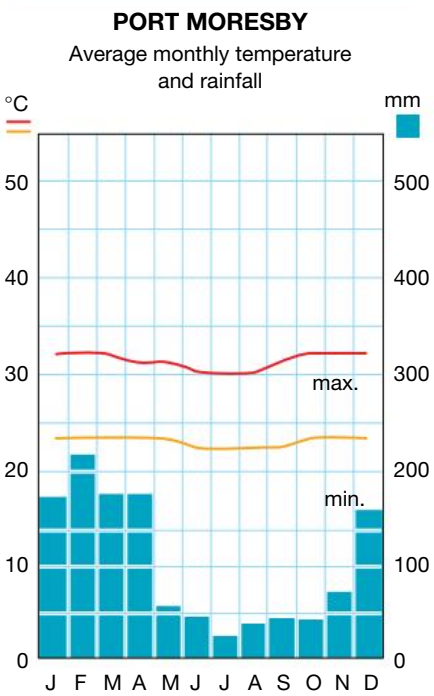
FIGURE 2 Location map of Port Moresby

Source: Spatial Vision

FIGURE 3 Climate graph for Port Moresby



Health

The government in PNG spends little on preventative measures such as clean water. It also spends little on healthcare. For instance, not all pregnant women can give birth in a hospital, which leads to many complications in childbirth.

Education

School facilities in PNG are quite poor, and attendance rates are very low, particularly for girls. Poor bus services, lack of interest and inability to pay school fees all influence the attendance rate. Only a small proportion of students complete Year 12. The **literacy rate** of 61.6 per cent is quite low by world standards.

Economy

The government in PNG applies a social security tax to both companies and employees, which is used to fund healthcare and welfare benefits. Unemployment rates are very high and most work is found in the **informal sector**. Many businesses in this sector involve selling food and other goods. About 40 per cent of the population lives on less than $1.25 a day. Fortunately, many families can take advantage of the good growing conditions to produce food to eat and sell.

Life is difficult for girls, and there is much discrimination. Not all girls get access to school; their literacy rate is lower than that of boys; child-bearing begins at a young age; and the level of violence against women is among the highest in the world.

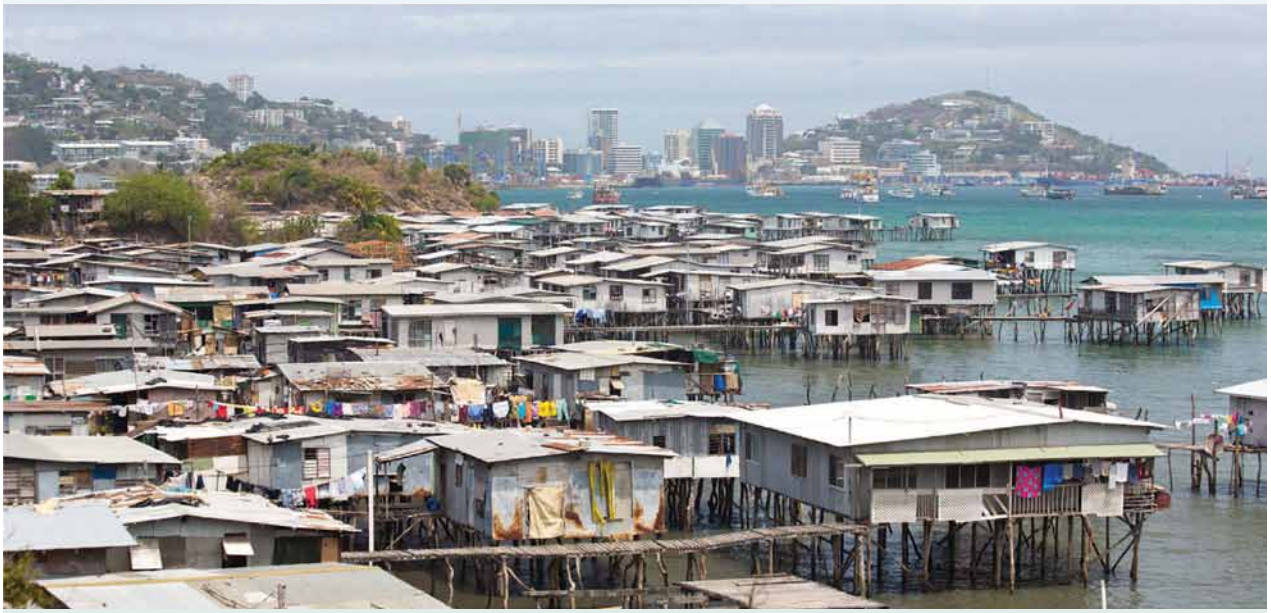
literacy rate the proportion of the population aged over 15 who can read and write

informal sector jobs that are not officially recognised by the government as official occupations and not counted in government statistics

FIGURE 4 Sick children in a ward in Port Moresby General Hospital

Infrastructure

FIGURE 5 Port Moresby is a mixture of high-rise urbanised landscapes and village landscapes.



Informal settlement

- Number growing to meet the needs of increased migration to city
- Found materials sometimes used in housing construction
- Some houses built over water to avoid disputes over land
- Streets unplanned
- Some street lighting
- Housing does not always withstand heavy rain and wind
- Poor access to power, water and sanitation
- Many households plant food crops

Formal settlement

- Street layout planned
- Rubbish collection, power, water and sanitation available
- High cost of housing and services
- Public transport
- Street lighting
- Public buildings (such as museums) and gardens
- Sealed roads

5.6.2 Dhaka — a less liveable city?

Dhaka is the capital city of Bangladesh. With a population of 22 478 116 and occupying 306.4 square kilometres, Dhaka has a population density of more than 23 000 per square kilometre. Some regions of Dhaka are similar to Australian suburban areas, with solid housing structures, shopping centres, high car ownership, and high expenditure on cars, household possessions, personal services and technology. However, the incidence of poverty and unplanned urban growth leads to the city being ranked as one of the least liveable in the world.

Environment

Dhaka is located in Asia at latitude 23.43 °N.

As you can see in **FIGURE 6**:

- there is a distinct dry season
- of total rain, 80 per cent falls in the wet season (the monsoon)
- it is often hot and humid
- approximately 2000 mm of rain falls per year
- it is warm to hot all year.

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Dhaka is only 2–13 metres above sea level. Snow-melt from the Himalayas feeds the rivers. This area is at high risk from climate change because increases in snow- and ice-melt or rainfall will add to river flow. Many rivers flow near Dhaka and the risk of flooding is high. Strong winds often occur during the monsoon, which also cause damage.

Infrastructure

The population of Dhaka is more than 22 million, and it is one of the most densely populated cities in the world. Dhaka's population has an annual growth rate of around 4.2 per cent. People migrate to the city in the hope of finding work in the growing industrial sector.

The huge influx of people has led to unplanned urban growth on vacant land, and about half the population live in slums. The government does not provide infrastructure to these slum areas.

FIGURE 6 Climate graph for Dhaka

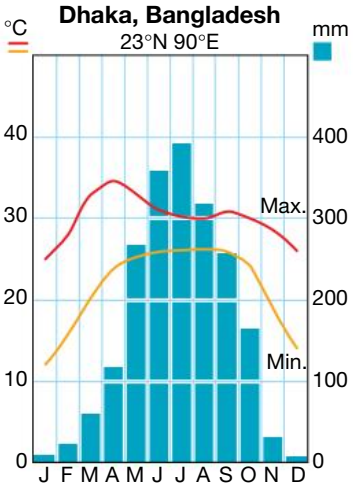


FIGURE 7 Location of Dhaka

Source: Spatial Vision

Safety

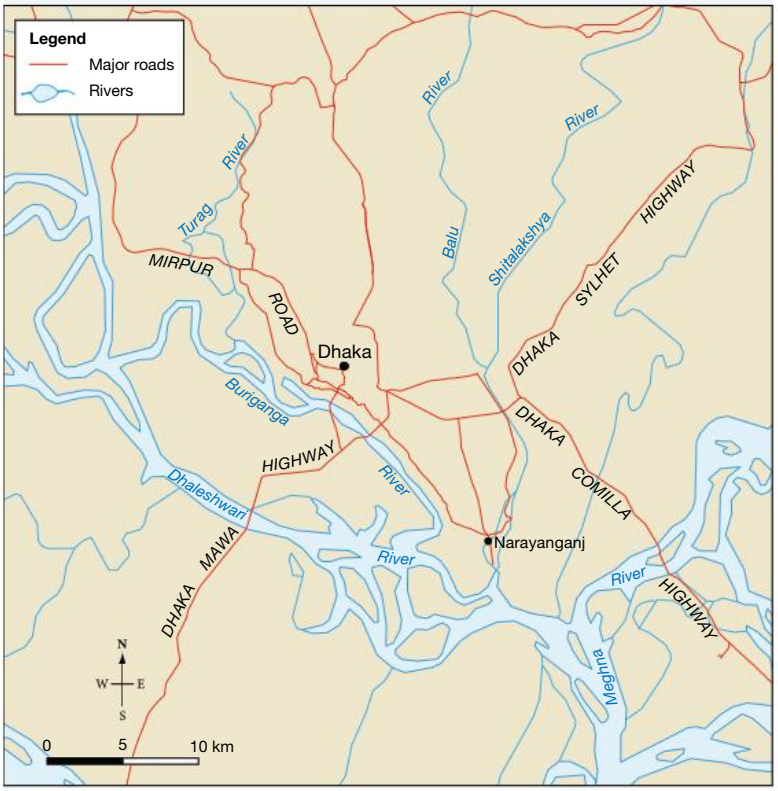
Crime rates are high in the poor areas of Dhaka. There is gangster violence; land grabbing; violence against women and children; arson; and crimes related to gambling, drugs, alcohol and illegal weapons. Not enough police officers are available, and they cannot be relied on to protect citizens.

