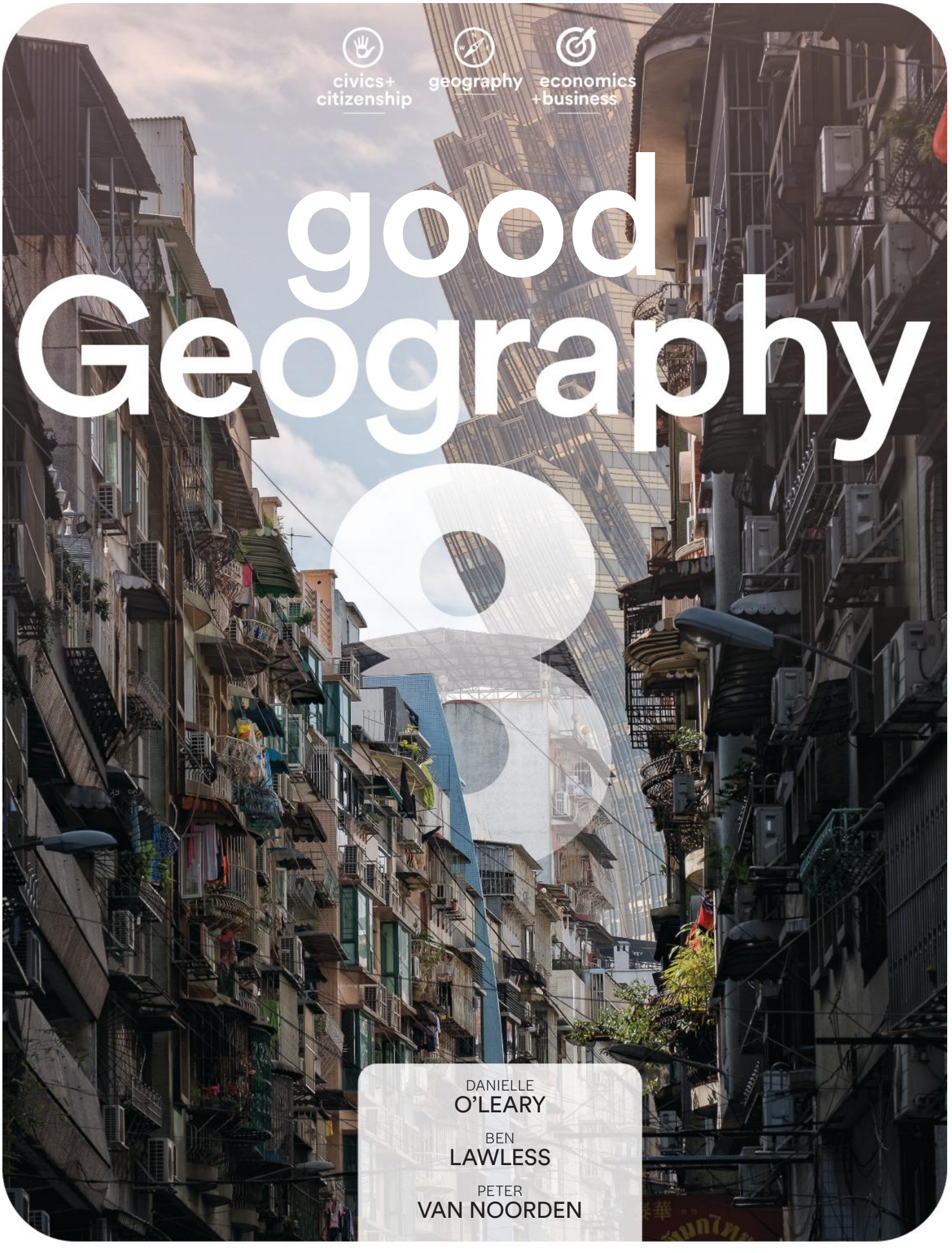
civics+
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Geography
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contents

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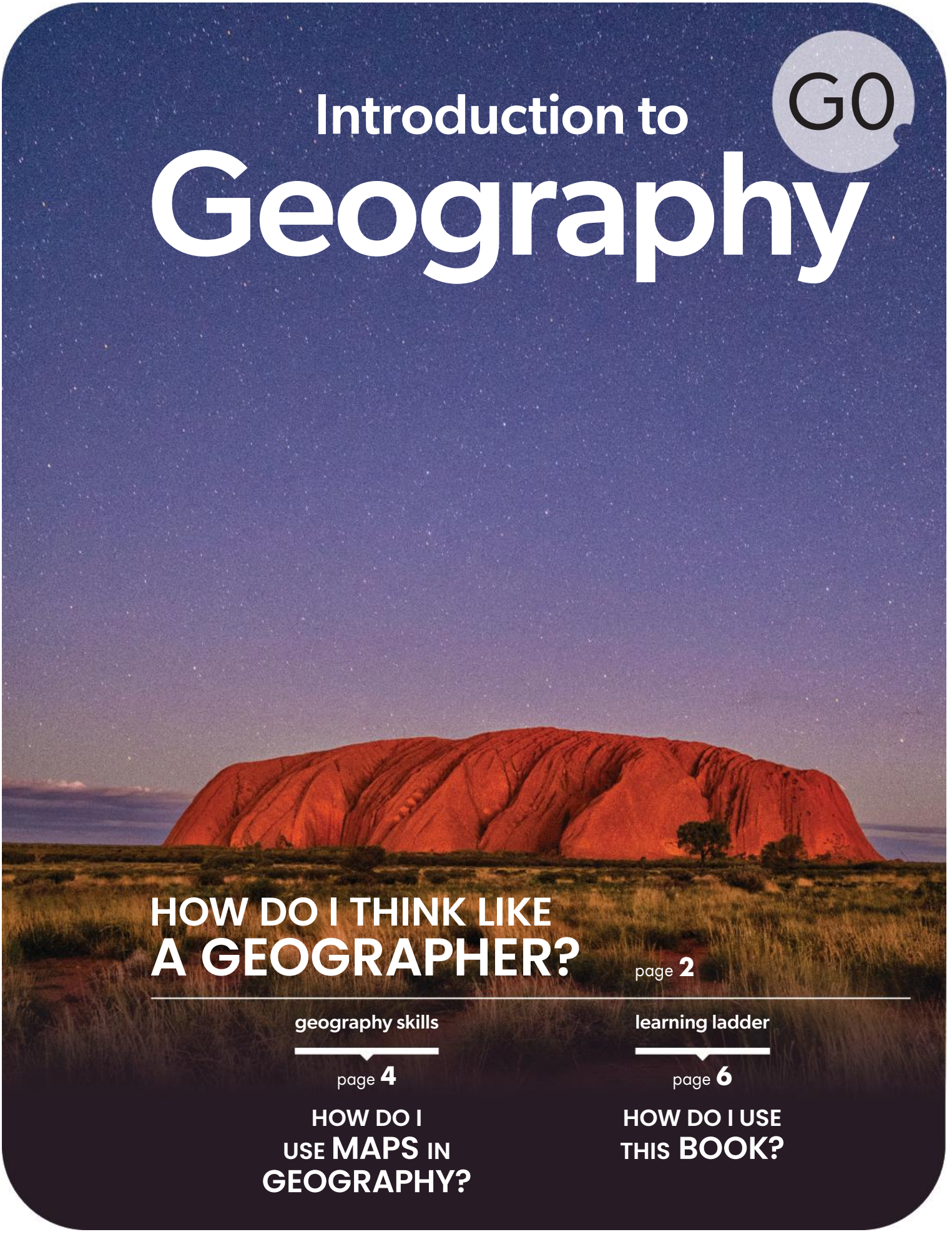


Introduction to Geography

G0

HOW DO I THINK LIKE A GEOGRAPHER?

geography skills

HOW DO I USE MAPS IN GEOGRAPHY?

learning ladder

HOW DO I USE THIS BOOK?

How do I think like a geographer?

Geography is the study of the world, its characteristics and patterns, and how it changes over time. In Geography we focus on two main factors: human activity and natural processes. We are interested in how humans influence the *space* in which they live and, in turn, how the natural *environment* influences how humans live. We use maps, images, graphs and other sources of data to explore spatial patterns and conduct fieldwork to answer research questions about different phenomena or *interconnections*. Geography is key to understanding the world around us, because 'without geography, you are nowhere!'.

Using geographic language: SPICESS

Using geographic language is important to help you write high-quality responses. Remembering the acronym SPICESS will help you improve your use of geographic terminology. Note: you do not have to use the terms from SPICESS directly in your responses; instead, try to use the concept to make your writing more geographical.

S Space (1)

In a geographical context, '*space*' does not refer to outer space. It refers to the way in which we use, *change* and distribute things on Earth's surface. For example, this *environment* can be broken up into two key *spaces*; the natural mountain *space* and human urbanised *space*.

P Place (2)

The concept of *place* allows humans to identify the location or position of something within a *space*. We can identify place through describing the **relative** or **absolute location** of that area. This *place* is Mt Fuji, Japan.

I Interconnection

Interconnection is the idea that two things or phenomena are related, interact or are linked in some way. For example, there is a strong *interconnection* between the Japanese people and Mt Fuji. Many people climb the mountain as a spiritual journey, stopping to pray at temples along the way.

C Change

Change refers to how a *place* is altered because of shifts in the environment or to meet the needs of humans. Change can be positive or negative and can occur over short or long periods. In this *place*, we can observe a change between the seasons through the vegetation. In spring, beautiful pink and white cherry blossoms bloom throughout Japan.

E Environment

An *environment* can be defined by its **geographic characteristics**. Some *environments*, such as coastlines, islands and forests, are largely natural and are untouched by humans. Other *environments*, such as cities and other urban areas, have undergone significant change and are largely unnatural. Within environments, we can observe processes, interconnections between **phenomena** and change over time. This is an example of both a natural and a human *environment*.

Source 1

Mt Fuji, Japan

S Scale

Scale usually refers to the size of something. Scale can be literal, such as a scale on a map using quantitative data to show you how big something would be in real life. We can also use scale as a qualitative word, such as when describing a region. For example, patterns can exist on a local, regional, national or global *scale*. Mt Fuji is Japan's tallest peak at 3776 metres.

S Sustainability

Sustainability is the concept of maintaining and preserving resources and *environments* for future generations. This could be through using *sustainable*, renewable energy such as solar power or wind-generated electricity. Mt Fuji is a major tourist attraction in Japan and therefore this *place* is subject to a lot of foot traffic and rubbish dumping. A range of groups and organisations have been developed over time to help *sustain* the natural *environment* surrounding Mt Fuji to ensure it remains beautiful for future visitors. Mt Fuji was listed as a World Heritage Site in 2013.

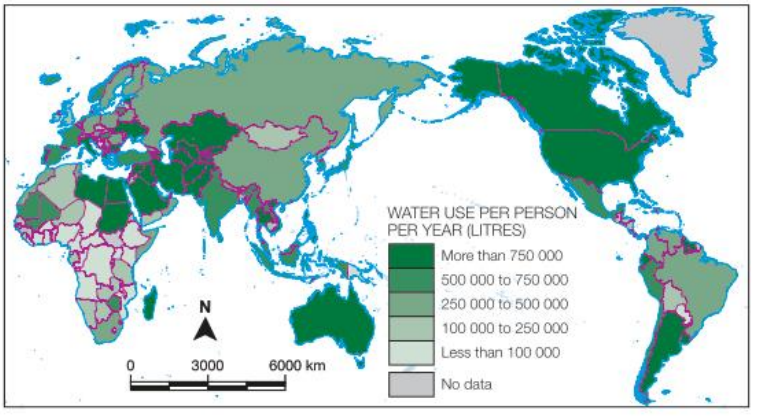
How do I use maps in Geography?

Maps are vital in Geography to visualise spatial patterns and identify *interconnections* between phenomena. There are many types of maps and each has a slightly different purpose.

Contour maps

Contour maps show how mountainous a region is. Contour maps can be identified by having a series of wiggly lines with numbers along them, known as contour lines. The closer the contour lines are together, the steeper the hill is. The numbers indicate how far above sea level that particular point is. Source 2 shows Uluru in the Northern Territory. Source 3 is an aerial view of Uluru, with a map overlaid on the photo showing how contour lines can be used to indicate height and depth.

World water use



Source: Matilda Education Australia

Source 1

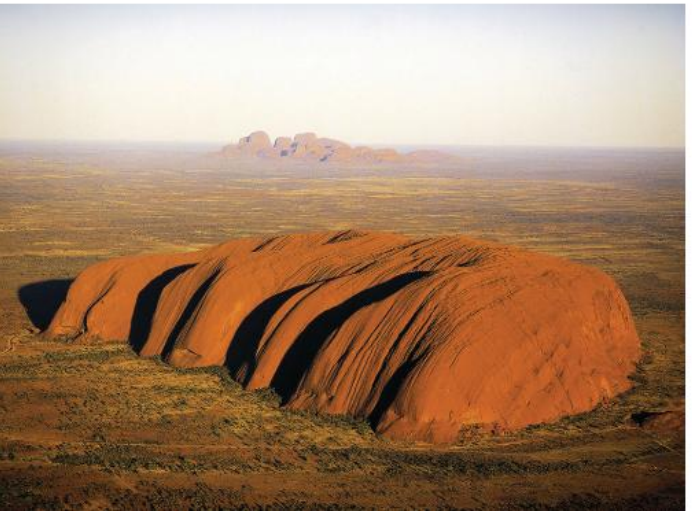
A choropleth map

Choropleth maps

Choropleth maps use darker and lighter shades of colour so that the reader can instantly see a pattern. The choropleth map in source 1 uses darker shades to represent the areas with highest water use per person per year and the lighter shades represent the areas with lowest levels of use. It is best to use colours of the same shade, such as light to dark green to clearly show the pattern.

Source 2

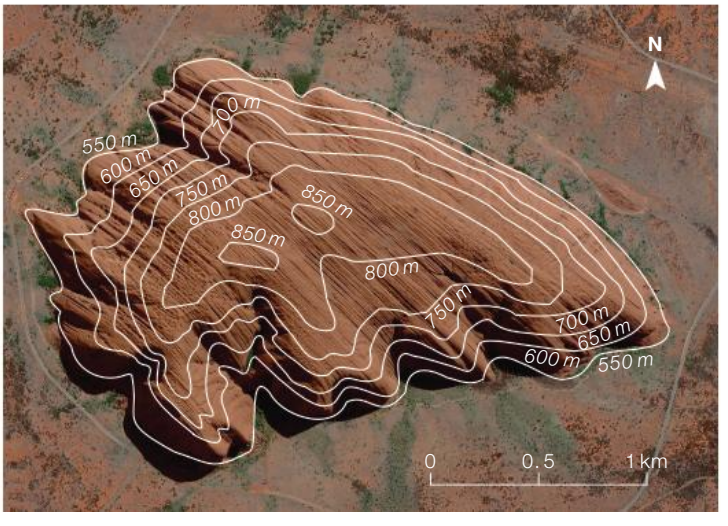
This aerial image of Uluru shows its shape and the weathering it has endured.



Source 3

A contour map of Uluru, overlaid on an aerial photo

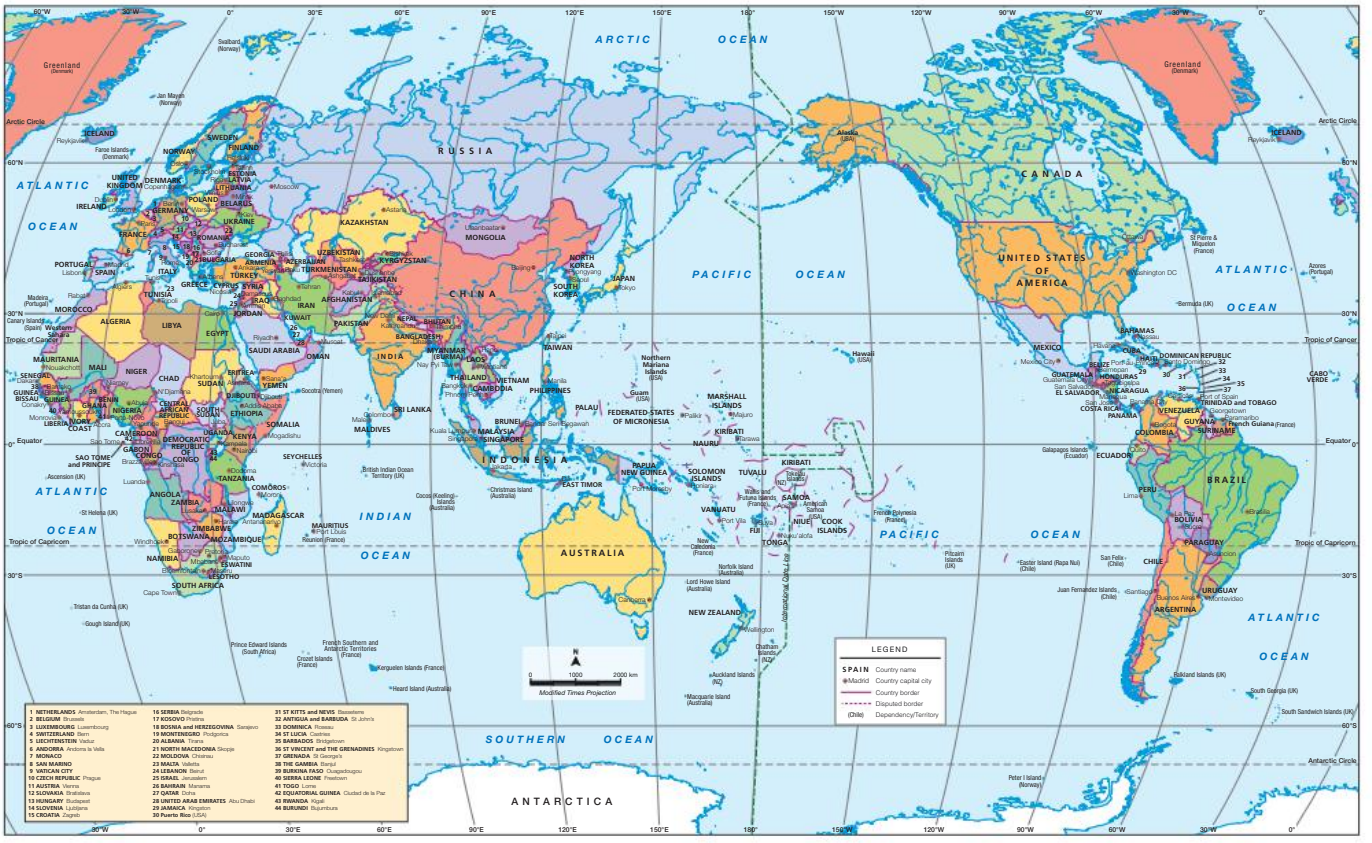
Uluru contour map



Source: contour map from Matilda Education Australia, Geoscience Australia

World political map

Source: Matilda Education Australia



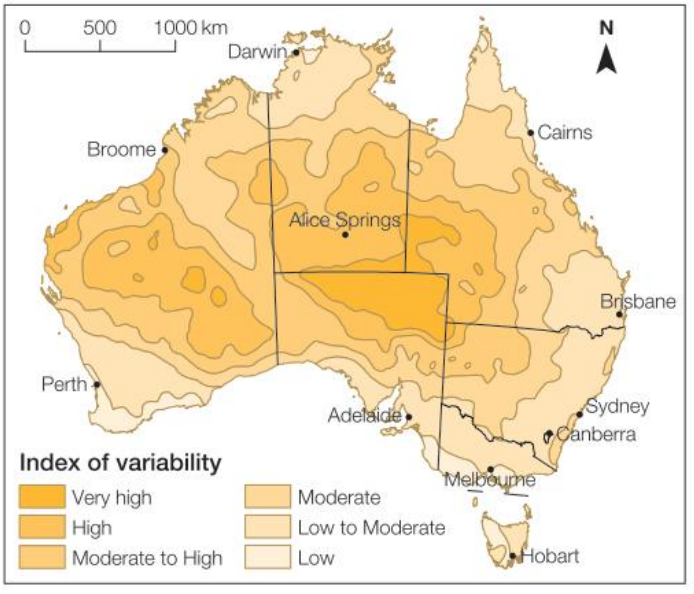
Source 4

A political map of the world

Political maps

Political maps show the boundaries of different countries, determined by political governance or ownership. Over time, these boundaries change as wars or treaties affect the borders of different areas.

Australia rainfall variability



Source 5

Source: Matilda Education Australia, BoM

A climate map

Climate map

In Geography, **climate** is important for determining land cover and how liveable a place is. While weather is what we observe day to day through our classroom window, climate represents the average conditions (usually temperature and rainfall) within a region over a period. Climate is important when studying Geography, as it gives us an indication of expected rainfall. In the map in Source 5, we can clearly see a pattern of variability (changes) in rainfall in different parts of Australia.

Learning ladder G0.2

1. Note down which maps you are already familiar with. When have you used these maps?
2. In a small group, discuss the list of maps you have used. Are you all familiar with the different kinds of maps discussed in this section?
3. Why are maps vital in Geography? Use bullet points to list at least three reasons.

How do I use this book?

Good Geography has been built to help you thrive as you work through the Level 8 Geography curriculum and to demonstrate your progress in every single lesson. This book explores two geographical topics: Landscapes and landforms and Changing nations. You will also find a Fieldwork section and a Geo How–To skills section. The Geo How–To section is vital and you should refer to it often.

Climb the Learning Ladder

Geography is a skills-based subject; and learning content alone does not mean that you have a geographical understanding. In order to be a geographer, you need to be able to write geographically, read a variety of data, interpret data and conduct and communicate your own research.

Each chapter in this book begins with a Learning Ladder. This is your 'plan of attack' for the skills you will practise in each chapter. It lists the five geographical skills you will be learning, and five levels of progress for each of those skills. Read it from the bottom to the top. As you progress through the chapter, you will climb *up* the Learning Ladder.

Each skill described in the Learning Ladder is a higher progression than the one below it. To be able to accomplish the higher-level skills, you need to be able to master the lower ones. Practising activities at all the levels will help you to achieve 'higher-order' skills such as evaluating. This approach is called developmental learning and puts you in charge of your own learning progression!

learning ladder

Source 1

The Learning Ladder helps you to take charge of your own learning.

	Spatial characteristics	Interconnections	Geographical challenge	Record, collect and display data	Analyse data
step 5	I can analyse the impact of change on places	I can explore spatial association and interconnections	I can plan action to tackle a geographical challenge	I can evaluate data	I can draw conclusions by analysing collected data
step 4	I can predict changes in the characteristics of places	I can evaluate the implications of significant interconnections	I can evaluate alternatives for a geographical challenge	I can use data to support claims	I can analyse relationships between different data
step 3	I can explain processes influencing places	I can identify and explain the implications of interconnections	I can compare strategies for a geographical challenge	I can choose, collect and display appropriate data	I can explain the reasons behind a trend or spatial distribution
step 2	I can explain spatial characteristics	I can explain interconnections	I can compare responses to a geographical challenge	I can recognise and use different types of data	I can describe patterns and trends
step 1	I can identify and describe spatial characteristics	I can identify and describe interconnections	I can identify responses to a geographical challenge	I can record, collect and display data in simple forms	I can use geographic terminology to interpret data

Check your progress

Each chapter is divided into sections. Each section is designed to cover one lesson, but your teacher may spend more or less time on a particular section. A section is usually two pages long, but some are four pages. At the end of every section, you will find different kinds of questions to help you check your progress.

1 Show what you know

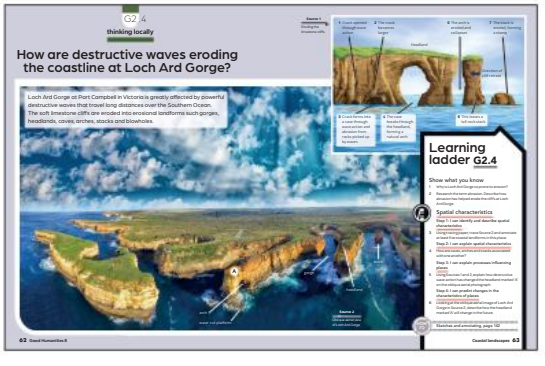
These questions ask you to look back at the content you have read and to show your understanding of it by listing, describing and explaining.

2 Learning Ladder

These activities are linked to the Learning Ladder. You can complete one of the questions or several of them, depending on your progress. Throughout each chapter, you will complete at least one activity for each level of the Learning Ladder.

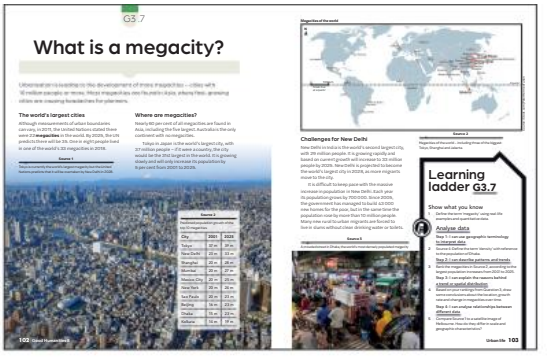
Case studies

Throughout every chapter, you will discover a variety of case studies that explore local, national and global places, issues and events. The local case studies are focused on Victorian contexts. The national case studies explore a case study from other parts of Australia and the global case studies describe places and events in other countries. Many of these link to interactive sources you can explore further using your eBook.



Source 2

Case studies are an important part of your Geography course.

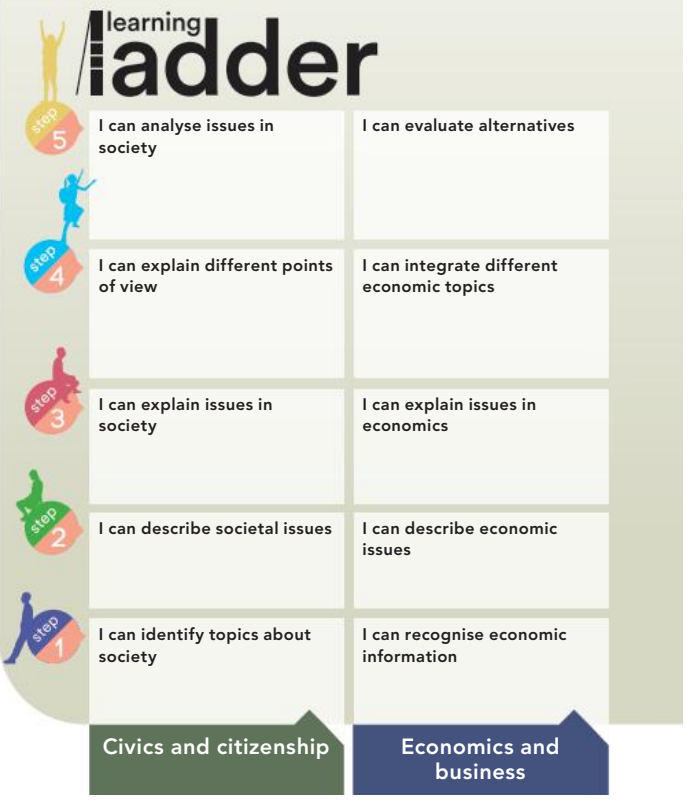


Source 3

Check your progress regularly. You can attempt one or all of the Learning Ladder questions.

civics+ citizenship **economics+ business**

The study of Geography can be complemented by the study of Civics and citizenship, and Economics and business. In every chapter of this book, you will discover either a Civics and citizenship *or* an Economics and business lesson. School is busy and you have a lot to cover, so designing a textbook where the important Civics and citizenship and Economics and business content is placed meaningfully next to relevant Geography lessons will help you connect your learning to a wider context.



Geo How-To

At the end of the book, you will find a guide to fieldwork and a skills section called Geo How-To. The How-To section features explanations about how to perform each skill. There are *many* examples. Refer to it often, especially when completing the Learning Ladder questions and Masterclass activities.

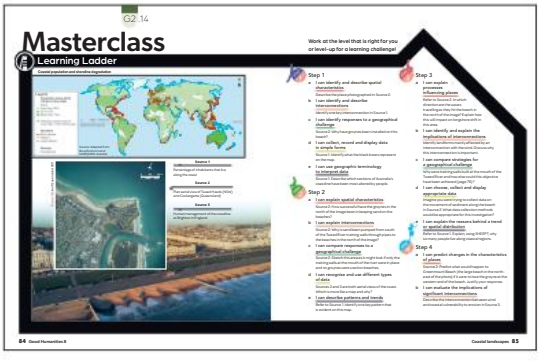
The Fieldwork section explains the skills you need for hands-on research as well giving you several suggested tasks.

Source 4

The Geo How-To section is your key to success – refer to it often!

Masterclass

At the end of each chapter is a review section – the Masterclass. The questions here are organised by the steps of the Learning Ladder. You can complete all the questions *or* your teacher may direct you to complete just some of them, depending on your progress.



Source 5

You did it! We knew you could! The Masterclass is your opportunity to show your progress. Take charge of your own learning and see if you can extend yourself.

Capstone

After you complete a chapter, it's time to put your new knowledge and understanding together for the capstone project to show what you *know* and what you *think*. In the world of building, a capstone is an element that finishes off an arch, or tops off a building or wall. That is what the capstone project will offer you, too: a chance to top off and bring together your learning in interesting and creative ways. It will ask you to think critically, to use key concepts and to answer 'big picture' questions. The capstone project is accessible online; scan the QR code to find it quickly.

Source 6

The capstone project brings together the learning and understanding of each chapter. It provides an opportunity to engage in creative and critical thinking.

Learning ladder G0.3

1. How can you use the Learning Ladder to monitor your progress in Year 8 Geography?
2. In a small group, discuss the idea of 'monitoring your own progress'. Why is this important?
3. Read through the steps of the Geography Learning Ladder and consider where you may be up to for each skill, based on your prior learning.
4. Draw a logo for the Geography learning area at your school. Make sure your logo includes elements which represent human geography and physical geography.

G1

Landscapes and landforms

WHAT HAPPENS WHEN A VOLCANO ERUPTS?

page 28

geographic challenge

page 32

WHAT ARE GEOHAZARDS?

thinking nationally

page 40

HOW DID ULURU FORM?

economics + business

page 42

HOW DO LANDFORMS ATTRACT TOURISTS?

How can I understand landscapes and landforms?

Mountains, glaciers, valleys, plateaus and many other natural features that we see on the surface of Earth are called landforms. Landforms are produced by natural processes. Similar landforms are grouped together as landscapes.

learning ladder

	Spatial characteristics	Interconnections	Geographical challenge
step 5	**I can analyse the impact of change on places** I can analyse and evaluate the implications of changes such as deforestation at different scales and calculate the impact on people and environments.	**I can explore spatial association and interconnections** I can compare distribution patterns and the interconnections between them; e.g. mountain ranges and tectonic plate boundaries.	**I can plan action to tackle a geographical challenge** I can frame questions, evaluate findings, plan actions and predict outcomes to tackle a landform-based geographical challenge.
step 4	**I can predict changes in the characteristics of places** I can predict changes in the characteristics of places over time due to geomorphic processes.	**I can evaluate the implications of significant interconnections** I can identify, analyse and explain key geomorphic interconnections within and between places, and evaluate their implications over time and at different scales.	**I can evaluate alternatives for a geographical challenge** I can weigh up alternative views and strategies on a landform-based geographical challenge using environmental, social and economic criteria.
step 3	**I can explain processes influencing places** I can explain the series of actions leading to change in a place, such as the formation of block mountains.	**I can identify and explain the implications of interconnections** I can identify, analyse and explain geomorphic interconnections and explain their implications.	**I can compare strategies for a geographical challenge** I can compare strategies for a geographical challenge, taking into account a range of factors and predicting the likely outcomes.
step 2	**I can explain spatial characteristics** I can identify concepts of Space, Place, Interconnection, Change, Environment, Scale and Sustainability (SPICESS) when I read about landscapes and landforms.	**I can explain interconnections** I can describe and explain interconnections and their effects, such as frost wedging in rocks.	**I can compare responses to a geographical challenge** I can identify and compare responses to a geographical challenge and describe its impact on different groups.
step 1	**I can identify and describe spatial characteristics** I can talk about spatial characteristics at a range of scales; e.g. volcanoes of the world.	**I can identify and describe interconnections** I can identify and explain simple interconnections involved in phenomena such as shifting tectonic plates and earthquakes.	**I can identify responses to a geographical challenge** I can find responses to a geographical challenge such as a volcanic eruption and understand the expected effects.

Warm up

Source 1

The basalt rock 'organ pipes' in the Organ Pipes National Park in Victoria formed about one million years ago from the lava flow of a nearby volcano. The lava filled a creek bed and cracked vertically as it cooled.

I can evaluate data
I can determine whether data presented about landscapes and landforms is reliable, and assess whether the methods I used in the field or classroom were helpful in answering a research question.

I can draw conclusions by analysing collected data
I can summarise findings and use collected data to support key patterns and trends I have identified for research.

I can use data to support claims
I can select or collect the most appropriate data and create specialist maps and information using ICT to support investigations into landscapes and landforms.

I can analyse relationships between different data
I can use multiple data sources, overlays and GIS to find relationships that exist in patterns of landscapes and landforms.

I can choose, collect and display appropriate data
I can select useful sources of data and represent them to conform with geographic conventions.

I can explain the reasons behind a trend or spatial distribution
I can identify Social, Historical, Economic, Environmental, Political and Technological (SHEEPT) factors to help me explain patterns in data.

I can recognise and use different types of data
I can define the terms primary, secondary, qualitative and quantitative data and represent data in more complex forms.

I can describe patterns and trends
I can identify Patterns, Quantify them and point out Exceptions (PQE) to describe the patterns I see.

I can collect, record and display data in simple forms
I can identify that maps and graphs use symbols, colours and other graphics to represent data.

I can use geographic terminology to interpret data
I can identify increases, decreases or other key trends on a map, graph or chart about landscapes and landforms.

Collect, record and display data

Analyse data

Spatial characteristics

1 Looking at Source 1, how would you describe the geographic characteristics of this *place*?

Interconnections

2 Source 1: The interconnection between which two phenomena formed the Organ Pipes?

Geographical challenge

3 What geographical challenge did the people of Hawaii face (see pages 30–31)?

Collect, record and display data

4 In the map of World mountain landscapes, Source 2 on page 17, is the data qualitative or quantitative?

Analyse data

5 Still looking at Source 2 on page 17, in which continent can the Himalayas be found?

What are landforms and landscapes?

Earth contains many different types of natural **landscapes**: mountain, desert, coastal and riverine landscapes. Each landscape features unique **landforms** created by natural forces, such as the movement of **tectonic plates**.

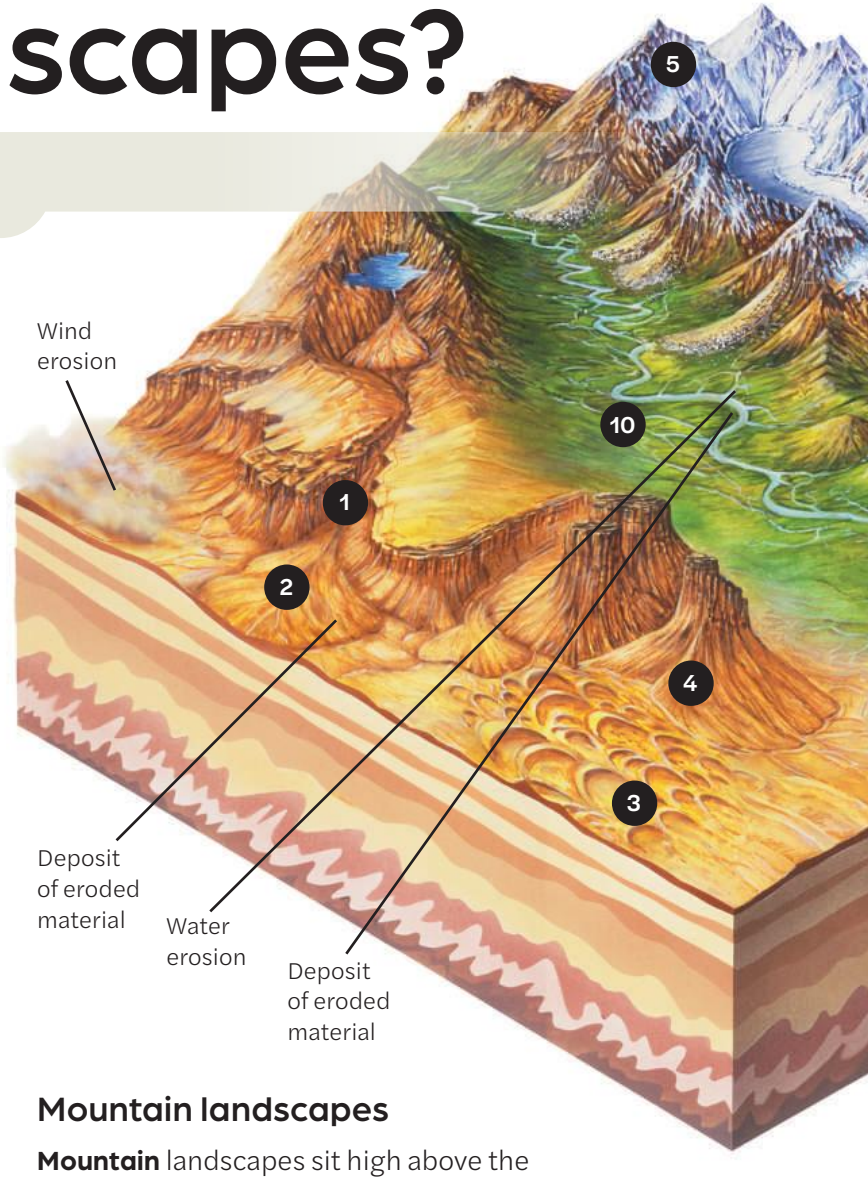
Landforms are shaped over time by **weathering** and **erosion**. Weathering wears them down and breaks them apart and erosion removes the weathered material. The growth of human settlement and activities such as farming, mining, logging and tourism can change and sometimes degrade landscapes.

Desert landscapes

Deserts are dry environments. They can be hot or cold and can be rocky, sandy or even covered in ice. Rocky deserts can be weathered and then eroded by water and wind into amazing shapes. Use the numbers for each landform below to locate them in Source 1.

Desert landforms

1. **Wadi**: Dry watercourse in a deep, narrow valley that divides a **plateau**.
2. **Alluvial fan**: Semicircular build-up of eroded material deposited by water and wind at the end of a wadi.
3. **Barchan dune**: A crescent-shaped **dune** formed by the wind blowing from one direction. They are a common landform in sandy deserts.
4. **Butte:** Isolated, steep, flat-topped hill of resistant rock (rock that does not erode easily).



Mountain landscapes

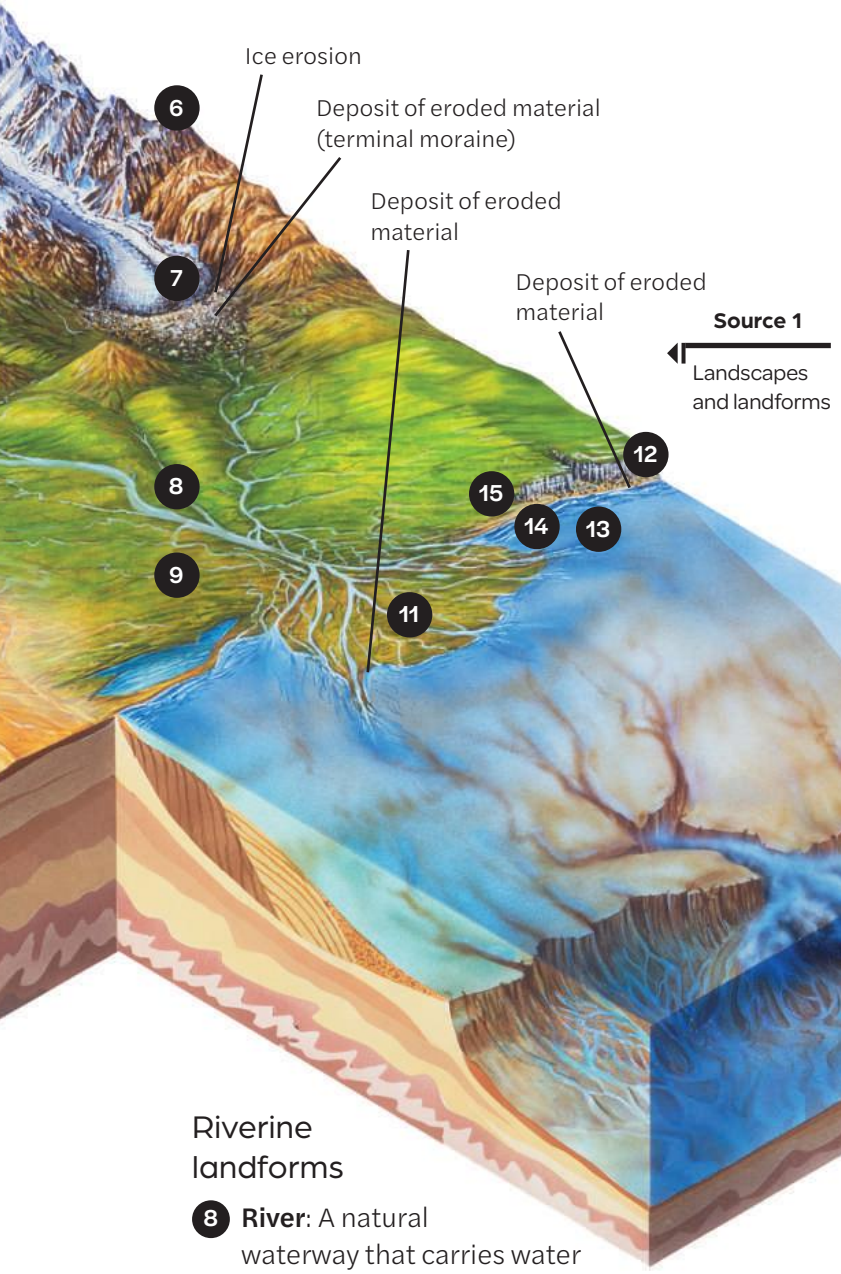
Mountain landscapes sit high above the surrounding land. They are formed by movements in Earth's crust, which also cause earthquakes and volcanoes. Use the numbers for each landform below to locate them in Source 1.