Education

Primary education is compulsory, but the government is unable to provide enough schools and resources for the increasing population. Many students do not attend school all the time because their families need them to earn money.

In spite of the tough conditions, the education rate in the city is slightly higher than in rural areas, and the national literacy rate is about 75 per cent.

FIGURE 8 Map showing many rivers that flow through and around Dhaka



Source: © OpenStreetMap contributors

FIGURE 9 A communal water pump in a slum region

Water is not pumped to houses.

Houses are built from found materials.

Some people have to walk 900 metres to a toilet.

Gangsters control the cost and supply of electricity.

Roads are poor and congested.

There are no gutters or sewerage systems.

FIGURE 10 This woman has to walk through floodwaters to collect drinking water. Poor areas have no drainage, and floodwater quickly spreads into houses and over paths.

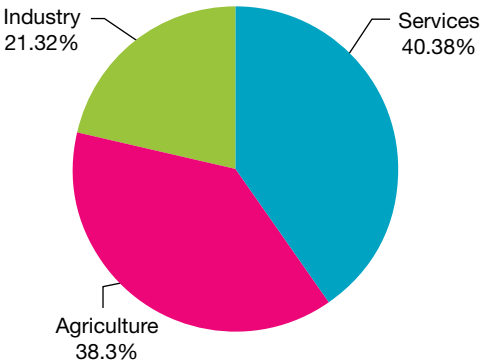
Economy

Most jobs are found in the informal sector; examples include rickshaw driver, street vendor and garment worker. Women are excluded from trades and transport, and most find work as servants or in agriculture. (Food is grown on vacant land within and around the city.) The pay in these types of jobs is low, and most or all household members need to work.

Child labour is common. It is estimated that 8 per cent of children under the age of ten are working, predominantly in the manufacturing sector. Between the ages of 8 and 14 it is estimated that almost 50 per cent of children have full-time jobs. Children as young as six have been found working instead of attending school.

In 2019 about 20.5 per cent of the population lived below the poverty line, surviving on less than $1.90 per day. This is an improvement on the 2016 rate, when 24.3 per cent of the population was classed as living below the poverty line. Even with these disadvantages, many people think the city offers a better quality of life than the rural areas do.

FIGURE 11 Employment by sector in Bangladesh



Healthcare

Healthcare is mainly provided through hospitals, which are located in the **formal** part of the city. There is a shortage of hospital beds, equipment, doctors and nurses. The slums have no medical facilities, and often families cannot afford to pay for treatment. Private charity groups do offer some programs, particularly for maternal health.

formal describes an event or venue that is organised or structured

FIGURE 12 Children as young as seven undertake exhausting work. This child is earning $1 a day.

on Resources

Interactivities	Environmental quality (int-3096) Safe as houses (int-3097)
Weblink	Slum life
Google Earth	Port Moresby Dhaka

5.6 SKILL ACTIVITY: Questioning and researching, Communicating

1. Choose one of the other least liveable cities (refer to lesson 5.3) and **investigate** how its natural environment creates challenges and provides benefits. **Consider** the city's location, climate and landscape.
2. Find an image of your chosen city that you think best reflects what you discovered during your investigation.
3. **Annotate** this image to communicate your findings.

5.6 Exercise

learnon

5.6 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 3, 7	4, 8, 9	5, 6, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
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Check your understanding

1. Refer to **FIGURE 2**. The latitude of Port Moresby is _____° south of the equator.
2. Why don't all children attend school in Port Moresby? Select all possible answers from the provided options.
   - **A.** It is often difficult to get to school.
   - **B.** There are no schools to go to.
   - **C.** Not all parents can afford the fees.
   - **D.** There can be little encouragement to attend.
   - **E.** All children do attend school because it is compulsory.
3. **Identify** the sector of the economy where most people find work in Port Moresby.
   - **A.** Formal sector
   - **B.** Service sector
   - **C.** Informal sector
   - **D.** Manufacturing sector
   - **E.** Business sector
4. Port Moresby is heavily influenced by its environment. **Explain** how environmental quality (such as climate) can influence living conditions in Port Moresby.
5. **Explain** why travellers are advised to be careful in Port Moresby.

Apply your understanding

Interpreting and analysing

6. Refer to **FIGURE 4**. **Describe** the biggest health issue facing Port Moresby.

Communicating

7. Dhaka is heavily influenced by its natural environment. **Explain** how the natural environment influences life in Dhaka.
8. Complete the following to **compare** Papua New Guinea and Australia.
   - **a.** The literacy rate in Papua New Guinea is _____ than in Australia.
   - **b.** The life expectancy in Australia is _____ than in Papua New Guinea.
   - **c.** Papua New Guinea was ranked _____ than Australia on the HDI index.
9. **Compare** the population of Dhaka with the population of Australia.

Interpreting and analysing

10. Life in the Dhaka slums is affected by a variety of factors.
    - **a.** **Explain** how the lack of resources that are normally provided by government (such as water, healthcare, education and safety) affect the people living in Dhaka.
    - **b.** **Explain** why very young children go into the workforce in Dhaka.
    - **c.** **Propose** reasons for the continued growth of Dhaka, even though it rates poorly in terms of liveability.

LESSON
5.7 How can liveability be improved?

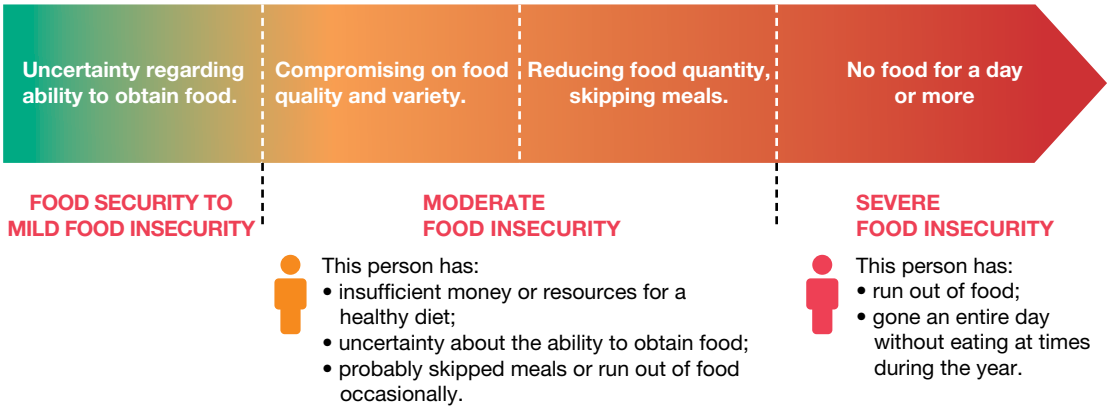
LEARNING INTENTION

By the end of this lesson you should be able to make links between hunger and liveability, identify reasons for the unequal distribution of food across the world, and explain how assistance from other countries can improve liveability.

TUNE IN

The Food and Agriculture Organization of the United Nations is the main international body driving global efforts to defeat hunger.

FIGURE 1 Defining food insecurity



Source: Food and Agriculture Organization of the United Nations.

1. What do you think is the link between hunger and food insecurity?
2. Brainstorm a list of reasons as to why people in some parts of the world have more than enough to eat, while in other regions they are starving.

5.7.1 Distribution of hunger

A basic human requirement is food, and access to enough food is a strong measure of liveability. Even in a world with plenty of food and where millions of people are overweight, about one person in nine does not have enough to eat.

Approximately 663 million **undernourished** people are in the world today. Many children in poorer countries are underweight and do not get enough food to be healthy and active. In 2000, 33 per cent of children in the world suffered from chronic malnutrition. This figure has fallen to 23 per cent today.

Three-quarters of all hungry people live in rural areas, mainly in the villages of Asia and Africa (see **FIGURE 2**). Most of these people depend on **agriculture** for their food. They rarely have other sources of income or employment. As a result, they may be forced to live on one-quarter of the recommended calorie intake and a small amount of water each day.

If enough rain does not fall at the right time of year, crops will not grow well and there will be little grass for **livestock**. However, rainfall is not the only factor contributing to hunger. **FIGURE 3** summarises causes of hunger.

undernourished not getting enough food for good health and growth

agriculture the cultivation of land, growing of crops or raising of animals

livestock animals raised for food or other products

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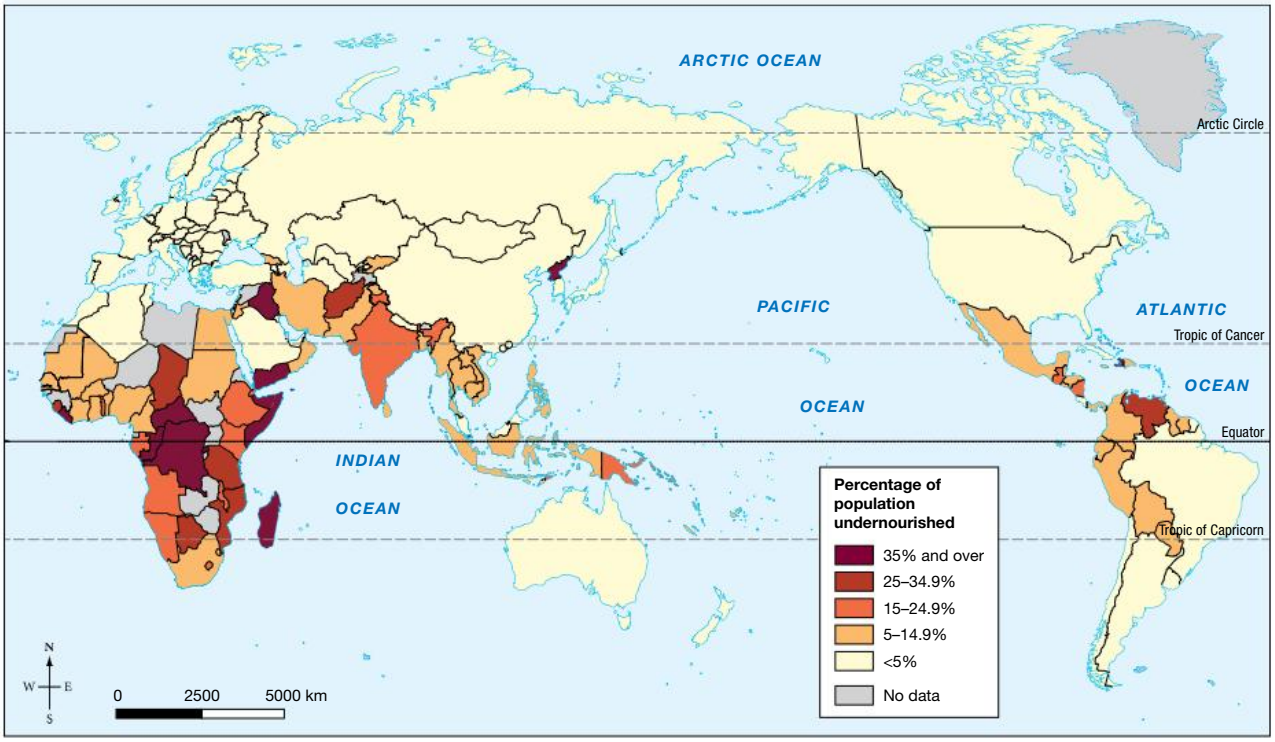
FIGURE 2 Distribution of hunger, 2019



Source: Food and Agriculture Organization

FIGURE 3 Causes of hunger

Conflict becomes more important than food production. Farmers have difficulty getting to and from markets, crops are destroyed, many are forced off the land, and fields and water may be contaminated.			There is a lack of key agricultural infrastructure, such as roads, warehouses and irrigation. The results include high transport costs, lack of storage facilities and unreliable water supply.
Growing export crops such as coffee, cocoa and sugar produces export income while decreasing basic food production. Food becomes expensive.			The poverty cycle means the poor cannot afford to buy or produce enough food. This leaves them hungry and weak and less able to produce more food.
Poor farming techniques, deforestation, overcropping and overgrazing reduce soil fertility.			Extreme weather events such as floods, tropical storms and long periods of drought ruin crops and infrastructure.

5.7.2 Impact of hunger

A lack of energy and poor health caused by a lack of food are made even worse by poor nutrition.

TABLE 1 The impact of hunger is felt by individuals, families, communities, regions and whole countries.

Social impacts	Economic impacts	Environmental impacts
People become unwell. Many people (particularly children) die. Fathers leave in search of work. Political unrest emerges.	Food production declines. The population of cities grows. Poverty increases. The government cannot afford new infrastructure.	Soil is overused. Too much land is cleared. Soil fertility and local biodiversity decline.

5.7.3 Ending hunger

A range of organisations focus on reducing hunger. Sometimes food is provided for immediate consumption and sometimes projects are undertaken to increase food production in the future. Actions can happen on a range of scales:

- Individuals in any country can join groups or donate to organisations that work to reduce hunger.
- The government of the affected country can provide assistance to the poor or improve infrastructure.
- Other countries can provide financial and food aid or consider the impact of their own policies.
- The United Nations and its various agencies can provide assistance through initiatives such as the World Food Program.

5.7.4 Sustainable Development Goals

Many countries cannot afford to provide infrastructure for their growing population. The underlying cause of very low liveability is poverty. Reducing poverty is fundamental to improving living conditions in many parts of the world.

United Nations Sustainable Development Goals

The United Nations (UN) is an organisation with members from 193 countries. In 2000, 189 countries signed a pledge to free people from extreme poverty by 2015 (as part of the Millennium Development Goals 2000–2015). In 2015, a new pledge was signed with 17 goals, each with specific targets to be reached over 15 years (known as the Sustainable Development Goals 2015–2030). The second of these Sustainable Development Goals is zero hunger, with the aim to 'end hunger, achieve food security and improved nutrition and promote sustainable agriculture'. **TABLE 2** shows the eight Millennium Development Goals and 16 of the Sustainable Development Goals.

Australian government and NGOs

The Australian government recognises that we are **global citizens**, and it supports an overseas aid program through its Department of Foreign Affairs and Trade. Overseas aid helps improve outcomes in health, education, economic growth and disaster response in many locations (see **FIGURE 4**).

The Australian government runs projects to improve living conditions, often working with other countries or with **non-government organisations** (NGOs). NGOs also run programs on their own. Well-known NGOs include World Vision, CARE Australia and Australian Red Cross.

global citizens people who are aware of the wider world, try to understand the values of others, and try to make the world a better place

non-government organisations non-profit groups run by people (often volunteers) who have a common interest and perform a variety of humanitarian tasks at a local, national or international level

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TABLE 2 UN Development Goals

Millennium Development Goals 2000–2015	Examples of achievements of MDGs	Sustainable Development Goals 2015–2030	
Eradicate extreme poverty and hunger	Fewer people live in extreme poverty.	No poverty	Industry, innovation and infrastructure
Achieve universal primary education	Primary school enrolments have increased.	Zero hunger	Reduced inequalities
Promote gender equality and empower women	Many more girls are attending school.	Good health and wellbeing	Sustainable cities and communities
Reduce child mortality	More babies are surviving.	Quality education	Responsible consumption and production
Improve maternal health	More mothers have access to healthcare when giving birth.	Gender equality	Climate action
Combat HIV/AIDS, malaria and other diseases	Vaccination has reduced incidence of measles.	Clean water and sanitation	Life below water
Ensure environmental sustainability	Safe water is available to more people.	Affordable and clean energy	Life on land
Develop a global partnership for development	Huge increase in number of people with phone and internet	Decent work and economic growth	Peace, justice and strong institutions

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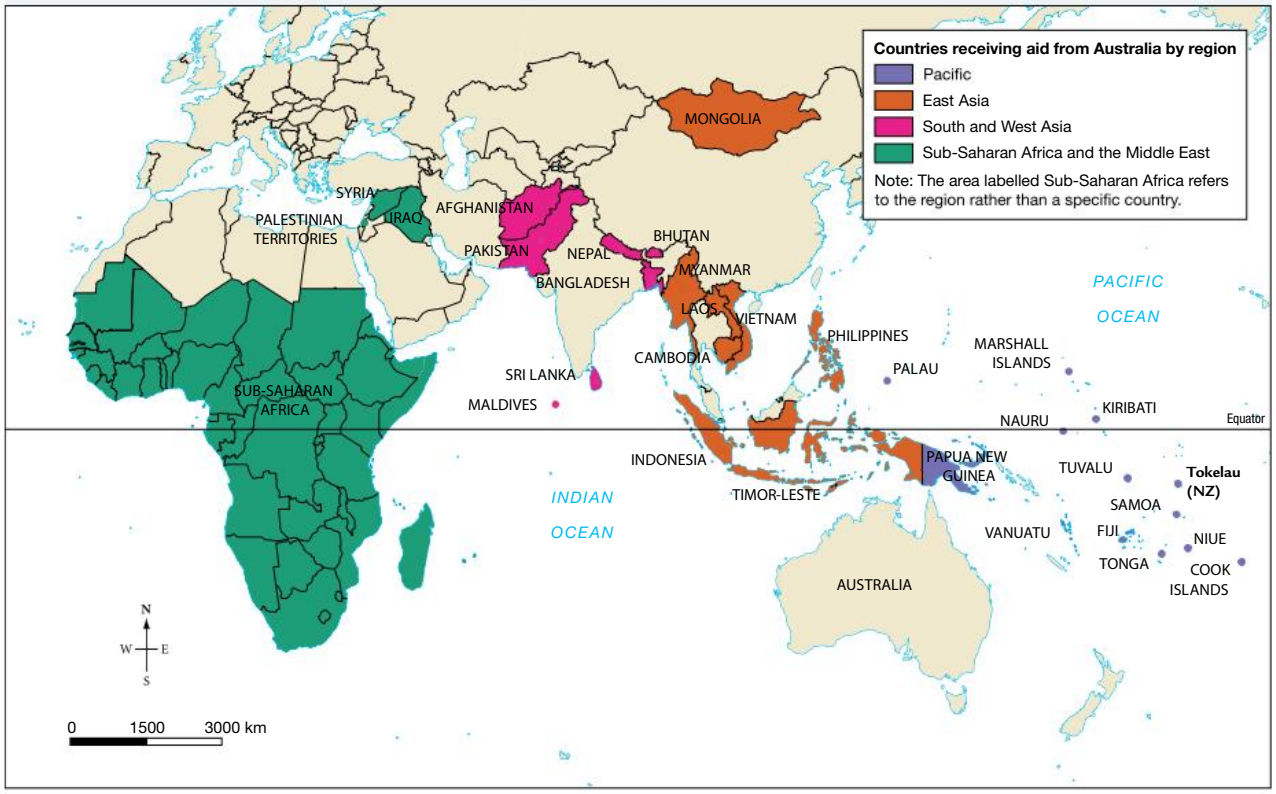
FIGURE 4 Countries receiving assistance from Australia