Mountain landforms

5. **Mountain**: Steep-sided, lone peak rising above the surrounding land.
6. **Fold mountains**: Formed when two tectonic plates collide and the crust folds and is pushed upwards.
7. **Glacier**: River of ice that moves downhill in response to gravity.

Riverine landscapes

Riverine landscapes are formed by the natural movement of a network of rivers in a **drainage basin**. These landscapes attract farming because they contain fresh water and fertile land from deposited silt. Use the numbers for each landform below to locate them in Source 1.



Source 1 Landscapes and landforms

Riverine landforms

8 **River**: A natural waterway that carries water downhill by gravity.

9 **Floodplain**: Flat land that water spills onto in flood conditions.

10 **Meander**: Loops in a river when it slows on flatter land. The river erodes the outside and deposits on the inside of the meander.

11 **Delta**: Deposited sediment at a river's mouth, which causes the river to block its own exit. The river splits into a number of finer channels that find their way to the sea.

Coastal landscapes

The coast is where the land meets the sea. Coastal landscapes are shaped by wind and waves that erode and deposit materials to create landforms that are constantly changing (see Chapter 2, Coastal landscapes). Use the numbers for each landform below to locate them in Source 1.

Coastal landforms

12 **Headland**: Narrow, high land jutting out into the sea, formed of harder rock that resists erosion

13 **Bay**: Curved indentation in the coastline.

14 **Beach**: Deposited rock particles, such as sand or gravel, along the coastline.

15 **Coastal dune**: Mound or ridge of wind-blown sand at the back of the beach.

Learning ladder G1.1

Show what you know

1 Name a landform that fits each of the following descriptions:
- a made of ice
- b made by erosion
- c created by eroded material being deposited
- d caused by movement of the Earth's crust
- e made by water.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

2 Identify different valley landforms from three different landscapes.

Step 2: I can explain spatial characteristics

3 Where do glaciers occur and why?

Step 3: I can explain processes influencing places

4 Explain the key process that drives the formation of desert landscapes.

Step 4: I can predict changes in the characteristics of places

5 Select one landscape or landform that will change the most dramatically due to global warming, where world temperatures are rising.

HOW TO Block diagrams, page 144

How are we connected to landscapes?

Landscapes and landforms around the world are valued in different ways. Some people may have a cultural, spiritual or aesthetic connection to a particular landscape, while others are more interested in the economic value of the place.

Aesthetic values

The **aesthetic value** of a landscape is linked to its uniqueness and its perceived beauty. People are drawn to a place for many reasons, including how it looks, how it makes them feel or through a personal connection with the place.

Mountains are among the most aesthetic landscapes (see pages 16–19). The beauty of mountains goes beyond an appreciation of the landscape and the **landforms** within it. It also includes concepts such as wilderness and adventure and emotions such as excitement, anticipation and even fear.

In Nepal, exploration and appreciation of the Mount Everest region is something that began when the peak was first climbed in 1953. Since then more than 5000 climbers have climbed to the peak of the world's tallest mountain (see page 22). Recently, mountaineers have complained that the crowds climbing Mount Everest are taking away from its aesthetic appeal.

Source 1

The aesthetic appeal of the Three Sisters landform in the Blue Mountains also provides an economic value, as the site attracts over 600 000 tourists every year. It is a place of cultural significance to the Gundangurra, Wiradjuri, Tharawal and Darug peoples.

Source 2

The aesthetic value of Mount Everest goes beyond the beauty of this mountain region. It includes its uniqueness and majesty as the world's highest mountain, along with the achievement of climbing it.

Spiritual and cultural values

Landscapes contain many landforms that are sites of spiritual importance, particularly for Indigenous peoples. In the Hawaiian religion, the ancient fire goddess Pele, who lives in the crater at the top of the Kīlauea volcano, created Hawaii's landscape. When Kīlauea erupts, lava is the physical embodiment of Pele. She is known to be unpredictable, so Hawaiians traditionally provide gifts and offerings to keep her happy. During the eruption of Kīlauea in 2018 (see page 30), Hawaiians left leaves in front of their homes and flowers in cracks caused by the volcano for good luck.

For Australia's First Nations Peoples, landscapes and landforms were formed by the Ancestors who continue to live in the land, water and sky. Indigenous Australians express the cultural value of the land to them through stories, song, dance and art.

The Three Sisters in the Blue Mountains (see Source 1) is significant to the Gundangurra, Wiradjuri, Tharawal and Darug peoples and was recognised as an Aboriginal place by the New South Wales Government in 2014.

One creation story tells the tale of three sisters from the Katoomba tribe who fell in love with three brothers from a neighbouring tribe. The law forbade the girls from marrying outside their own people. When the brothers decided to capture the girls, a major battle erupted. A clever man from the Katoomba tribe cast a spell to turn the sisters to stone to keep them safe. During the battle, the clever man was killed and unable to reverse his spell, so the sisters remain trapped in stone to this very day.

Learning ladder G1.2

Show what you know

1 What is your favourite landform or landscape? Create and deliver a short presentation on this place. Consider the following:
   - a the location of the landform or landscape
   - b how it was formed
   - c why you have a connection to that place.

2 Conduct a survey of your class or a large group of students asking them the following questions. Record your data using a tally.
   - a What is your favourite landform or landscape?
     - i Mountains (including glaciers and volcanoes)
     - ii Rivers
     - iii Deserts
     - iv Coastal (including beaches, bays and headlands)
     - v Other
   - b What is your main connection to that place?
     - i Spiritual
     - ii Visual
     - iii Cultural
     - iv Other

3 Create two bar graphs to display your findings from question 2. Discuss your findings as a class.

Interconnections

Step 1: I can identify and describe interconnections

4 Why do you think tourists are attracted to particular landscapes and landforms?

Step 2: I can explain interconnections

5 How do Indigenous Australians and Hawaiians show their connection to the land?

Step 3: I can identify and explain the implications of interconnections

6 Source 1: How does this place interconnect both spiritually and aesthetically with people?

Step 4: I can evaluate the implications of significant interconnections

7 Source 2: Evaluate why there is a strong interconnection between climbers and Mount Everest.

HOW TO

Graphing, page 146

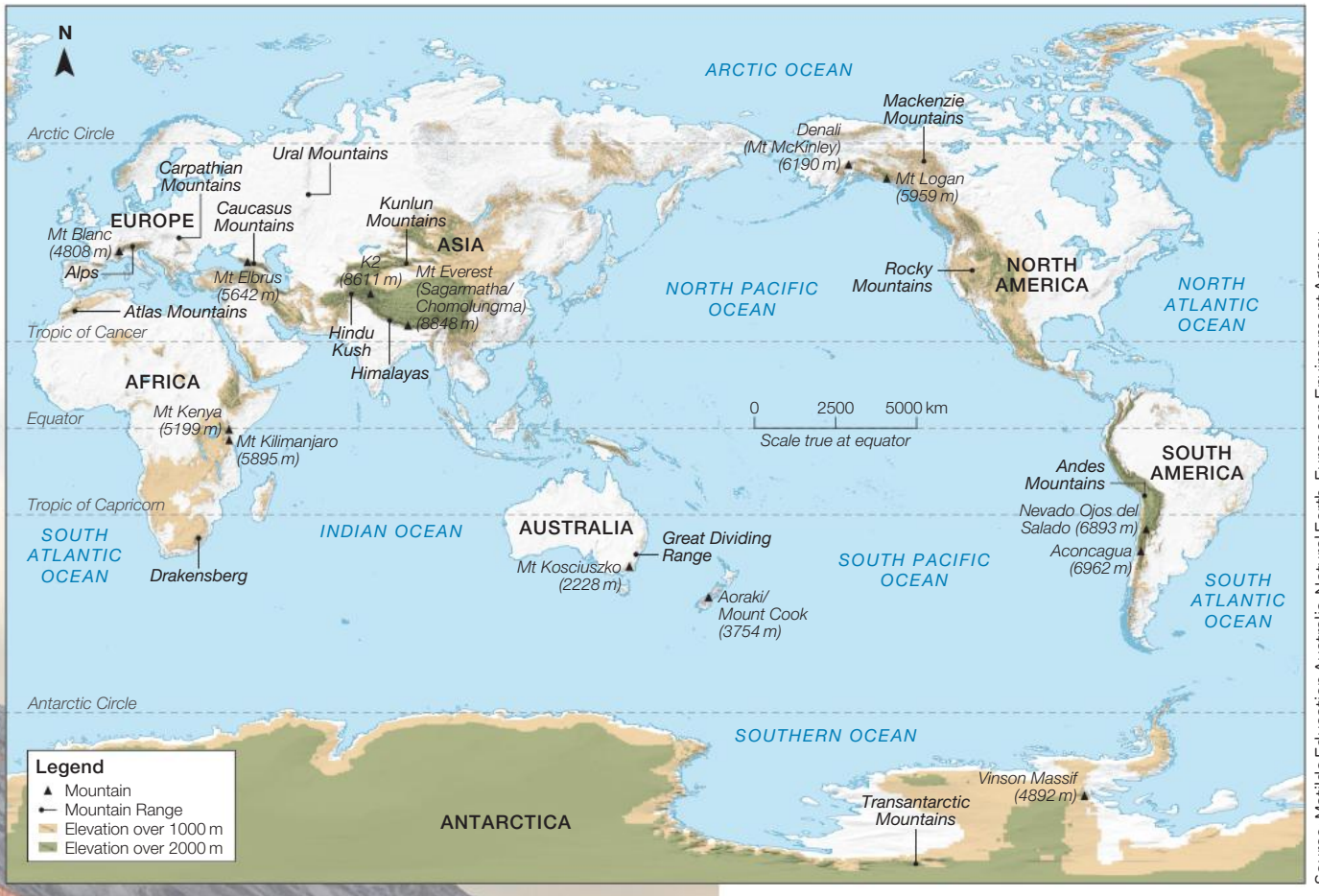
How are mountains formed?

Mountains are landforms that rise high above the surrounding land. They are formed when tectonic plates in the Earth's crust move to push up the land. Sometimes this allows molten magma to reach the surface, which creates volcanic mountains.

Source 1

At 5895 metres above sea level, Mount Kilimanjaro is Africa's highest mountain and the tallest freestanding mountain in the world. It is a volcanic mountain formed over a hot spot in the Earth's crust. The top is covered in ice and snow even though the mountain is located near the equator.

World mountain landscapes



Source: Matilda Education Australia, Natural Earth, European Environment Agency

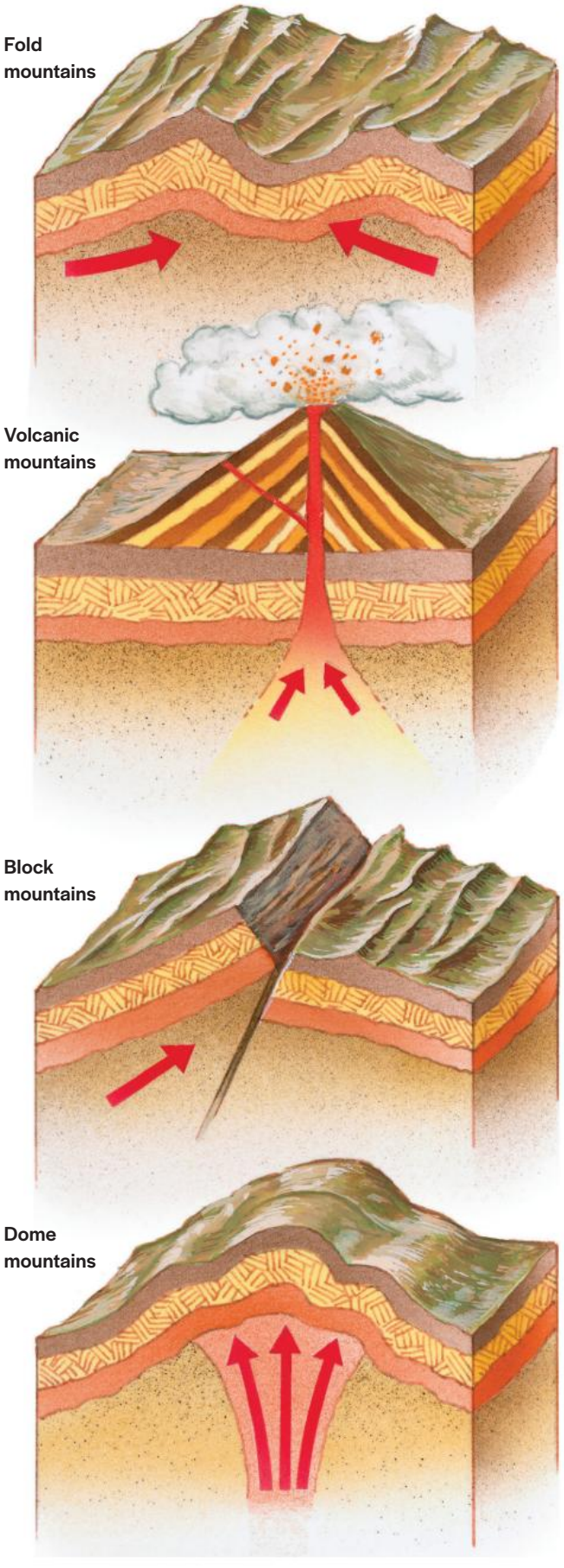
Source 2

World mountain landscapes

What are mountains?

A **mountain** is a large landform that sits above the surrounding land, usually in the form of a peak. A mountain is steeper than a hill. A few mountains, such as Mount Kilimanjaro in Africa, are isolated, but most are part of a series of mountains called a **mountain range**. Earth's highest mountain is Mount Everest in Asia's Himalayan mountain range. Its summit is 8848 metres above sea level. Australia's highest mountain, Mount Kosciuszko, is just 2228 metres tall.

The world's longest above-water mountain range is found in South America. Known as the Andes, this mountain range is 7000 kilometres long and travels through seven countries. Australia's longest mountain range is the Great Dividing Range, stretching more than 3500 kilometres through Victoria, New South Wales, the Australian Capital Territory and Queensland.



Source 3

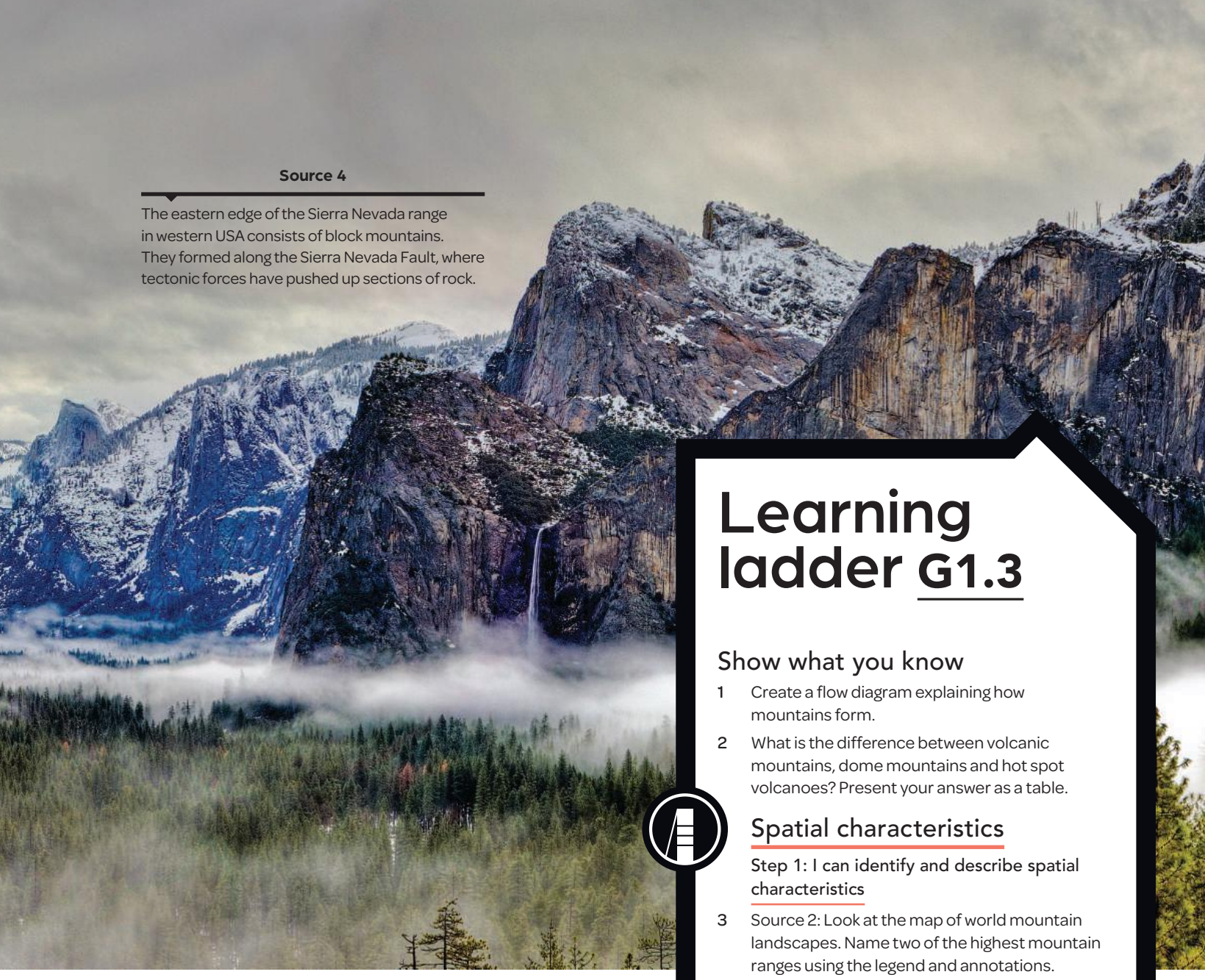
Different mountain formations: fold, volcanic, block and dome

How do mountains form?

Mountains are formed through earth movements or volcanic action. Strong forces inside Earth can push up the surface into long mountain chains or punch through the surface at **hot spots** (see page 25) to create **volcanoes** such as Kīlauea in Hawaii (see page 30) and Mount Kilimanjaro in Tanzania (see Source 1 on page 16).

Fold mountains

Fold mountains are pushed upwards where two continental **tectonic plates** (see pages 20–21) collide. Layers of rock are bent and pushed upwards to create the fold mountains. The world's largest fold mountains are found in the Himalayan mountain range (see pages 22–23), with over 50 peaks more than 7200 metres high.



Source 4

The eastern edge of the Sierra Nevada range in western USA consists of block mountains. They formed along the Sierra Nevada Fault, where tectonic forces have pushed up sections of rock.

Volcanic and dome mountains

Volcanic mountains form when **magma** from below the Earth's surface is pushed through an opening in the Earth's crust. This material can build up to form a cone-shaped mountain known as a volcano (see pages 24–25). **Dome mountains** form when magma is injected between two layers of **sedimentary rock**, causing the top layer to bulge upwards forming the dome shape.

Block mountains

Block mountains form when blocks of rocks are forced upward or downward along faults or cracks in Earth's crust. The uplifted blocks are block mountains or **horsts**. Dropped blocks are called **graben**, which can form **rift valleys**.

Learning ladder G1.3

Show what you know

1 Create a flow diagram explaining how mountains form.

2 What is the difference between volcanic mountains, dome mountains and hot spot volcanoes? Present your answer as a table.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

3 Source 2: Look at the map of world mountain landscapes. Name two of the highest mountain ranges using the legend and annotations.

Step 2: I can explain spatial characteristics

4 Source 2: Which are the highest and flattest continents?

Step 3: I can explain processes influencing places

5 Simulate tectonic plates by placing two sheets of paper end to end on a flat surface (about two centimetres apart). Place four fingers on both sheets of paper and move the left sheet slowly towards the right.

a Sketch what happens when the paper meets.

b What type of mountains form like this?

Step 4: I can predict changes in the characteristics of places

6 Draw a labelled block diagram to explain how and where block mountains form.

HOW TO

Flow diagrams, page 144
Block diagrams, page 144

What is the theory of plate tectonics?

Earth's surface is made up of huge tectonic plates, much like a big jigsaw puzzle. These plates are always moving, but usually by only a few centimetres per year. As they collide, mountains form and volcanoes and earthquakes are generated. When plates move apart, ocean trenches can form.

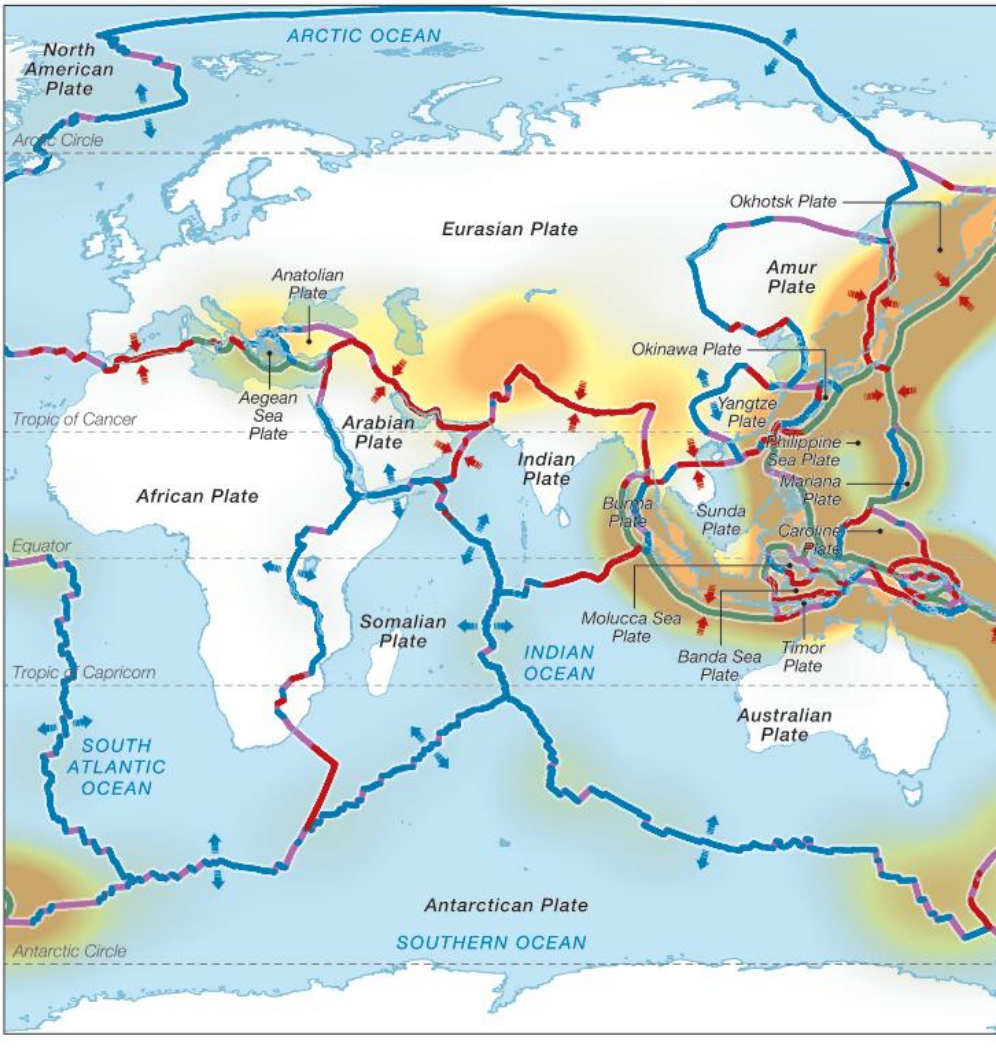
Moving tectonic plates

Earth's crust is made up of seven major **tectonic plates** that float and move on the semi-molten rocks in the **mantle**. As the plates move apart (**diverging margins**) or collide (**converging margins**), landforms such as mountains, ridges and ocean trenches are created.

Most of the world's volcanoes are located along converging margins or subduction zones. **Subduction** occurs when a continental plate, such as the North American Plate, converges with an oceanic plate, such as the Caribbean Plate. The heavier oceanic crust bends and moves down toward the upper mantle (see page 26). The edge of the plate melts into magma that feeds volcanoes along the converging margin, such as Mount Pinatubo in the Philippines.

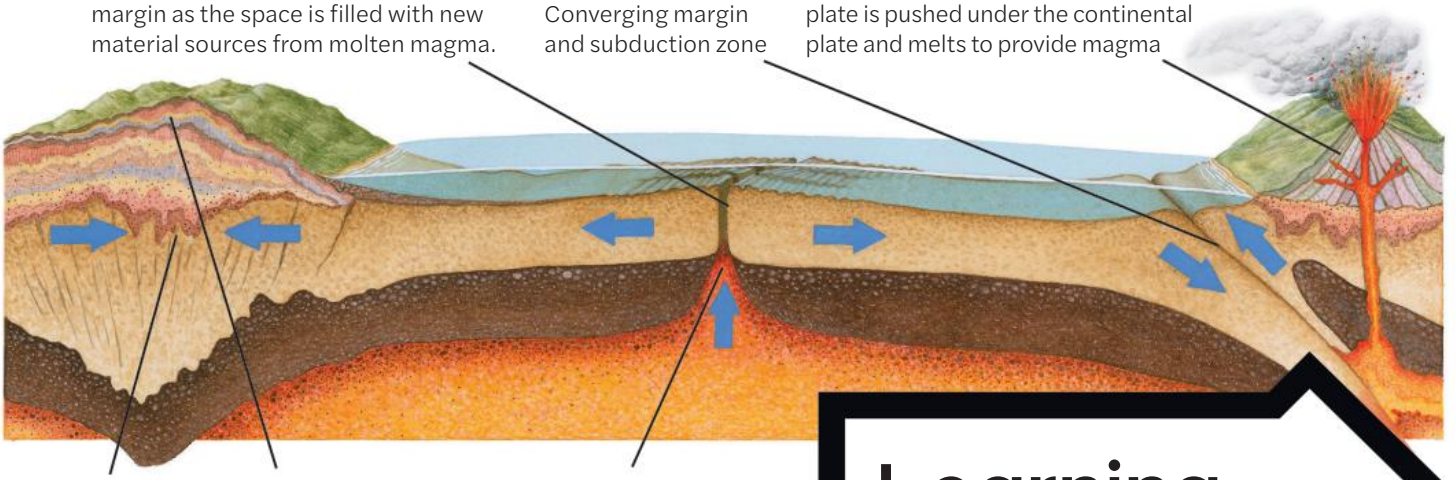
Most earthquakes occur near the edges of converging plates or along **transform margins**, which is where the plates slide past one another. Here the plates can become stuck and then break free with a sudden movement that triggers an earthquake. California's San Andreas Fault is a transform margin between the North American and Pacific Plates that suffers many earthquakes.

The world's tectonic plates



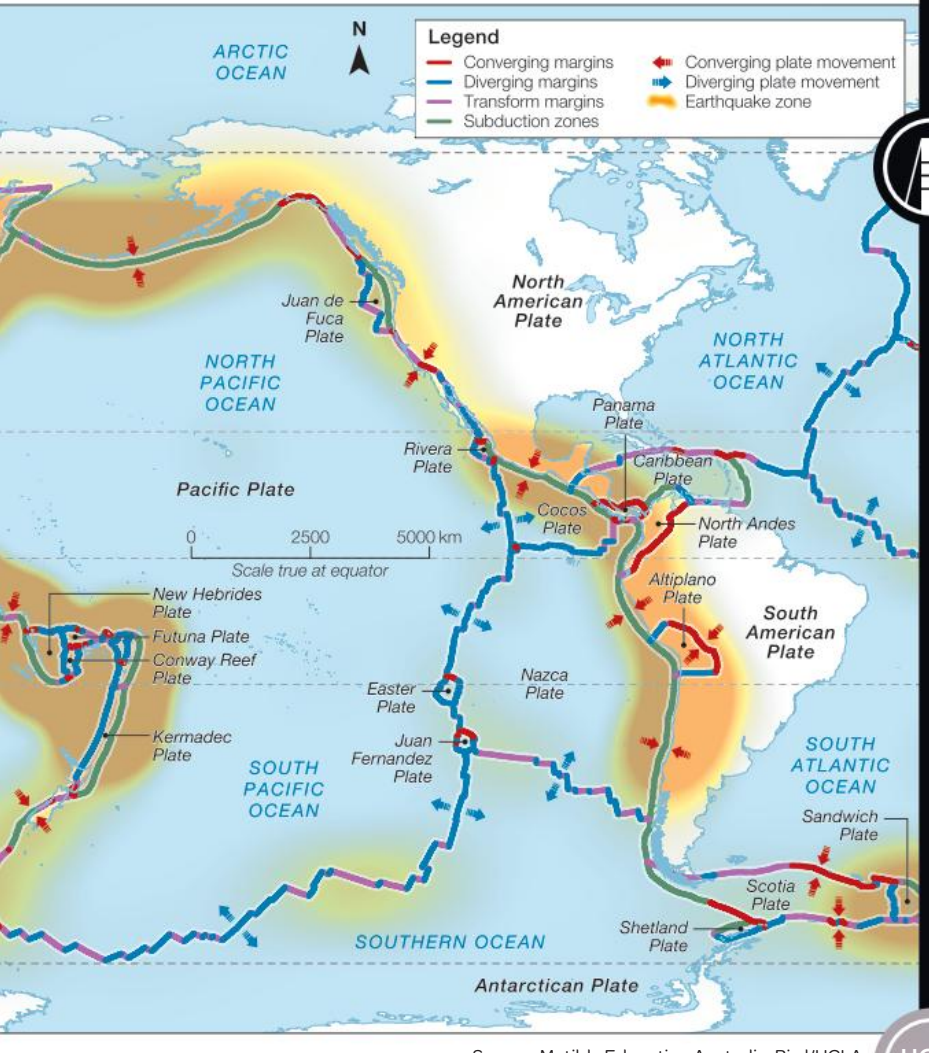
Source 1

The world's tectonic plates – seven major plates and some of the minor plates



Source 2

Tectonic plate movement



Source: Matilda Education Australia, Bird/UCLA

Learning ladder G1.4

Show what you know

1 Briefly explain one key difference difference between the formation of mountains and volcanoes.

2 What landform can be created along diverging plate boundaries?

Interconnections

Step 1: I can identify and describe interconnections

3 Source 1: Use PQE to help with the following.
- a Along which tectonic plate boundaries do earthquakes and volcanoes occur?
- b Quantify this pattern with a count or estimated percentage, or use of the legend.
- c Give an example of an exception to the pattern.

Step 2: I can explain interconnections

4 Draw a block diagram of Earth's crust. Annotate your diagram to explain the process of tectonic plate movement that forms a mountain or volcano.

Step 3: I can identify and explain the implications of interconnections

5 Using SHEEPT, explain the interconnection between the location of tectonic plates and the presence of earthquakes, mountain ranges and volcanoes.

Step 4: I can evaluate the implications of significant interconnections

6 The phreatic volcanic eruption (see page 29) on New Zealand's White Island killed 21 tourists in December 2019. What interconnection made this eruption particularly dangerous?

HOW TO

Block diagrams, page 144
PQE, page 138
SHEEPT, page 140

G1.5

thinking globally

How did the Himalayas form?

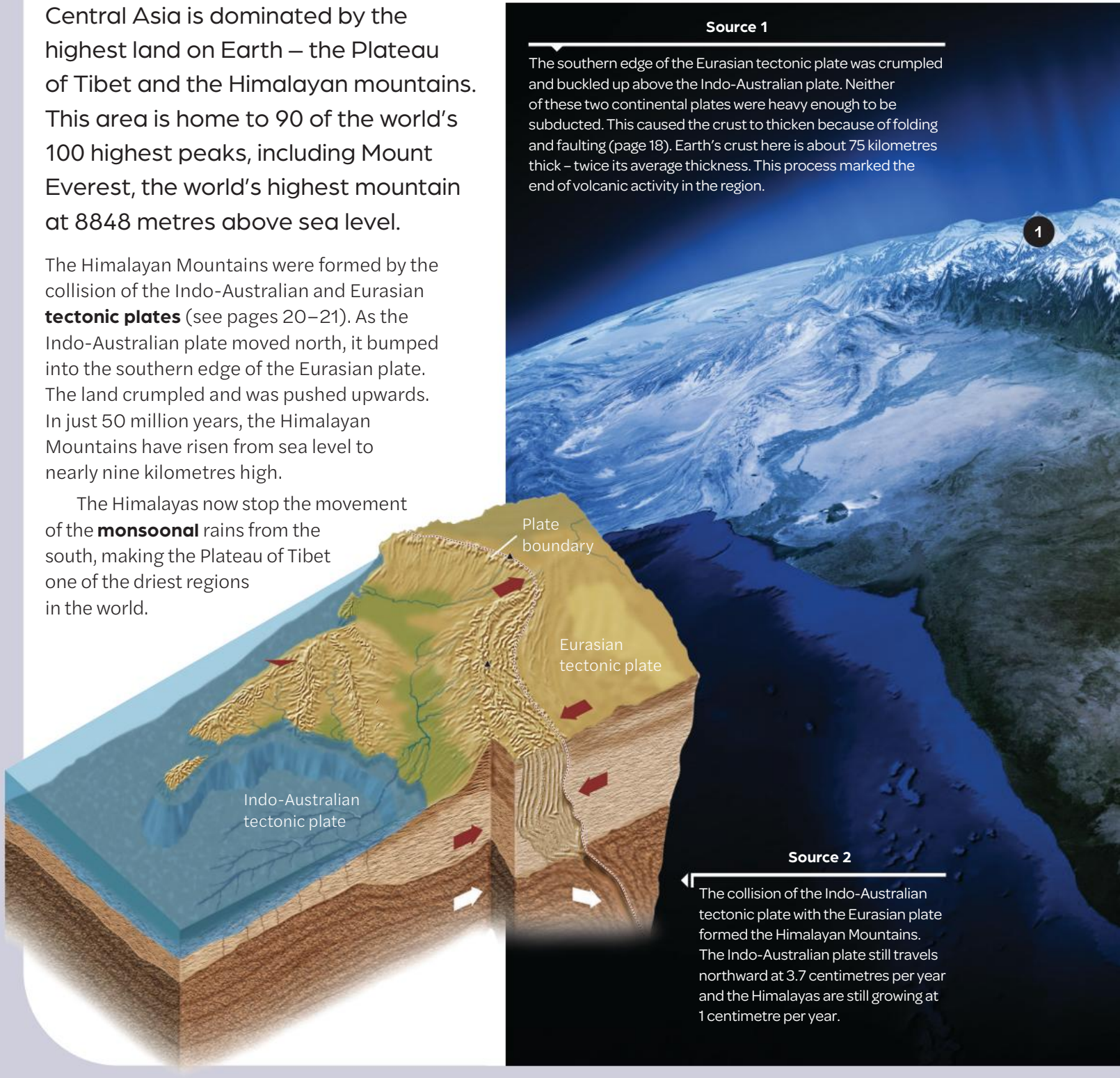
Central Asia is dominated by the highest land on Earth – the Plateau of Tibet and the Himalayan mountains. This area is home to 90 of the world's 100 highest peaks, including Mount Everest, the world's highest mountain at 8848 metres above sea level.

The Himalayan Mountains were formed by the collision of the Indo-Australian and Eurasian **tectonic plates** (see pages 20–21). As the Indo-Australian plate moved north, it bumped into the southern edge of the Eurasian plate. The land crumpled and was pushed upwards. In just 50 million years, the Himalayan Mountains have risen from sea level to nearly nine kilometres high.

The Himalayas now stop the movement of the **monsoonal** rains from the south, making the Plateau of Tibet one of the driest regions in the world.

Source 1

The southern edge of the Eurasian tectonic plate was crumpled and buckled up above the Indo-Australian plate. Neither of these two continental plates were heavy enough to be subducted. This caused the crust to thicken because of folding and faulting (page 18). Earth's crust here is about 75 kilometres thick – twice its average thickness. This process marked the end of volcanic activity in the region.

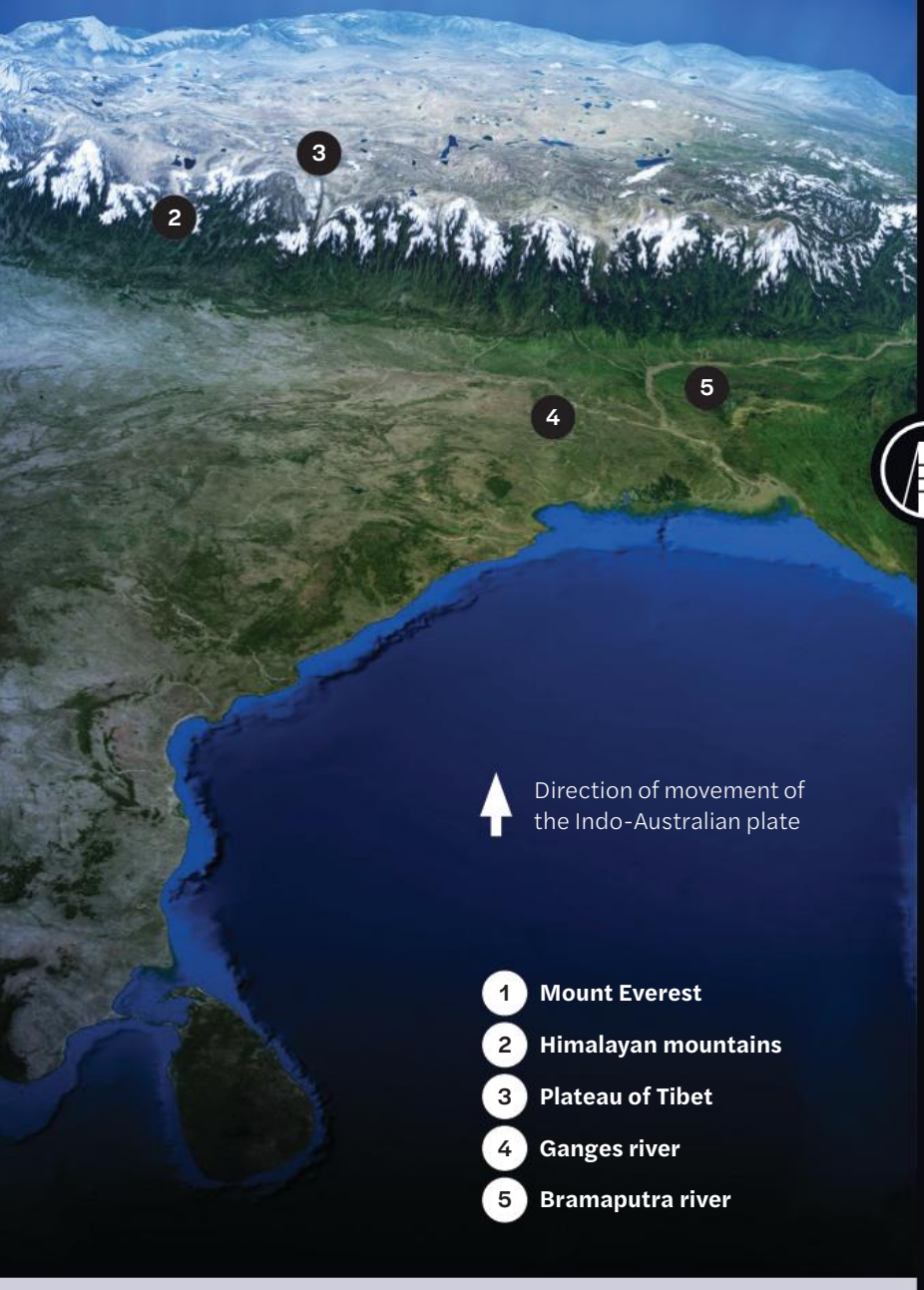


Source 2

The collision of the Indo-Australian tectonic plate with the Eurasian plate formed the Himalayan Mountains. The Indo-Australian plate still travels northward at 3.7 centimetres per year and the Himalayas are still growing at 1 centimetre per year.

Source 3

Climbing the south face of Mount Everest. The mountain was first climbed in 1953 by Sir Edmund Hillary and Tenzing Norgay.



Learning ladder G1.5

Show what you know

1 How was the Himalayan Mountain range formed and what is unique about it?

2 What issue do mountain climbers face at 8000 metres above sea level?

Analyse data

Step 1: I can use geographic terminology to interpret data

3 Refer to the sources on this spread. In which region of the world are the Himalayas and Plateau of Tibet found?

Step 2: I can describe patterns and trends

4 Look at the image in Source 1.
- a Which tectonic plates are involved in the creation of the Himalayan Mountains?
- b Describe how the Himalayas were formed.

Step 3: I can explain the reasons behind a trend or spatial distribution

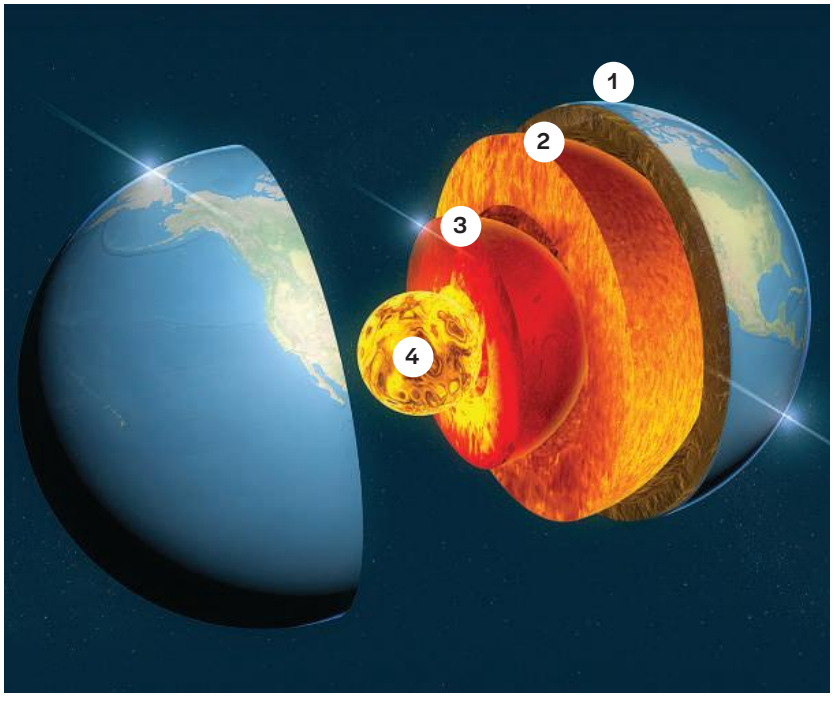
5 How does the movement of the Indo-Australian plate affect the Himalayan Mountains?