Source: Department of Foreign Affairs and Trade

FIGURE 5 Examples of projects to improve liveability: (a) a child immunisation clinic on the Kokoda Track (b) building schools and improving education in Indonesia (c) planting grasses in Fiji to stabilise sea banks

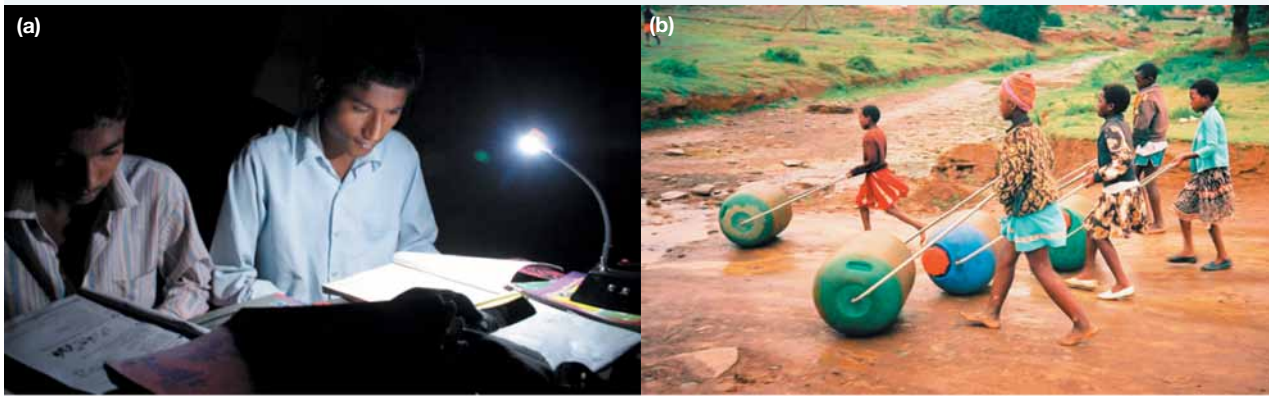
Small changes, big results

Simple and **appropriate technology** can make an enormous difference to people's lives in developing countries (see **FIGURE 6**). In addition, a small amount of money can sometimes make a big difference to an individual or community group.

Microfinance, or microcredit, is a system of lending small amounts of money, perhaps $150. The money is used to invest in something that can generate income. A person might buy an animal for milking and breeding, equipment for basket-making, stock for a store, or materials for jewellery-making. The loan must be repaid, but at a low interest rate, and further loans can be taken out.

appropriate technology
technology designed specifically for the place and the people who will use it; features include being affordable and repairable locally

FIGURE 6 Appropriate technology: (a) electricity in Nepal is not available to all houses, so a solar lamp increases the opportunities to read. (b) In South Africa, people push hippo rollers, which make it easier to collect water from distant wells and bring it home.



5.7 SKILL ACTIVITY: Concluding and decision-making and Communicating

1. Choose one of the Sustainable Development Goals shown in **FIGURE 7**. Use the **Sustainable Development Goals** weblink to find out more details.

FIGURE 7 The 17 Sustainable Development Goals

2. Use a visual organiser, such as a flowchart or diagram, to **brainstorm** how achieving this goal will improve liveability.
3. **Evaluate** your ideas by considering the flow-on effects and the impact on society, the economy and the environment. **Summarise** this in a brief paragraph or two.
4. **Communicate** your evaluation to your teacher or class.

on Resources

Weblink Sustainable Development Goals

5.7 Exercise

learnon

5.7 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
2, 3, 5, 6	1, 7, 8	4, 9, 10

These questions are even better in jacPLUS!

- Receive immediate feedback
- Access sample responses
- Track results and progress

Find all this and MORE in jacPLUS

Check your understanding

1. Refer to **FIGURE 2** and select the appropriate word from the word list to complete this sentence.

Australia	Arctic Circle	Asia-Pacific	Sub-Saharan Africa	Latin America Caribbean

_____ has the largest percentage of its population undernourished and _____ has one of the lowest.

2. **Select** the correct options to complete the sentence.
Most of the world's hungry people live in **cities** / **rural villages** / **inner suburbs** / **coastal towns** in **Asia and Europe** / **Asia and Africa** / **North America and Africa**.
3. Refer to **FIGURE 2**. The map indicates that the highest number of undernourished people are in Africa. True or false?
4. Poor roads contribute to hunger. **Explain** the connection between poor roads and hunger.
5. **Identify** the organisation that developed both the Millennium Development Goals and the Sustainable Development Goals.

Apply your understanding

Interpreting and analysing

6. Consider **TABLE 1** in section 5.7.2. **Propose** one more example for each category of impact — social, economic and environmental.
7. Study the images in **FIGURES 5** and **6**. **Identify** the Sustainable Development Goals that have been addressed in these projects.
8. Refer to **FIGURE 4**. **Describe** the distribution of places that receive aid from Australia. Think in terms of region, such as Asia, East Asia, the Middle East, South Asia, West Asia, Pacific, Africa and the Caribbean.

Communicating

9. **Explain** how simple technology and microfinance are transforming lives in developing countries.
10. **Explain** why addressing issues related to hunger is an essential component of improving liveability.

LESSON
5.8 What makes our communities liveable?

LEARNING INTENTION

By the end of this lesson you should be able to identify strategies that can be employed at the local level to enhance the liveability of places for different people.

TUNE IN

In a liveable community, the needs of a broad spectrum of people are catered for.

What is on your wish list?

1. Brainstorm a list of characteristics or features that are essential in your community.
2. Compare your list with the other members of your class. Do any items appear on most people's lists? Is anything missing?
3. Work collaboratively to determine the top five or six characteristics that make your community liveable.

FIGURE 1 Improved beach access is on some people's wish list.

5.8.1 Liveability studies

A study of a region's liveability will reflect its natural characteristics and human characteristics. All communities would like a safe, healthy and pleasant place to live, a sustainable environment, the chance to earn a liveable wage, reliable infrastructure and opportunities for social interaction.

The findings of a liveability survey will be influenced by a range of factors.

- Where a person lives influences their access to services, employment and environmental features, and their address may influence their perception of the quality of the region.
- Different age groups have different views and needs.
- Current economic conditions influence a person; for example, a major employer may have closed or opened.
- Environmental conditions affect a person; for example, a region may be experiencing drought.
- Government policies influence infrastructure, housing assistance and grants to local sports clubs.

To find out about the liveability of an area, a number of themes need to be investigated. Some of these can be gained from **census** statistics, while others can be gained only through surveys and fieldwork.

census a regular survey used to determine the number of people living in Australia; also has a variety of other statistical purposes

In any community, agreement will usually exist about some things that improve liveability. All groups accept that safe water, sealed roads and a reliable power supply are important. If a community wants to obtain certain kinds of items on its liveability 'wish list', it sometimes needs help from national, state or local government.

Examples of such items include major roads, railways and desalination plants. Sometimes, though, a wish-list item is best obtained by an individual or community. This is the case when setting up sporting clubs, youth groups and local music events.

TABLE 1 Matching liveability indicators to key themes

Measure	Examples of indicators	
Social	• Population characteristics (gender, age) • Education (primary, secondary, tertiary) • Health (life expectancy, health-centre attendance, length of walking tracks, smoking rates, weight, chronic diseases) • Safety (perception, crime rates, road deaths and injuries, work safety)	• Volunteering • Voting • Aged care accommodation • Access to public transport • Membership of clubs and organisations • Diversity (ethnicity)
Environmental	• Biodiversity • Planning for the future • Water access • Waste management • Ecological footprint	• Public spaces • Household recycling • Weather • Land clearing
Economic	• Employment • Variety of businesses • Income • Financial stress • Housing types	• House ownership • Infrastructure • Internet access • Power • Car ownership

FIGURE 2 Community wish list: some aspects of liveability are common to all groups and some are desired by particular groups.

Community wish list

- Family housing
- Financial security
- Friendly community
- Health services
- Neighbourhood house
- Parks and gardens
- Paths for prams
- Paths for scooters
- Playgrounds
- Primary schools
- Public seating
- Public transport
- Recognition of those from non-English-speaking backgrounds
- Shopping nearby
- Single-person housing
- **University of the Third Age**

5.8.2 Transport strategies

People in towns and cities are always looking for strategies to improve their living conditions. A community is made up of people from a range of age groups, a number of different land uses, a range of needs and a variety of interests. Ideas and plans for improvement may be overarching or targeted.

The movement of people within and between neighbourhoods is an important issue in towns and cities. The humble bicycle is now seen as a way of increasing mobility, reducing traffic congestion, reducing air pollution and boosting health. Bicycle tracks encourage recreational riding for all ages (see **FIGURE 3**), while dedicated bicycle paths along main routes (see **FIGURE 4**) encourage people to commute by bicycle, rather than car, to work and school.

FIGURE 3 Recreational riding along a trail mainly designed for bicycles

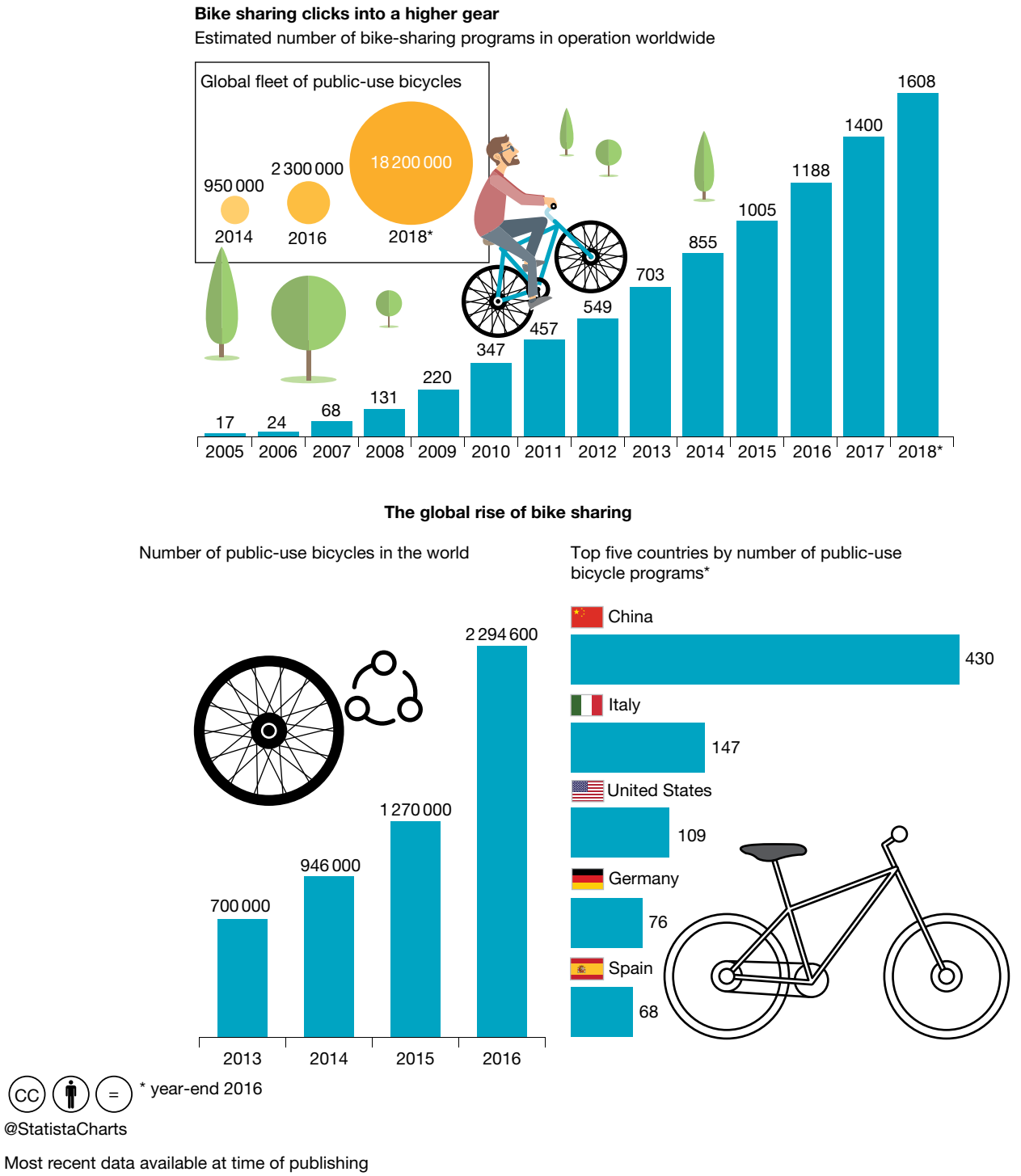
FIGURE 4 Special bicycle lanes increase the safety of bike riding.

In 1965, a group in Amsterdam, the Netherlands, introduced the idea of bike sharing — public bicycles that are hired, usually for short trips. This first attempt was not a success, but the idea persisted. Modern bike-sharing systems have overcome problems of theft and vandalism by using easily identifiable specialty bicycles, monitoring the bicycles' locations with radio frequency or GPS. Additionally, a credit-card payment or smart-card based membership is required to check out bicycles. In some places, bicycles can be located on your mobile phone, and links between bicycle lanes and existing public transport are increasing. Between 2014 and 2018, bike-sharing programs doubled in size. More than 3000 programs are now in operation, providing almost 18.2 million bikes to 20 million registered users.

University of the Third Age
an international movement that promotes lifelong learning; focuses on engaging with specific areas of interest as a person's working and parenting life scales down (referred to as the 'Third Age')

Copenhagen was rated as the world's most bike-friendly city in 2014 and has retained this position every year since. Over half the population rides a bike to work, collectively covering a distance of 1.44 million kilometres each day. Beijing is the world leader in bike-share programs, with 2.4 million share bikes and 11 million registered users. Bike-sharing programs are an example of a popular strategy that is aimed at improving liveability for a range of ages and locations within a community.

FIGURE 5 Bike sharing is on the rise globally.



An example of a successful bike-sharing scheme is in Paris. The Vélib was introduced in 2007 and quickly doubled in size. By 2012, bicycle trips in the city had grown by 41 per cent. The program continues to grow and today has more than 200 000 bikes and 1800 share stations, each around 300 metres apart. Of the total bike-share fleet, 40 per cent now have an electric motor with a range of around 50 kilometres when fully charged. These new bikes also have a basket with a carrying capacity of 50 kilograms. The program has proved popular among locals and tourists. It boasts 400 000 subscribers and millions of trips are registered each month. During peak times in summer, a single bike may clock up more than ten journeys.

It is anticipated that the new electric bikes will overcome problems associated with maintaining a share-bike program in hilly or uneven terrain, where commuters will ride a bike downhill in the morning, but then elect to return home using alternative transport — leading to a surplus of bikes in one area and a lack of them in others. Bike sharing is also part of a plan to reduce car traffic and pollution in Paris, which includes closing streets to cars on weekends, reducing speed limits, encouraging bus travel and extending bicycle lanes.

Resources

Weblink Bike sharing
Google Earth Amsterdam

5.8 SKILL ACTIVITY: Communicating

1. Some cities provide schemes to encourage people to ride bikes. **Conduct research** to find out about the success of bike incentive schemes in European cities. Include the following:
   - the name of the city
   - the date of the scheme
   - a summary of the scheme
   - evidence of success or failure of the scheme.
2. **Predict** whether a similar scheme would be viable in the area where you live.
   a. Would the scheme work as it is?
   b. What modifications might be needed? Why?

5.8 Exercise

learnon

5.8 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 5, 10	4, 6, 7	3, 8, 9

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Check your understanding

1. **Identify** the three measures used when investigating liveability.
   A. Population
   B. Social
   C. Environmental
   D. Economic
   E. Sustainability
2. All information to determine the liveability of an area can be obtained from census statistics. True or false?
3. a. Refer to **TABLE 1** and **identify** two aspects that could be placed in a different theme. **Justify** your suggested change.
   b. **Propose** one more indicator that should be included. In which theme would it belong?

4. **Recall** three advantages of increasing bicycle riding.
5. **Identify** the problems that were faced by the first bike-sharing schemes.
   - **A.** Increased accidents
   - **B.** Reduced cars on the road
   - **C.** Theft and vandalism
   - **D.** Increased public transport use
   - **E.** None of the above

Apply your understanding

Interpreting and analysing

6. Refer to **FIGURE 2**. **Compare** and **contrast** the liveability wish lists for young families and older people. You may wish to present your answer in a visual way (for example, as a Venn diagram).
7. Liveability means different things to people of different ages.
   With the use of an example, **demonstrate** how improving liveability for one age group might help the liveability of another age group.
8. Refer to **FIGURE 5**.
   - **a.** **Propose** a reason for the rapid increase in the number of share bikes in cities around the world.
   - **b.** **Propose** a reason China is the fastest growing market for share bikes.
   - **c.** **Explain** how the introduction of electric bikes might encourage more people to use share bikes.
   - **d.** **Predict** potential problems that might be caused using electric bikes.
9. Refer to the community wish list in section 5.8.1. **Identify** three items from the community wish list that you think are most needed in the area you live in. **Justify** your answer.
10. **Discuss** whether a bike-sharing scheme would be a viable option in your area. **Justify** your answer.

LESSON
5.9 How does connection to Country make places liveable?

LEARNING INTENTION

By the end of this lesson you should be able to explain why connection to Country makes places liveable for First Nations Peoples of Australia.

TUNE IN

Did you know that smoking ceremonies by First Nations Peoples of Australia have been held for more than 60 000 years? It is believed that the smoke produced by native vegetation has cleansing properties and will keep bad spirits away. Smoking ceremonies are conducted when people arrive on Country (or to specific places on Country) as a way of cleansing them before they continue to travel about Country. Once cleansed, they are given safe passage to continue their journey.