Step 4: I can analyse relationships between different data

6 Create a cartoon series explaining the formation of the Himalayan Mountain range. Use captions and speech bubbles to explore the different stages and incorporate the following key terms:
- a tectonic plate
- b collision
- c sea level
- d peak.

How do volcanoes form?

Volcanoes form when magma from beneath Earth's surface pushes through Earth's crust along tectonic boundaries and at hot spots in Earth's mantle.



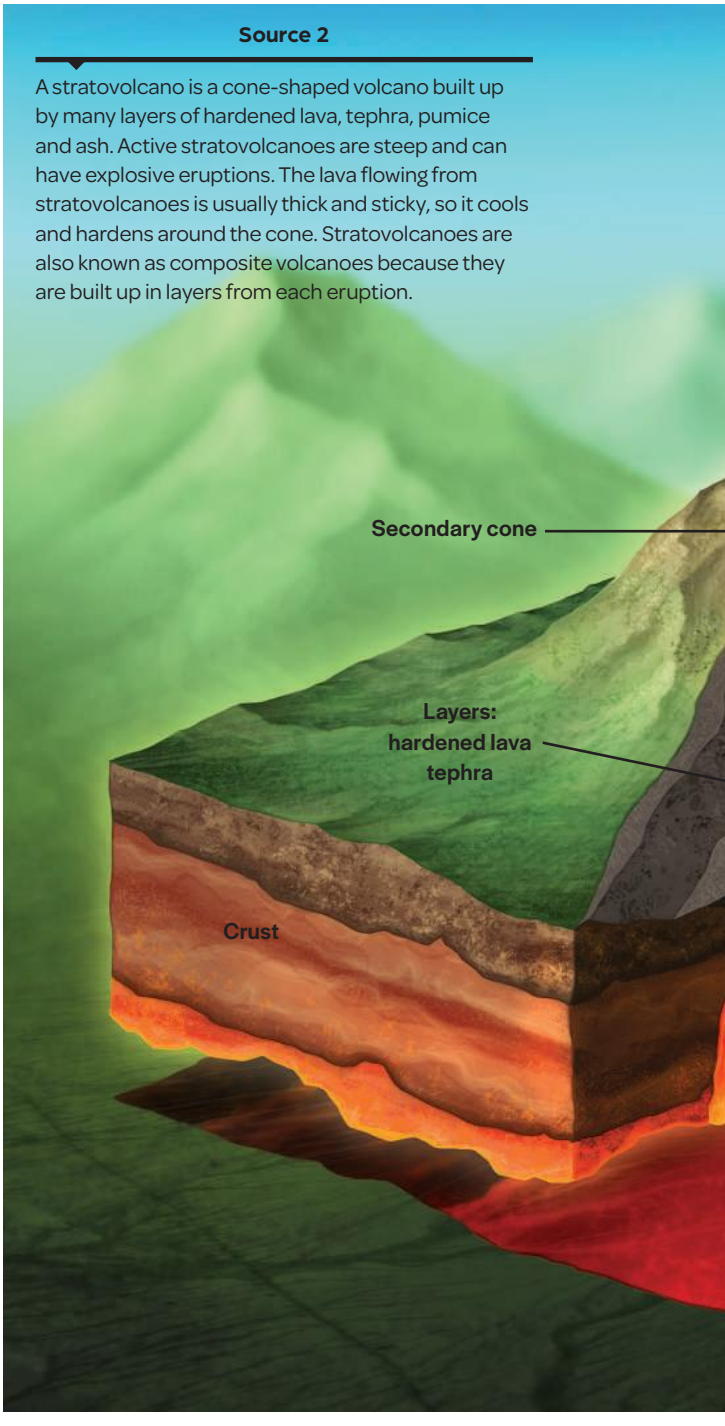
Source 1

Structure of Earth

1. The crust is broken into tectonic plates that form mountains and cause earthquakes.
2. Parts of the solid mantle can melt into magma and move to the surface through volcanoes.
3. With temperatures up to 6000°C, the outer core is the only completely liquid layer.
4. Earth's inner core is solid iron and nickel with temperatures up to 10 000°C.

Source 2

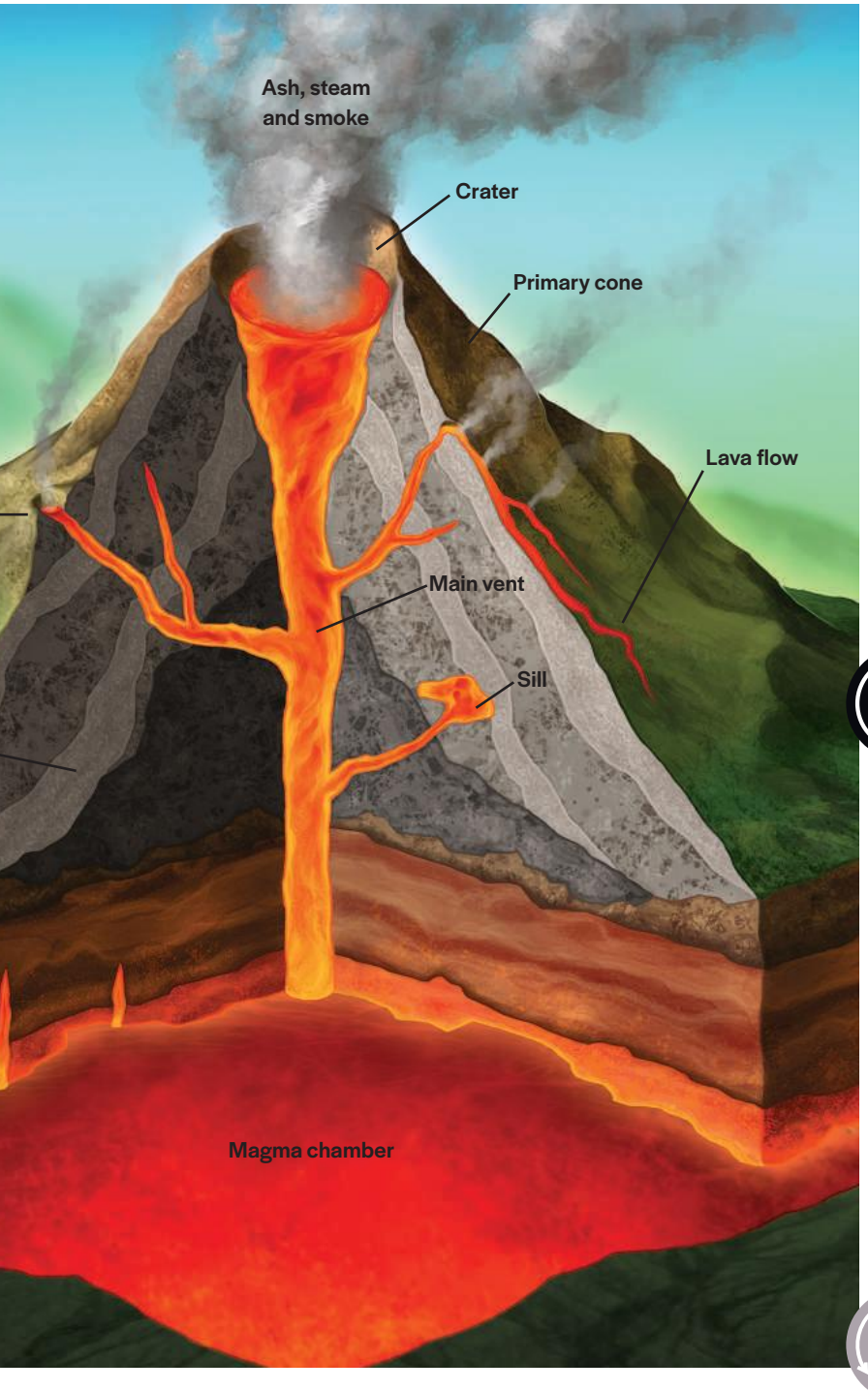
A stratovolcano is a cone-shaped volcano built up by many layers of hardened lava, tephra, pumice and ash. Active stratovolcanoes are steep and can have explosive eruptions. The lava flowing from stratovolcanoes is usually thick and sticky, so it cools and hardens around the cone. Stratovolcanoes are also known as composite volcanoes because they are built up in layers from each eruption.



Volcanoes

Volcanic mountains form when **magma** – melted rock from below Earth's surface – is pushed through an opening in Earth's crust. This material can build up to form a cone-shaped mountain known as a **volcano**.

Volcanoes are mainly found along **tectonic plate** boundaries where plates collide and one plate is forced downwards into the Earth's **mantle** in a process called **subduction** (page 20). The edge of the sinking plate melts into magma to feed the volcanoes along the plate boundary.



Hot spot volcanoes are found far from plate boundaries. They occur when particularly hot areas of the mantle burn through Earth's crust, such as Mount Elephant in Victoria (discussed on page 26).

The material that spews from a volcano builds up Earth's surface, creating new landforms. Each volcanic eruption brings new material to the surface as **tephra** (rocks and ash) or **lava** (magma that reaches Earth's surface). Across Earth's surface, lava flows cover material from previous eruptions to build the height of the land in layers.

Volcanoes are classified as **active** (erupting or likely to erupt), **dormant** (inactive but may erupt in the future) and **extinct** (unlikely to erupt again).

Learning ladder G1.6

Show what you know

1 Source 1: Which of Earth's layers is completely liquid?

2 Source 2: What is the name of the melted rock from the mantle layer that feeds volcanoes? What is it called when it reaches the surface?

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

3 Explain why volcanoes can only be present in certain *places* on Earth.

Step 2: I can explain spatial characteristics

4 Create a photo essay of different volcanoes around the world. For each photo state the location and type of the volcano in that place, as well as whether it is active, dormant or extinct.

Step 3: I can explain processes influencing places

5 Explain why stratovolcanoes form in layers.

Step 4: I can predict changes in the characteristics of places

6 Research how volcanologists predict volcanic eruptions. Is it an exact science?

HOW TO Photo essays, page 145

G1.7

thinking locally

Does Victoria have any volcanoes?

The Western Victorian Volcanic Plains stretch more than 400 km from Melbourne in the east to Mount Gambier in the west. They comprise the third-largest area of volcanic plains in the world, with more than 400 volcanoes and extensive lava flows.

Western Victorian Volcanic Plains

The Western Victorian Volcanic Plains cover more than 10 per cent of the state of Victoria. These **basalt** plains were formed by volcanic eruptions over the last six million years; the most recent eruption was 5000 years ago at Mount Gambier.

Volcanoes such as Mount Elephant and Tower Hill erupted explosively with a huge ash cloud and fire fountains creating volcanic cones. Tower Hill is actually a group of **scoria cones** in a large **maar crater**. Maar craters are formed by the explosive interaction between magma and groundwater; they are usually shallow, with steep sides and often fill with water.

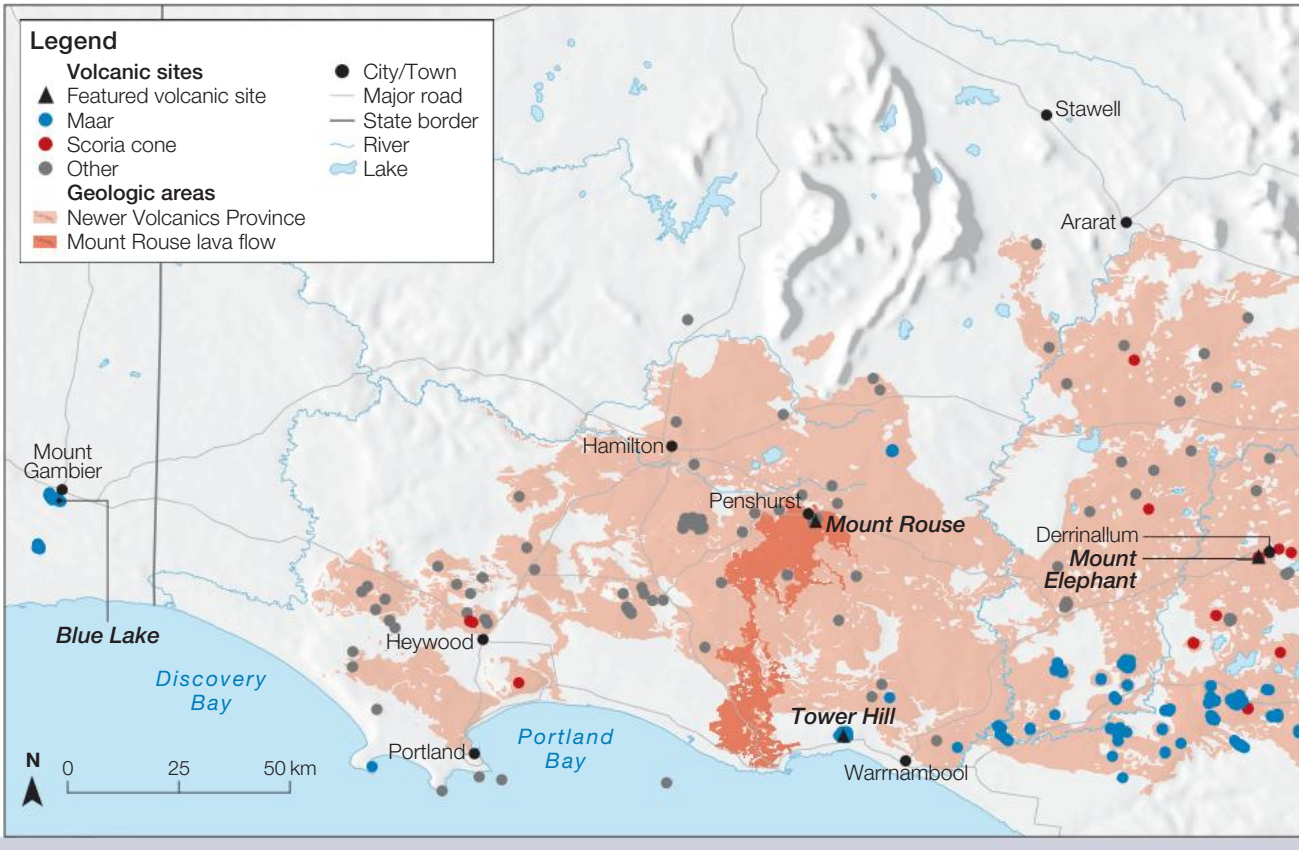
Mount Elephant

Mount Elephant at Derrinallum in Victoria is a 240-metre scoria cone formed by a **dormant** volcano. Recent scientific testing estimated that it last erupted 550 000 years ago. Scoria cones are small volcanoes with relatively steep sides, usually formed as the result of a single volcanic eruption.

Source 1

The Western Victorian Volcanic Plains are the third-largest volcanic plains in the world, with an average lava depth of 60 metres. More than 400 volcanic sites have been identified in this region.

Western Victorian Volcanic Plains



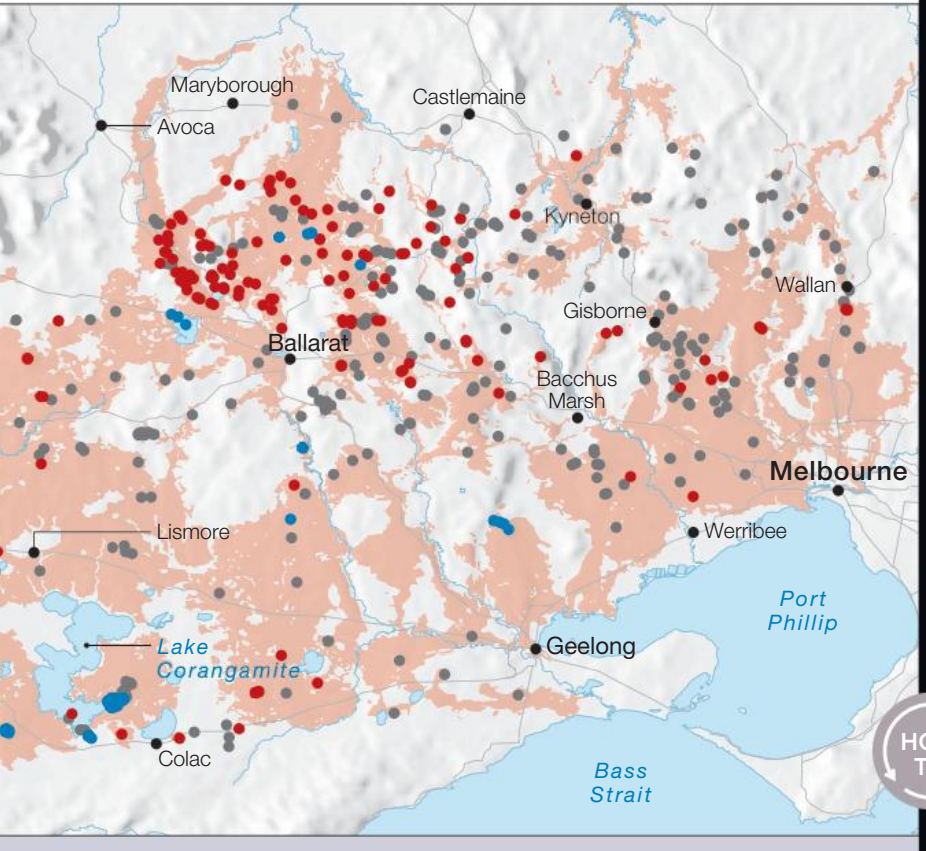
Source: Matilda Education Australia, Victorian State Government, Julie Boyce

Source 3

The eruption of Mount Elephant breached (broke) the crater at the top of the mountain. The quarry in the foreground was a scoria mine, used to make many of the roads and buildings in and around the town of Derrinallum.

Source 2

Lake Bullen Merri near Camperdown is a shallow maar volcanic crater formed by a volcanic eruption with little lava.



Learning ladder G1.7

Show what you know

1 When did Mount Elephant last erupt?

2 Is Mount Elephant extinct, dormant or active? Define all three of these terms.

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

3 Suggest how the oblique aerial image in Source 2 was collected.

Step 2: I can recognise and use different types of data

4 The map in Source 1 is an example of a secondary source of data. Use the following questions to help demonstrate your understanding of this map.

- a Where are the volcanic plains located in Victoria?
- b Describe the location of the greatest concentration of scoria cones in relation to Melbourne.
- c Where is the greatest concentration of maar craters? What other volcanic feature is also found in this location?

Step 3: I can choose, collect and display appropriate data

5 Make a sketch map of Mount Elephant from Source 3 and include these labels:

- a scoria
- b cone
- c breach
- d crater
- e quarry.

Step 4: I can use data to support claims

6 Consider the map in Source 1. How helpful do you think this map would be when investigating the presence of volcanoes at Tower Hill? Justify your response and suggest alternatives.

HOW TO Sketching, page 142

G1.8

What happens when a volcano erupts?

Volcanic eruptions are one of the most dangerous natural hazards on Earth. Explosive eruptions can completely destroy the surrounding area and ash clouds can travel for thousands of kilometres. Other eruptions may just produce small ash clouds or slow-flowing streams of lava.

The main categories of **volcanic eruptions** are:

1. **effusive eruptions** where magma flows out of the volcano as a lava, also known as Hawaiian eruptions
2. **explosive eruptions** are either where magma full of bubbling gas explodes as it reaches the surface, also called a Plinian eruption, or where magma reacts with water to create a steam-blast, also called a phreatic eruption.

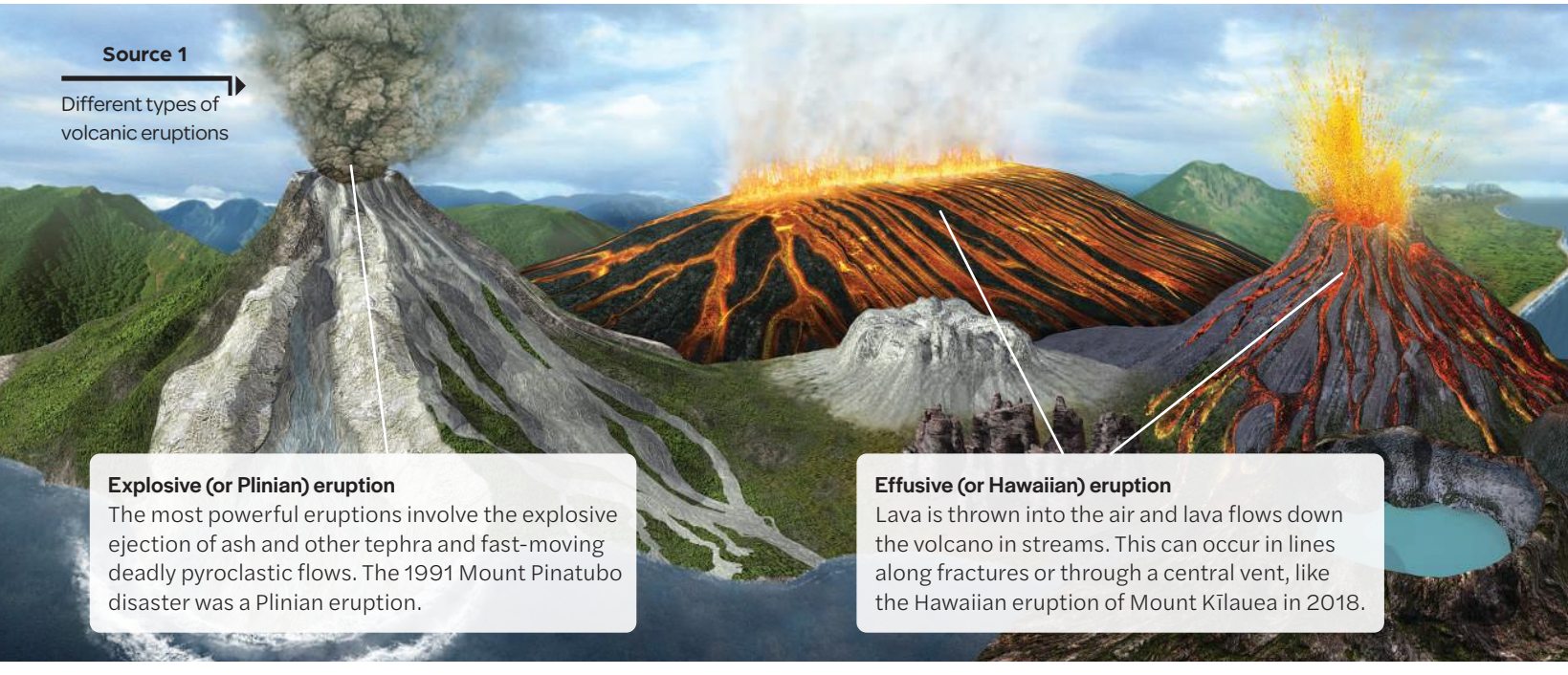
The **magma** that feeds **volcanoes** along plate boundaries generally contains a lot of gas. If magma moves up through the volcano's vent slowly, the gases are released slowly and escape safely. However, if magma moves to the surface quickly, most gases are retained and will explode if there is enough pressure. Explosive volcanic eruptions push huge amounts of ash and gas high into the air. Powerful eruptions can launch large rocks, known as **volcanic bombs**, into the air.

Mount Pinatubo erupts

When Mount Pinatubo erupted in the Philippines in 1991, it ejected more than 5 cubic kilometres of material from its vent and the ash cloud rose 35 kilometres into the air. An ash and sulfur-dioxide gas cloud travelled several times around the globe, blocking the sun and lowering world temperatures by 0.5°C for a year.

Source 1

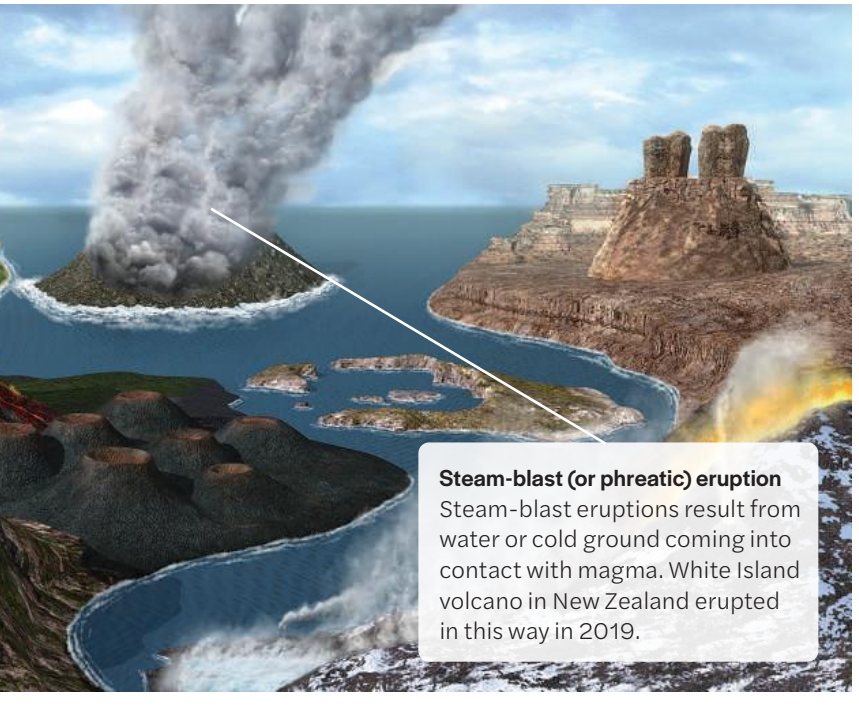
Different types of volcanic eruptions



Source 2

The Mount Pinatubo eruption in 1991 was the second-largest volcanic eruption of the 20th century.

A **pyroclastic flow** raced down Mount Pinatubo, wiping out villages and everything else in its way. A pyroclastic flow is a huge avalanche of hot gas and rock particles, known as **tephra**, that can move at speeds of up to 700 kilometres per hour and heat to temperatures of 1000°C, destroying everything is its path. Near Mount Pinatubo, valleys were filled with ash and rock up to 200 metres thick. Heavy rains washed this material onto lowlands in fast-moving mudflows called **lahars**, creating even more damage than the eruption. More than 700 lives and 100 000 homes were lost in the Mount Pinatubo eruption.



Steam-blast (or phreatic) eruption
Steam-blast eruptions result from water or cold ground coming into contact with magma. White Island volcano in New Zealand erupted in this way in 2019.

Learning ladder G1.8

Show what you know

1 How does the speed of moving magma influence volcanic eruptions?

2 What is a pyroclastic flow and why is it so dangerous?

Analyse data

Step 1: I can use geographic terminology to interpret data

3 Source 2: Was the eruption of Mount Pinatubo in 1991 an effusive or explosive eruption? Explain.

Step 2: I can describe patterns and trends

4 What impact did Mount Pinatubo's eruption have:
- a locally?
- b globally?

Step 3: I can explain the reasons behind a trend or spatial distribution

5 Refer to the map of Hawaii's lava danger zones on page 30. Explain why different areas have different hazard-level ratings. Are you surprised by the locations of any of the zones ranked as a low–medium hazard? Why or why not?

Step 4: I can analyse relationships between different data

6 Outside the classroom, use sand, papier-mâché or a cylindrical container to build a mini volcano-shaped mountain. Add two spoonfuls of baking soda and about a spoonful of dish soap to your volcano. When you are ready, add about 30 mL of vinegar and observe your volcano 'erupt'. As a class, compare this basic experiment to the real process of eruption.

What was the impact of the Kīlauea eruption?

Kīlauea Erupts

Tuesday 8 May 2018, Hawaii, USA

Hawaii's Kīlauea volcano is causing a state of emergency on the Big Island, spewing lava and dangerous fumes and destroying everything in its path.

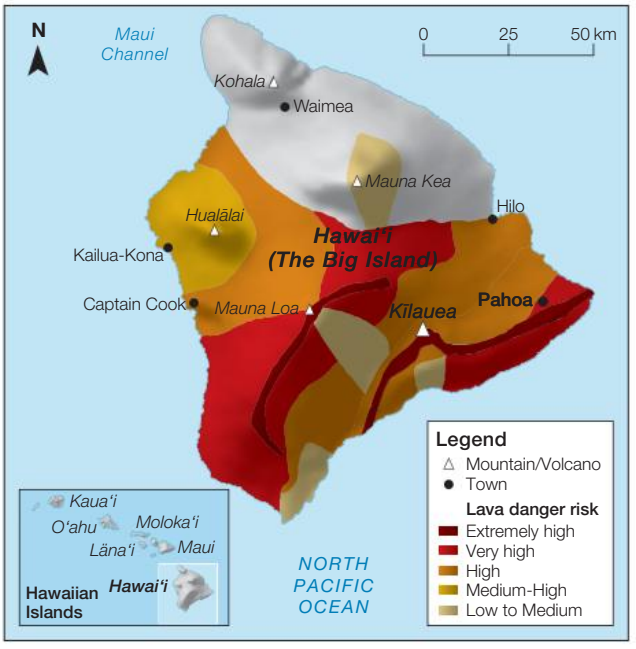
Lava destroys homes

A dangerous lava flow has already destroyed 26 homes and forced 1700 people to evacuate. The 1247-metre Kīlauea volcano began erupting on Thursday afternoon, following a magnitude 5 earthquake. Another earthquake on Friday was measured at magnitude 6.9, the most powerful earthquake to hit Hawaii since 1975. Kīlauea has been erupting continuously since 1983 and is one of five currently active volcanoes on Hawaii's Big Island.

Twelve volcanic vents have opened, sending large flows of lava into residential areas near Pahoa. People in the affected area have been ordered to evacuate, but not all people have left.

Sixty-five-year-old Sam Knox lives less than 100 metres from a volcanic fissure. He has decided not to leave, even as lava flows across his neighbour's property. 'It was roaring sky high. It was incredible ... rocks were flying out of the ground ... I decided to stay because I wanted to experience this in my life,' he said.

People are also at risk from deadly sulfur-dioxide gases produced by Kīlauea. Winds from the east have spread the toxic gas as far as 100 kilometres across the southern part of the island.



Source 1

Lava danger zones on Island of Hawaii

Source: Matilda Education Australia, ESRI, USGS, Hawaii State GIS Program

No end in sight

Though the rate of movement is slow, there is no indication when the lava might stop or how far it might spread. 'There's more magma in the system to be erupted. As long as that supply is there, the eruption will continue,' volcanologist Wendy Stovall said.

Aerial footage showed orange streams of lava bursting through openings in the ground and moving through residential areas, covering roads and starting small fires.

Offerings to a goddess

Hawaiians believe the goddess Pele lives in Kīlauea's crater. She is known to be unpredictable, so residents in the disaster zone are leaving gifts for her outside their homes to keep her happy.

Source: Author article based on multiple press reports.

Source 2

A wall of lava travels down a suburban street

Source 3

Lava from the erupting Kīlauea volcano surrounds a home and ignites the staircase on Hawaii's Big Island.

Learning ladder G1.9

Show what you know

1 What triggered the eruption of Kīlauea?

2 Explain why people have been able to escape the lava flows.

Geographic challenge

Step 1: I can identify responses to a geographical challenge

3 Source 1: In which lava danger zone is Kīlauea located? In which direction from Kīlauea does this danger zone extend?

Step 2: I can compare responses to a geographical challenge

4 List two different actions people took in response to the Kīlauea eruption.

Step 3: I can compare strategies for a geographical challenge

5 Research the White Island eruption in December 2019. Why was it different to the Kīlauea eruption and how was the response different?

Step 4: I can evaluate alternatives for a geographical challenge

6 Why do you think the areas southeast and west of Kīlauea are more hazardous than the area to the south?

What are geohazards?

Geomorphic hazards, or geohazards, are dangers that originate at or near the Earth's surface, such as volcanic eruptions, earthquakes and landslides. They pose a great threat to people and environments.

Volcanoes

Volcanoes pose a huge threat to nearby communities. Dangerous **pyroclastic** flows, **volcanic bombs**, **lava flows** and volcanic gases are an immediate threat to people. Other **geomorphic hazards** can follow a volcanic eruption, including **lahars** (mudflows), **landslides** and even **tsunamis** caused by ocean-floor volcanic eruptions.

Earthquakes

Earthquakes are one of the deadliest geomorphic hazards. An earthquake is caused when **seismic waves** shake the surface of the Earth. These waves are generated from the sudden release of energy in or beneath Earth's crust. The shaking can cause massive damage to buildings and large death tolls. Earthquakes can also trigger landslides and tsunamis.

Source 1

Ash-covered Aeta people were forced from their villages on the slopes of Mount Pinatubo (see pages 28–29) following a volcanic eruption in 1991. More than 200 000 Aeta lost their homes and were forced into resettlement camps or moved to urban areas.

Source 2

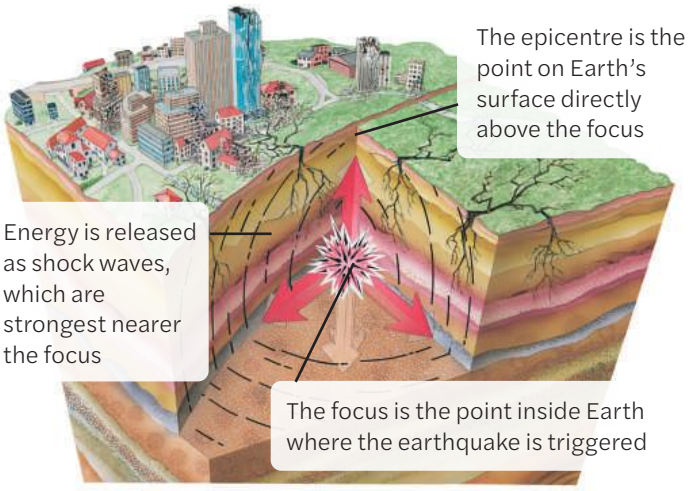
A devastated street in Port-au-Prince, Haiti, a week after the powerful 2010 earthquake.

A major earthquake struck Haiti's capital, Port-au-Prince in January 2010. Up to 85 000 people died and another million were made homeless. Haiti is a **less economically developed country (LEDC)** and most of its population live in poverty. Those left homeless by the earthquake could not afford to move elsewhere. In the devastated urban areas, displaced Haitians were forced into crowded and unsanitary camps in city parks, and they were living in self-made structures or donated tents.

Humanitarian aid was supplied by organisations such as the United Nations and the Red Cross. Countries sent doctors, relief workers and supplies in the wake of the disaster in Haiti. Aid agencies struggled to supply the most basic needs and in October contaminated food and water caused an outbreak of cholera in the camps, claiming hundreds of lives. Two years after the earthquake, more than half a million people were still living in refugee camps.

Landslides

A landslide is the mass movement of soil, rock and debris down a slope. In most cases, landslides are caused by extended rainfall or flooding, where the soil becomes saturated and heavy. Landslides can also be triggered by earthquakes, volcanic eruptions or cutting into slopes for buildings and roads. In 1997, a landslide at Thredbo in New South Wales destroyed two buildings and killed 18 people. Miraculously, rescue workers pulled the sole survivor Stuart Diver from the rubble after three days in sub-zero temperatures.



Source 3

An earthquake in action

Learning ladder G1.10

Show what you know

1 List four geomorphic hazards.

2 Source 3: How do earthquakes work and why do they cause so much damage?

3 List one other geomorphic hazard that earthquakes can trigger.

4 Summarise why mountain landscapes are prone to landslides.

5 Connect to the following site: http://mea.digital/W9t2. Explore the locations of historical and recent geohazards and discuss as a class any clear patterns.

Geographic challenge

Step 1: I can identify responses to a geographical challenge

6 List the threats from a volcanic eruption.

Step 2: I can compare responses to a geographical challenge

7 What made the earthquake disaster in Haiti more difficult to deal with? What more could have been done?

Step 3: I can compare strategies for a geographical challenge

8 Compare the response to the Mount Pinatubo and Haiti disasters. What similarities are there?

Step 4: I can evaluate alternatives for a geographical challenge

9 Source 2: What rules need to be made for buildings in earthquake-prone areas? Why might this be difficult to enforce in countries like Haiti?

How does weathering affect landforms?

When rock is exposed on Earth's surface it can be broken down by water, temperature and the roots of plants. Moving ice, water and wind can further wear down rock and carry it away.

Weathering and erosion

Landforms change because of **weathering** and **erosion**. Weathering is a process where rock is worn away, broken down or dissolved into smaller and smaller pieces by water, heat and cold.

Weathering involves two processes that work to break down rocks on the surface of Earth. **Chemical weathering** is a chemical change in a rock, while **mechanical weathering** involves rocks being broken into pieces.

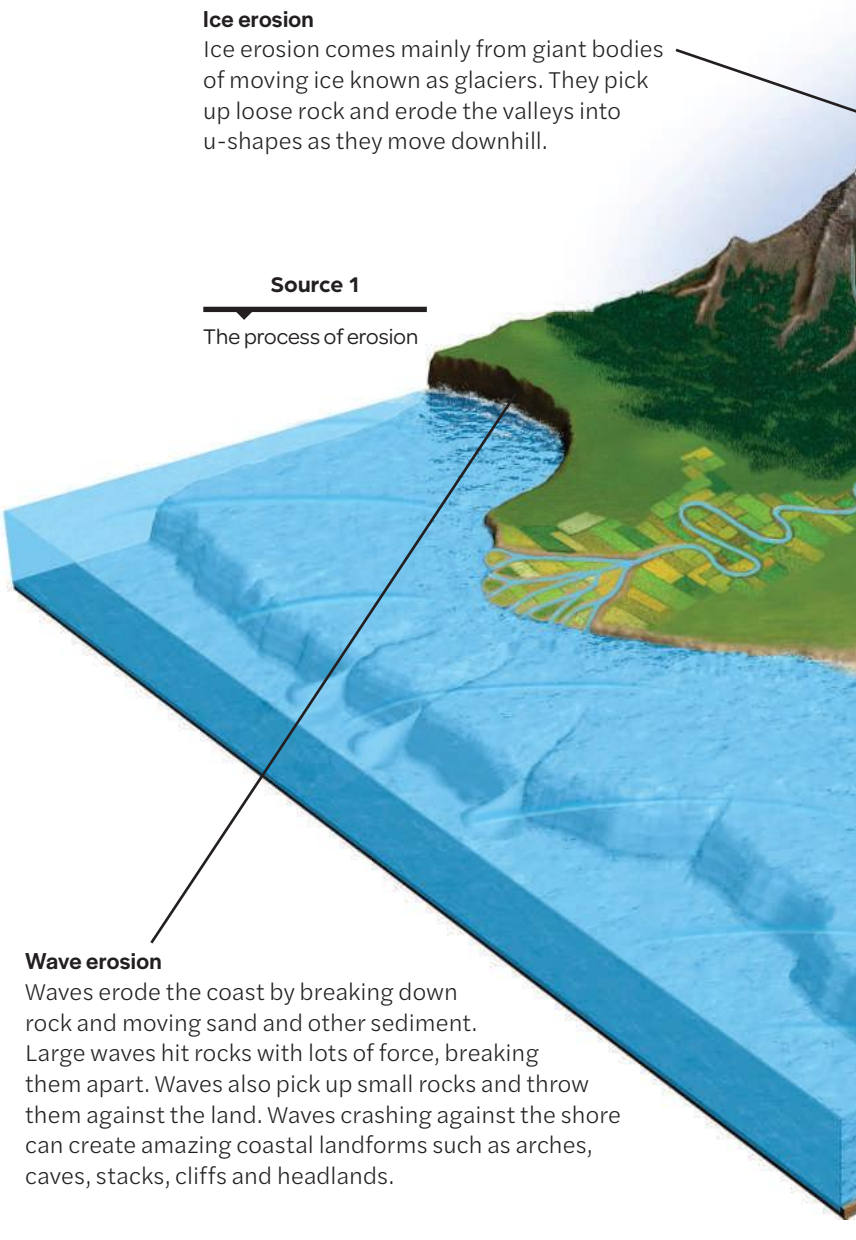
A weathered rock particle is loosened but stays in its place. When the particle begins moving, we name this erosion, or **mass wasting**. Mass wasting is simply the movement of rocks downhill due to gravity, such as rock falls and landslides. Erosion is where rock particles are moved by flowing air (wind), water (rivers, sea and rain) or ice (glaciers). Erosion acts more quickly on softer rocks. Harder rocks remain as landforms such as mountains or **headlands**.

Mechanical weathering

Mechanical weathering is where large rocks on Earth's surface are broken down into smaller ones. Mechanical weathering is caused by:

- *temperature* – cold nights and hot days cause rocks to expand and contract, which makes them crack and break apart.
- *ice* – water seeps into cracks in rocks. When the water freezes it expands by 9 per cent, splitting the rocks.
- *roots and plants* – vegetation pushes into rocks and acts as a wedge to push the rocks apart.

Ice erosion
Ice erosion comes mainly from giant bodies of moving ice known as glaciers. They pick up loose rock and erode the valleys into u-shapes as they move downhill.



Source 1
The process of erosion

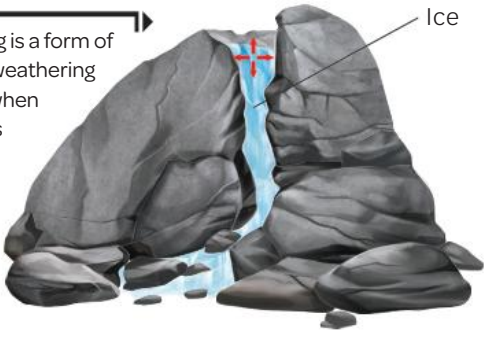
Wave erosion
Waves erode the coast by breaking down rock and moving sand and other sediment. Large waves hit rocks with lots of force, breaking them apart. Waves also pick up small rocks and throw them against the land. Waves crashing against the shore can create amazing coastal landforms such as arches, caves, stacks, cliffs and headlands.

Source 2

Mechanical weathering is the key agent that shapes the amazing rock features of Monument Valley in the USA. The hot days and cold nights enable the rocks to expand and contract, which causes cracks that eventually split sections of rock. Wind erosion picks up the small dry weathered rock particles and blasts them against larger rocks, which further shapes them.

Source 3

Frost wedging is a form of mechanical weathering that occurs when water freezes and expands in a crack in a rock.



Water erosion

Water erosion occurs from the force of the flow of water and the eroded rock and other material carried in the water. Rocks or debris carried by a river erode its banks and bed as they crash into it.

Wind erosion

Wind erosion is particularly active in dry desert areas. Light objects such as sand and pebbles are swept up and carried by the wind. The small rock particles are thrown against landforms, eroding materials off them. The newly eroded material is also swept away by the wind to sandblast the desert landscape into amazing shapes.

Source 4

The pressure of expanding plant roots causes rocks to crack and break away.

Antelope Canyon

Mechanical weathering processes such as temperature change and frost wedging opened wide cracks in the soft sandstone rock of Antelope Canyon. Flash floods carrying sand, rocks, logs and other debris eroded large amounts of rock to further widen the cracks. Over time, erosion has cut and smoothed a skinny deep slot canyon. The amazing shapes of Antelope Canyon are very popular with tourists.

Chemical weathering

Chemical weathering decomposes rocks and minerals. Chemicals in water or the reaction of water with minerals in rocks either form or destroy minerals in the rock, breaking down the bonds holding rocks together. This weathering is common in locations where there is a lot of water to help the chemical reactions take place.

The most common types of chemical weathering are:

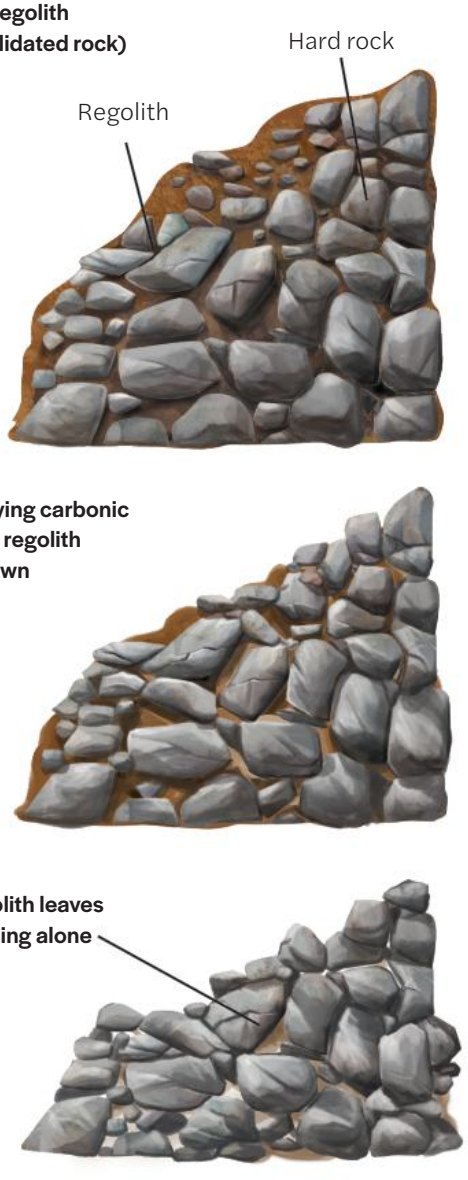
- *hydrolysis* – hydrogen in water reacts with minerals in the rocks to form new minerals. For example, hard granite rock changes to softer clay through hydrolysis. Clay is more prone to mechanical weathering and erosion than granite.
- *carbonation* – rainwater contains carbonic acid because carbon dioxide in the atmosphere dissolves in it. This carbonic acid reacts with minerals in some rocks, causing the rocks to weather.
- *oxidation* – when oxygen combines with other elements in rocks, new types of rock are formed. As with hydrolysis, these new rocks are generally softer and easier for mechanical weathering to break apart.

Source 5

Antelope Canyon has been formed by a combination of weathering and erosion in the semi-desert region of Arizona, USA.

Karlu Karlu

Karlu Karlu (the Devil's Marbles) in the Northern Territory is a local example of chemical weathering. The granite rock has been shaped into round boulders by a chemical weathering process known as **spheroidal weathering**. Water seeps into cracks and chemical reactions cause the rocks to disintegrate along the edges. The cracks are opened wider, allowing even more water to reach the surfaces. Corners are attacked by water from more than one direction and wear away more rapidly. The sharp corners are rounded, forming spherical rocks.

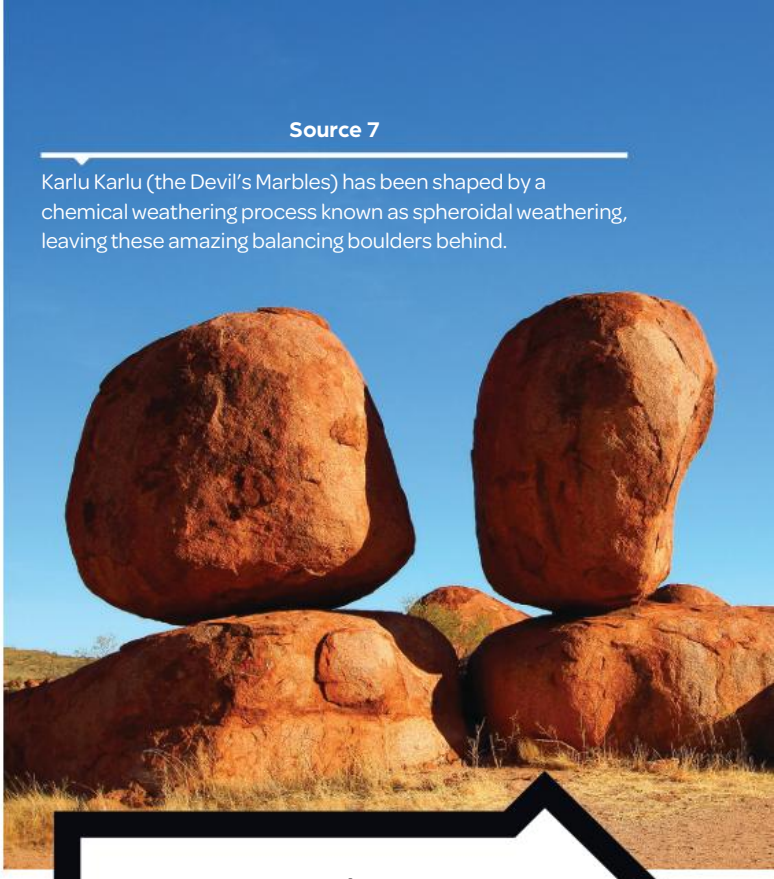


Source 6

Chemical weathering causes a chemical change in the rock that enables softer rock to be worn away, leaving harder rock behind.

Source 7

Karlu Karlu (the Devil's Marbles) has been shaped by a chemical weathering process known as spheroidal weathering, leaving these amazing balancing boulders behind.



Learning ladder G1.11

Show what you know

1 Define the term 'weathering'.

2 What are the two types of weathering and how are they different?

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

3 Source 4: Draw a two-stage flow diagram to show how plants can cause mechanical weathering.

Step 2: I can explain spatial characteristics

4 What is the interconnection between weathering and erosion?

Step 3: I can explain processes influencing places

5 Weathering is due to a range of *interconnecting* factors, which ultimately leads to a *change* in landforms over time. Discuss.

Step 4: I can predict changes in the characteristics of places

6 Source 5: Describe the change over time in this location and describe the processes that have caused the changes.

HOW TO Flow diagrams, page 144

What are deserts?

Deserts are dry environments. They can be hot or cold and be rocky, sandy or even covered in ice. Rocky deserts can be weathered and then eroded by water and wind into amazing shapes.

Different desert landscapes

Deserts cover about thirty per cent of Earth's surface and receive less than 250 millimetres of rain per year. Most are hot deserts that lie between the latitudes of 15 and 30 degrees north and south of the equator. Cold deserts are found in temperate areas or high **plateaus**, while polar deserts are localised at the North and South poles.

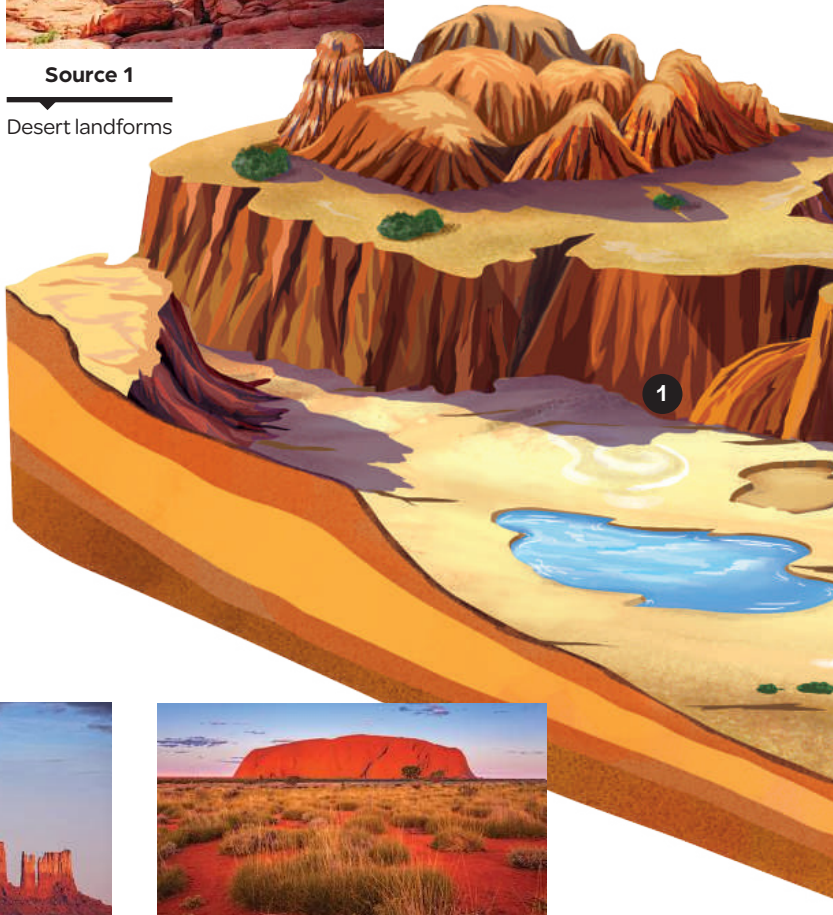
Desert **landscapes** can vary greatly. Some deserts are seas of sand; others are vast, stony plains; others have spectacular rock formations shaped by **weathering** and **erosion**. Plateaus of rock weather and erode into isolated **mesas**, **buttes** and chimney rocks. Natural arches form from weathering along joints that leave narrow walls of rock. When the lower wall erodes, an arch results. **Inselbergs** such as Uluru (see pages 40–41) are islands of rock that remain after a long period of erosion of the surrounding soft rock.

The world's deserts are expanding through a process known as **desertification** (see pages 44–45). This occurs when land along the edge of a desert becomes damaged by drought and through overuse by humans.

4 *Arch* – a natural bridge weathered and eroded through a solid rock cliff over time.

Source 1

Desert landforms

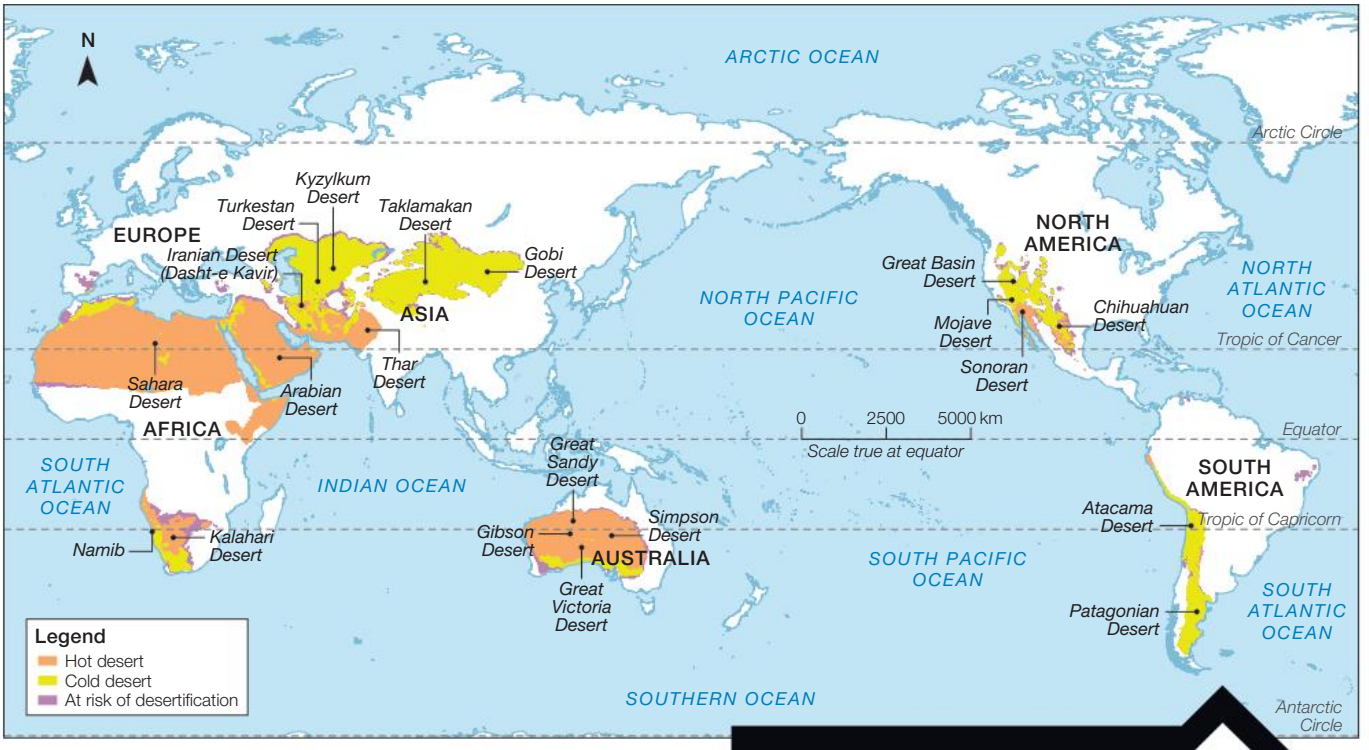


1 *Alluvial fan* – semicircular build-up of eroded material deposited by water and wind at the end of **wadis** (desert valleys).

2 *Butte* – isolated hill with vertical sides and a small flat top. Buttes are smaller than mesas.

3 *Inselberg* – isolated steep-sided mountain, uncovered as the softer land around it is eroded away.

World deserts



Source: Matilda Education Australia and Beck, Zimmerman, McVicar, Vergopolan, Berg, Wood

Source 2

World deserts

5 *Mesa* – broad, isolated flat-topped landform found in desert areas. They are the eroded remains of a wide plateau.

6 *Chimney rock* – thin pillars of rock that are the remains of buttes. Evaporating water creates a hard crust on top to protect it from chemical weathering as the column wears away.

Learning ladder G1.12

Show what you know

1 Explain how deserts can be classified as both hot and cold.

2 Outline how desert landscapes can vary.

Analyse data

Step 1: I can use geographic terminology to interpret data

3 Describe the geographical characteristics of a desert.

Step 2: I can describe patterns and trends

4 Describe, using PQE, the distribution of deserts on a global scale.

Step 3: I can explain the reasons behind a trend or spatial distribution

5 Using SHEEPT, explain the distribution of hot and cold deserts on a global scale.

Step 4: I can analyse relationships between different data

6 Source 1: Look at the photographs of the mesa, butte and chimney rocks. Analyse the relationship between these landforms.

HOW TO

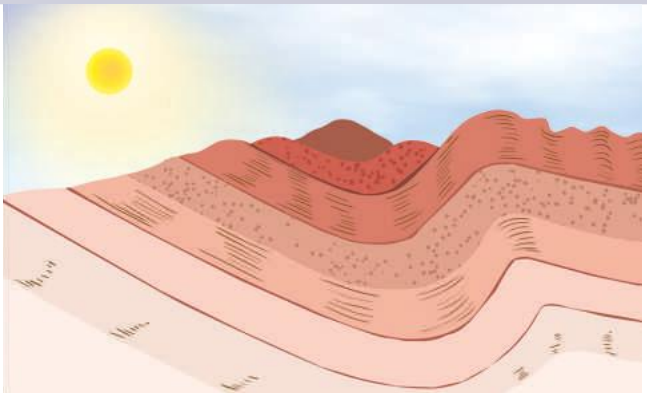
PQE, page 138
SHEEPT, page 140

How did Uluru form?

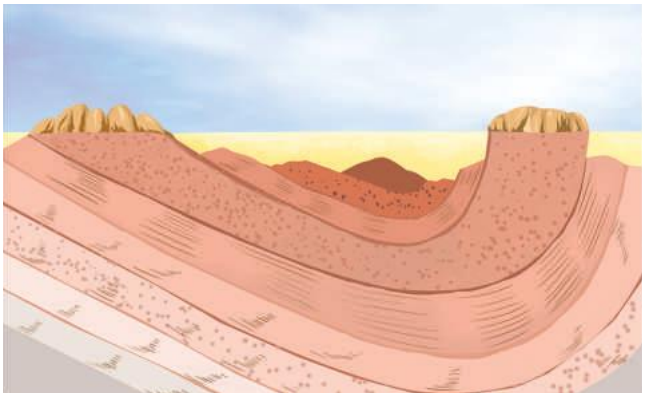
Uluru and nearby Kata Tjuta are inselbergs that were uncovered as the land around them eroded away.

About 500 million years ago, colliding **tectonic plates** caused the land in Central Australia to **fold** and be pushed upwards (pages 18–19). The layers of sedimentary rock were gradually worn away by **weathering** and **erosion** (pages 34–37), leaving only the hardest rocks showing as the **inselbergs** of Uluru and Kata Tjuta on the surface. Uluru is the largest surface rock in the world. It rises 348 metres above the surrounding land and covers an area of 3.3 square kilometres.

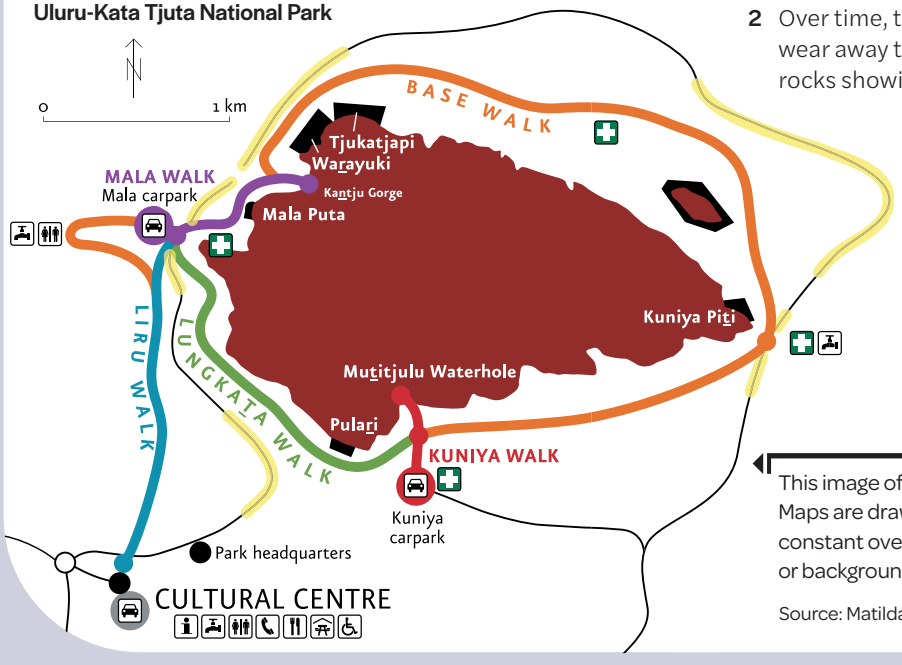
Uluru and Kata Tjuta are sacred to the Pitjantjatjara Anangu, who have their own version of how they formed. The information has been passed down over thousands of years through stories, songs, ceremonies, dances and art. For the Anangu people, Uluru isn't just a rock, it's a living place – with the marks of the creation beings shown everywhere.



1 Fold mountains (see page 18) are pushed upwards due to pressure in Earth's crust. Layers of sedimentary rock are bent and pushed upwards to create fold mountains.



2 Over time, the processes of weathering and erosion wear away the softer rock, leaving only the harder rocks showing on the surface of the land.



Source 1

The formation of Uluru and Kata Tjuta

Source 2

This image of Uluru is in the *plan view* – directly above. Maps are drawn from the plan view because the scale is constant over the area shown. There is no foreground or background in plan-view images and maps.

Source: Matilda Education Australia, Parks Australia

Source 3

This is an *oblique aerial view* of Uluru. These angled views are good at showing the shape of landforms, as they show the foreground and the background. Uluru is featured in the foreground. Kata Tjuta appears much smaller because it is in the background.

Learning ladder G1.13

Show what you know

1 What record does Uluru hold?

2 What spiritual connection do the Anangu people have with Uluru?

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

3 Create a statistics bank that contains five pieces of quantitative data about Uluru and its formation.

Step 2: I can recognise and use different types of data

4 Outline the advantages and disadvantages of using oblique aerial views to study a landform.

5 What is the key advantage of using maps and images in plan view?

Step 3: I can choose, collect and display appropriate data

6 Go to the contour map of Uluru, Source 26 on page 151. Draw a cross-section of Uluru from:
- a Point A to B
- b Point C to D.

Step 4: I can use data to support claims

7 What role did the following have on the formation of Uluru?
- a Movement of tectonic plates
- b Weathering and erosion

Cross-sections, page 151

HOW TO

How do landforms attract tourists?

Images of Australian landforms and iconic outback landscapes are marketed to tourists from all over the world. Tourism Australia uses our vast outback and unique landforms such as Uluru and the Great Barrier Reef to attract tourists to Australia. Tourists are more likely to come to Australia when the value of the Australian dollar is low compared to other currencies.

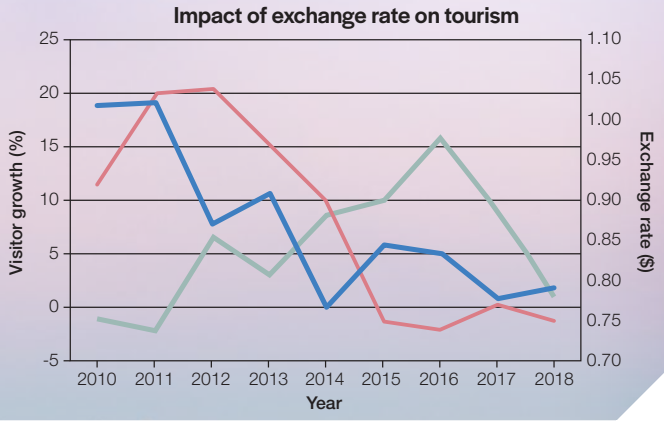
Marketing Australia

Tourism Australia promotes Australia's **landforms** and **landscapes** and the Australian lifestyle to the world. Like other businesses, Tourism Australia needs to find something distinctive and special about its product to compete with other countries for tourist dollars. In 1986, actor and comedian Paul Hogan developed the character of the popular bush larrikin Crocodile Dundee, with successful films that promoted interest in travel to Australia.

The Crocodile Dundee films became tourism advertisements for Australia. Outback landscapes and landforms were filmed in Kakadu National Park, in the Northern Territory. The films created great interest in Australia from the USA. In the 1980s, airfares reduced and the value of the Australian dollar against the American dollar was low, so American tourists could travel and stay relatively cheaply in Australia.

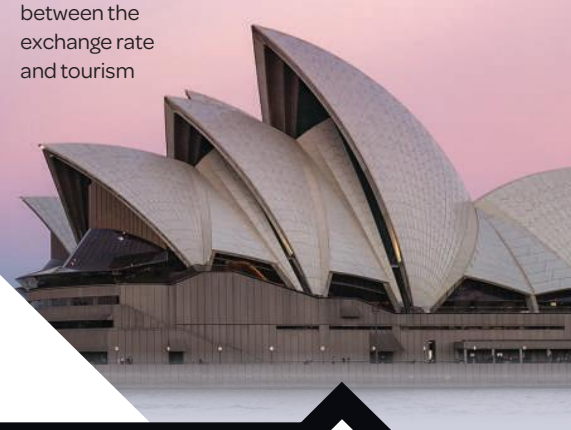
In 2018, Tourism Australia launched a reboot of the Crocodile Dundee campaign with a $36 million advertising campaign featuring well-known Australian actors such as Chris Hemsworth, Margot Robbie and Hugh Jackman. The campaign aimed to increase the current 780 000 American visitors to Australia.

Source 1
Crocodile Dundee rebooted by Tourism Australia



Source 2

The relationship between the exchange rate and tourism



Exchange rates

An **exchange rate** is how much one **currency** is valued compared to another currency. Exchange rates continually respond to changes in a country's **economy**. Higher-valued currencies are generally associated with confidence in a government and its economy; for example, currency investors are confident in a country's low rates of **inflation**.

The value of a currency is determined by the movement of money in and out of a country. When a currency is in high demand, this leads to an increase in its value.

The exchange rate defines the amount of a foreign currency you can buy with one Australian dollar. In 2012, when the Australian dollar was in demand, you would receive $1.04 American dollars for every Australian dollar. The average exchange rate with the American dollar in 2018 was just 75 cents. This means that you receive 75 American cents for every Australian dollar.

Exchange rates and tourism

When travelling, exchange rates greatly influence the prices you will pay in a foreign country. When the Australian dollar is high compared to other countries, Australians are encouraged to travel overseas because they can buy more with their money, but international tourists to Australia are discouraged because their currency is not worth as much when converted to Australian currency.

Consumers such as tourists respond to changing prices in the market. Australian tourism benefits when the Australian dollar is low against other currencies. In 2016, when the Australian dollar exchange rate was just 74 cents against the American dollar, USA tourist numbers to Australia grew by nearly 16 per cent. In 2011 when the Australian dollar exchange rate was $1.03 against the American dollar, USA tourist numbers fell by more than 2 per cent.

Learning ladder G1.14

Show what you know

1 How are landforms and landscapes important in promoting tourism to Australia?

Economics and business

Step 1: I can recognise economic information

2 Define these terms from the information on these pages: currency, exchange rate, inflation.

Step 2: I can describe economic issues

3 Source 1: Why do you think Tourism Australia turned to famous Australian actors to help them in marketing Australia?

Step 3: I can explain issues in economics

4 What impact do exchange rates have on the Australian tourism industry?

Step 4: I can integrate different economics topics

5 Look carefully at the line graph in Source 2.
- a When was the best time for Australians to travel overseas and why?
- b When was the best time for American tourists to travel to Australia and why?
- c Compare the USA and Australian tourist growth trends shown on the graph. Why are they different?

Step 5: I can evaluate alternatives

6 Using Source 2 as a reference, why do you think Tourism Australia chose 2018 to make a large investment in attracting American tourists to Australia? Could there have been a better time?

How do humans degrade landscapes?

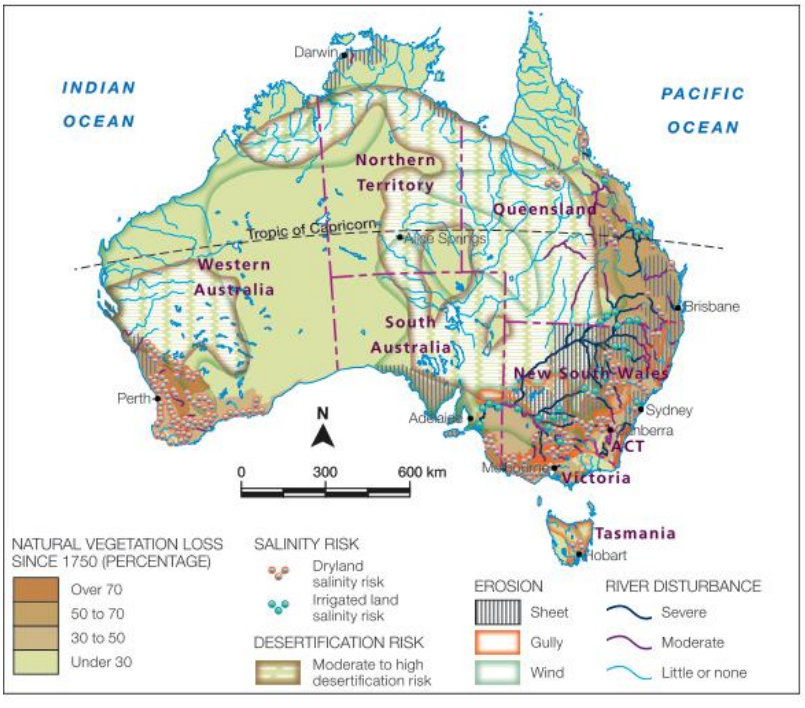
As humans change landscapes, the land can be degraded through processes such as deforestation and desertification. Natural vegetation is cut down for fuel and timber and replaced with farms, mines and towns.

Soil erosion

Deforestation and overgrazing account for two-thirds of Australia's land degradation. Vegetation binds the soil together with its roots, so when trees are cut or plants are trampled by cattle the soil is opened to **erosion** (see pages 34–37).

Water can remove unprotected soil in sheets or cut gullies into the earth. Wind can pick up dry soil and deposit it great distances away. The eroded soil can clog rivers and the deforested land can no longer hold onto water, causing more erosion and flooding. Worldwide, half of Earth's topsoil has been lost in the last 150 years.

Land degradation in Australia



Source: Matilda Education Australia

Desertification

Desertification occurs on the edges of deserts, when fragile land is over-farmed and overgrazed, causing the desert to spread. Desertification can also be caused by drought.

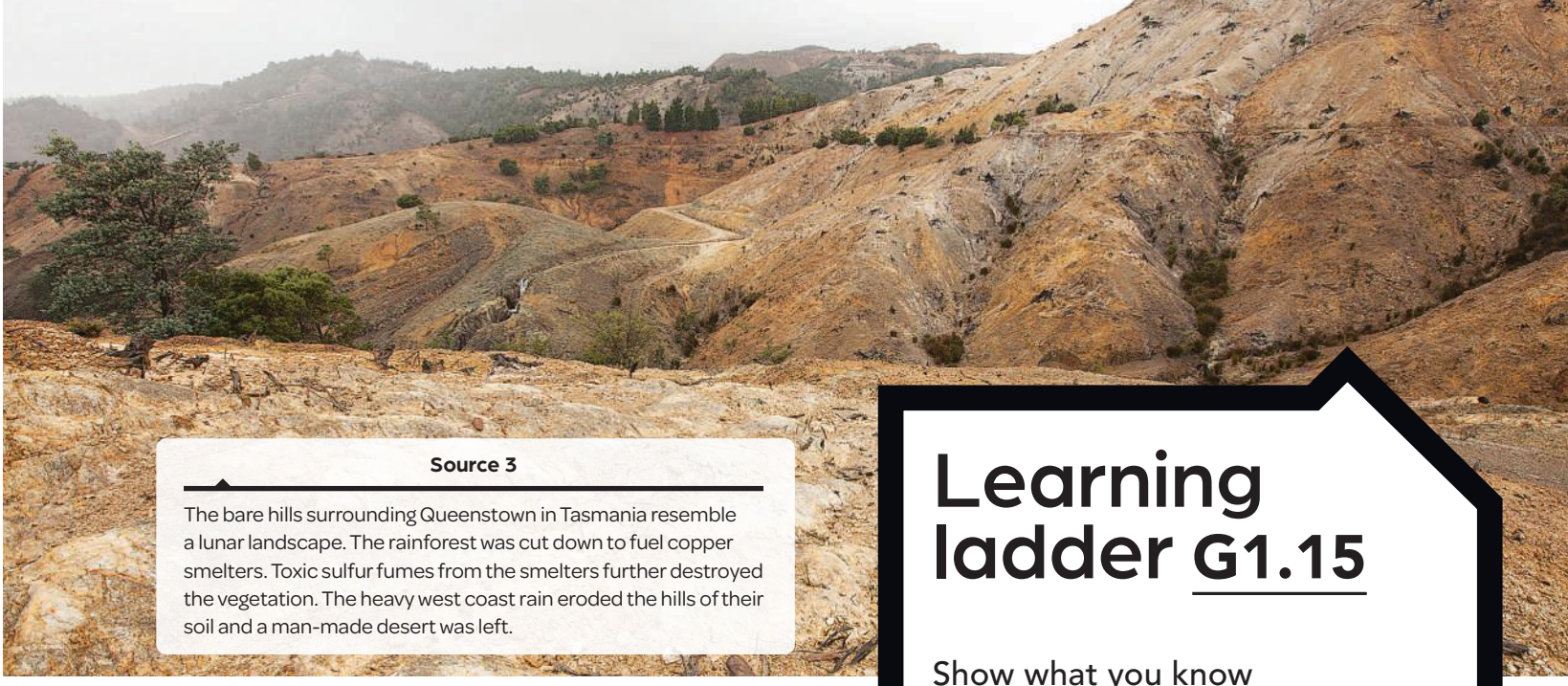
Source 1

a Forested hillside binds the soil together and takes up water through its roots.

b Deforested hillside leaves the soil unprotected and easily eroded by water and wind.

Source 2

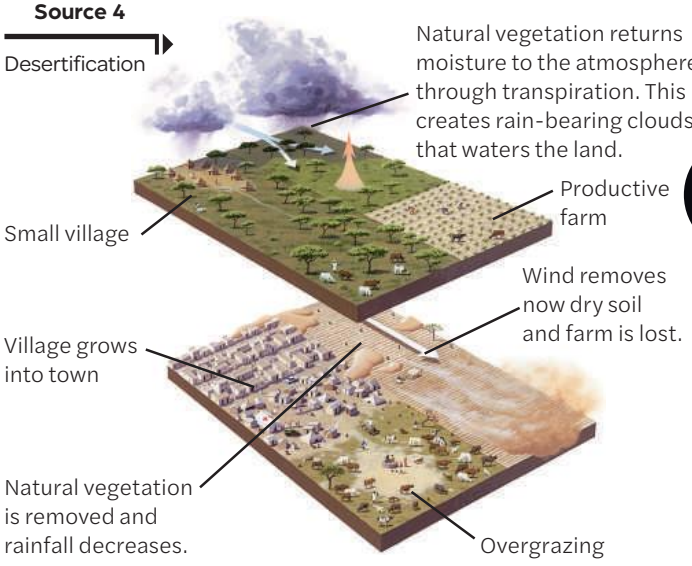
Land degradation in Australia



Source 3

The bare hills surrounding Queenstown in Tasmania resemble a lunar landscape. The rainforest was cut down to fuel copper smelters. Toxic sulfur fumes from the smelters further destroyed the vegetation. The heavy west coast rain eroded the hills of their soil and a man-made desert was left.

Source 4



Source 5

This aerial view shows the sand-covered streets of Nouakchott, the capital city of Mauritania in Africa. In 1960, Nouakchott was many days' walk from the Sahara Desert, but now the advancing sand dunes have covered outlying towns and forced people and animals to come to Nouakchott, putting further pressure on the land.

Learning ladder G1.15

Show what you know

1 What is deforestation and why does it lead to increased erosion?

2 What is desertification and how is it caused?

3 List three similarities between desertification and deforestation.

Geographical challenge

Step 1: I can identify responses to a geographical challenge

4 Source 5: Why have people been forced to relocate to Nouakchott?

Step 2: I can compare responses to a geographical challenge

5 Source 4: What are the key causes of desertification and how are humans affected? What plans can be put in place to reduce desertification and repair the land?

Step 3: I can compare strategies for a geographical challenge

6 Create an infographic to raise awareness of how humans are acting to degrade landforms and landscapes. Include the following key ideas in your graphic:

- a causes of degradation
- b examples of locations undergoing severe degradation
- c ways we can reduce our impacts on the landscape.

Step 4: I can evaluate alternatives for a geographical challenge

7 Source 2: Identify the areas of Australia affected by salinity. Draw a block diagram to show how salinity occurs and present some alternatives for reducing salinity.

HOW TO
Block diagrams, page 144
Infographics, page 150

How can we take action to save landscapes?

To help improve a landscape or stop its destruction, people can let their voices be heard by protesting or lobbying members of parliament through letters and petitions.

Participating in democracy

Democracy is government by the people. In order for people to participate in democratic government and influence issues such as protecting natural landscapes, they can take actions to enable their voices to be heard. These actions include:

- voting for government representatives that support their views
- contacting their local member of parliament to let them know their views
- taking **direct action** such as protesting, strikes or signing a petition
- contacting or joining an interest group that will lobby elected representatives to make changes in the laws to support their views.

Direct action

People raise awareness about environmental and other issues through direct action. You can take direct action to have your voice heard even if you have not reached the voting age of 18 years. Direct action is an effective way of raising awareness about issues. Today, people use social media to quickly spread messages about direct action events and bring issues to people's attention.

Protests are an effective form of direct action where protesters march or hold a **demonstration** at the site of an issue such as a deforested area or the steps of parliament.

Protests can attract large numbers of people with placards, t-shirts and badges showing slogans to get their message across. Protest organisers

Source 1

Protesters gather outside Queensland's parliament to protest against deforestation. Lobby group, the Queensland Conservation Council, stated that '... Our native woodlands have been exposed to unnecessary and unrestrained land clearing'.

Source 2

Australian land damaged by deforestation for cattle grazing

invite the media to their demonstrations to record speeches and beam the protest to a wider audience in Australia and around the world.

In May 2018, protesters demonstrated against deforestation outside Queensland's parliament. Protesters erected a large billboard to show how deforestation has a great impact on native animals. Farmers who held an opposing view also gathered to demonstrate against proposed changes to land-clearing laws. Both groups were trying to influence the members of the Queensland parliament who were about to vote on the issue.

Lobby groups

Lobbying is any attempt by individuals or groups to influence the decisions of government. Lobby groups work on behalf of a particular cause to influence political decisions. In Australia, there are many conservation organisations that work to influence public and government opinions on issues such as deforestation, pollution and the impact of introduced species.

The World Wildlife Fund (WWF) is a lobby group that works around the world to protect endangered species and habitats. It tries to influence political decisions about the environment through media campaigns or speaking directly with federal or state members of parliament. The WWF website gives interested people the chance to email a message to members of parliament on issues such as protecting koalas from **deforestation**.

The WWF also organises online **petitions** to gather as many signatures as possible to lobby national governments and the United Nations to support causes such as stopping plastics from polluting our oceans and endangering wildlife. Petitions are used to persuade politicians that there is large support for a cause. Anyone can start a petition, so it is a popular form of direct action to help show rising support for an issue.

Learning ladder G1.16

Show what you know

1 How can people let others know what they think about an issue?

2 What is a lobby group and how do they operate?

Civics and citizenship

Step 1: I can identify topics about society

3 What is direct action and why is it a democratic right of citizens?

Step 2: I can describe societal issues

4 Explain why deforestation is an issue and the problems that are caused by deforestation.

Step 3: I can explain issues in society

5 Look at the photograph in Source 1.
- a What form of direct action is shown here?
- b What are they doing to get their message across?
- c Who were they trying to influence and why?

Step 4: I can explain different points of view

6 An opposing group held a protest at the same time as the protesters in Source 1. Research the web to find out who the opposing group represented. What views might they have about land clearing?

Step 5: I can analyse issues in society

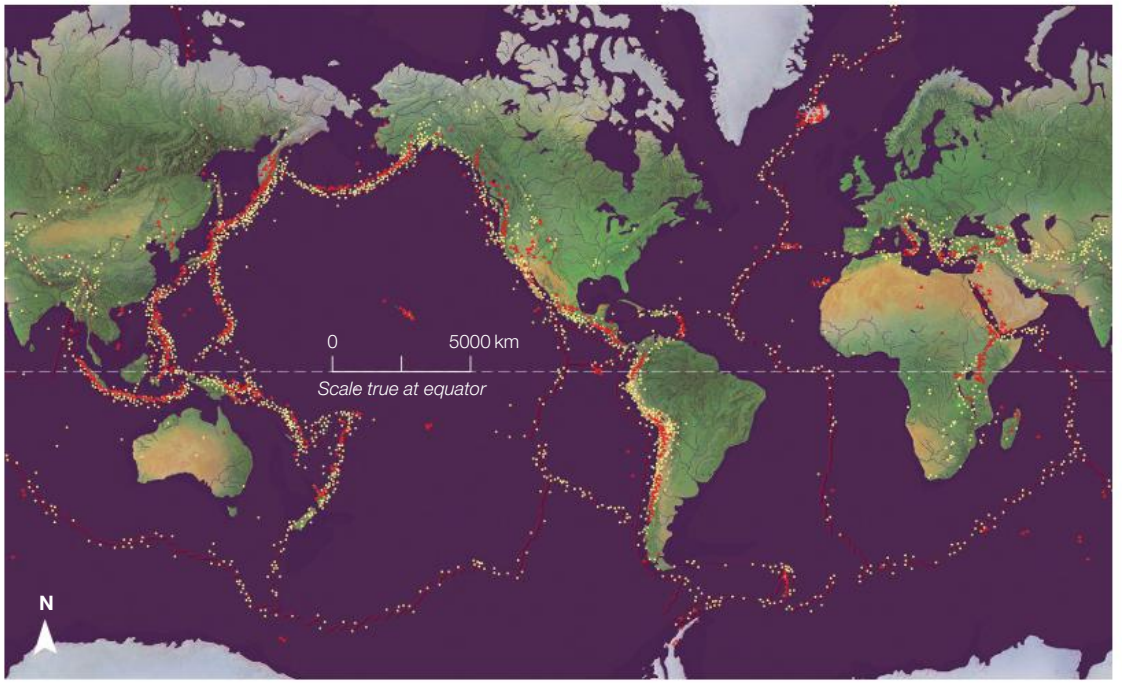
7 Analyse how a lobby group operates by visiting http://mea.digital/pdPo.
- a What do you think this lobby group is trying to achieve?
- b What petitions or letters to members of parliament is the lobby group currently organising?

Masterclass

Learning Ladder

Work at the level that is right for you or level-up for a learning challenge!