1. What do you think the people in **FIGURE 1** are doing?
2. How do you think this type of ceremony promotes connection to Country?

FIGURE 1 First Nations Australians have held smoking ceremonies for millennia.

5.9.1 The Yolngu Peoples of Arnhem Land

The Yolngu Peoples are the traditional custodians of 55 000 hectares of land in the Northern Territory. It is a diverse landscape comprising rocky outcrops, floodplains, white-sandy beaches and rugged coastline.

Despite constant pressure to adopt the western lifestyle of non-Indigenous people, the Yolngu Peoples have maintained their close connection to **Country** and their cultural ancestry, which dates back more than 50 000 years. With more than 40 languages spoken across Eastern Arnhem Land, English is the second or third spoken language of the people who make up the First Nations population.

FIGURE 2 Arnhem Land, Northern Territory

5.9.2 The Wurundjeri Peoples of the Kulin Nation

Wurundjeri lands extend over approximately 12 500 square kilometres, taking in the areas from what is now known as the Yarra River in Melbourne and extending as far as Whittlesea, Macedon, Lancefield and Woodend. They trace their ancestry back to over 65 000 years ago, when the creator spirit formed their land, people and all living things.

The Wurundjeri connection to land and Country is governed by their cultural and spiritual values. Central to these beliefs is the notion of belonging to the land rather than owning the land. They did not build permanent settlements but rather lived a cyclical lifestyle. They set up temporary camps within defined boundaries and moved to a new area when the land needed time to regenerate, returning only when the land could sustain them again. The land catered for all their needs, such as food, water, medicine and shelter. The people in turn treated the land with respect, taking only what they needed and caring for the land.

Country the place where a First Nations Australian comes from and where their ancestors lived; it includes the living environment and the landscape

FIGURE 3 Healesville is part of the Wurundjeri lands

5.9.3 Why do First Nations Peoples of Australia choose to live on Country?

First Nations Peoples of Australia have a deep spiritual connection with the land. For tens of thousands of years, they have lived in harmony with the natural world and placed immense value on sustaining the resources of Country. The land has sustained them and provided all their needs. Rather than simply seeing the land, they regard the land as the foundation of all their people — past, present and future.

Connection to Country is seen as highly spiritual and entwined with both their sense of belonging and their identity. Country is more than the physical land; it also includes the plants, sky, animals, people, customs, seasons, language, creation spirits, cultural practices and heritage.

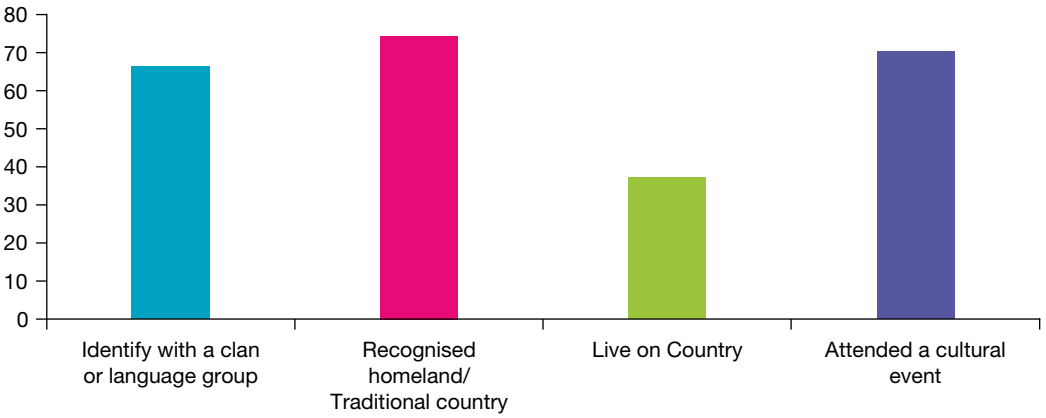
FIGURE 4 Country is a complex idea where all aspects of physical and spiritual life are connected.

The land is like a 'living museum,' for First Nations Australians; it holds their collective memory from the time of the Dreaming, reflected in ancient burial grounds, cultural sites and the watering holes that have been an essential element of their survival throughout the generations.

First Nations Peoples of Australia are connected to each other and the land through kinship groups. The elders are entrusted with the knowledge and responsibility of caring for the land and passing it down to future generations. Their intimate knowledge of the land is reflected in language, which includes words and concepts that have no equivalent in the English language. It is this deep relationship between the land and the people that is referred to as connection to Country.

This spiritual connection to the land is maintained through ceremonial practices. The land provides for the people and sustains them, while the people sustain and manage the land through their cultures, ceremonies, kinship and laws.

FIGURE 5 First Nations Peoples of Australia have a strong connection to their family, community and culture.



Data sourced from the Australian Bureau of Statistics.
Graph drawn in Excel using raw data.

Language and culture

According to the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), more than 250 different First Nations languages are spoken in Australia. In the 2016 census, one in 10 First Nations People said that they spoke a First Nations language at home.

Acknowledgement of Country

As a sign of respect, both First Nations and non-First Nations people acknowledge Aboriginal and Torres Strait Islander Peoples as the traditional custodians of the land and acknowledge their ancestors and traditions.

5.9.4 How are First Nations Australians connecting others to Country?

About 200 kilometres north of Broome lies the Kimberley region. Here, local First Nations communities have established a series of camping sites where visitors can engage in a cultural experience. Visitors can enjoy yarns around the campfire, where they can learn about the local history, and can find out more about the seasonal lifestyle, including bush foods and fishing methods. Supported by Tourism Western Australia and run by the Traditional Custodians of the land, the aim of the experience is to foster an understanding between First Nations and non-Indigenous people. Money generated through tourism remains in the local community.

FIGURE 6 In 2022, First Nations communities on the Dampier Peninsula welcomed non-Indigenous visitors to connect with the oldest living culture in the world.

5.9 SKILL ACTIVITY: Questioning and researching, Communicating

First Nations Australians have a strong connection to the land. Children are taught from an early age to respect the environment. They stay in an area for a time and then move to another as the seasons change. This ensures that they do not overhunt, overfish or overharvest the resources in any one area. They are taught to take only what they need and not to waste anything.

The mangrove regions of the north of Australia are an important source of food, timber and medicines for the First Nations communities who live in this region.

Use online resources to **investigate** how First Nations Australian communities live with and care for the mangrove environment.

1. As a class, **brainstorm** a list covering how mangroves are used as a source of food, shelter, timber and medicine.
2. Divide the list among the members of your class for further **investigation**.
3. **Create** a poster that reflects your research.
   a. **Outline** what you have investigated.
   b. How is the land cared for?
   c. What is the land providing for the people?
   d. How is connection to Country evident?
4. Use the posters to **create** a class collage.

5.9 Exercise

learnon

5.9 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 5	3, 4, 6, 9	7, 8, 10

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Check your understanding

1. According to the AIATSIS, more than _____ language groups are across Australia.
   - A. 50
   - B. 110
   - C. 220
   - D. 250
2. **Identify** the term used by First Nations Peoples of Australia to describe the land, waterways and sky to which they are connected.
   - A. Clan
   - B. Country
   - C. Culture
   - D. Creation spirit
3. **Identify** the statement that best **describes** the purpose of a smoking ceremony.
   - A. A smoking ceremony is a vital component of a controlled burn that will regenerate the land.
   - B. A smoking ceremony is needed to call the creation spirits.
   - C. A smoking ceremony has cleansing properties and will keep bad spirits away.
   - D. A smoking ceremony is used to threaten strangers.
4. **Determine** whether each of the following statements is true or false.
   - a. English is the first language of First Nations Peoples living in the Northern Territory.
   - b. Connection to Country is just about land management.
   - c. For First Nations Peoples, the land holds their collective memory from the time of the Dreaming.

Apply your understanding

Interpreting and analysing

5. **Identify** the statements that indicate how First Nations Peoples of Australia are connected to each other.
   - A. Through traditional ceremonies.
   - B. Through land and kinship groups.
   - C. Through their seasonal campsites.
   - D. Through smoking ceremonies.
6. **Explain** why ceremonial activities are important to First Nations Australians.
7. **Explain** what is meant by the phrase, 'the land is a living museum'?
8. **Explain** how First Nations communities in the Kimberley region of Western Australia are working to foster an understanding between Indigenous and non-Indigenous Australians.
9. **Describe** the benefits to local communities from running a tourism venture such as that offered in the Kimberley region north of Broome.
10. Refer to **FIGURE 5**. **Explain** how the graph demonstrates a strong connection to Country.

LESSON
5.10 Investigating topographic maps: Liveability in Badu and Moa

LEARNING INTENTION

By the end of this lesson you should be able to describe what liveability is like in Badu and Moa.

5.10.1 Badu and Moa islands

Both of these islands are located 40–60 kilometres off the far north Queensland coast in the Torres Strait. Moa Island has a small population of approximately 240 people. Badu Island has a slightly larger population of around 850 people.

These small isolated communities rely on the ocean to provide food and as a pathway for trade. Their livelihood is threatened by climate change, particularly rising sea levels. Communities on the islands are heavily reliant on regular rainfall and have reservoirs to ensure a secure clean water supply. More recently, septic tanks and drainage facilities have been installed, improving the environmental health of the islands. Because of improved water security and the development of infrastructure, an increasing number of tourists are travelling to Badu and Moa Islands.