Global distribution of volcanoes and earthquakes

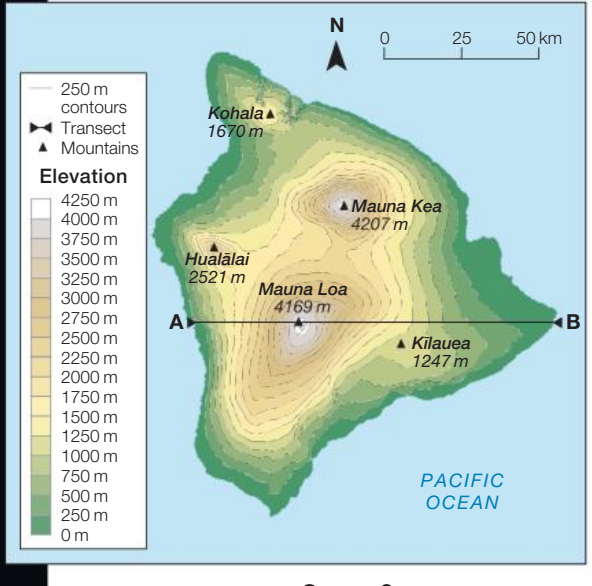


Source: Simon Stone/Science Photo Library

Source 1

Global distribution of volcanoes (red dots) and earthquakes (yellow dots)

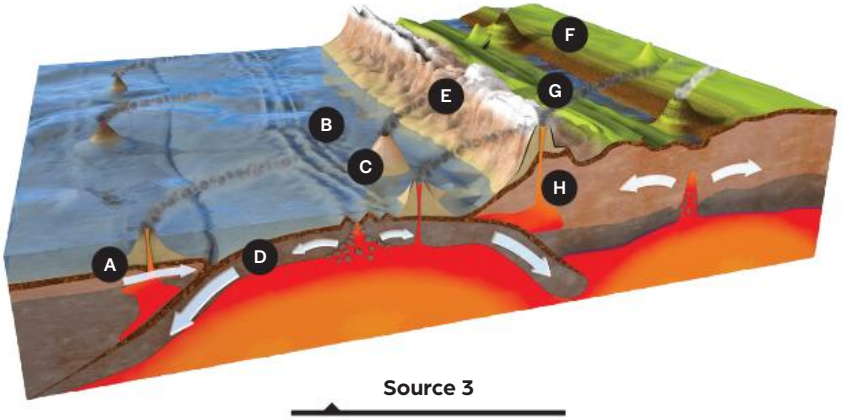
Hawaii contour map



Source: Matilda Education Australia, USGS

Source 2

A contour map of Hawaii featuring Mauna Loa volcano.

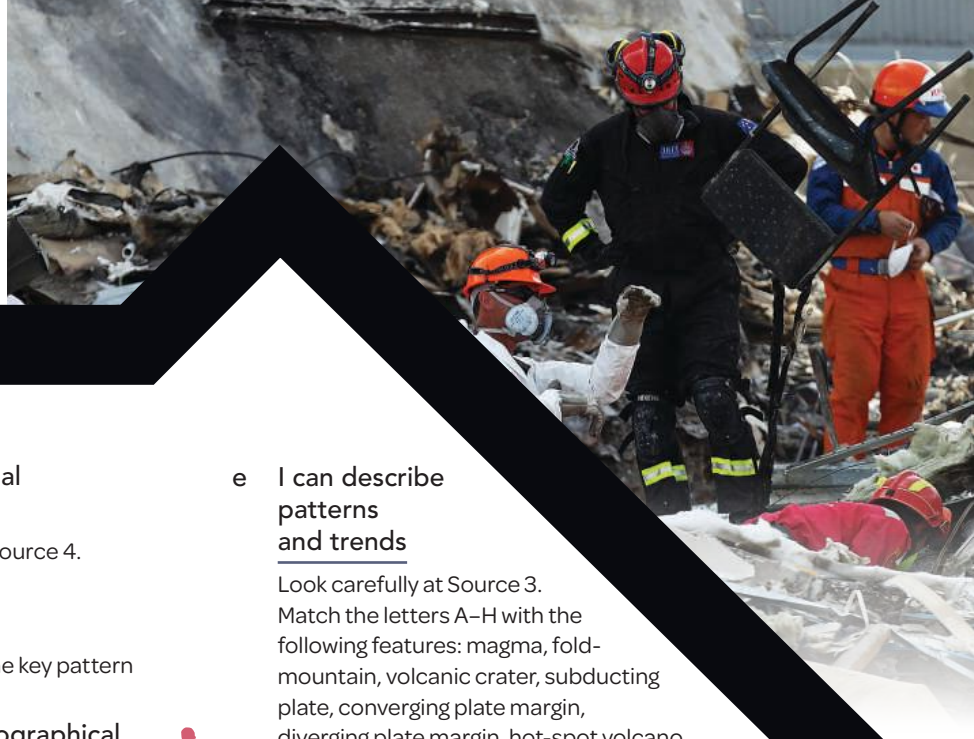


Source 3

Block diagram of a landscape

Source 4

Rescue teams work carefully through rubble in the search for missing people following the 6.3 magnitude earthquake that hit Christchurch, New Zealand in 2011.



Step 1

a I can identify and describe spatial characteristics

Describe the *place* photographed in Source 4.

b I can identify and describe interconnections

With reference to Source 1, identify one key pattern of earthquake risk on a global scale.

c I can identify responses to a geographical challenge

Source 4: What response is shown to the Christchurch earthquake disaster in 2011?

d I can collect, record and display data in simple forms

Refer to Source 1. Identify what the triangles and circles represent on the map.

e I can use geographic terminology to interpret data

Source 2: Where is the land under 250 metres located on this island?

Step 2

a I can explain spatial characteristics

Source 2: What are the key landforms on this Hawaiian island?

b I can explain interconnections

Outline two strong interconnections with the subduction zone shown in Source 1.

c I can compare responses to a geographical challenge

Source 4: Compare this image with the case study of Haiti on page 33. What additional issues did the Haitian earthquake provide?

d I can recognise and use different types of data

Refer to Source 1. List the continents that currently have hot spots.

e I can describe patterns and trends

Look carefully at Source 3. Match the letters A–H with the following features: magma, fold-mountain, volcanic crater, subducting plate, converging plate margin, diverging plate margin, hot-spot volcano, mid-ocean ridge.

Step 3

a I can explain processes influencing places

Refer to Source 2. Explain the processes that have helped to form this landscape.

b I can identify and explain the implications of interconnections

Source 1. What are the implications for New Zealand given its location on a tectonic plate boundary?

c I can compare strategies for a geographical challenge

What action did authorities and individuals take in response to the 2018 Kīlauea volcanic eruption (pages 30–31)?

d I can choose, collect and display appropriate data

Using Source 2, create a cross-section for transect A–B.

e I can explain the reasons behind a trend or spatial distribution

Use SHEEPT to explain the pattern shown in Source 2 on page 43.

Masterclass

Step 4

a **I can predict changes in the characteristics of places**

Predict what will happen to Nouakchott if desertification remains unchecked (see page 45).

b **I can evaluate the implications of significant interconnections**

There is an interconnection between converging plates with both fold mountains and volcanoes. Why are different landforms created from the same process?

c **I can evaluate alternatives for a geographical challenge**

What are some key challenges for aid agencies when natural disasters occur in LEDCs? What alternatives might be considered to help (see page 33)?

d **I can use data to support claims**

The photograph in Source 4 was taken after the 2011 earthquake in Christchurch, New Zealand. The disaster had both economic and social impacts. Discuss these with reference to evidence in the photo.

e **I can analyse relationships between different data**

Compare the map in Source 1 with the block diagram in Source 3. Explain how they represent the process of subduction in different ways.

Step 5

a **I can analyse the impact of change on places**

Source 4: Analyse the short- and long-term impact on Christchurch following the 2011 earthquake.

b **I can explore spatial association and interconnections**

Explain why earthquakes follow a clustered, linear distribution on a global scale.

c **I can plan action to tackle a geographical challenge**

List the methods that can be used to tackle the issue of deforestation and select the most tactical. Justify your decision (see pages 46–47).

d **I can evaluate data**

Justify whether you think Source 1 would be reliable in predicting and planning for an earthquake event. What additional information would be required?

e **I can draw conclusions by analysing collected data**

Source 4 depicts the outcome of the 2011 Christchurch earthquake in New Zealand. Based on your knowledge of geohazards and tectonic plates, explain whether you think that the local community was adequately prepared for this event. If not, what could have been done to reduce the negative outcomes of this earthquake?

Capstone

How can I understand landscapes and landforms?

In this chapter, you have learnt a lot about landscapes and landforms. Now you can put your new knowledge and understanding together for the capstone project to show what you know and what you think.

In the world of building, a capstone is an element that finishes off an arch or tops off a building or wall. That is what the capstone project will offer you, too: a chance to top off and bring together your learning in interesting, critical and creative ways. You can complete this project yourself, or your teacher can make it a class task or a homework task.

mea.digital/GHV8_G1

Scan this QR code to find the capstone project online.

G2

Coastal landscapes

HOW DO WAVES SHAPE LANDFORMS?

page 56

spatial distributions and patterns

page 68

HOW ARE COASTS USED?

thinking locally

page 70

WHAT ARE THE EFFECTS OF EROSION?

economics + business

page 72

HOW DO TOURISTS VALUE THE COAST?

How can I learn about coastal landscapes?

Coastal landscapes are continually shaped and reshaped by both natural and human forces. Shifting sand, waves and other erosional systems such as wind, ice and rain all have a huge impact on coastal landscapes over time. Humans are now beginning to shape these landscapes to prevent further erosion, as well as to meet the rising demands for housing, trade and tourism.

learning ladder

	Spatial characteristics	Interconnections	Geographical challenge
step 5	**I can analyse the impact of change on places** I can analyse and evaluate the implications of changing coastal land use over time and at different scales and calculate its impact on people and environments.	**I can explore spatial association and interconnections** I can compare distribution patterns and the interconnections between them; e.g. the erosional landforms along limestone coastal areas.	**I can plan action to tackle a geographical challenge** I can frame questions, evaluate findings, plan actions and predict outcomes to tackle a coastal-based geographical challenge.
step 4	**I can predict changes in the characteristics of places** I can predict changes in the characteristics of places over time due to coastal erosion and geohazards such as tsunamis.	**I can evaluate the implications of significant interconnections** I can identify, analyse and explain key coastal-based interconnections within and between places, and evaluate their implications over time and at different scales.	**I can evaluate alternatives for a geographical challenge** I can weigh up alternative views and strategies on a coastal-based geographical challenge using environmental, social and economic criteria.
step 3	**I can explain processes influencing places** I can explain the series of actions leading to change in a place, such wave action.	**I can identify and explain the implications of interconnections** I can identify, analyse and explain coastal-based interconnections and explain their implications.	**I can compare strategies for a geographical challenge** I can compare strategies for a geographical challenge, taking into account a range of factors and predicting the likely outcomes.
step 2	**I can explain spatial characteristics** I can identify concepts of Space, Place, Interconnection, Change, Environment, Scale and Sustainability (SPICESS) when I read about coastal landscapes.	**I can explain interconnections** I can describe and explain interconnections and their effects, such as wave action and soft coastal rock.	**I can compare responses to a geographical challenge** I can identify and compare responses to a geographical challenge and describe its impact on different groups.
step 1	**I can identify and describe spatial characteristics** I can talk about spatial characteristics at a range of scales; e.g. headlands and bays.	**I can identify and describe interconnections** I can identify and explain simple interconnections involved in phenomena such as wave direction and sand build-up.	**I can identify responses to a geographical challenge** I can find responses to a geographical challenge such as coastal erosion and understand the expected effects.

Source 1

Shodo Island in Japan is a tombolo formed by longshore drift depositing a sand spit to link the island to the mainland.

Warm up

Spatial characteristics

1 Looking at Source 1, what geographic characteristics can you identify? Describe how they may have occurred using the SPICESS terms of space and place.

Interconnections

2 Source 1: How does the spit provide an interconnection between the mainland and the island?

Geographical challenge

3 What geohazards threaten coastlines?

Collect, record and display data

4 With a partner, discuss what you think might be some of the most devastating types of natural forces that affect coastal landscapes. Pick one, and research some examples of it.

Analyse data

5 Looking at the plan aerial views of the Maroochy River in Source 1 on pages 66–67, identify at least one key change that occurred between 1973 and 2003.

I can evaluate data
I can determine whether data presented about coastal landscapes is reliable and assess whether the methods I used in the field or classroom were helpful in answering a coastal-based research question.

I can draw conclusions by analysing collected data
I can summarise findings and use collected data to support key patterns and trends I have identified for coastal-based research.

I can use data to support claims
I can select or collect the most appropriate data and create specialist maps and information using ICT to support investigations into coastal landscapes.

I can analyse relationships between different data
I can use multiple data sources, overlays and GIS to find relationships that exist in patterns of coastal land use.

I can choose, collect and display appropriate data
I can select useful sources of coastal data and represent them to conform with geographic conventions.

I can explain the reasons behind a trend or spatial distribution
I can identify Social, Historical, Economic, Environmental, Political and Technological (SHEEPT) factors to help me explain patterns in data.

I can recognise and use different types of data
I can define the terms primary, secondary, qualitative and quantitative data and represent data in more complex forms.

I can describe patterns and trends
I can identify Patterns, Quantify them and point out Exceptions (PQE) to describe the patterns I see.

I can collect, record and display data in simple forms
I can identify that maps and graphs use symbols, colours and other graphics to represent data.

I can use geographic terminology to interpret data
I can identify increases, decreases or other key trends on a map, graph or chart about coastal landscapes.

Collect, record and display data

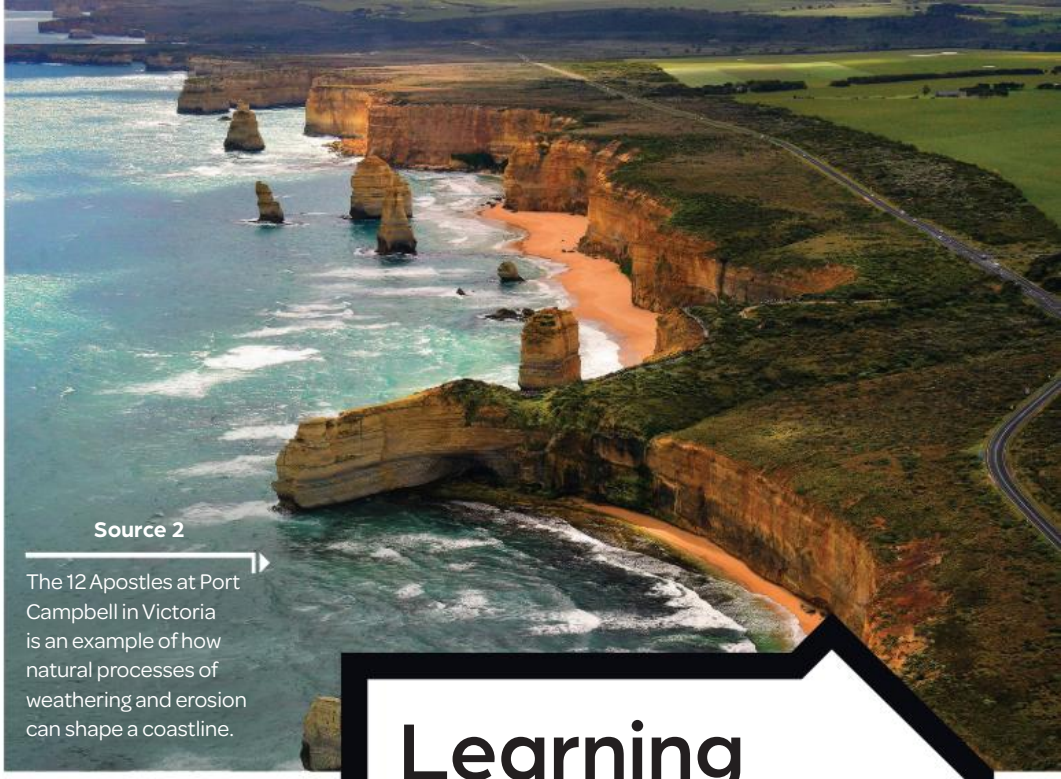
Analyse data

How are coastal landscapes formed?

Coastal **landscapes** are formed through a range of natural process over thousands of years. As humans began developing coastlines for residential, trade and recreational purposes, we also began shaping this fragile landscape. Coastlines are excellent examples of how both natural and human forces can alter landforms and landscapes over time.

Source 1

These **training walls** (see pages 74–77) built to protect the river mouth at Narooma, NSW are one example of how humans have altered the coastline.



Source 2

The 12 Apostles at Port Campbell in Victoria is an example of how natural processes of weathering and erosion can shape a coastline.

Learning ladder G2.1

Show what you know

1 Identify how humans have altered the coastline in Source 1.

2 Source 2: The 12 Apostles are the rock columns standing offshore at Port Campbell in Victoria. How do you think they formed?

3 As a class, brainstorm a list of ways humans alter coastlines to suit their own personal needs. Do you think these changes are *sustainable*?

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

4 Both Source 1 and Source 2 are oblique aerial photographs – taken at an angle from the air. What are the advantages of these types of photographs for showing landscapes?

Step 2: I can recognise and use different types of data

5 How are oblique aerial views different to plan views (directly from above)? What advantages does a plan view have?

Step 3: I can choose, collect and display appropriate data

6 Prepare a before and after sketch of Source 1 to show the change caused by the building of the training walls. Why do you think they were built?

Step 4: I can use data to support claims

7 Source 2: Describe the change over time in this location and describe the processes that have caused the changes.

How do waves shape landforms?

Waves are one of the strongest forces shaping coastal landforms. Waves can be generated by wind or movements in Earth's surface. They can travel for thousands of kilometres through water, before breaking in shallower water near coasts, building or scouring away the coastline in the process.

How do waves begin?

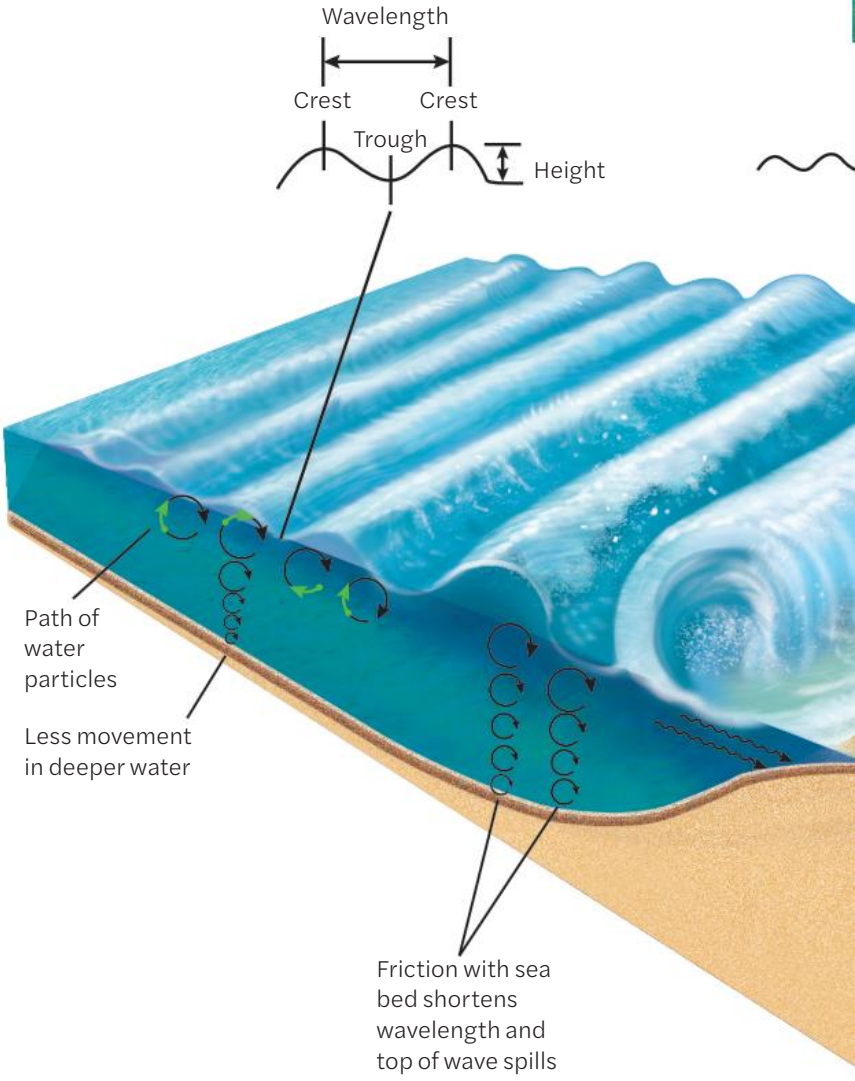
Waves travel through water. The water moves up and down but does not actually travel with the wave. It is the energy that travels with the wave. The energy required to create waves most commonly comes from wind, but may also come from **earthquakes** or volcanic eruptions.

When wind blows across water it creates ripples on the surface. The wind forces the water to rise and gravity pulls it back down again. Water rising and falling creates a circular movement of water particles beneath the surface. On the surface, we see the top of this orbit, known as the **crest**, and the zone where it falls, called the **trough**.

The orbiting waves can travel for long distances as **swells** through the ocean. A swell is a collection of waves formed by winds. The size of the swell is measured from the crest to the trough. The largest swell ever measured in the southern hemisphere was a 23.8 metre swell off New Zealand's Campbell Island in May 2018.

Why do waves break?

As waves move into increasingly shallower water near the coastline or offshore **reefs**, the bottom of the wave orbit comes into contact with the sea floor and slows down. The wavelength is shortened and the crest of the wave overtakes the bottom of the wave. It spills forward as a **breaking wave**. Waves will generally start to break when they reach a water depth of 1.3 times the wave height.

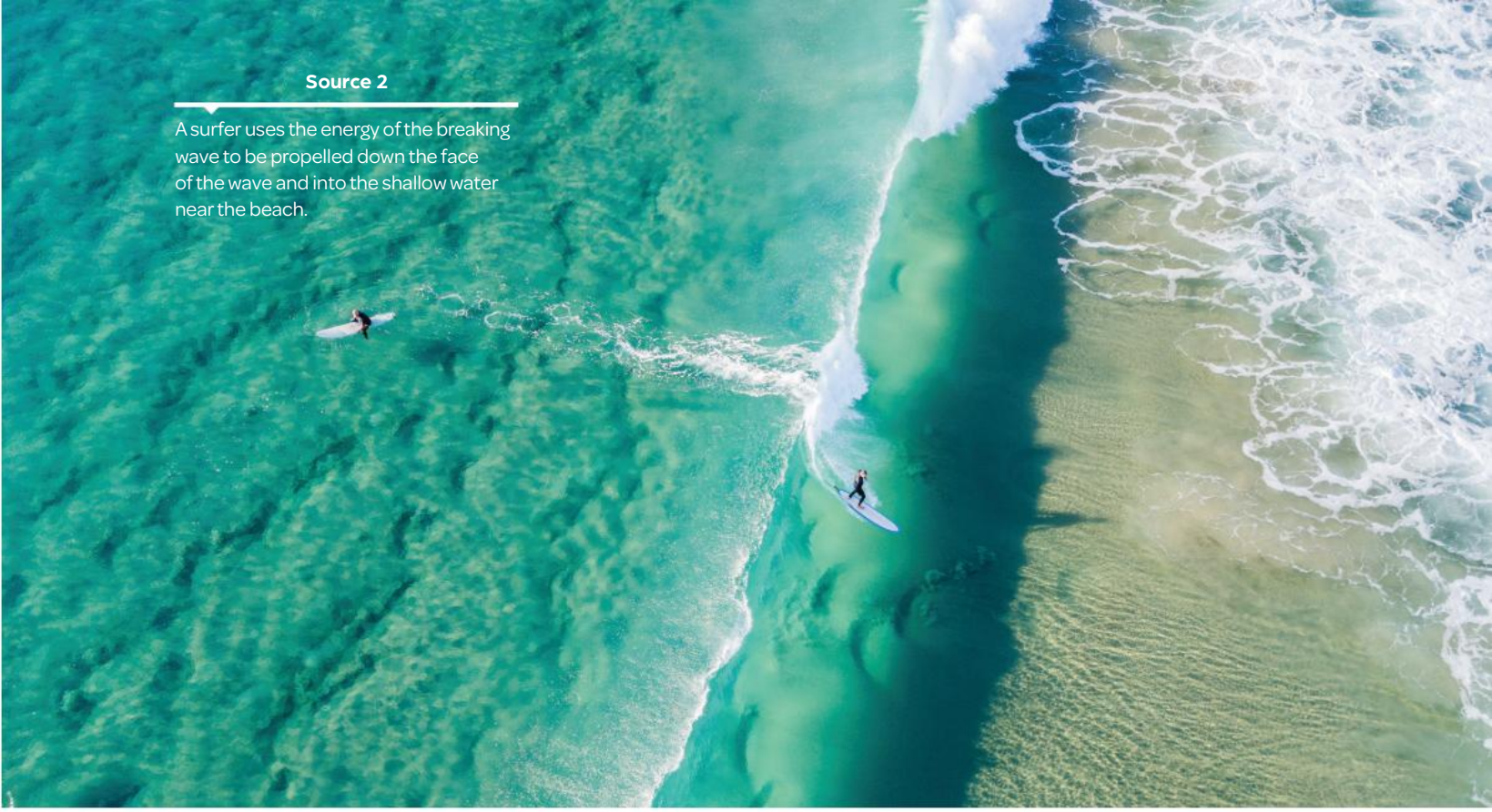


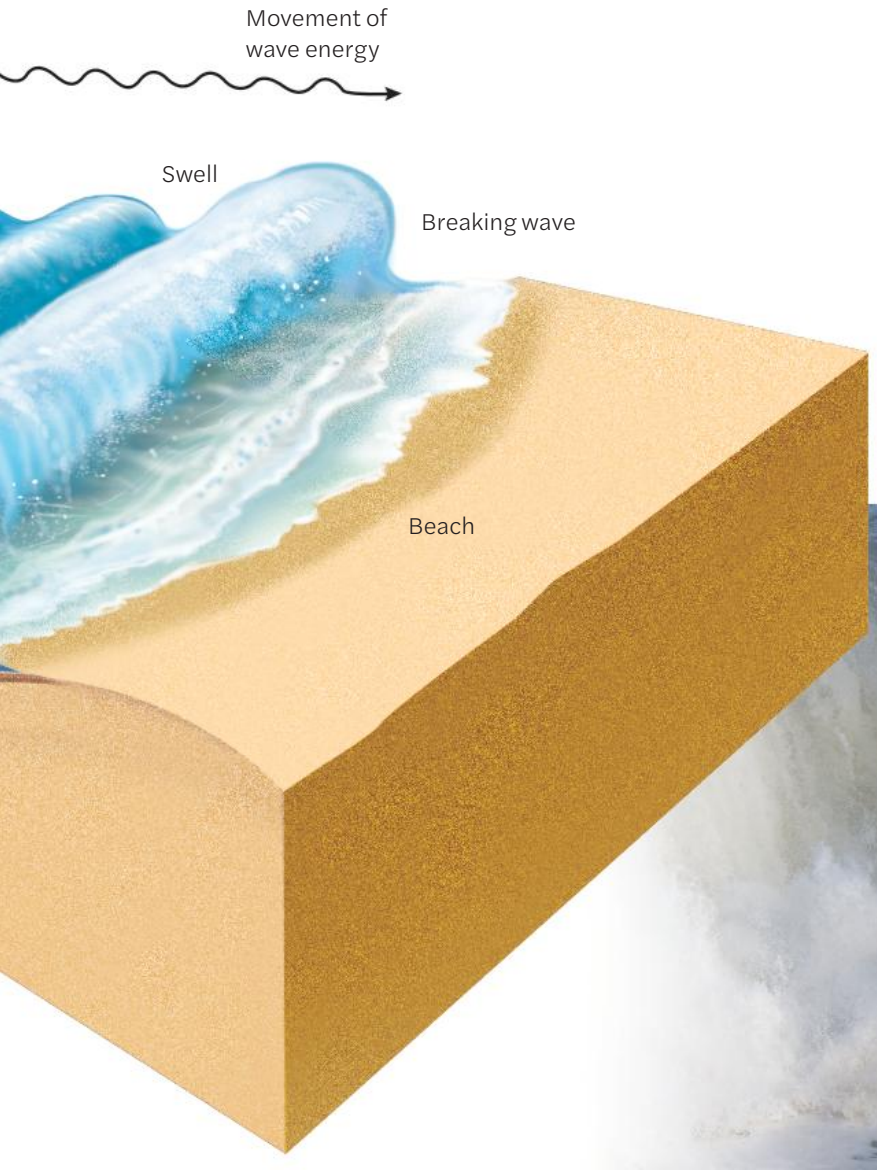
Source 1

How waves work

Source 2

A surfer uses the energy of the breaking wave to be propelled down the face of the wave and into the shallow water near the beach.





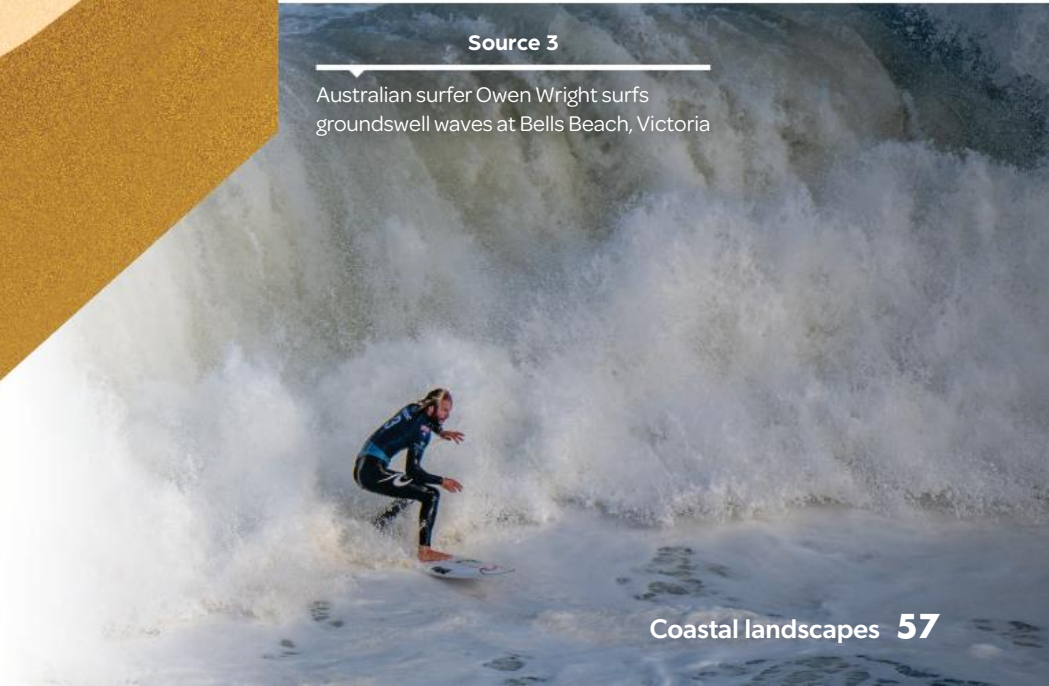
What conditions do surfers look for?

Groundswell waves are steeper and faster. They are the result of strong wind storms in the open ocean that create longer wavelength waves that move quickly into shallow water before breaking. Wind swell waves are the smaller, less powerful waves formed by local winds.

Offshore winds create the best waves as wind blows against the top of the wave to delay it from breaking. Onshore winds push the top of the wave forward, causing the wave to break before the usual breaking depth is reached.

Source 3

Australian surfer Owen Wright surfs groundswell waves at Bells Beach, Victoria



How do different waves shape landforms?

Coastal landforms are both created and worn away by wave action. **Destructive waves** destroy and erode the coastline. Destructive waves are large and powerful; they constantly crash onto the coastline, wearing away cliffs and digging out areas of beach.

Destructive waves travel across open ocean and build a significant amount of energy that hits coastal cliffs and beaches with great force. Cliffs can be carved into amazing erosional landforms such as headlands, caves, arches and stacks.

Constructive waves are smaller and less frequent. They deposit sand on the beach rather than scouring it away. Constructive waves are responsible for creating depositional landforms such as beaches, sand dunes, sand bars, spits and tombolos.

The amount of eroded material taken away or deposited on the coastline depends on the water flowing onto the beach – **swash** – and returning to the sea – **backwash**. Destructive waves have weak swash, but strong backwash that removes material. Constructive waves have strong swash and weak backwash, helping it to build up sand.

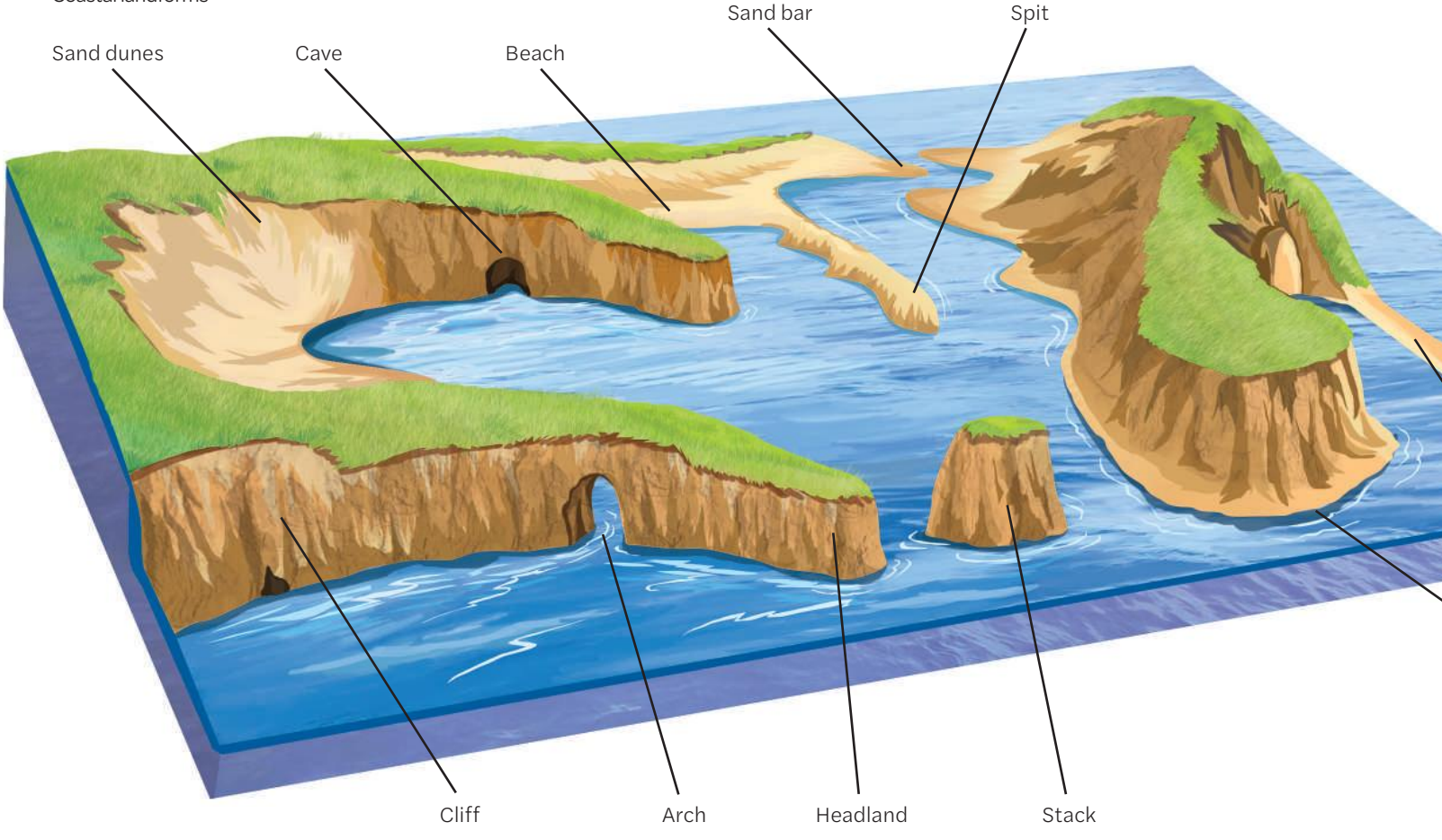
Erosional landforms

Destructive waves create erosional landforms including:

- *cliffs* – the almost vertical rock face along many coastlines
- **headlands** – narrow, high land jutting out into the sea, formed of harder rock that resists erosion
- *caves* – formed as waves bend around headlands and attack softer rock
- *arches* – formed when caves on either side of a headland join, leaving a gap
- **stacks** – pillars of rock separated from cliffs or a collapsed arch
- **wave–cut platforms** – flat eroded areas of rock at the base of coastal cliffs.

Source 4

Coastal landforms



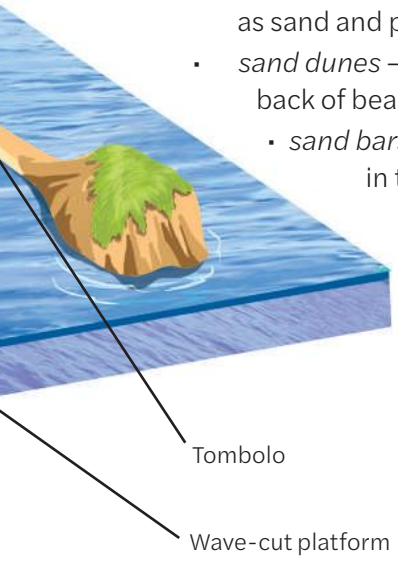
Source 5

The action of waves and other erosional forces such as wind, ice and rain are continually shaping and reshaping our coastlines. The famous Elephant Rock sits on the Tongaporutu coastline in New Zealand. It was a double arch in the shape of an elephant until continued erosion and an earthquake removed the elephant's trunk in 2016. Elephant Rock sits alongside the Three Sisters stacks in the same location. One of the Three Sisters disappeared following a storm in 2003, but it was replaced with another sister that became separated from the Tongaporutu cliff face in 2013.

Depositional landforms

Constructive waves create depositional landforms, including:

- *beaches* – made up of loose particles such as sand and pebbles deposited by waves
- *sand dunes* – hills of sand that form at the back of beaches from wind-blown sand
- *sand bars* – ridges of deposited sand in the ocean that are exposed at low tide
- **spits** – narrow bars of deposited sand linked to the coast
- **tombolos** – form when waves deposit a bar of sand to link an island to the coast.



Learning ladder G2.2

Show what you know

1 Identify two ways that different wave types can *change* coastlines.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

2 Sketch the scene in Source 2 on page 55. Annotate the sketch with at least three coastal features highlighted on this spread.

Step 2: I can explain spatial characteristics

3 Outline how the *place* Elephant Rock has *changed* over time.

Step 3: I can explain processes influencing places

4 Construct a flow diagram showing the process from wave formation to wave break.

Step 4: I can predict changes in the characteristics of places

5 Create a Venn diagram comparing the similarities and differences between destructive and constructive waves.

HOW TO Flow diagrams, page 144

How do bays form?

Headlands and bays form along coastlines that have alternating bands of hard and soft rock. The hard rock is more resistant to erosion and wears away more slowly, leaving a headland that extends out into the sea. Softer rock is less resistant to erosion and bays are carved out between headlands.

Different rates of erosion

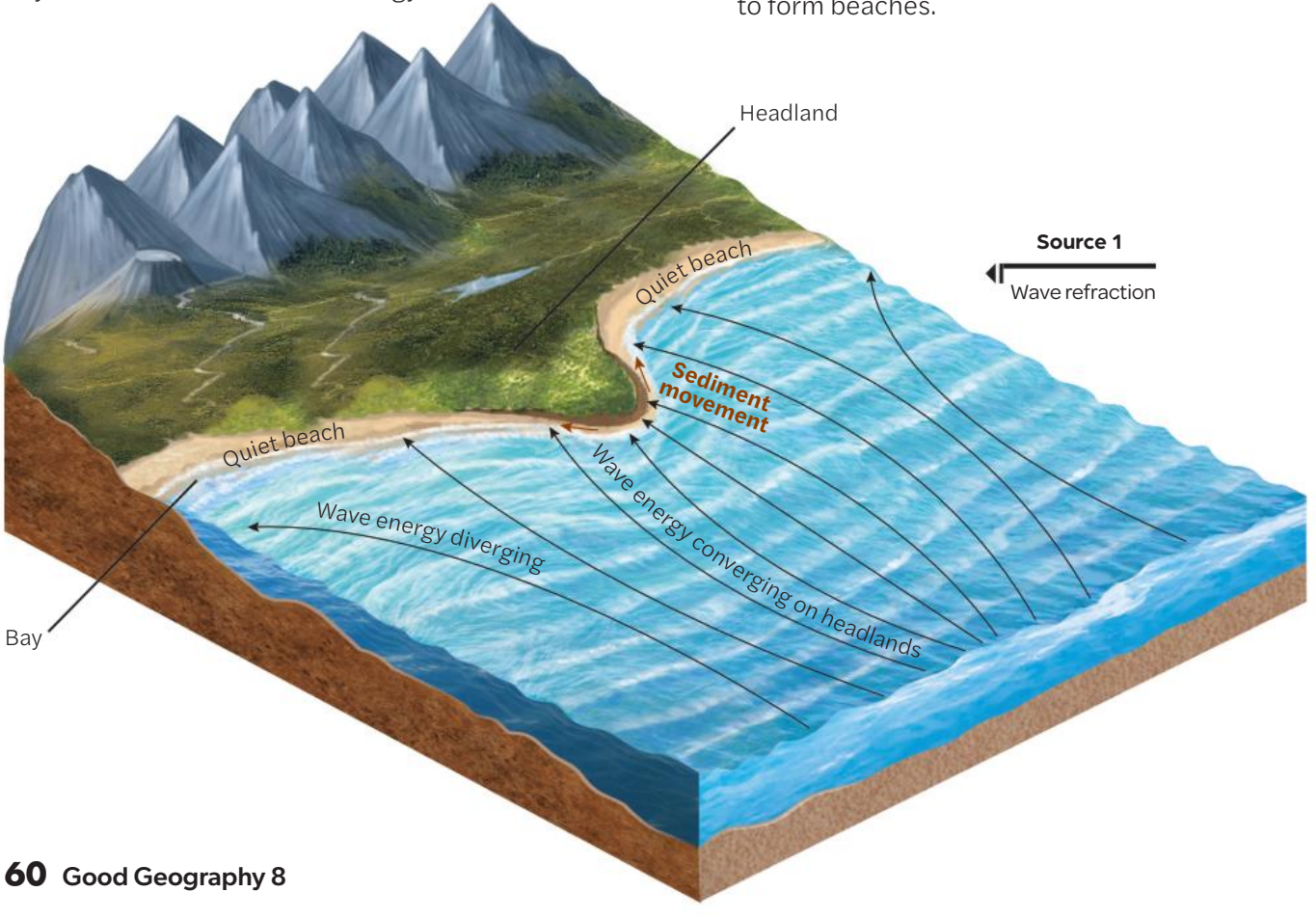
Headlands take the full force of waves, because they jut out from the coastline. As waves approach land they bend to the shape of the coast in a process known as **refraction**. Wave energy is concentrated on the headlands, which erodes into landforms such as caves, arches and **stacks** (see pages 58–59).

Waves in bays are more spread out and the wave energy is reduced, allowing for sand to be deposited. Beaches are usually found in shallow bays where waves have less energy.

How bays and headlands form over time

Refer to Source 3 at right.

1. Waves attack the alternating bands of hard and soft rock along a coastline.
2. Destructive waves erode the cliff causing the cliff to retreat.
3. Softer rock erodes more quickly to create bays. The resistant hard rock sticks out to sea as headlands.
4. The protected bays allow deposition of sand to form beaches.

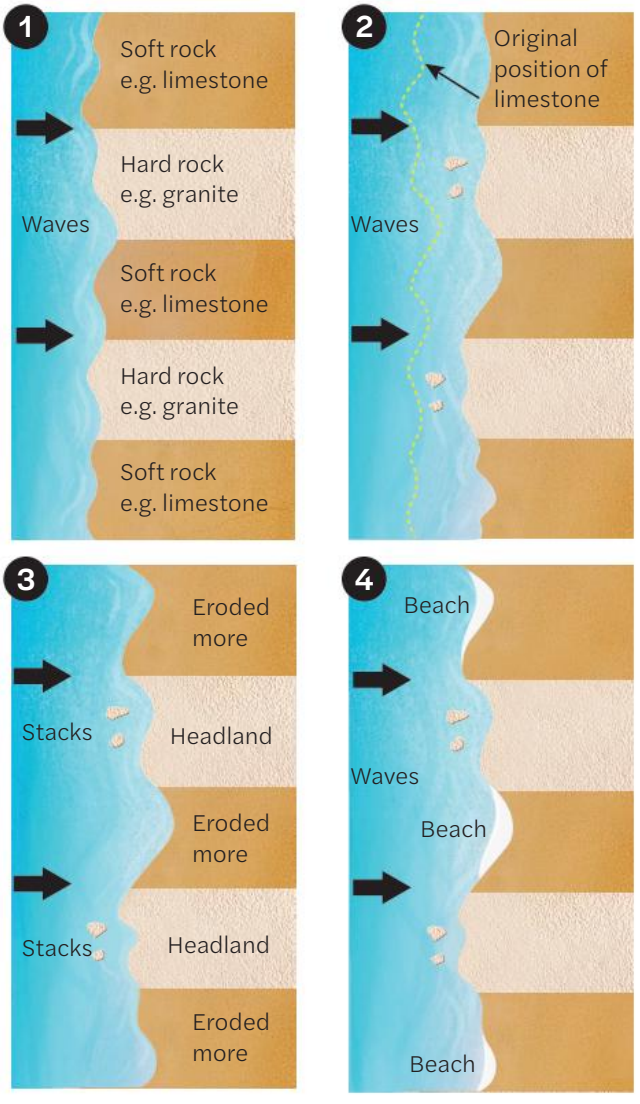


Source 2

Wineglass Bay on the east coast of Tasmania is a calm body of water protected by two granite headlands. Granite is a very hard rock that is resistant to erosion. The white quartz sand is eroded material from the granite rocks, which are rich in quartz.

Source 3

The formation of bays and headlands over time



Learning ladder G2.3

Show what you know

1 Identify the difference between a bay and a headland.

2 What is meant by the terms 'hard rock' and 'soft rock'? What impact does rock type have on a coastline?

3 Using plasticine or clay, construct a headland, cave, arch and stack. Using these models, discuss the 'story' of coastal erosion with a partner.

Interconnections

Step 1: I can identify and describe interconnections

4 Source 1: Refraction is caused by the interconnection of waves and which coastal feature?

Step 2: I can explain interconnections

5 Source 3: How does the interconnection of waves and soft rock lead to the formation of bays?

Step 3: I can identify and explain the implications of interconnections

6 Source 3: Construct a flow diagram identifying how wave interaction with coastal landforms may have shaped Wineglass Bay (Source 2). Use the following key terms when constructing your diagram:

a hard rock
b soft rock
c erosion
d headland
e bay
f wave.

Step 4: I can evaluate the implications of significant interconnections

7 Evaluate the implications of the interconnection of headlands and waves.

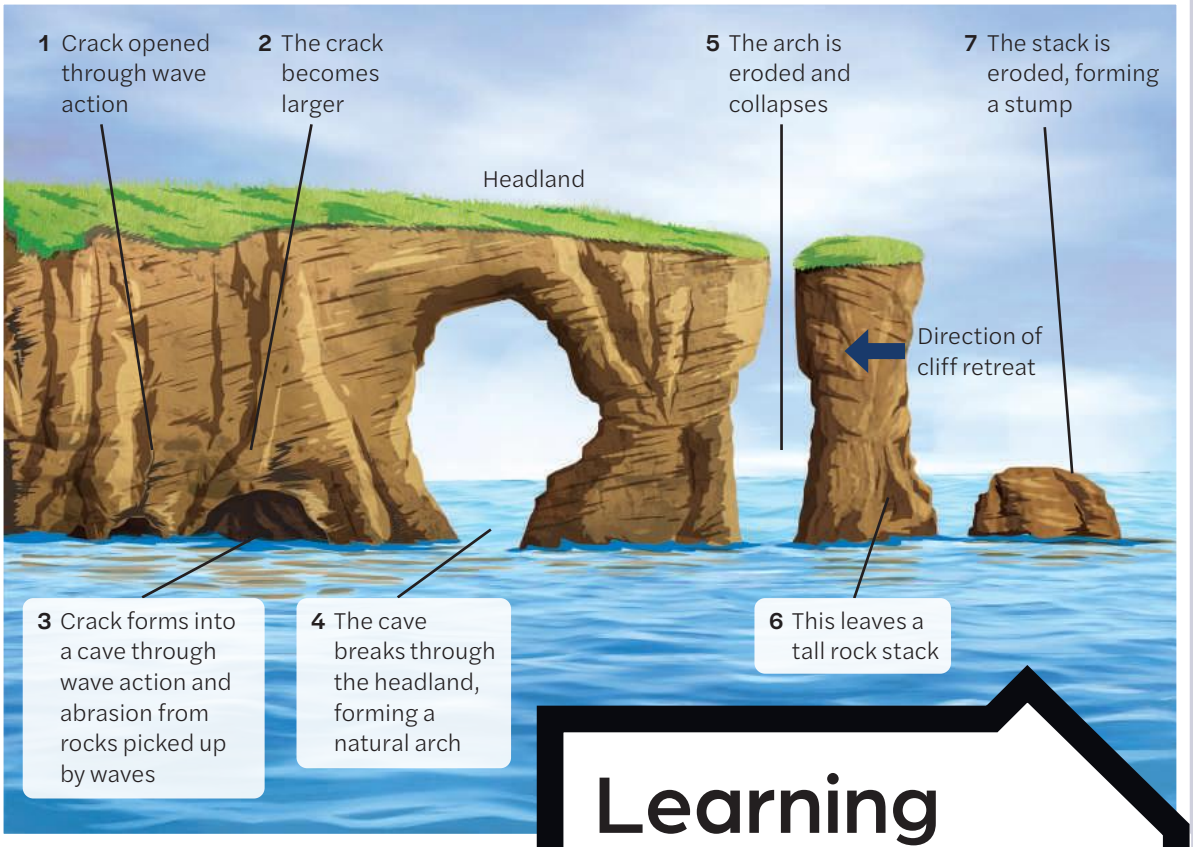
HOW TO Flow diagrams, page 144

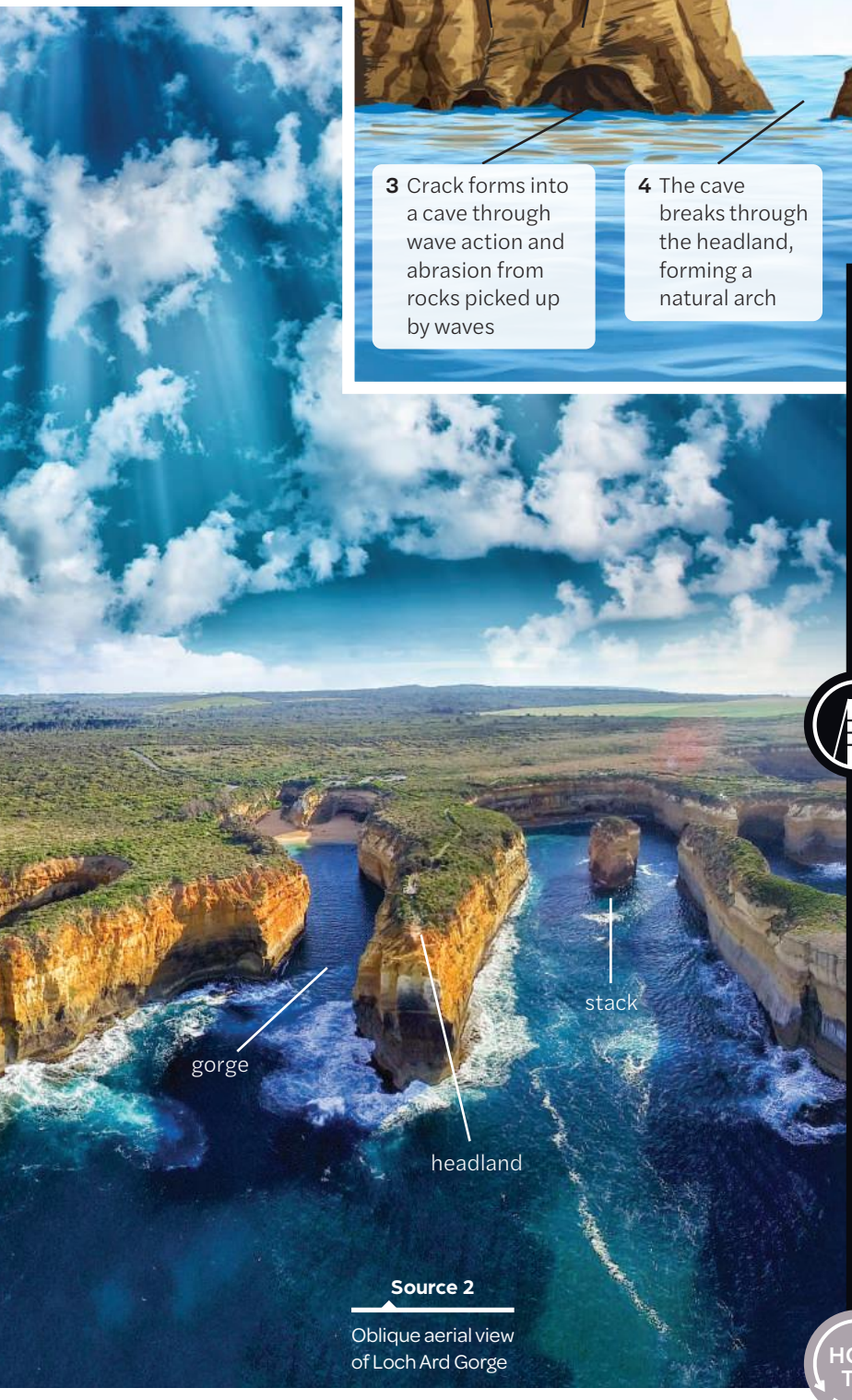
How are destructive waves eroding the coastline at Loch Ard Gorge?

Loch Ard Gorge at Port Campbell in Victoria is greatly affected by powerful destructive waves that travel long distances over the Southern Ocean. The soft limestone cliffs are eroded into erosional landforms such gorges, headlands, caves, arches, stacks and blowholes.

Source 1

Eroding the limestone cliffs





Source 2

Oblique aerial view of Loch Ard Gorge

Learning ladder G2.4

Show what you know

1 Why is Loch Ard Gorge so prone to erosion?

2 Research the term abrasion. Describe how abrasion has helped erode the cliffs at Loch Ard Gorge.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

3 Using tracing paper, trace Source 2 and annotate at least five coastal landforms in this place.

Step 2: I can explain spatial characteristics

4 How are caves, arches and stacks associated with one another?

Step 3: I can explain processes influencing places

5 Using Sources 1 and 2, explain how destructive wave action has changed the headland marked 'A' on the oblique aerial photograph.

Step 4: I can predict changes in the characteristics of places

6 Looking at the oblique aerial image of Loch Ard Gorge in Source 2, describe how the headland marked 'A' will change in the future.

HOW TO

Sketches and annotating, page 142

How does sand move?

As waves hit beaches, the waves move sand along the coast. Constructive waves deposit sand to form other beaches, as the sand builds up against obstacles such as headlands or groynes. Dry sand on the beach can be blown by onshore winds to the back of the beach where it forms sand dunes.

How is sand moved by waves?

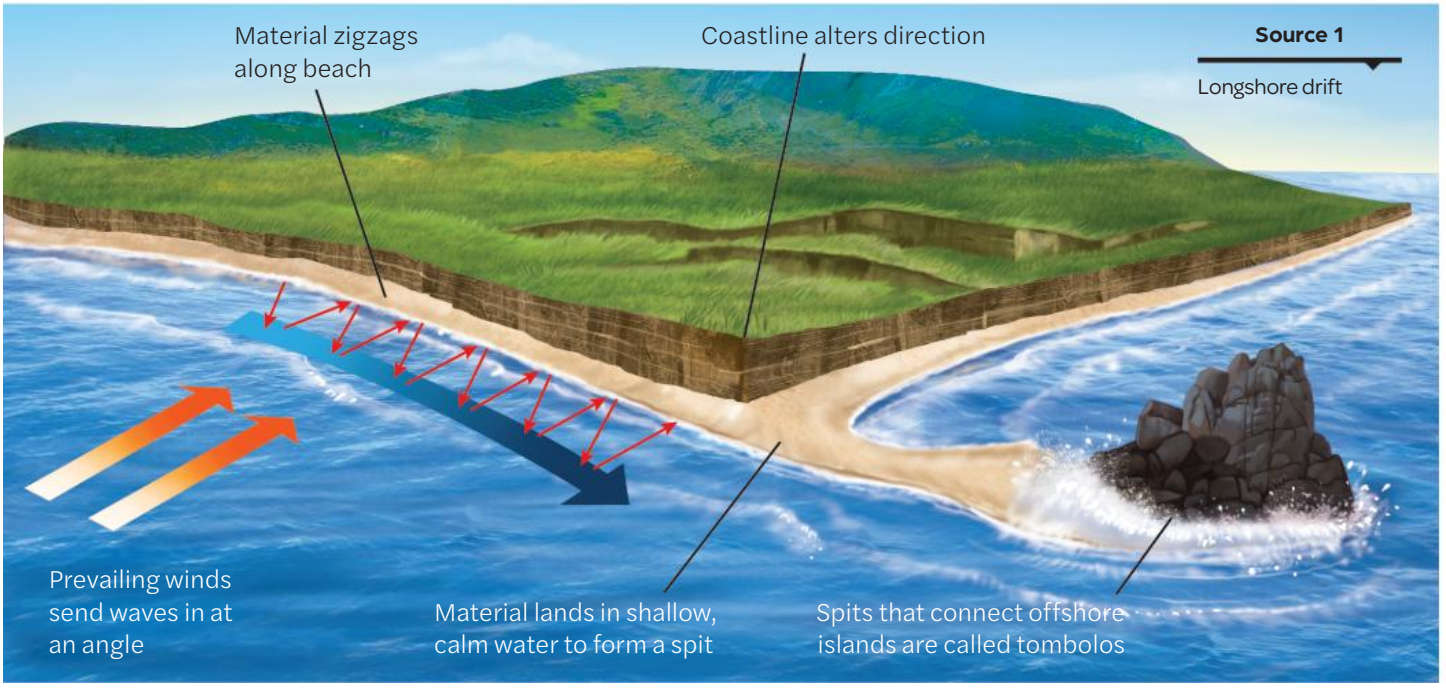
Most **constructive waves** hit the coast at an angle because of the direction of the wind and the shape of the land. Strong **swash** from the waves picks up grains of sand and moves them along the beach. Gravity takes the weak **backwash** and some sand directly back into the ocean ready for the next wave to move the sand further along the beach.

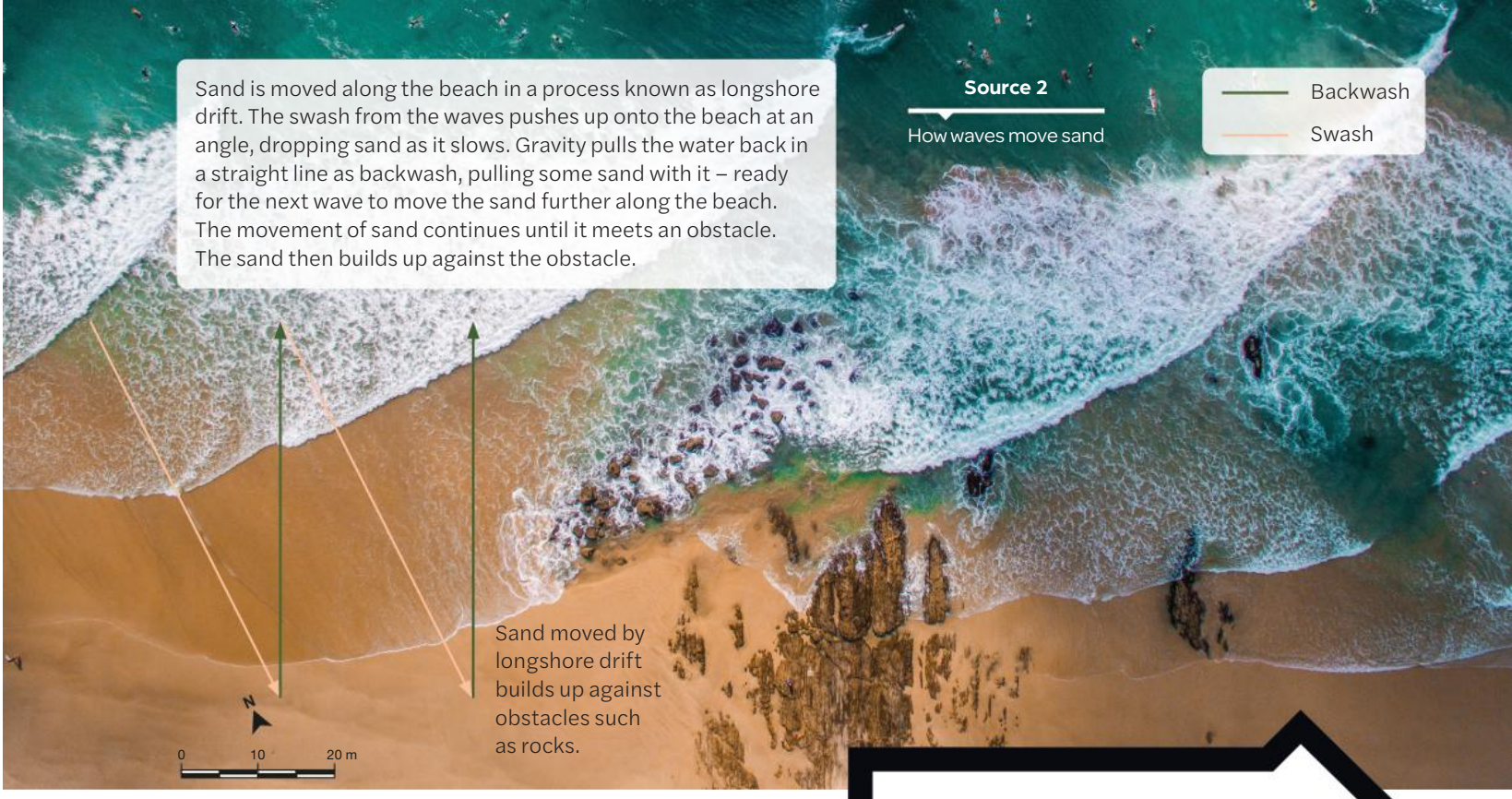
Along the beach, the sand moves in this zigzag fashion, known as **longshore drift**, until it meets an obstacle such as a **headland**, rocks or human constructions such as **groynes**. The sand builds up against the obstruction, widening the beach.

Longshore drift is also responsible for forming narrow bars of sand, called **spits**, that jut out into the ocean. Spits occur when the coastline changes direction or the beach meets the mouth of a river. The sand is deposited and builds up on itself to form a spit. Sometimes the spits join an island to form a **tombolo**.

How does wind move sand?

At low tide, sand particles on the beach dry out and can be picked up by onshore winds and moved further inland. The moving sand grains may be trapped by obstructions such as plants and mounds at the rear of the beach to form a **primary dune**.



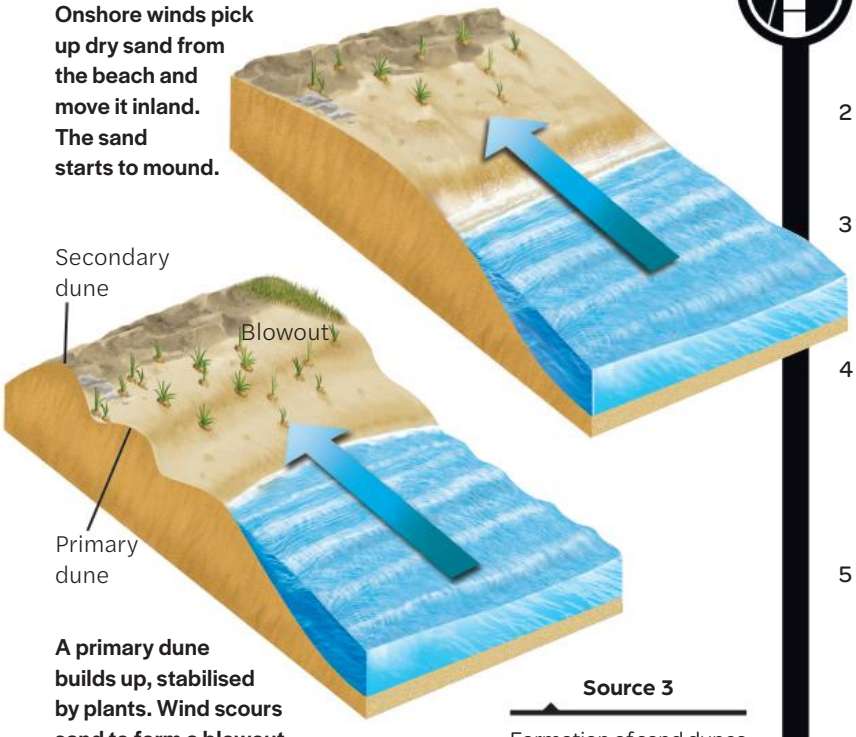


Source 2

How waves move sand

There is little soil in a primary dune, so plants find it difficult to take root. Some grasses with shallow roots, such as marram grass, can grow in this very salty environment. Plants hold the sand dunes together and allow the dune to grow larger.

Wind can also erode bare patches on sand dunes, forming **blowouts**. The sand is blown further inland, eventually forming a **secondary dune**.



Source 3

Formation of sand dunes

Learning ladder G2.5

Show what you know

1 How does the movement of sand change coastal landscapes?

Interconnections

Step 1: I can identify and describe interconnections

2 Is longshore drift the only natural process that influences sand movement?

Step 2: I can explain interconnections

3 How is wind interconnected with the direction of longshore drift?

Step 3: I can identify and explain the implications of interconnections

4 Evaluate the implications of the interconnection of plants and wind on sand dunes. Why is it not wise to trample or remove vegetation from sand dunes?

Step 4: I can evaluate the implications of significant interconnections

5 Evaluate the implications of the building of Sandringham Harbour for Hampton Beach (pages 78–79). What has been done to repair the damage and why?

G2.6

thinking nationally

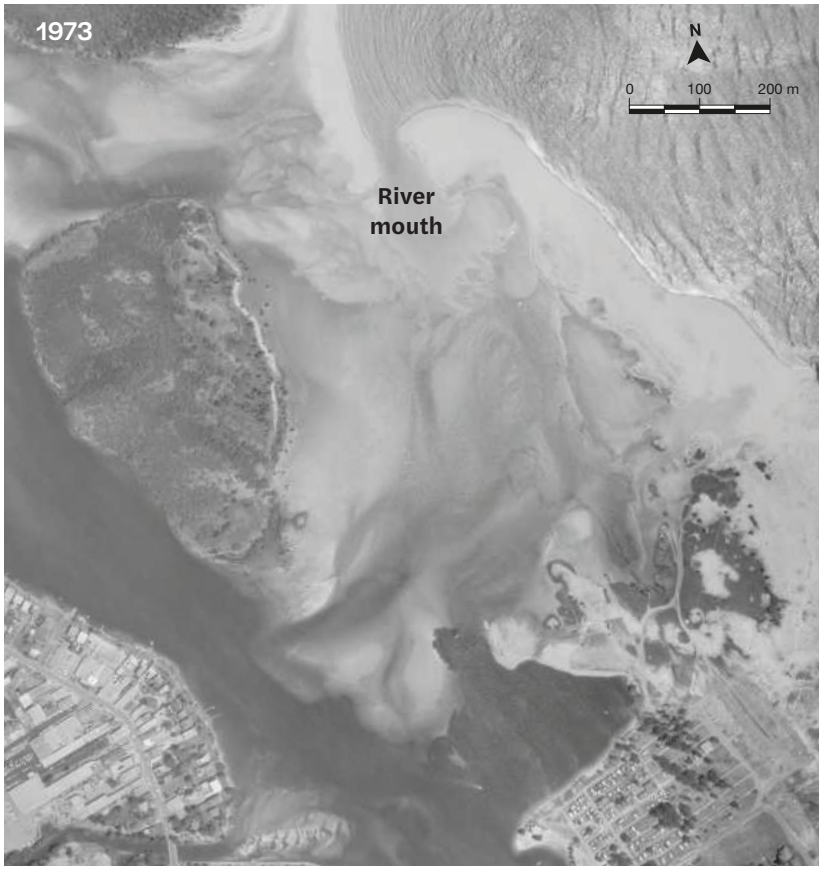
How is the Maroochydore beach constantly changing?

Like other beaches, the Maroochydore beach on Queensland's Sunshine Coast is made of loose sand. The beach is constantly changing as waves erode, transport and deposit material on the beach.

Rivers can also change coastlines where they meet the ocean. The Maroochy River mouth constantly changes and adds to coastal erosion issues. **Groynes** made of large sacks of sand have been placed to the south of the river mouth to help keep the sand on the beach. Note the groynes in Source 3 and how **longshore** drift (see pages 64–65) has pushed sand up against the groynes.

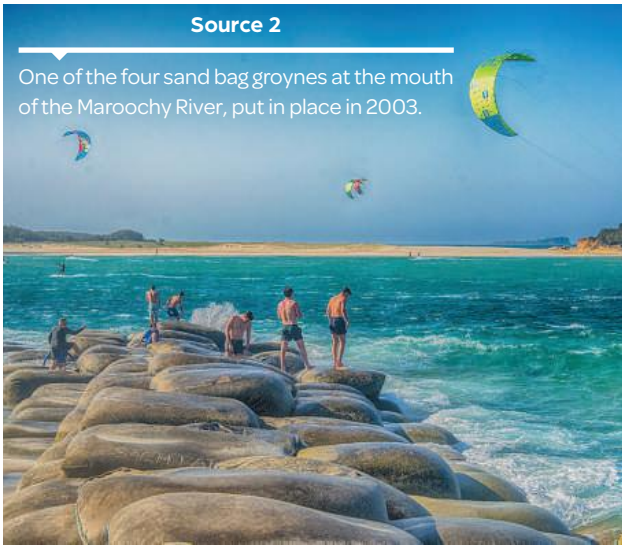
Source 1

Plan aerial views of the Maroochy River from 1973, 1986 and 2003 show how the position of the river mouth changes and the impact it has on the beaches around it.



Source 2

One of the four sand bag groynes at the mouth of the Maroochy River, put in place in 2003.



Source 3

Oblique aerial view of the mouth of the Maroochy River in 2018. Groynes have been positioned on the south bank of the river mouth to keep sand on the beach.

Learning ladder G2.6

Show what you know

1 What effects could longshore drift, wind and river movement have on the local communities near Maroochydore Beach?

Analyse data

Step 1: I can use geographic terminology to interpret data

2 What are groynes and how are they used to reduce the impacts of longshore drift?

Step 2: I can describe patterns and trends

3 Describe how the mouth of the Maroochy River has changed using the satellite images from Source 1.

Step 3: I can explain the reasons behind a trend or spatial distribution

4 Using the criteria below, provide a detailed description of at least one change identified in Question 3.

- a Relative location of *change*.
- b Name of the new coastal feature formed.
- c Probable cause of the *change*.

Step 4: I can analyse relationships between different data

5 Trace or sketch an outline of the scene in Source 3. Mark in the location of the groynes and describe their interaction with longshore drift of sand.

Source: State of Queensland, 2019

HOW TO
Sketches and annotating, page 142
Satellite images, page 149

How are coasts used?

In Australia, human activities are concentrated along the coast, where most people choose to live. Tourists are also attracted to Australia's beaches and businesses conduct international trade through major harbours along the coastline.

How do people use coasts?

Australia's coastline attracts heavy use from our population: more than 85 per cent of Australians live within 50 kilometres of the ocean, and more than 25 per cent live within 3 kilometres of the ocean. More and more people are choosing to live near the coast and coastal towns are growing, with new houses, shops, businesses and recreational facilities.

As well as being a popular place for people to live, Australia's coastline is also a major tourist destination. The Gold Coast attracts 13 million tourists each year, mainly from within Australia, in addition to gaining 12 500 new residents yearly. Sydney's Bondi Beach attracts 2.6 million tourists per year, with more than half coming from overseas.

Australia's coast is also important for overseas trade. Sheltered bays are transformed into harbours for large ships to export and import goods from overseas. These harbours are developed near major cities or near resources such as mines.

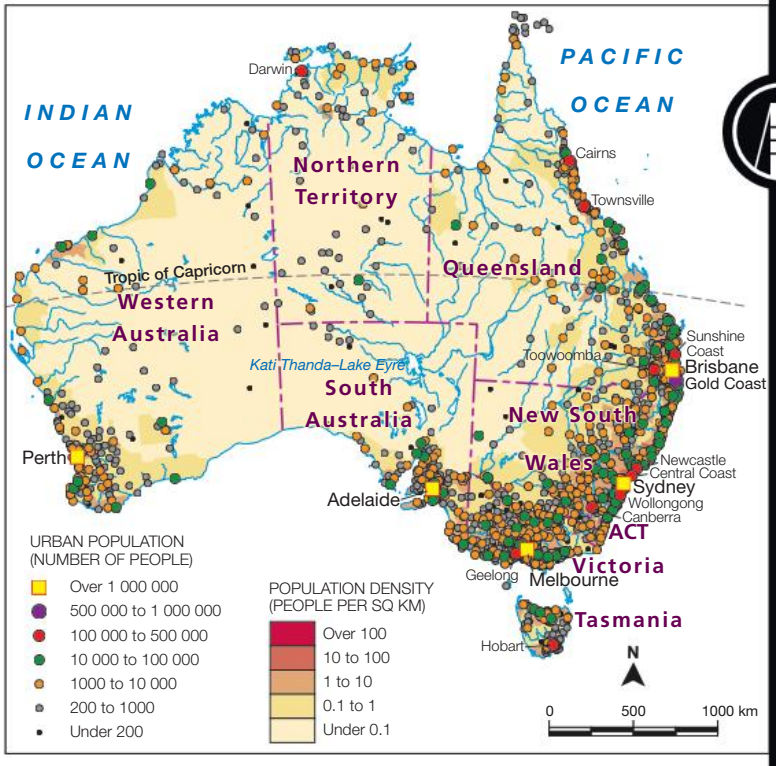
Source 1

The foreground of this photo shows Sea World, one of many Gold Coast theme parks. In the middle of the image is the Marina Mirage resort and boat marina. The background shows high-rise accommodation and the residential area of Surfers Paradise.

Source 2

Bondi Beach attracts thousands of local people and tourists each summer.

Australian population distribution



Source 3

This map shows the heavy distribution of Australia's population around the coastlines.

Source: Matilda Education Australia

Learning ladder G2.7

Show what you know

1 Where do most Australians live?

2 Why are sheltered bays important?

Analyse data

Step 1: I can use geographic terminology to interpret data

3 Use the terms foreground and background to describe the locations of tourist attractions on the Gold Coast in Source 1.

Step 2: I can describe patterns and trends

4 Describe, using PQE, the distribution of Australia's population using Source 3.

Step 3: I can explain the reasons behind a trend or spatial distribution

5 Using the results from Question 4, suggest reasons to explain the pattern. Classify your reasons into the SHEEPT categories.

Step 4: I can analyse relationships between different data

6 How are coastlines interconnected with our tourism industry?

HOW TO
PQE, page 138
SHEEPT, page 140

G2.8

thinking locally

What are the effects of erosion?

Erosion Swallows Homes

Tuesday 7 June 2016 COLLAROY, SYDNEY

Huge waves and a king tide smash the New South Wales coast and swallow exclusive homes in Narrabeen and Collaroy.

Huge waves hit coast

Huge waves have battered the coast of New South Wales over the last four days – the deadly combination of a high spring tide and a violent storm. Narrabeen and Collaroy beaches have lost 50 metres of beach and many waterfront houses are now at risk of falling into the sea.

'The beach is 50 metres narrower now than it was on Saturday afternoon,' said Professor Ian Turner, the director of the Water Research Laboratory at the University of NSW.

'Also, in the area where we surveyed, for every metre along the beach we've seen up to 150 cubic metres of sand stripped off the upper beach, and it is now sitting out there in the surf zone.

'The storm is certainly starting to abate, but there are still very large waves, and still a large tide, which are continuing to cause damage along the beachfront.'

A plane with a laser scanner will be sent out today to survey the damage along the coastline.

'We will be able to very, very carefully detail the damage that has been caused by the storm and will be using that information to be able to predict the damage of future storms,' Professor Turner said.

Emergency response

Waterfront properties along Collaroy beach have been undermined by the large waves. Erosion to the beach has already claimed a swimming pool and the sunroom of one house has already fallen onto the beach. Coastal engineers inspected the damaged homes and the State Emergency Service sandbagged the beach to prevent further damage.

New South Wales Premier, Mike Baird, said, 'This was a ferocious storm that has devastated communities, washing away beaches, flooding inland areas and inundating businesses. Emergency services and volunteers have been doing an incredible job since the storm began last Friday. I want to ensure their efforts are coordinated in a way that allows communities to rebuild and recover as quickly as possible.'

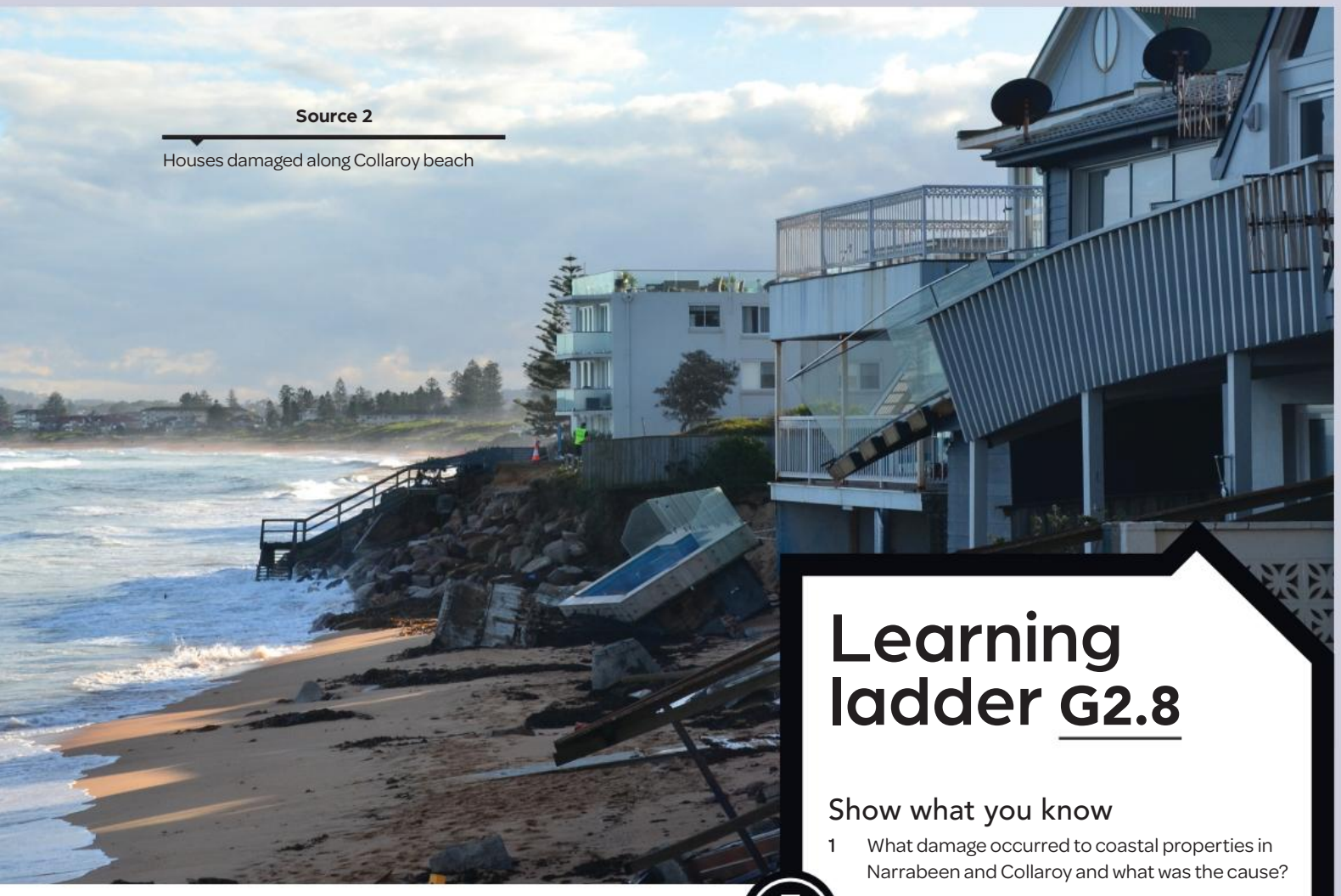
Source: Author article based on combined press reports.

Source 1

Huge waves hit Bondi Beach

Source 2

Houses damaged along Collaroy beach



Learning ladder G2.8

Show what you know

1 What damage occurred to coastal properties in Narrabeen and Collaroy and what was the cause?

Geographic challenge

Step 1: I can identify responses to a geographical challenge

2 Source 1: What action do you think would have been taken by the operators of the pool in the foreground during this incident?

Step 2: I can compare responses to a geographical challenge

3 Source 2: Make a field sketch of the scene and provide labels to indicate the damage using information from the news article. What short-term responses are needed to make the area safe?

Step 3: I can compare strategies for a geographical challenge

4 Why was a plane with a laser scanner used to survey damage?

Step 4: I can evaluate alternatives for a geographical challenge

5 Source 2: What information in the photograph shows an attempt to stop erosion? What other action could be taken to protect the homes and the coastline?

HOW TO Sketches and annotating, page 142

G2.9

economics+business

How do tourists value the coast?

Australia's coastline is the number one attraction for international visitors and it earns Australians more than $40 billion every year in local and international tourism.

Tourism

Tourism is a very important part of the Australian **economy**. It contributes 3.2 per cent of Australia's total wealth, also known as the country's **Gross Domestic Product (GDP)**. Tourism also employs nearly 5 per cent of all Australians. Australia welcomed 9.1 million international visitors in 2018 and they spent $42.5 billion.

Tourism Australia is the government agency responsible for attracting international visitors to Australia. To continue to grow tourism, Tourism Australia undertakes research to understand what tourists enjoy about Australia. This research underpins the planning and **marketing** activities that Tourism Australia undertakes.

Source 1

The 'There's nothing like Australia' marketing campaign puts the focus on exploring Australia's natural offerings, especially on the coast.

Source 2

Tourism Australia's research shows that the Australian coastline is very popular with international visitors.

The economic value of the coast

Tourism Australia's research shows that 70 per cent of our international visitors enjoy aquatic and coastal experiences as part of their trip to Australia. The tourists rank Australia as the best place in the world to enjoy marine wildlife and coastal beaches. Approximately seven million international visitors enjoy Australia's coastline each year and they contribute $35 billion to the Australian economy.

What attracts international visitors – Tourism Australia 2020 Report

Source: Tourism Australia

Source 3

What attracts international visitors – Tourism Australia 2020 report

Learning ladder G2.9

Economics and business

Step 1: I can recognise economic information

1 Using quantitative data, describe how tourism contributes to the Australian economy.

Step 2: I can describe economic issues

2 Outline two positive and two negative impacts to the environment and economy if tourism was banned from Australia's coastlines.

Step 3: I can explain issues in economics

3 Discuss the interconnection between Tourism Australia's marketing campaigns and the popularity of coastlines as a tourist destination.

Step 4: I can integrate different economic topics

4 Source 3: Using the data from the Tourism Australia 2020 report, create an advertising campaign that promotes other attractions within Australia, as an alternative to visiting coastlines.

Step 5: I can evaluate alternatives

5 How could we make tourism more sustainable to ensure our coastlines do not suffer for economic gain?

How do people manage coasts?