FIGURE 1 Moa Island is the second largest island in the Torres Strait.

int-8954

FIGURE 2 Topographic map extract of Badu Island and Moa Island in the Torres Strait

Source: Data based on QSpatial, State of Queensland (Department of Natural Resources, Mines and Energy, Department of Environment and Science), http://qldspatial.information.qld.gov.au/catalogue/; Geoscience Australia.

on Resources

eWorkbook	Investigating topographic maps — Liveability in Badu and Moa (ewbk-10688)
Digital document	Topographic map of Badu and Moa islands (doc-39378)
Video eLesson	Investigating topographic maps — Liveability in Badu and Moa — Key concepts (eles-6010)
Interactivity	Investigating topographic maps — Liveability in Badu and Moa (int-8954)
Google Earth	Badu and Moa

5.10 Exercise

learnon

5.10 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 3	2, 4	5, 6

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- Receive immediate feedback
- Access sample responses
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Check your understanding

1. **Describe** where Badu and Moa are located. Use the terms *latitude* and *longitude* in your answer.
2. **Identify** the height and area reference of Mt Augustus.
3. Locate and give the area references for three different human features located on these islands.

Apply your understanding

Interpreting and analysing

4. Based on what you can see on the map, **explain** how liveable you think islands are. Support your answer with evidence from the map.
5. What factors might affect how liveable Badu and Moa islands are for different people? Choose one feature of the islands and **explain** the following.
   a. Why might someone born and raised on the islands think that feature increases liveability?
   b. Why might someone born and raised on the islands think that feature decreases liveability?
   c. Why might someone born and raised in a big city in Australia think that feature increases liveability?
   d. Why might someone born and raised in a big city in Australia think that feature decreases liveability?
6. **Determine** what challenges could exist if the island communities are reliant on rainfall for their water source.

LESSON
5.11 INQUIRY: Liveable cities investigation

LEARNING INTENTION

By the end of this lesson you should be able to explain what it means for a city to be liveable, and communicate what these characteristics are and how they are determined.

Background

In this inquiry, you will investigate what it means for a city to be liveable and how this is determined. You will share your findings through an oral presentation.

Every year the Economic Intelligence Unit (EIU) ranks 140 major cities based on five key indicators:

- stability
- healthcare
- culture and environment
- education
- infrastructure.

FIGURE 1 Many factors affect how liveable a city is.

FIGURE 2 Education and infrastructure are two of the five key indicators in the EIU liveability rankings.

Discuss the following:

1. The five key indicators used by the EIU to rank cities and what they mean.
2. What do you know about liveable and less liveable cities?
3. What would you like to know?
4. Find out which cities are in the EIU's top 10 and which are in the bottom 10. Which cities would you like to investigate and compare?

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: Write your inquiry question

In this inquiry, you will need to make comparisons between one of the cities in the top 10 and one in the bottom 10 ranked cities.

- **Select** your two cities and **write** your inquiry question — make sure you chose cities that have not been covered in detail in this topic.

Step 2: Questioning and researching

- **Conduct research** into your chosen cities.
- Collect relevant data in table or graph form.
- Use the key indicators to guide your research, and make notes under these indicators for each city.
- Locate appropriate images to **illustrate** each indicator; you might like to annotate these for future reference.

Step 3: Analysis, evaluation and interpretation

- **Create** a summary table for each city.
- **Identify** connections between your summary tables and your other elements such as graphs, tables and images.

Step 4: Civic participation and decision-making

- **Reflect** on what makes one place liveable and another less liveable.
- **Decide** which information you will use in your presentation and how it can be used effectively.

Step 5: Communicating

- **Create** your PowerPoint presentation.
- Remember to take care with your font size and colour. Avoid making your slides text-dense.
- Use visuals and dot points. Prepare cue cards to help guide you through your presentation.

Complete your self-assessment using the **Inquiry rubric** or access the 5.11 exercise set to complete it online.

Resources

Digital document Inquiry rubric (doc-39379)

LESSON
5.12 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

Find all this and MORE in jacPLUS

5.12.1 Key knowledge summary

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

5.2 What is liveability?

- Different people have different perceptions of liveability.
- Perceptions of liveability are coloured by a person's background, stage in life and expectations.

5.3 Where are the most liveable cities?

- Cities around the world are ranked against a set of criteria to create the liveable city index.
- Melbourne, Vienna and Vancouver have for several years shared the number 1 ranking; however, in 2021 Auckland took over the top ranking and Adelaide claimed second spot, with Melbourne falling to sixth place, and Vancouver and Vienna dropping out of the top 10.
- Changes to the top 10 rankings are largely the result of improvements made in cities that are pushing to move up the rankings, although COVID-19 had an effect on the 2021 rankings.
- More than one ranking index is available, but one that is widely used and relied on for this lesson is produced by the Economist Intelligence Unit.

5.4 Is Perth a liveable city?

- Perth has featured in the top 20 of most liveable cities for many years, and was took out sixth place in the 2021 rankings.
- Some factors, such as weather, work both for and against Perth as a liveable city.

5.5 Is there a connection between liveability and sustainable living?

- Liveability and sustainability are different.
- High-income countries feature strongly in the list of liveable cities; however, these cities also have a high ecological footprint.
- A high ecological footprint means we are using resources at a faster rate than they can be regenerated by the Earth.

5.6 What makes a city less liveable?

- Less liveable cities tend to be in developing countries.
- Extreme poverty is an issue in these places, with many living below the poverty line.
- Literacy levels are low, though showing some improvement.

5.7 How can liveability be improved?

- For those living below the poverty line, liveability will not improve until they have access to enough food.
- While some people do not have enough to eat, others have too much.
- Hunger has social, environmental and economic impacts.
- The United Nations has identified poverty as the underlying cause of low liveability.
- Australia provides aid to many countries around the world.

5.8 What makes our communities liveable?

- People have different perceptions of liveability and this is coloured by their stage in life and where they live.
- Bicycle-sharing schemes are increasing and are a way of reducing traffic congestion, reducing pollution and improving health.
- Beijing in China has more share bikes than any other community.
- Paris is introducing electric bikes to its bike-sharing system.

5.9 How does connection to Country make places liveable?

- First Nations Peoples are the oldest continuous culture on Earth.
- First Nations communities have more than 150 different language groups.
- Connection to Country is deeply spiritual and entwined with a sense of belonging and identity.

5.10 Investigating topographic maps: Liveability in Badu and Moa

- Because these communities rely on the ocean for food and trade, their livelihood is threatened by climate change.
- The installation of septic tanks and drainage facilities has improved the environmental health and liveability of the islands.

5.11 INQUIRY: Liveable cities investigation

- What makes one city more liveable than another can be determined by certain indicators.
- These indicators can be used to rank and compare cities.

5.12.2 Key terms

agriculture the cultivation of land, growing of crops or raising of animals

amenities desirable or useful features of a place that make it more pleasant or attractive

appropriate technology technology designed specifically for the place and the people who will use it; features include being affordable and repairable locally

biodiversity the variety of life in the world or in a particular habitat or ecosystem

census a regular survey used to determine the number of people living in Australia; also has a variety of other statistical purposes

community a group of people who live and work together and share similar values; a group of people living in a particular region

conurbation an extended urban area, usually made up of a town merging with the suburbs of a city

Country the place where a First Nations Australian comes from and where their ancestors lived; it includes the living environment and the landscape

ecological footprint total area of land used to produce the goods and services consumed by an individual or country

formal describes an event or venue that is organised or structured

global citizens people who are aware of the wider world, try to understand the values of others, and try to make the world a better place

informal sector jobs that are not officially recognised by the government as official occupations and not counted in government statistics

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

literacy rate the proportion of the population aged over 15 who can read and write

livestock animals raised for food or other products

natural environment elements — such as wind, soil, flowing water, plants and animals — that influence the characteristics of an area

non-government organisations non-profit groups run by people (often volunteers) who have a common interest and perform a variety of humanitarian tasks at a local, national or international level

population density the number of people living in a square kilometre

temperate climate climate with generally warm summers and cool winters, without extremes

undernourished not getting enough food for good health and growth

University of the Third Age an international movement that promotes lifelong learning; focuses on engaging with specific areas of interest as a person's working and parenting life scales down (referred to as the 'Third Age')

5.12.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

What effect does the distribution of resources and services have on our concept of liveability over place and time?