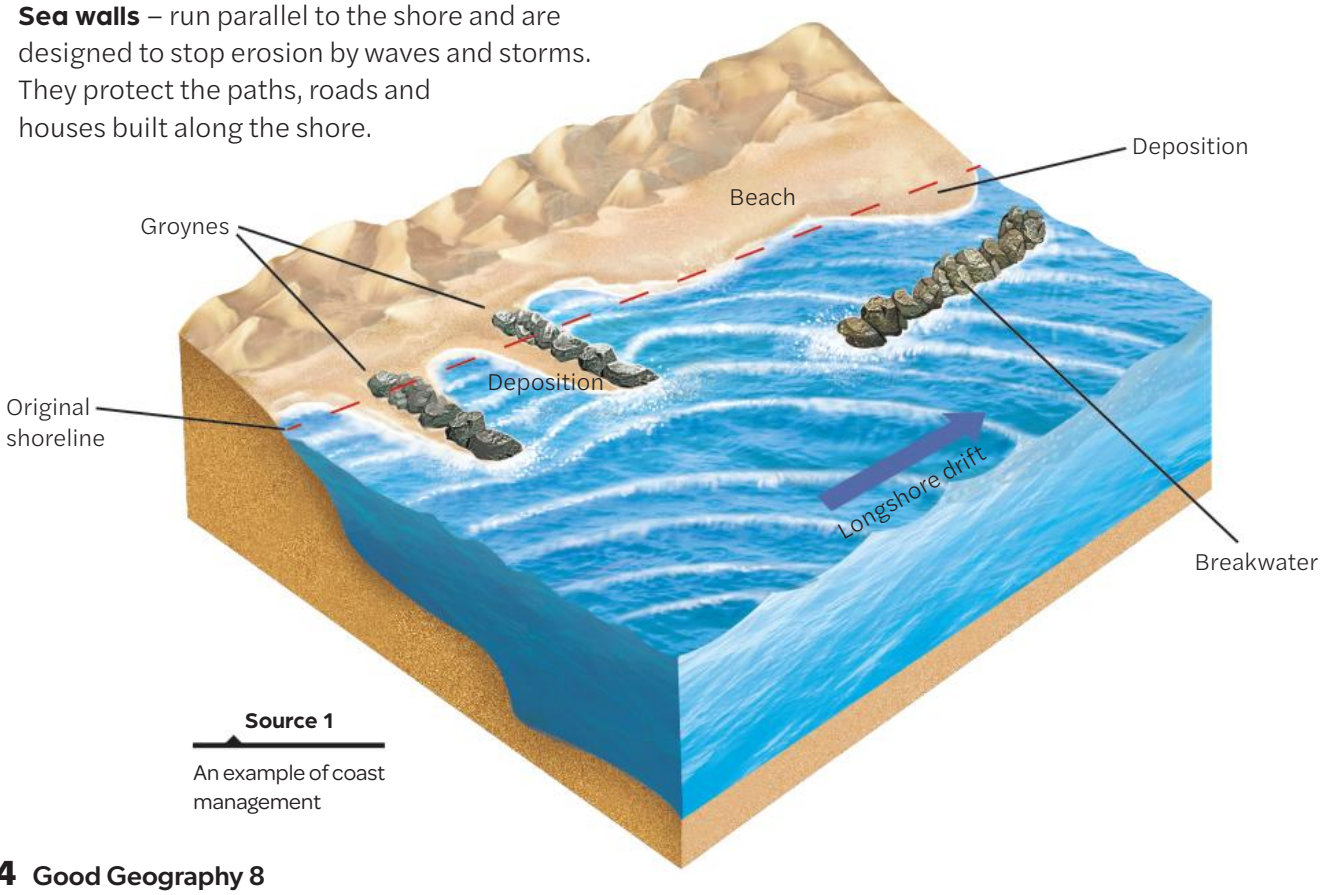
Natural processes such as longshore drift and events such as storms are constantly changing the shape of our coastlines. Settlements built in coastal areas are affected by these changes.

Managing coastlines

Humans have tried to manage coasts to ensure we have beaches to enjoy, that erosion doesn't threaten communities and that sand doesn't clog harbours. To stop or slow the movement of sand, communities construct walls from concrete, rock, timber and sandbags. Solid sea walls deflect wave energy down, scouring sand away and undermining the wall. Loose rock walls help disperse the energy of the wave.

The different types of walls are as follows:

- **Sea walls** – run parallel to the shore and are designed to stop erosion by waves and storms. They protect the paths, roads and houses built along the shore.
- **Breakwaters** – are rock walls parallel to the beach and located in the water. They are designed to direct the force of the waves at the wall and not at the beach and sand dunes behind it.
- **Groynes** – are walls that extend out from a beach into the sea. They are designed to trap the sand moving along the beach. Groynes also direct waves away from the shore, reducing erosion.
- **Training walls** – are built on either side of a river mouth to stop sand from blocking it.



Source 1

An example of coast management

Source 2

A huge dredger pumps sand towards the Surfers Paradise coastline to replenish eroded beaches. Sand is dredged from kilometres offshore and pumped back about 50 metres away from the breaking waves to redistribute to the beaches.

Repairing damaged coastlines

Coastal engineers use a number of methods to repair damaged beaches. They can transport sand by truck or **dredge** it from offshore, and then pump it back just offshore to replenish eroded beaches. This process is known as **beach nourishment**. On the Gold Coast, millions of cubic metres of sand have been dredged from the sea floor or transported from other places to restock eroding beaches.

Sand dunes are stabilised and repaired by erecting fences and signs to keep people off the dunes. Replanting sand dunes with vegetation such as coastal grasses and native plants helps bind the sand together and holds it in place. Sand also mounds up against the plants.

Source 3

The North Cronulla sand dune revegetation program involved fencing and replanting.

Source 4

Plan view of Tweed Heads (NSW) and Coolangatta (Queensland)

Source: State of Queensland 2011

Source 5

The Tweed Heads and Coolangatta coastline

Managing the coast at Coolangatta

Coolangatta is a popular tourist resort on Queensland's Gold Coast, just north of Tweed Heads. After many attempts to restore them, the wide beaches along Coolangatta have returned to the way they were 100 years ago.

Changes made along the coastline on the border between Queensland and New South Wales greatly affected the beaches at Coolangatta. In 1962, the **training walls** on either side of the Tweed River were extended to protect the mouth of the river from a build-up of sand. Unfortunately, **longshore drift** was unable to move sand past the training walls and the Greenmount Beach quickly disappeared.

In 1972, a **groyne** was constructed at Kirra Point at the northern end of Greenmount Beach to help restore it. The beach expanded as sand accumulated against the groyne. **Beach nourishment** in 1974, 1989 and 1995 pumped sand onto the beach.

From 2001, sand has been pumped from south of the Tweed River training walls through pipes to Greenmount and Kirra beaches to match the natural longshore drift of sand that was in place before they were built.

Source 6

Changes in beaches at Coolangatta 1935 to 2004

Learning ladder G2.10

Show what you know

1 Source 6: How is the Coolangatta coastline now similar to the 1935 profile?

2 How has sand been pumped to Greenmount and Kirra beaches?

Geographical challenge

Step 1: I can identify responses to a geographical challenge

3 Source 3: Describe what coastal managers are attempting to do using these constructions.

Step 2: I can compare responses to a geographical challenge

4 Source 1: How are groynes and breakwaters similar and different in managing the coastline?

Step 3: I can compare strategies for a geographical challenge

5 What is the management strategy shown in Source 2? How is this strategy interconnected with the natural process of longshore drift?

Step 4: I can evaluate alternatives for a geographical challenge

6 Create a photo essay illustrating the use of key coastal management strategies in real-life situations. For each photo, describe the management strategy being used and what natural process it is trying to prevent.

HOW TO Photo essays, page 145

How did people destroy and then rescue Hampton Beach?

Hampton is a bayside suburb located 15 kilometres south of Melbourne on Port Phillip Bay, between the suburbs Brighton and Sandringham. Hampton Beach was nearly lost because of the construction of a local harbour.

Longshore drift moves sand northwest towards Green Point in summer and southeast towards Picnic Point in winter, as shown in Source 2. However, the building of Sandringham Harbour trapped sand in the harbour. In summer, the waves couldn't move the sand back to Green Point so, by the 1970s, Hampton Beach was gone. Sand has been pumped back onto the beach and rock and timber **groynes** were built to keep it there. The latest rock groyne was completed in 2012.

Seasonal longshore drift at Hampton Beach, Port Phillip Bay

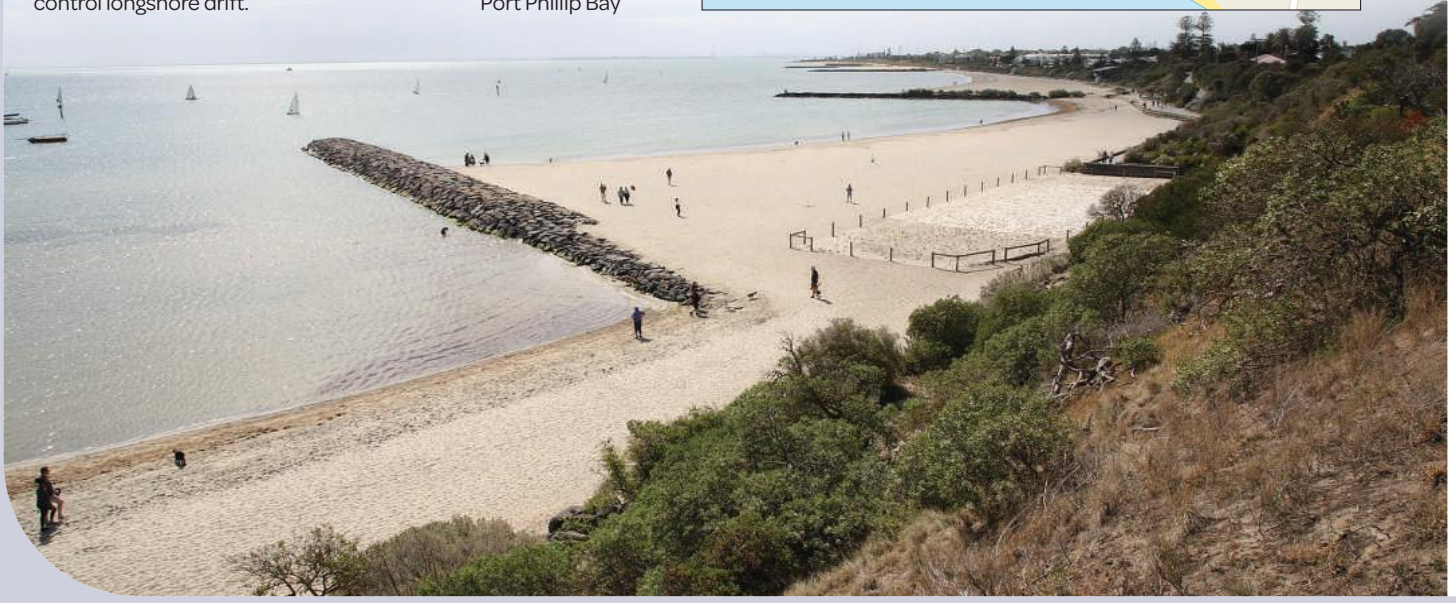
Source: Matilda Education Australia, Open Street Maps

Source 1

Groynes on Hampton Beach help retain the sand and control longshore drift.

Source 2

Longshore drift at Hampton Beach, Port Phillip Bay

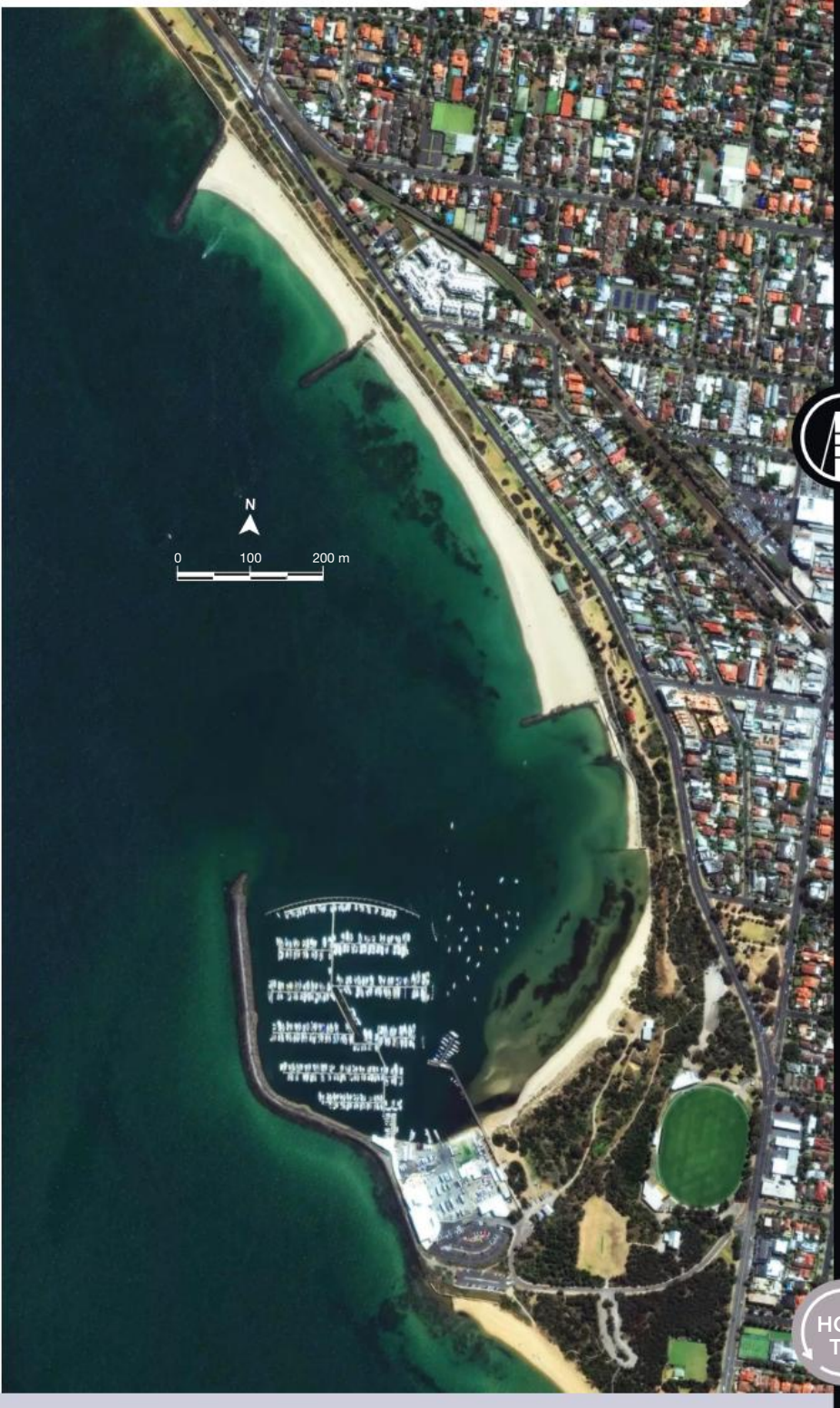


Source 3

An early photo of Hampton Beach c. 1900

Source 4

Hampton beach in 2018



Learning ladder G2.11

Show what you know

1 Source 1: Why has the sand built up on only one side of the groyne?

2 Why did the building of Sandringham Harbour cause issues for Hampton Beach?

Interconnections

Step 1: I can identify and describe interconnections

3 Source 1: Describe the interconnection between sand and groynes on Hampton Beach.

Step 2: I can explain interconnections

4 Source 4: Trace or sketch the scene in the satellite image and annotate the following:

- a the various ways humans have changed this place over time.
- b natural characteristics and features of the coastal landscape.
- c the coastal management strategies that have been implemented.

Step 3: I can identify and explain the implications of interconnections

5 The direction of longshore drift at Hampton Beach depends on the season. Using your knowledge of this natural process, identify whether the aerial image in Source 4 was taken in summer or winter. Justify your response.

Step 4: I can evaluate the implications of significant interconnections

6 Using data from the map and images on this spread, explain why the marina would have a large impact on the movement of sand along the Hampton Beach coastline.

HOW TO

Sketches and annotating, page 142
Satellite images, page 149

How do tsunamis impact coastlines?

Tsunamis are **geohazards** that originate at or near Earth's surface, when water is pushed up by undersea earthquakes and volcanoes, as discussed in Chapter 1. They travel at speeds of up to 800 kilometres per hour and cause extensive damage when they crash onto coastlines.

How tsunamis work

When there is an undersea **earthquake** or volcanic eruption, the upward movement of the sea bed moves the water above it, creating a fast-moving **tsunami**. Tsunamis can cross the entire Pacific Ocean in less than a day.

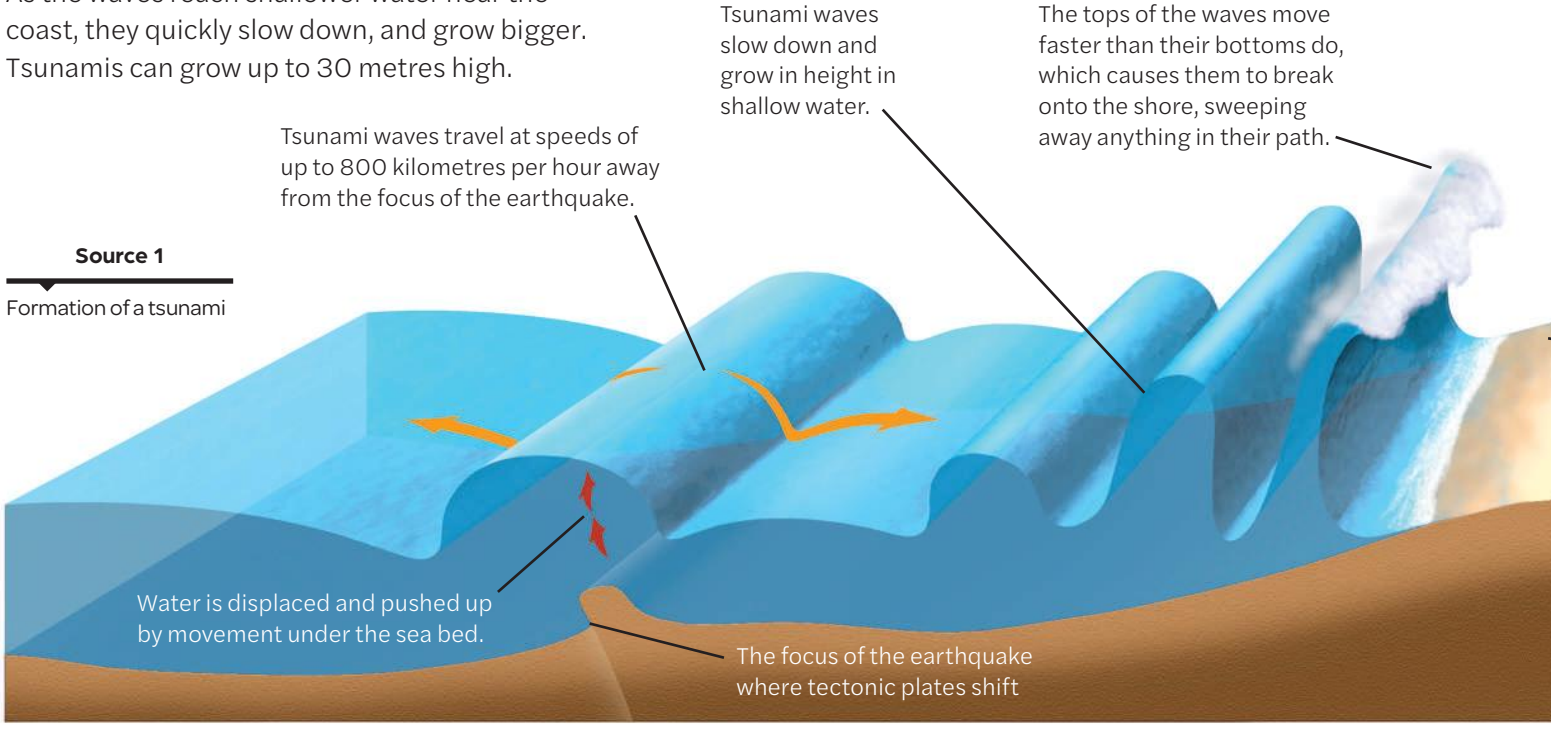
The long wavelengths of tsunamis lose very little energy as they travel away from the focus of the earthquake, which is the location where the earthquake begins. In the deep ocean, tsunami waves may only be about 30 centimetres high. As the waves reach shallower water near the coast, they quickly slow down, and grow bigger. Tsunamis can grow up to 30 metres high.

The trough between the tsunami wave crests often reaches the shore first. This acts like a vacuum, sucking water in the shallows out to sea, exposing the sea bed. The retreating sea water is an important warning sign that a tsunami wave is coming.

Tsunamis hit the shore as a huge wave or a surging tide of water. They cause incredible damage to coastlines and in low-lying coastal areas can flow many kilometres inland, sweeping everything away.

Source 1

Formation of a tsunami



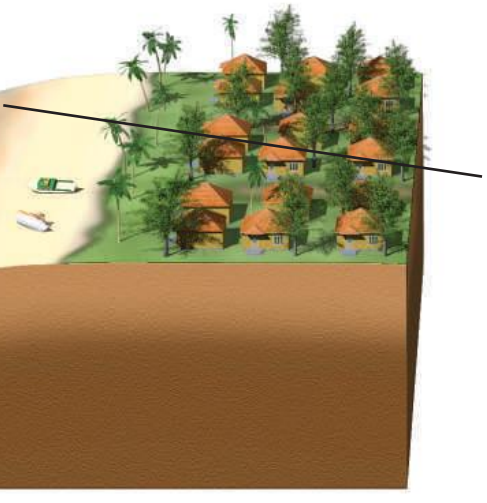
Source 2

The city of Miyako on the north-east coast of Japan's Honshu island was devastated by the 2011 tsunami. The 13-metre-high tsunami swamped the city's sea wall and tsunami shelters. Over 600 people were killed and 6000 buildings were destroyed in that city.

Japan Tsunami 2011

In 2011, a massive undersea earthquake, measuring 9 on the Richter scale, occurred about 80 kilometres off the east coast of Japan. Less than one hour later, tsunami waves up to 13 metres high crashed onto Japan's east coast.

The water flowed over the **sea walls** built to protect the coastline and washed away buildings, ships, cars, roads and people. More than 16 000 people were killed and 300 000 buildings were completely destroyed.



Water is sucked out to sea as the wave trough hits the shore, exposing the sea bed.

Learning ladder G2.12

Show what you know

1 What is a tsunami and how do they occur?

2 Why is Japan vulnerable to tsunamis? How does this vulnerability affect Japan's coastlines?

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

3 With a partner, research five tsunamis. For each tsunami, summarise the following:
- a location and date
- b height of waves
- c impact to the coastline of the region
- d impact to human population of the region.

Step 2: I can recognise and use different types of data

4 Source 2: Give examples of damage caused by tsunamis from this oblique aerial image.

Step 3: I can choose, collect and display appropriate data

5 Consider the websites that you used to complete the research in Question 3. Were they reliable or appropriate for this research?

Step 4: I can use data to support claims

6 Explore http://mea.digital/Blyn
- a How does this data show Japan's tsunami vulnerability at any given time?
- b How could websites or data such as this be used to plan and prepare the coastal environment for a disaster event?

What was the impact of the Palu earthquake and tsunami?

On 28 September 2018, a large magnitude 7.5 earthquake occurred 77 kilometres from Palu in Indonesia. The earthquake caused major **soil liquefaction**, where the soil turned to mud, submerging buildings. It also created a tsunami.

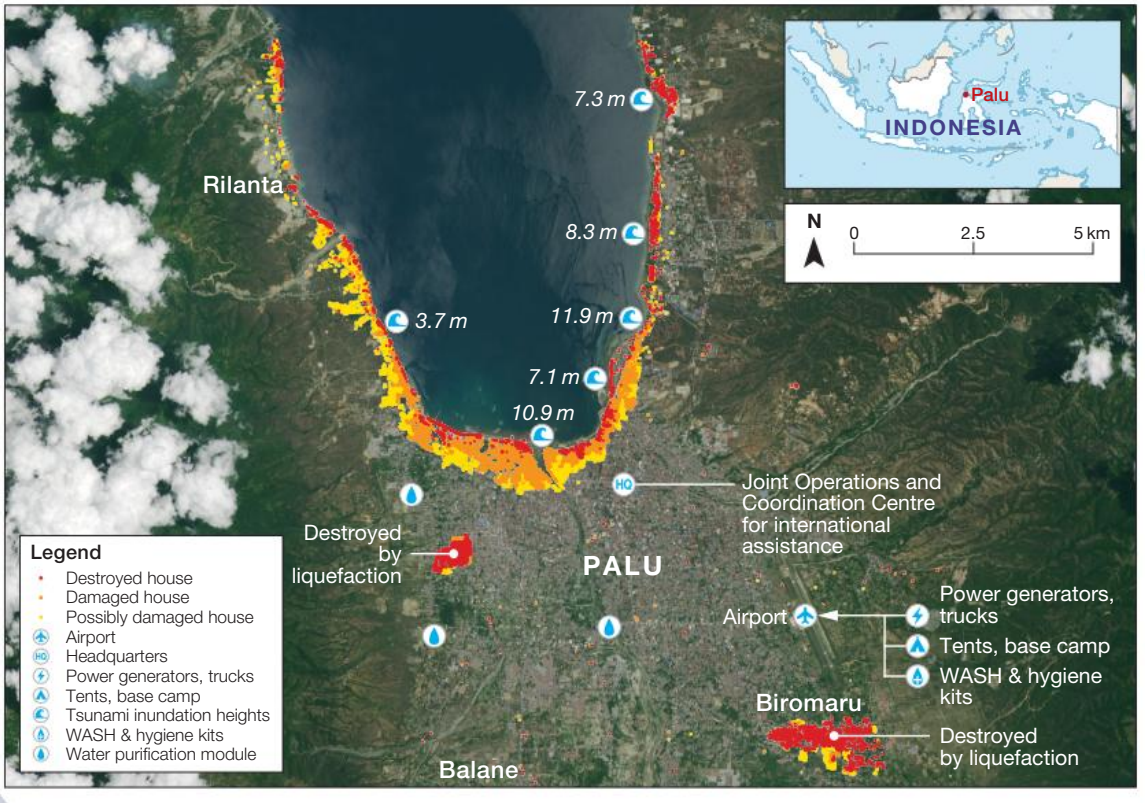
What impact did the tsunami have on Palu?

The **tsunami** produced waves up to 12 metres high that struck Palu and other coastal settlements. It destroyed around 70 000 homes and pushed debris inland, damaging bridges and roads along its path. The combined impact of the earthquake and tsunami led to the deaths of at least 2000 people.

More than 200 000 people were made homeless by the natural disaster and relief camps were set up to give them shelter, supply food and clean water, and to treat injuries and infections.

Source 1

Disaster management map of Palu, October 2018



Source: European Commission, ERCC, Matilda Education, Copernicus EMS

Source 2

This ship was transported inland by the tsunami that struck Indonesia in 2018.

Source 3

An oblique aerial view showing the devastated city of Palu in Indonesia following an earthquake and tsunami in September 2018

Learning ladder G2.13

Show what you know

1 What was the impact of the tsunami on Palu?

2 What is soil liquefaction?

Geographical challenge

Step 1: I can identify responses to a geographical challenge

3 Source 1: International aid agencies needed to get to Palu. Describe the relative location of Palu in Indonesia using the inset map provided.

Step 2: I can compare responses to a geographical challenge

4 Source 1: Once aid arrived to Palu, which areas did they need to get to and why?

Step 3: I can compare strategies for a geographical challenge

5 Source 1: Imagine you are coordinating an aid team on the ground in Palu. List the different jobs needed to respond to the damage and threats.

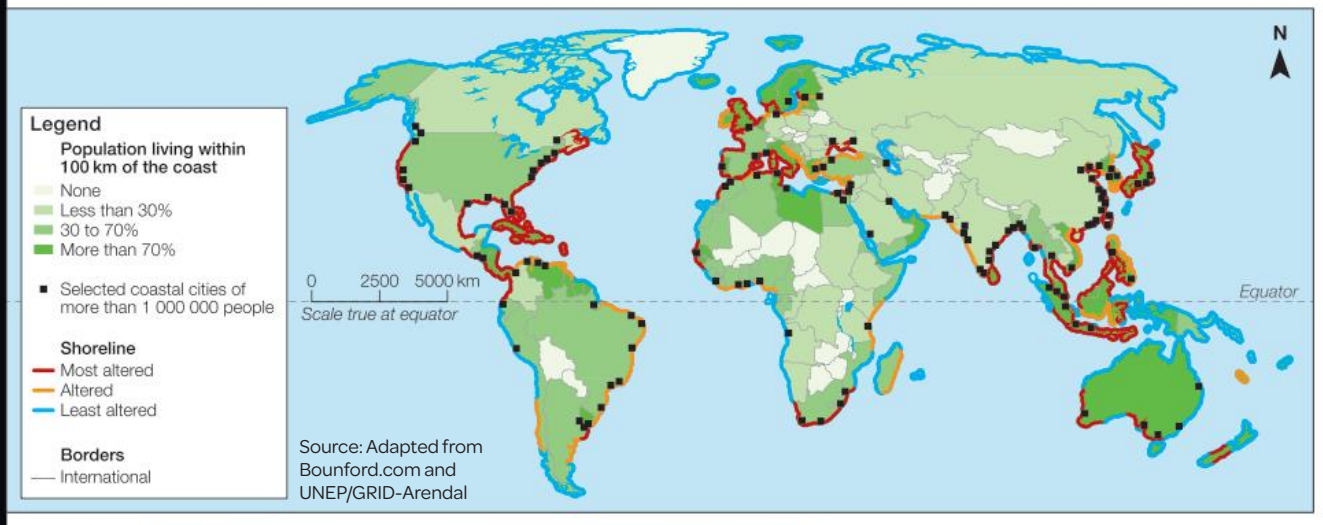
Step 4: I can evaluate alternatives for a geographical challenge

6 Imagine your class is responsible for providing resources and shelter to people affected by the disaster in Palu. Based on the damage and outcomes of the tsunami, create an action plan to help them recover from this event.

Masterclass

Learning Ladder

Coastal population and shoreline degradation



Source: State of Queensland 2011

Source 1

Percentage of inhabitants that live along the coast

Source 2

Plan aerial view of Tweed Heads (NSW) and Coolangatta (Queensland)

Source 3

Human management of the coastline at Brighton in England.

Work at the level that is right for you or level-up for a learning challenge!

Step 1

a **I can identify and describe spatial characteristics**

Describe the place photographed in Source 2.

b **I can identify and describe interconnections**

Identify one key interconnection in Source 1.

c **I can identify responses to a geographical challenge**

Source 2: Why have groynes been installed on this beach?

d **I can collect, record and display data in simple forms**

Source 1: Identify what the black boxes represent on the map.

e **I can use geographic terminology to interpret data**

Source 1: Describe which sections of Australia's coastline have been most altered by people.

Step 2

a **I can explain spatial characteristics**

Source 2: How successful have the groynes in the north of the image been in keeping sand on the beaches?

b **I can explain interconnections**

Source 2: Why is sand been pumped from south of the Tweed River training walls through pipes to the beaches in the north of the image?

c **I can compare responses to a geographical challenge**

Source 2: Sketch this area as it might look if only the training walls at the mouth of the river were in place and no groynes were used on beaches.

d **I can recognise and use different types of data**

Sources 2 and 3 are both aerial views of the coast. Which is more like a map and why?

e **I can describe patterns and trends**

Refer to Source 1. Identify one key pattern that is evident on this map.

Step 3

a **I can explain processes influencing places**

Refer to Source 2. In which direction are the waves travelling as they hit the beach in the north of the image? Explain how this will impact on longshore drift in this area.

b **I can identify and explain the implications of interconnections**

Identify landforms mainly affected by an interconnection with the wind. Discuss why this interconnection is important.

c **I can compare strategies for a geographical challenge**

Why were training walls built at the mouth of the Tweed River and how else could this objective have been achieved (page 76)?

d **I can choose, collect and display appropriate data**

Imagine you were trying to collect data on the movement of sediment along the beach in Source 2. What data collection methods would be appropriate for this investigation?

e **I can explain the reasons behind a trend or spatial distribution**

Refer to Source 1. Explain, using SHEEPT, why so many people live along coastal regions.

Step 4

a **I can predict changes in the characteristics of places**

Source 2: Predict what would happen to Greenmount Beach (the large beach in the north-east of the photo) if it were to lose the groyne at the western end of the beach. Justify your response.

b **I can evaluate the implications of significant interconnections**

Describe the interconnection between wind and coastal vulnerability to erosion in Source 3.

Masterclass

c I can evaluate alternatives for a geographical challenge

Source 2: Compare the roles of the training walls and groynes in the image. What similarities and differences are there?

d I can use data to support claims

Referring to Source 3, discuss the conclusion 'This place has clearly been affected by longshore drift'.

Do you agree with this statement? Use evidence from the source to justify your answer.

e I can analyse relationships between different data

Compare Sources 1 and 3 on pages 82–83. Describe how useful each would be to aid workers before they arrive in Palu.

Step 5

a I can analyse the impact of change on places

Prepare a table to analyse the short and long-term impact on Palu following the 2018 earthquake and tsunami (pages 82–83).

b I can explore spatial association and interconnections

'A coastline is an environment that is highly interconnected with both land and marine processes.' Discuss.

c I can plan action to tackle a geographical challenge

A geographer conducting fieldwork on longshore drift completes a field sketch as their only source of data. Evaluate this method's likely success in helping understand longshore drift in this location. Suggest other methods that may be useful to the researcher.

d I can evaluate data

Justify whether you think Source 1 is a reliable data source given that populations are constantly changing and moving.

e I can draw conclusions by analysing collected data

Consider the coastal management strategies evident in Source 2. From the image, do you think they are successful? Suggest other management techniques that may also help preserve the coastline.

Capstone

How can I understand coastal landscapes?

In this chapter, you have learnt a lot about coastal landscapes. Now you can put your new knowledge and understanding together for the capstone project to show what you know and what you think.

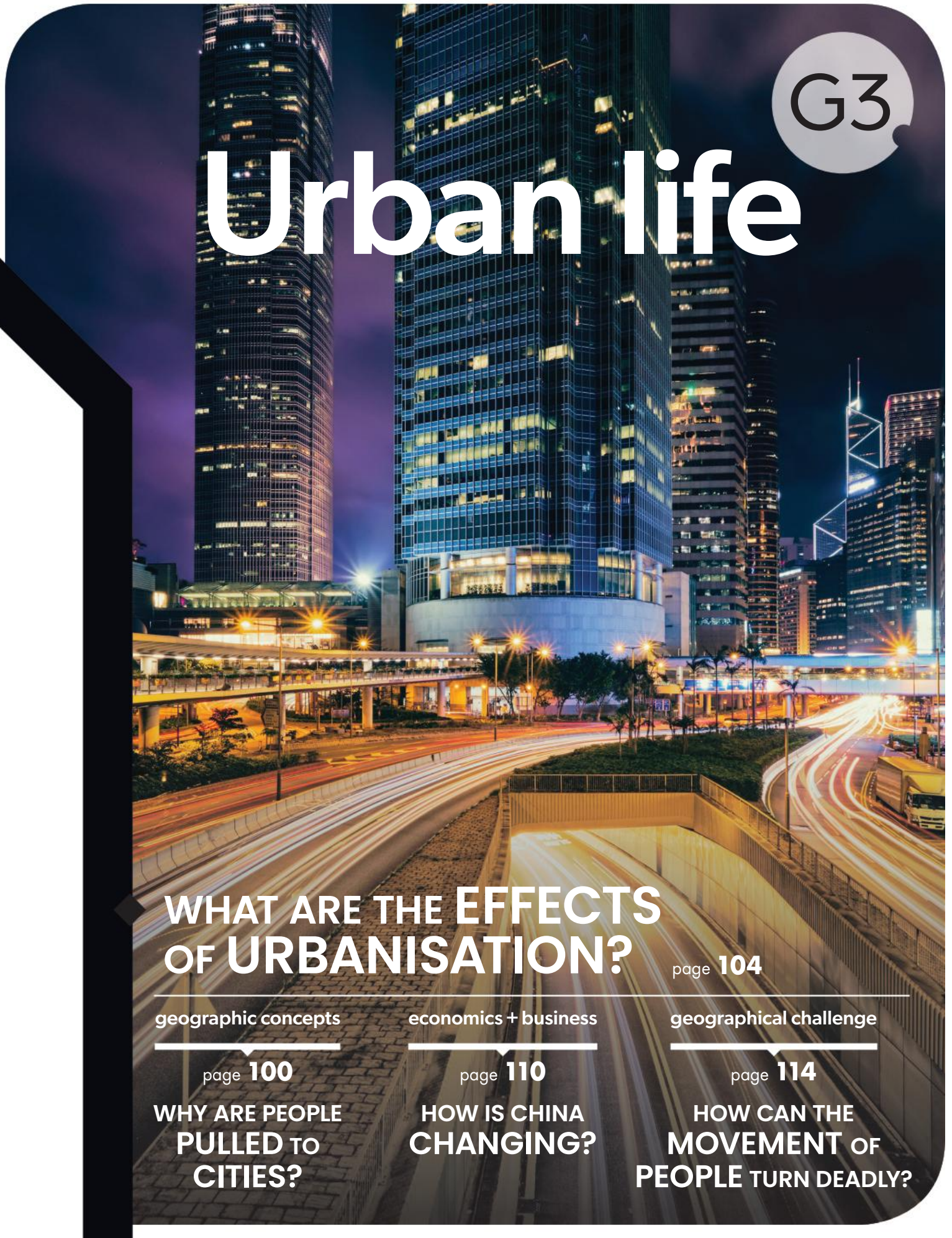
In the world of building, a capstone is an element that finishes off an arch or tops off a building or wall. That is what the capstone project will offer you, too: a chance to top off and bring together your learning in interesting, critical and creative ways. You can complete this project yourself, or your teacher can make it a class task or a homework task.

mea.digital/GHV8_G2

Scan this QR code to find the capstone project online.

G3

Urban life



WHAT ARE THE EFFECTS OF URBANISATION?

page 104

geographic concepts

page 100

WHY ARE PEOPLE PULLED TO CITIES?

economics + business

page 110

HOW IS CHINA CHANGING?

geographical challenge

page 114

HOW CAN THE MOVEMENT OF PEOPLE TURN DEADLY?

How can I learn about urban life?

More than half the world's population now lives in urban areas, as large numbers of people move from rural areas to cities seeking job opportunities, higher pay, and better access to health care and education. However, urbanisation negatively impacts the environment through higher carbon emissions, deforestation and reduced farming areas, as well as straining existing infrastructure and services. Urbanisation leads to the growth of megacities, or to many cities spreading into one to form a conurbation.

learning ladder

	Spatial characteristics	Interconnections	Geographical challenge
step 5	**I can analyse the impact of change on places** I can analyse and evaluate the implications of growth or decline of places and calculate the impact on people and environments.	**I can explore spatial association and interconnections** I can compare distribution patterns and the interconnections between them such as the growth of conurbations.	**I can plan action to tackle a geographical challenge** I can frame questions, evaluate findings, plan actions and predict outcomes to tackle a population-based geographical challenge.
step 4	**I can predict changes in the characteristics of places** I can predict changes in the characteristics of places over time due to urbanisation.	**I can evaluate the implications of significant interconnections** I can identify, analyse and explain key interconnections within and between places, and evaluate their implications over time.	**I can evaluate alternatives for a geographical challenge** I can weigh up alternative views and strategies on a population-based geographical challenge using environmental, social and economic criteria.
step 3	**I can explain processes influencing places** I can explain the series of actions leading to change in a place, such as rural-urban migration.	**I can identify and explain the implications of interconnections** I can identify, analyse and explain population-based interconnections and explain their implications.	**I can compare strategies for a geographical challenge** I can compare strategies for a geographical challenge, taking into account a range of factors and predicting the likely outcomes.
step 2	**I can explain spatial characteristics** I can identify concepts of Space, Place, Interconnection, Change, Environment, Scale and Sustainability (SPICESS) when I read about changing nations.	**I can explain interconnections** I can describe and explain interconnections and their effects, such as the growth of cities into one another to form conurbations.	**I can compare responses to a geographical challenge** I can identify and compare responses to a geographical challenge and describe its impact on different groups.
step 1	**I can identify and describe spatial characteristics** I can talk about spatial characteristics at a range of scales; e.g. urbanisation in the USA.	**I can identify and describe interconnections** I can identify and explain simple interconnections such as poorer people in rural areas being attracted to opportunities in large cities.	**I can identify responses to a geographical challenge** I can find responses to a geographical challenge such as urbanisation and understand the expected effects.

Source 1

In the 19th century, London became the world's largest city, as people poured into the city for work in the new factories as part of the **Industrial Revolution**. Today, the largest and fastest growing cities are in the world's **less economically developed countries (LEDCs)**, particularly in Asia.

Warm up

Spatial characteristics

1 Looking at Source 1, what geographic characteristics can you identify? Describe how they may have occurred using the SPICESS terms of space and place.

Interconnections

2 Source 1: Why do large cities such as London attract so many people?

Geographical challenge

3 What challenges do large cities present for planners and governments? Give three examples.

Collect, record and display data

4 Conduct a quick survey of your class, asking them the following question: Would you rather live in an area that was:
a urbanised?
b rural?
Record your data using a tally.

Analyse data

5 Look carefully at the graph in Source 3 on page 93. Is Australia an urbanised nation? Suggest reasons to support your answer.

I can evaluate data
I can determine whether data presented about human settlements is reliable and assess whether the methods I used in the field or classroom were helpful in answering a population-based research question.

I can draw conclusions by analysing collected data
I can summarise findings and use collected data to support key patterns and trends I have identified for population-based research.

I can use data to support claims
I can select or collect the most appropriate data and create specialist maps and information using ICT to support investigations into urban settlements.

I can analyse relationships between different data
I can use multiple data sources, overlays and GIS to find relationships that exist in patterns of urbanisation on Earth.

I can choose, collect and display appropriate data
I can select useful sources of population data and represent them to conform with geographic conventions.

I can explain the reasons behind a trend or spatial distribution
I can identify Social, Historical, Economic, Environmental, Political and Technological (SHEEPT) factors to help me explain patterns in data.