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

eWorkbooks Customisable worksheets for this topic (ewbk-13435)
Reflection (ewbk-10689)
Crossword (ewbk-10551)

Interactivity Liveable places crossword (int-7705)

5.12 Review exercise

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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Multiple choice

1. Which of the following is a way in which liveability can change? Select the best response.
   - A. Over a number of years
   - B. Over seasons
   - C. After an extreme event
   - D. All of the above
2. Why is infrastructure so important for improving liveability? Select all possible options from the provided answers.
   - A. It provides roads for transport.
   - B. It adds to the visual appeal of a city.
   - C. It provides hospitals for healthcare.
   - D. It provides clean water for drinking.
3. Identify the three aspects included in the concept of liveability.
   - A. Political
   - B. Social
   - C. Economic
   - D. Liveability
   - E. Environmental

4. The general connection between the ecological footprint and liveability is that regions that rank highly in terms of liveability have a _____ ecological footprint.
   A. Small **B.** Large **C.** Non-existent **D.** Medium
5. Identify three aspects of the typical Australian way of life that contribute to high resource use.
   A. Fossil fuel–powered transport
   B. Solar-powered houses
   C. Many possessions that require electricity
   D. Electric cars
   E. Single-use products
6. Identify the types of jobs people from the poorer regions of Port Moresby and Dhaka have access to.
   A. Jobs in the mining industry
   B. Jobs in the corporate industry
   C. Jobs in the informal sector
   D. Jobs in the formal sector
7. How many Sustainable Development Goals are there?
   A. One **B.** Three **C.** Ten **D.** Seventeen
8. Identify a small change that can make a big positive difference to living conditions.
   A. A solar light to make it possible to do homework
   B. A long walk to school
   C. Moving to a slum area
   D. Girls staying home to tend the fire
9. For most poor farmers in developing countries, growing a cash crop and selling for export does not help decrease hunger. Identify which of the following helps explain why this is so.
   A. It adds land to food production.
   B. Growing for export means locally produced food crops become less common and so more expensive.
   C. It makes more sense for poor farmers to grow cash crops.
   D. They don't want to eat what they grow.
10. Identify one of the advantages of increasing bicycle riding.
    A. Increasing traffic congestion
    B. Reducing public transport use
    C. Reducing people's health
    D. Reducing air pollution

Short answer

Communicating

11. **Explain** how the place in which you live influences your view of what makes a satisfactory standard of liveability.
12. **Propose** at least three examples that show the influence of the environment on living conditions.
13. What are the advantages and disadvantages of the informal sector of the economy?
14. What are the advantages and disadvantages of informal housing?
15. **Explain** how geography skills help in projects that aim to improve liveability.

GLOSSARY

aerial photograph a photograph taken of the ground from an aeroplane or satellite

agriculture the cultivation of land, growing of crops or raising of animals

alluvium the loose material brought down by a river and deposited on its bed, or on the floodplain or delta

amenities desirable or useful features of a place that make it more pleasant or attractive

appropriate technology technology designed specifically for the place and the people who will use it; features include being affordable and repairable locally

aquifer a body of permeable rock below the Earth's surface that contains water, known as groundwater; water can move along an aquifer

arid lacking moisture; especially having insufficient rainfall to support trees or plants

artesian aquifer an aquifer confined between impermeable layers of rock; the water in it is under pressure and can flow upward through a well or bore

aspect feature or quality, or the direction something is facing

atmosphere the layer of gases surrounding Earth

avalanche rapid movement of snow down a slope, usually under the influence of gravity; can also be triggered by animals, skiers or explosions

barometer an instrument used to measure air pressure

biodiversity the variety of life in the world or in a particular habitat or ecosystem

built environment a place that has been constructed or created by people

catchment the drainage basin of a river

catchment area the area of land that contributes water to a river and its tributaries

census a regular survey used to determine the number of people living in Australia; also has a variety of other statistical purposes

climate change any change in climate over time, whether due to natural processes or human activities

cloud seeding implanting clouds with substances to cause rain

community a group of people who live and work together, and generally share similar values; a group of people living in a particular region

continuous resource a resource that is never used up by humans

conurbation an extended urban area, usually made up of a town merging with the suburbs of a city

Country the place where a First Nations Australian comes from and where their ancestors lived; it includes the living environment and the landscape

crevasse a deep crack in ice

cumulonimbus clouds huge, thick clouds that produce electrical storms, heavy rain, strong winds and sometimes tornadoes; they often appear to have an anvil-shaped flat top and can stretch from near the ground to 16 kilometres above the ground

cyclones intense low-pressure systems producing sustained wind speeds in excess of 65 km/h; they develop over tropical waters where surface water temperature is at least 27 °C

demographic describes statistical characteristics of a population

desalination a process that removes salt from sea water

Dreaming The Dreaming in First Nations spirituality, the beginning of earth and the cycles of life and nature, explaining creation and the nature of the world, the place that every person has in that world and the importance of ritual and tradition

drought a long period of time when rainfall received is below average

ecological footprint total area of land used to produce the goods and services consumed by an individual or country

El Niño the reversal (every few years) of the more usual direction of winds and surface currents across the Pacific Ocean; this change causes drought in Australia and heavy rain in South America

environmental resource a material found in nature that is necessary or useful to people

evaporate to change liquid, such as water, into a vapour (gas) through heat

evaporation the process by which water is converted from a liquid to a gas and thereby moves from land and surface water into the atmosphere

flood inundation by water, usually when a river overflows its banks and covers surrounding land

fly in, fly out (FIFO) workers who fly to work in remote places, work 4-, 8- or 12-day shifts and then fly home

formal describes an event or venue that is organised or structured

frostbite damage caused to the skin when it freezes, brought about by exposure to extreme cold; extremities such as fingers and toes are most at risk, along with exposed parts of the face

gale force wind wind over 62 kilometres per hour

global citizens people who are aware of the wider world, try to understand the values of others, and try to make the world a better place

groundwater a process in which water moves down from the Earth's surface into aquifers

hailstone an irregularly shaped ball of frozen precipitation

hailstorm any thunderstorm that produces hailstones large enough to reach the ground

horticulture the growing of garden crops such as fruit, vegetables, herbs and nuts

hydrologic cycle another term for the water cycle

hypothermia when a person's core body temperature falls below 35 °C and the body is unable to maintain key systems; risk of death without treatment

incentive encourages a person to do something

informal sector jobs that are not officially recognised by the government as official occupations and not counted in government statistics

infrastructure the basic physical and organisational structures and facilities that help a community run, including roads, schools, sewage and phone lines

inundate to cover with water, especially floodwater

irrigation water provided to crops and orchards by hoses, channels, sprays or drip systems in order to supplement rainfall

isobars lines on a map that join places with the same air pressure

literacy rate the proportion of the population aged over 15 who can read and write

liveable city a city that people want to live in, which is safe, well planned and prosperous and has a healthy environment

livestock animals raised for food or other products

location a point on the surface of the Earth where something is to be found

meteorologist a person who studies and predicts weather

monsoon rainy season accompanied by south-westerly summer winds in the Indian subcontinent and South-East Asia

mound spring mound formation with water at its centre, formed by minerals and sediments brought up by water from artesian basins

natural disaster an extreme event that is the result of natural processes and causes serious material damage or loss of life

natural environment elements — such as wind, soil, flowing water, plants and animals — that influence the characteristics of an area

natural hazard an extreme event that is the result of natural processes and has the potential to cause serious material damage and loss of life

natural resources resources (such as landforms, minerals and vegetation) that are provided by nature rather than people

neighbourhood a region in which people live together in a community

non-government organisations non-profit groups run by people (often volunteers) who have a common interest and perform a variety of humanitarian tasks at a local, national or international level

non-renewable resource a resource that cannot be renewed in a short time and is finite

place specific area of the Earth's surface that has been given meaning by people

population density the number of people living in a square kilometre

potential resource a resource that exists but is unusable in its current state, such as salt water, ice and water vapour

precipitation rain, sleet, hail, snow and other forms of water that falls from the sky when water particles in clouds become too heavy

primary research collection of original information

pull factors positive aspects of a place; reasons that attract people to come and live in a place

push factors reasons that encourage people to leave a place and go somewhere else

rainfall variability the change from year to year in the amount of rainfall in a given location

rebate a partial refund on something that has already been paid for

region any area of varying size that has one or more characteristics in common

relative humidity the amount of moisture in the air

remote a place that is distant from major population centres

renewable resource a resource that can be naturally replaced if carefully managed

sea change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small coastal town

secondary research collection of resources on an issue, prepared by others and offering different viewpoints

soak place where groundwater moves up to the surface

southern oscillation a major air pressure shift between the Asian and east Pacific regions; its most common extremes are El Niño events

storm surge a sudden increase in sea level as a result of storm activity and strong winds; low-lying land may be flooded

temperate climate climate with generally warm summers and cool winters, without extremes

torrential rain heavy rain often associated with storms, which can result in flash flooding

tree change the act of leaving a fast-paced urban life for a more relaxing lifestyle in a small country town, in the bush, or on the land as a farmer

troposphere layer of the atmosphere closest to the Earth, extending about 17 kilometres above the Earth's surface, but thicker at the tropics and thinner at the poles; where weather occurs

typhoon the name given to cyclones in the Asian region

undernourished not getting enough food for good health and growth

University of the Third Age an international movement that promotes lifelong learning; focuses on engaging with specific areas of interest as a person's working and parenting life scales down (referred to as the 'Third Age')

uranium a dense grey radioactive metal used as a fuel in nuclear reactors

virtual water all the hidden water used to produce goods and services

vulnerability the state of being without protection and open to harm

water footprint the total volume of fresh water that is used to produce the goods and services consumed by an individual or a country

water scarcity when the demand for water is greater than the supply available

water stress a situation that occurs in a country with less than 1000 cubic metres of renewable fresh water per person

water vapour water in its gaseous form, formed as a result of evaporation

weir a barrier across a river, similar to a dam, which causes water to pool behind it; water is still able to flow over the top of the weir

whiteout a weather condition where visibility and contrast is reduced by snow; individuals become disoriented because they cannot distinguish the ground from the sky

wilderness a natural place that has been almost untouched or unchanged by the actions of people

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