I can recognise and use different types of data
I can define the terms primary, secondary, qualitative and quantitative data, and represent data in more complex forms.

I can describe patterns and trends
I can identify Patterns, Quantify them and point out Exceptions (PQE) to describe the patterns I see.

I can collect, record and display data in simple forms
I can identify that maps and graphs use symbols, colours and other graphics to represent data.

I can use geographic terminology to interpret data
I can identify increases, decreases or other key trends on a map, graph or chart about urban settlements.

Collect, record and display data

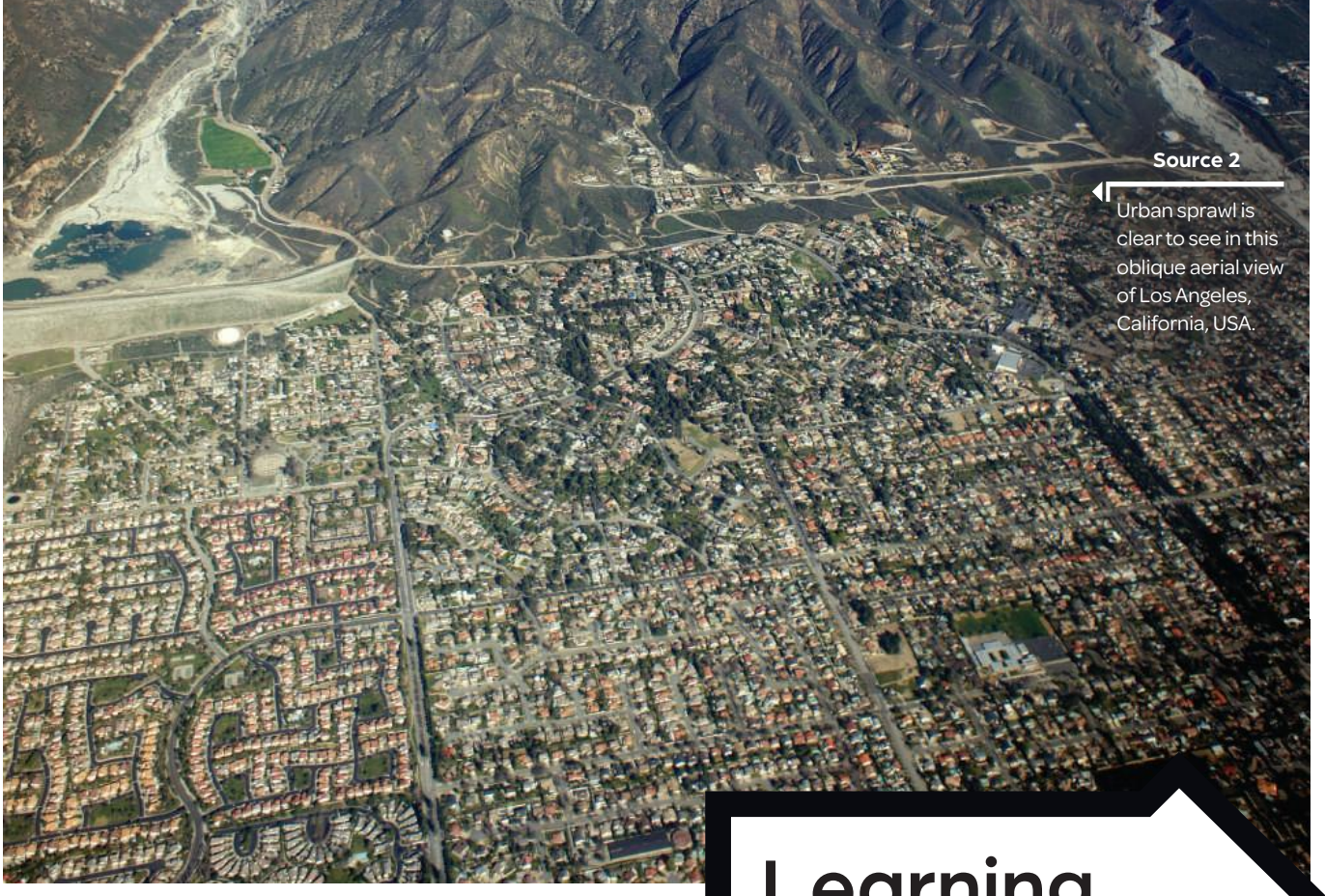
Analyse data

How do nations change?

Nations constantly change and develop as the population grows and technology improves. As the world population increases, we are seeing an increase in the urbanisation of environments. Urbanisation can be positive, as cities provide people with better access to employment, health care, education and higher living standards, but urbanisation also has negative impacts on people and place through higher carbon emissions, more competition for resources due to population density and a reduction in open space for recreation and farming.

Source 1

Changes in Dubai's urban landscape from 1990 to 2003 – look for the five square white buildings that appear in both photos to see the scale of the change.



Source 2

Urban sprawl is clear to see in this oblique aerial view of Los Angeles, California, USA.

Learning ladder G3.1

Show what you know

1 Brainstorm some key changes over time that have led to an increase in urbanised areas.

Analyse data

Step 1: I can use geographic terminology to interpret data

2 Look up the term 'urban sprawl'. How do you think this concept is interconnected with the idea of urbanisation shown in Source 2?

Step 2: I can describe patterns and trends

3 Source 1: Describe the pattern of high-rise buildings in Dubai in 2003.

Step 3: I can explain the reasons behind a trend or spatial distribution

4 Suggest reasons to explain the pattern in Source 2. Classify your reasons into the SHEEPT categories.

Step 4: I can analyse relationships between different data

5 Identify the buildings from 1990 in the photo of Dubai in 2003. Describe what has changed and suggest what the scene may look like today.

HOW TO

SHEEPT, page 140

Where are the world's urbanised areas?

More than half of the world's population now lives in urban areas, mainly along coastal regions in the northern hemisphere. Urbanisation has seen cities in Asia grow rapidly.

What is an urban area?

An **urban** area is a densely populated human settlement. In Australia, urban areas are defined as centres of 1000 or more people, with a **population density** of at least 200 people per square kilometre. Urban areas such as cities and towns contain commercial and residential buildings, and **infrastructure** such as transport, power, water and sewage treatment.

Urbanisation refers to the growth of urban areas as more people move from **rural** areas to cities. Projections show 68 per cent of all people will live in urban areas by 2050.

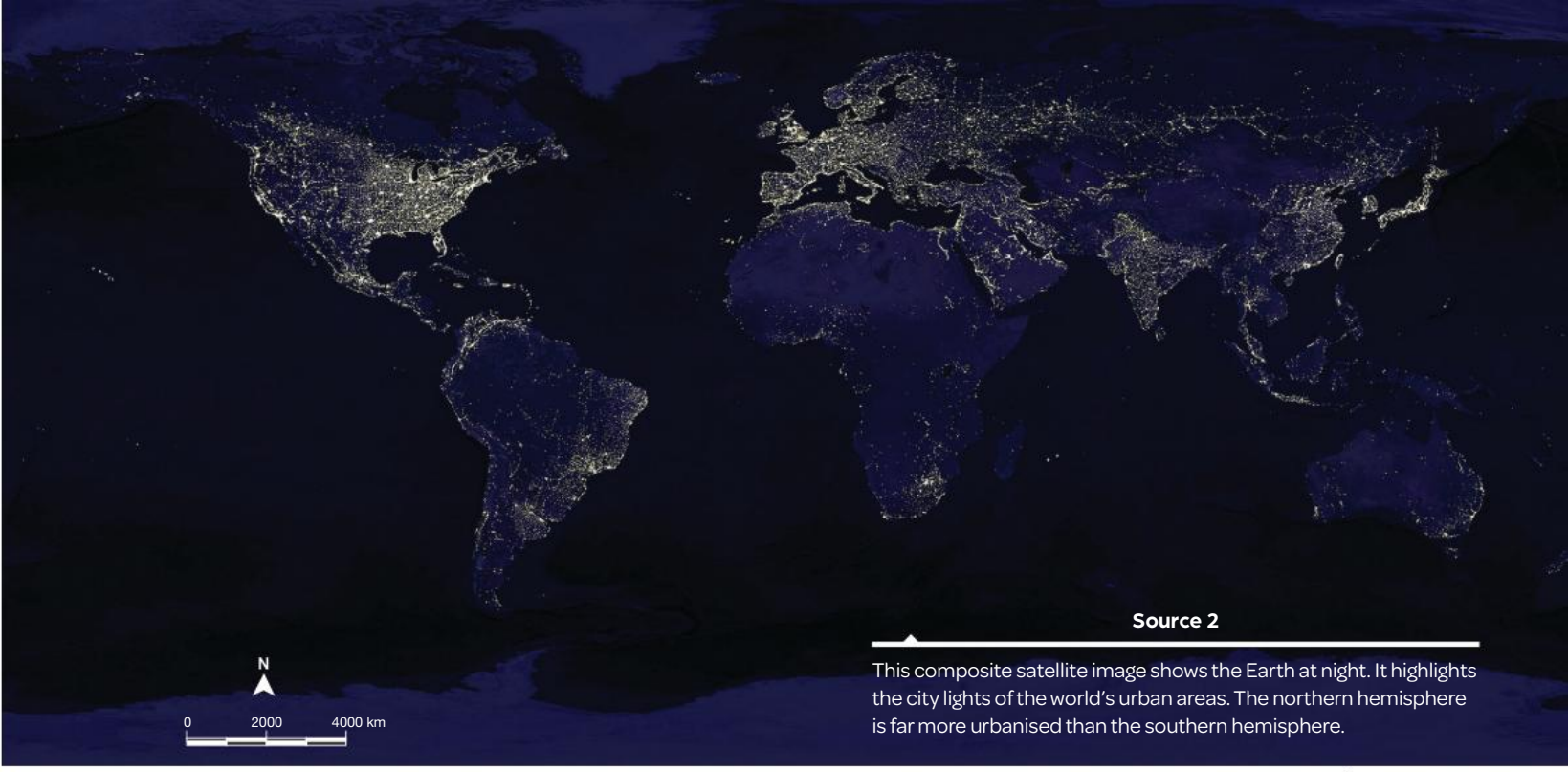
Where are urban areas?

The world's urban areas are generally located close to coastlines and transport routes. They are found in areas of high rainfall and on flat land. Desert, mountain, forest and polar environments have some of the lowest population densities on Earth.

In addition, the **northern hemisphere** contains most of the world's largest urban areas and cities. Europe and the USA are two regions that have been highly urban for a long time and that feature **more economically developed countries (MEDC)** of the world.

Source 1

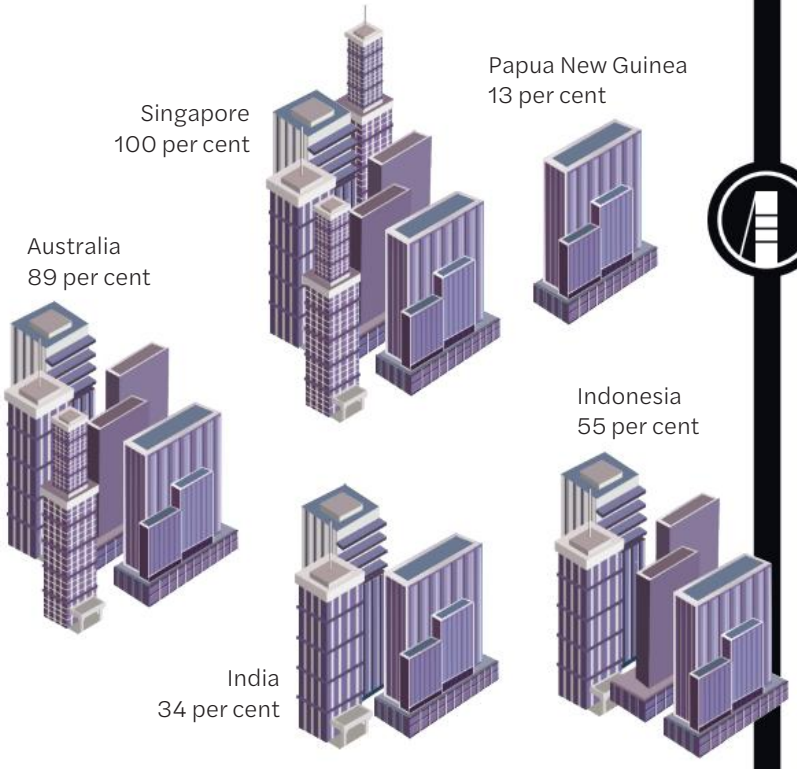
Gardens by the Bay in Singapore. Singapore is one of 11 countries in the world that are 100 per cent urbanised. With only about 700 square kilometres of land, Singapore has increased its land area by 23 per cent by reclaiming land from the sea and has relied on high-rise apartments to house its population.



Source 2

This composite satellite image shows the Earth at night. It highlights the city lights of the world's urban areas. The northern hemisphere is far more urbanised than the southern hemisphere.

The Asian countries of China, India, Indonesia and Singapore are examples of countries where urbanisation has been recent and rapid. The largest cities in the **southern hemisphere** are found along the coasts of South America.



Source 3

In 1950, only 30 percent of the world's population lived in urban areas. Urbanisation occurred mainly in developed countries such as Australia. Today 55 per cent of people live in urban areas; however, some countries, such as Papua New Guinea, remain largely rural.

Learning ladder G3.2

Show what you know

1 Define the concept of an 'urban area' using at least four pieces of quantitative data.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

2 Source 2: Which hemisphere is the most urbanised? How can you tell from this image?

Step 2: I can explain spatial characteristics

3 Source 3: What impacts do you think urbanisation has had on the environment in Singapore?

Step 3: I can explain processes influencing places

4 As a class, discuss why most urbanised areas are located along coastlines. You may wish to use the SHEEPT factors to broaden your thinking.

Step 4: I can predict changes in the characteristics of places

5 Conduct some research and create a list of the top 10 fastest-growing cities on Earth. Discuss why these places are growing so quickly.

HOW TO

SHEEPT, page 140

How urbanised are Australia and the USA?

Highly urbanised and wealthy countries such as the USA and Australia have many similarities. Large cities develop along the coastline and continue to expand through a process known as urban sprawl.

Urbanisation

Although the USA has a population 13 times the size of Australia, the two countries have many similar urban patterns. Both countries are highly urbanised. In Australia, 89 per cent of the population lives in urban areas. In the USA, 82 per cent of people live in urban areas.

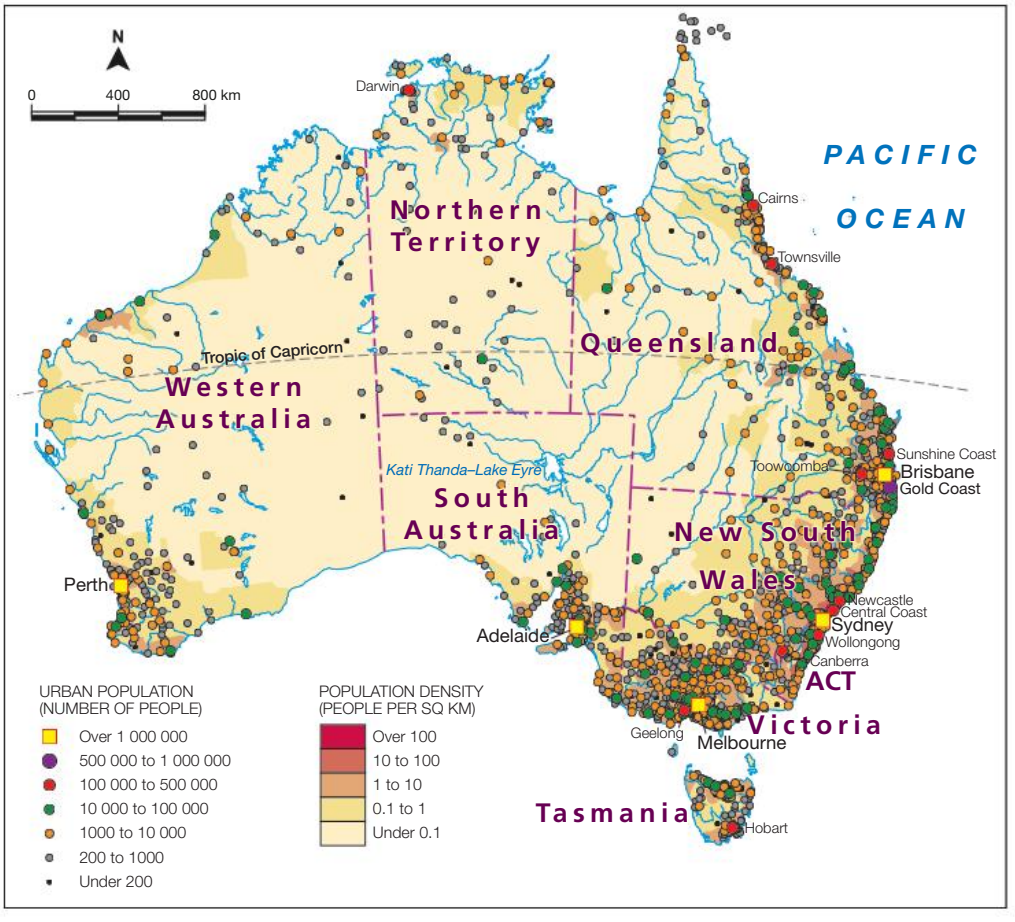
Urban sprawl

Australian and American cities are both characterised by **urban sprawl**. Land in city centres is expensive, so high-density offices and apartments are built for businesses and residents. Surrounding the city centre lies a broad area of medium-density residential housing called **suburbs**.

Settlement patterns

The populations of the USA and Australia are concentrated in large cities and towns along the east, west and south-east coasts. Both the USA and Australia have large areas of dry inland desert where virtually no-one lives. In the USA, the large desert city of Las Vegas is an exception to the pattern. The resort town has grown by 400 per cent since 1980 and now has a population of 640 000.

Australia's urban areas

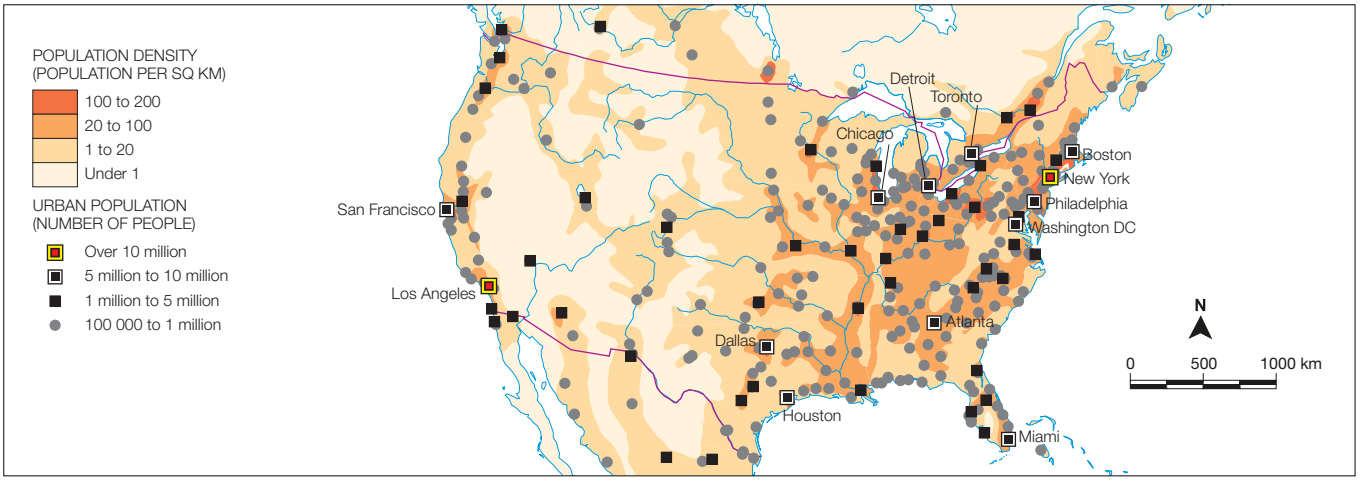


Source: Matilda Education Australia

Source 1

This map shows Australia's most densely populated urban areas

The USA's urban areas



Source: Matilda Education Australia

Source 2

This map shows the USA's most densely populated urban areas

Commuter towns are separated from suburbs by farmland and open space, but connected by roads and rail. People in these towns commute to the city for work. Over time, suburbs and commuter towns join together, increasing the urban sprawl.

Sometimes whole cities merge together into a continuous urban area known as a **conurbation**. The South East Queensland conurbation stretches for 200 kilometres joining the Sunshine Coast, Brisbane and the Gold Coast. In the north-eastern USA, the Boswash conurbation (see page 96) joins a number of major cities. More than 52 million people live in this conurbation – 16 per cent of the entire population of the USA.

Source 3

American and Australian cities are characterised by sprawling suburbs like Henderson in the Las Vegas metropolitan area. Las Vegas is an exception to the settlement patterns of the USA and Australia, where the urban areas are generally concentrated on the coast. Las Vegas is a large city in the middle of the American desert.

Learning ladder G3.3

Show what you know

1 Define urban sprawl using examples from Australia and the USA.

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

2 Identify the most urbanised regions in the USA.

Step 2: I can explain spatial characteristics

3 Using Sources 1 and 2, discuss any similarities or differences between the location of urbanised areas in Australia and the USA.

Step 3: I can explain processes influencing places

4 Draw a sketch map of a place (either real or imaginary) that has urban sprawl. Include and annotate your sketch using the following key ideas:

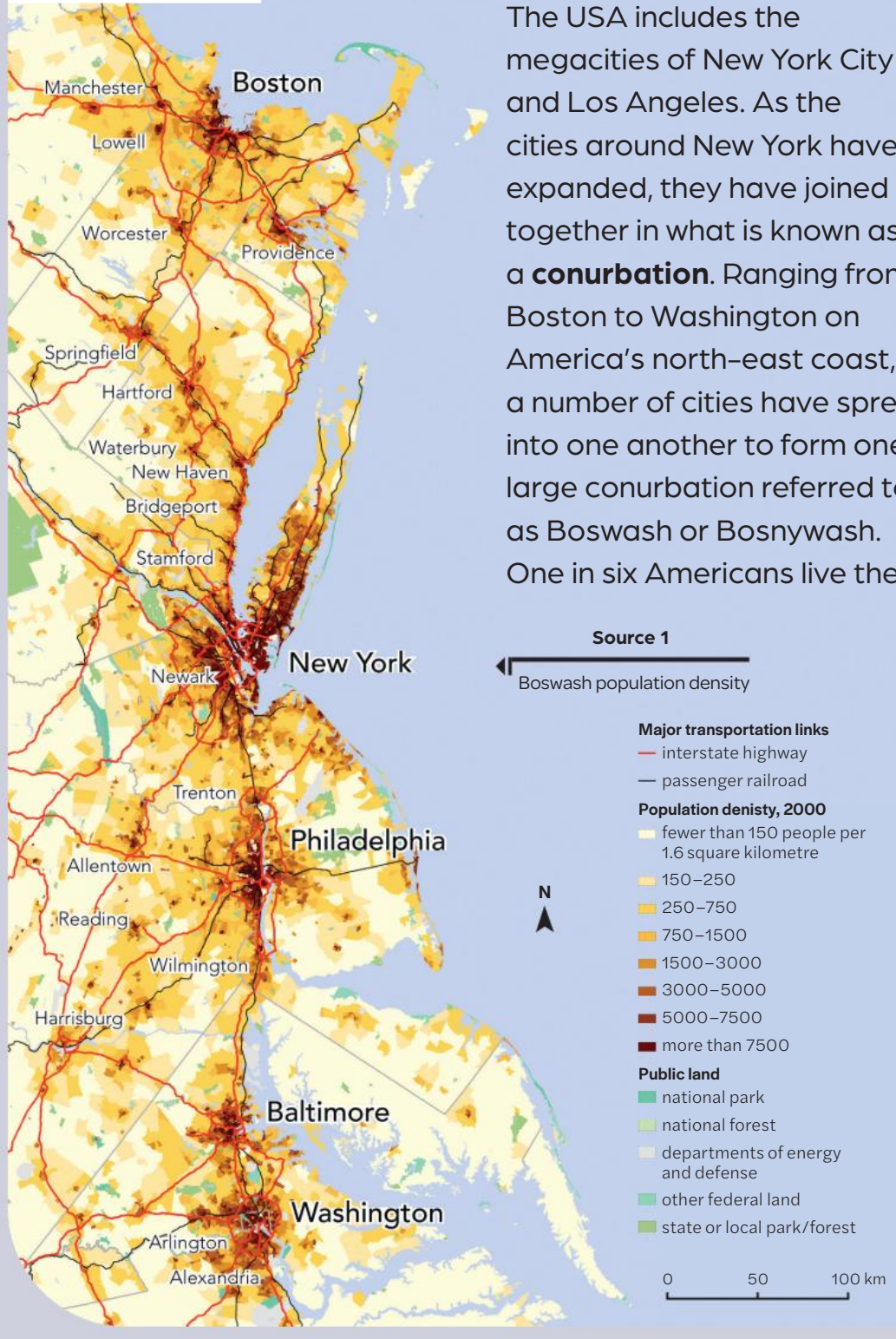
a urban sprawl
b commuter town
c farmland
d open space
e roads
f rail
g suburbs
h city.

Step 4: I can predict changes in the characteristics of places

5 What are commuter towns and what is likely to happen to them in the future as urban areas expand?

What happens when cities grow into one another?

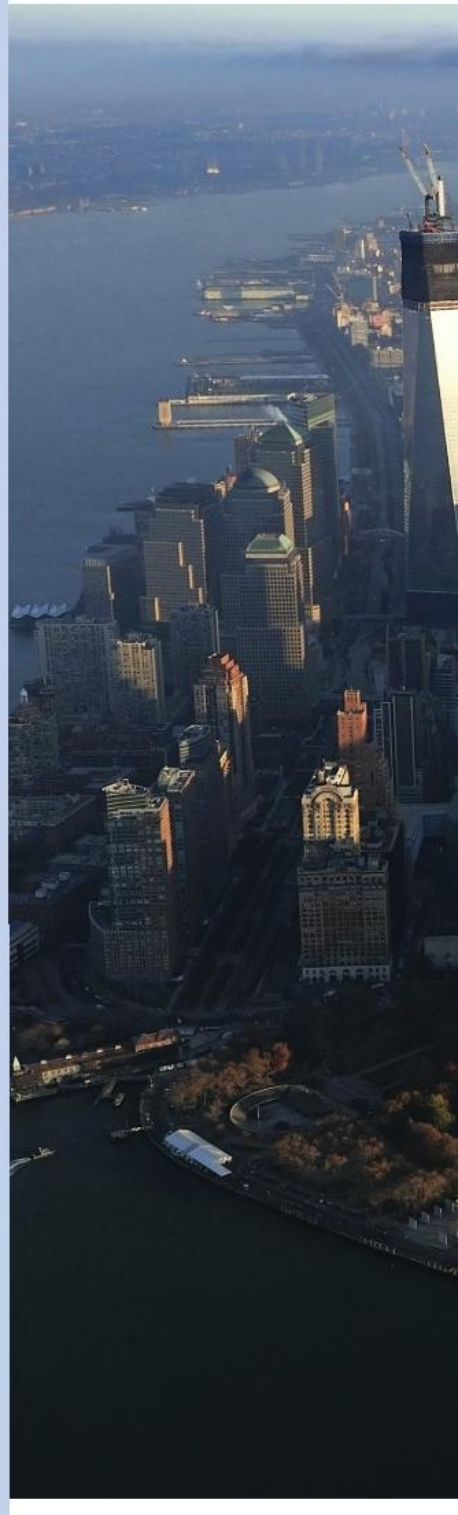
Boswash population density



The USA includes the megacities of New York City and Los Angeles. As the cities around New York have expanded, they have joined together in what is known as a **conurbation**. Ranging from Boston to Washington on America's north-east coast, a number of cities have spread into one another to form one large conurbation referred to as Boswash or Bosnywash. One in six Americans live there.

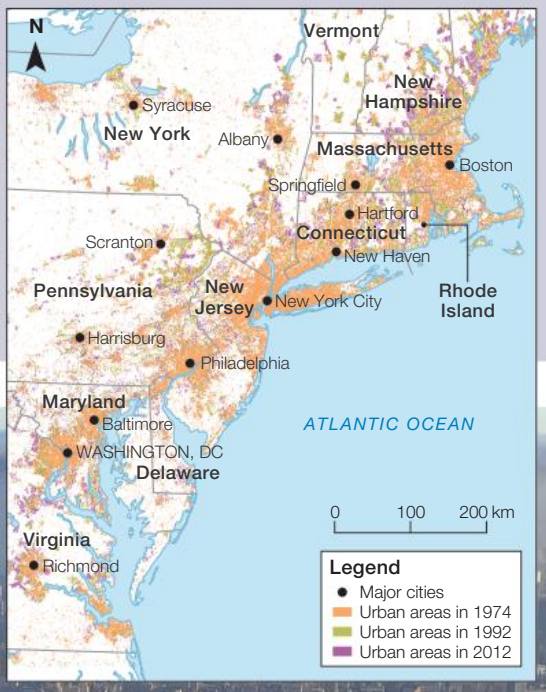
Source 1

Boswash population density



Source: Radical Cartography

Growth of urban area for Boswash: 1974–2012



Source: Matilda Education Australia, USGS

Source 2

Growth of urban area for Boswash

Source 3

Boswash forest area change 2000–2019

Forest area change 2000–2019 for Boswash area

Source: Matilda Education Australia, USGS, Hansen/UMD

Source 4

With a population of 22 million people, New York City is the largest and most densely populated city in the USA, with 72 000 people per square kilometre. The city is home to over 6500 high rise buildings, including the tallest building in the USA, the 541-metre One World Trade Center. The tower was built on the site of the former World Trade Center that was destroyed in the terrorist attacks of 11 September 2001.

Learning ladder G3.4

Show what you know

1 Define the term conurbation and provide an example.

2 Source 3: When did the greatest growth between New York and Philadelphia occur?

Interconnections

Step 1: I can identify and describe interconnections

3 Source 1: Which American cities are interconnected as part of the Boswash conurbation?

Step 2: I can explain interconnections

4 Explain how conurbations develop using the term interconnection.

Step 3: I can identify and explain the implications of interconnections

5 Source 4: Why is it difficult for New York to expand further? How has the city responded to this problem?

Step 4: I can evaluate the implications of significant interconnections

6 Compare Source 1 and Source 4. As a class, discuss how the urbanisation of Boswash has impacted the region's natural environment. Do you believe that urbanisation should be prioritised over environmental sustainability? As a class, justify your answer with data.

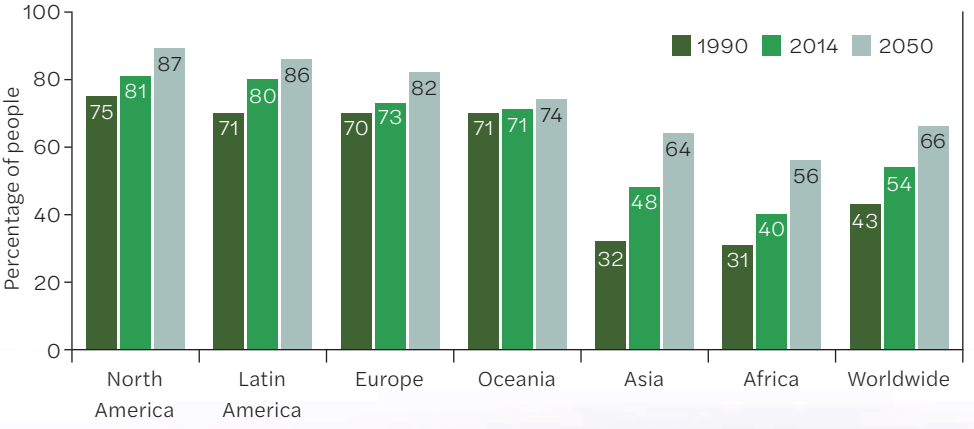
How are populations changing?

Rural to urban migration has seen large numbers of people move from farming areas to cities. Today, 54 per cent of all people in the world live in urban areas.

The lure of the city

The promise of job opportunities and better services pulls people from **rural** areas to cities. In 1900, just 16 per cent of people lived in **urban** areas. By 2050, this percentage is likely to grow to two-thirds of the population, as more African and Asian rural dwellers move to cities.

Percentage of people living in urban areas



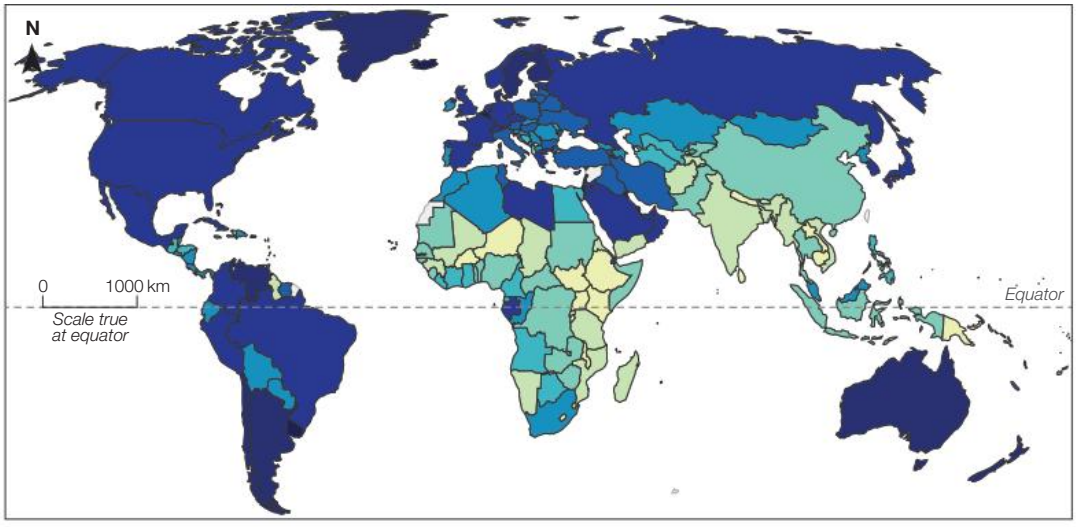
Source 1

Seoul was the destination for most rural migrants in South Korea. Between 1960 and 1970 many farmers left for opportunities in the city. In 1960, just 28% of all South Koreans lived in cities. By 1970, 41% lived in cities. Today, South Korea's urban population is 82% and it has quickly grown from one of the poorest to one of the wealthiest nations in the world.

Source 2

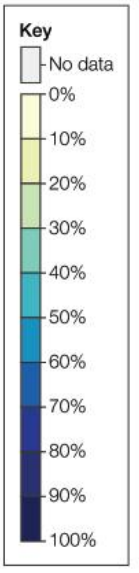
Percentage of people living in urban areas

Global patterns of urbanisation, 1995

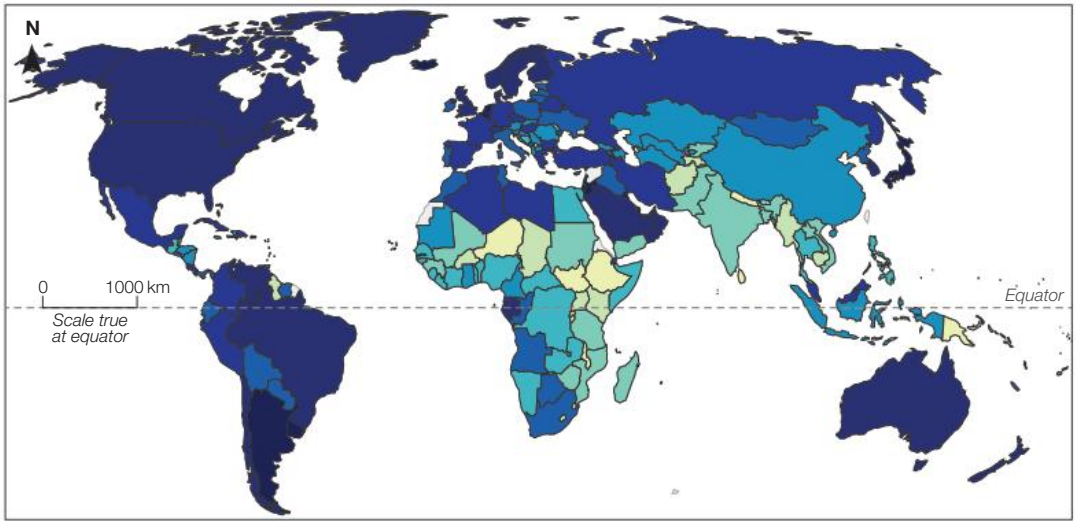


Source 3

Global patterns of urbanisation, 1995



Global patterns of urbanisation, 2015



Source 4

Global patterns of urbanisation, 2015, this map shows that many countries, particularly in Asia and Africa, are becoming more urbanised.

Source: Our World in Data (CC BY 4.0)

Learning ladder G3.5

Show what you know

1 Source 2: Identify which regions have the largest predicted increase in urbanisation from 1990 to 2050.

2 Consider what you know about each of the world regions you identified in Question 1. Why would these places have such large changes over time?

3 Create a comparison table highlighting the pros and cons of living in an urban or rural environment (consider the SHEEPT factors).

Spatial characteristics

Step 1: I can identify and describe spatial characteristics

4 Source 2: Using PQE, describe the pattern of change in urban areas between 1990 and 2014.

Step 2: I can explain spatial characteristics

5 Explain why people from rural areas are drawn to cities.

Step 3: I can explain processes influencing places

6 Source 4: Using SHEEPT, explain why we have seen increased urbanisation occur over time on a global scale. You may wish to reference specific regions to quantify your response.

Step 4: I can predict changes in the characteristics of places

7 Source 2: Where is the greatest and least urbanisation set to occur between 2014 and 2050? Suggest reasons to support the trend identified.

PQE, page 138
SHEEPT, page 140

HOW TO

Why are people pulled to cities?

Over the last 150 years, there has been a clear pattern of **migration** from rural to urban areas. This urbanisation of the world's population is driven by people seeking better jobs and services.

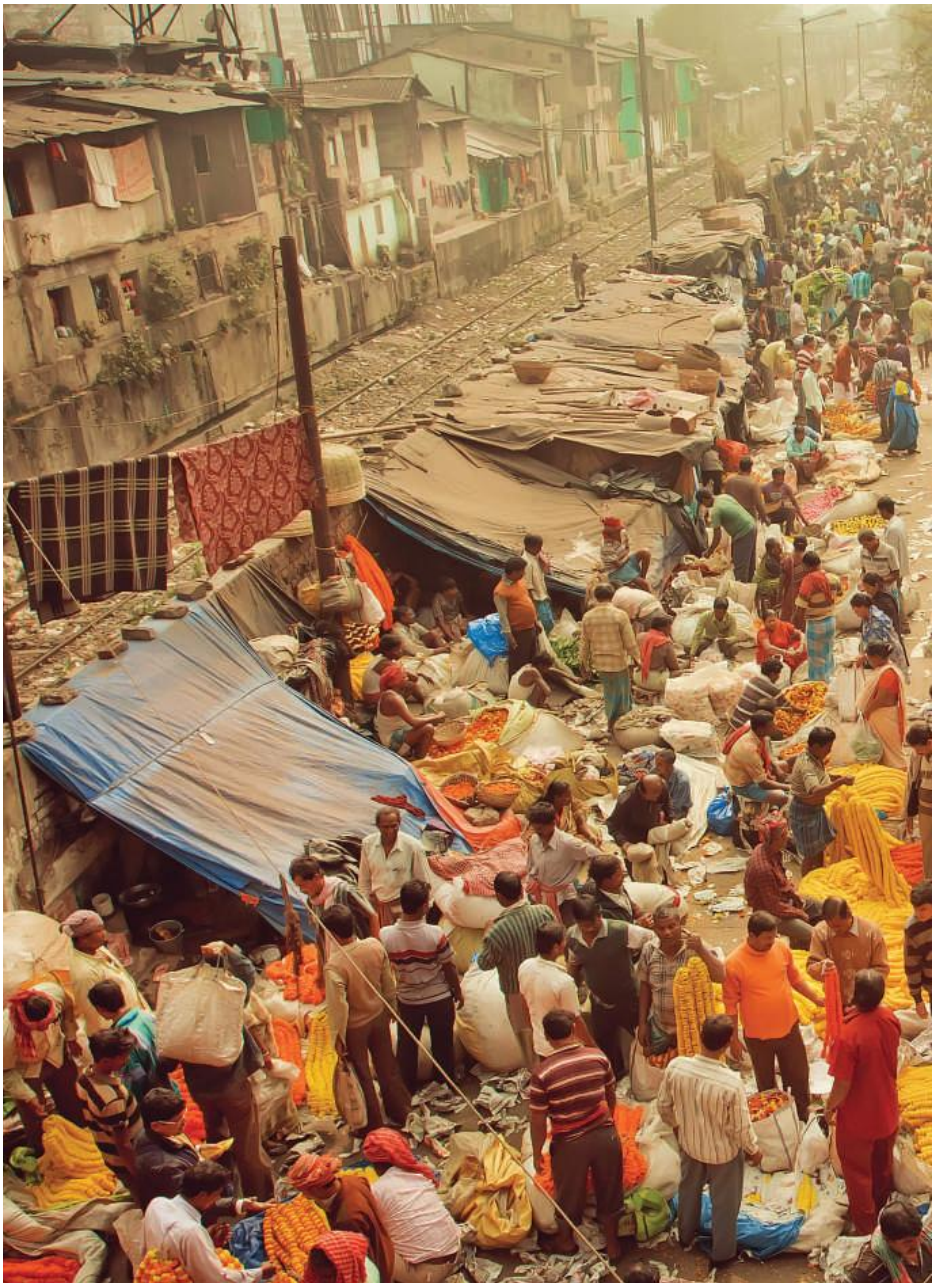
Push and pull factors

There are a number of factors pushing people from rural areas and pulling people towards urban areas. Push factors can include droughts, floods, famine, lack of employment opportunities, and even **civil war**. Many young people today also see farming the land as a difficult, unglamorous and unrewarding career.

Pull factors encouraging people to move to cities include the chance of better jobs with higher salaries; greater access to education, goods and services; and a higher living standard.

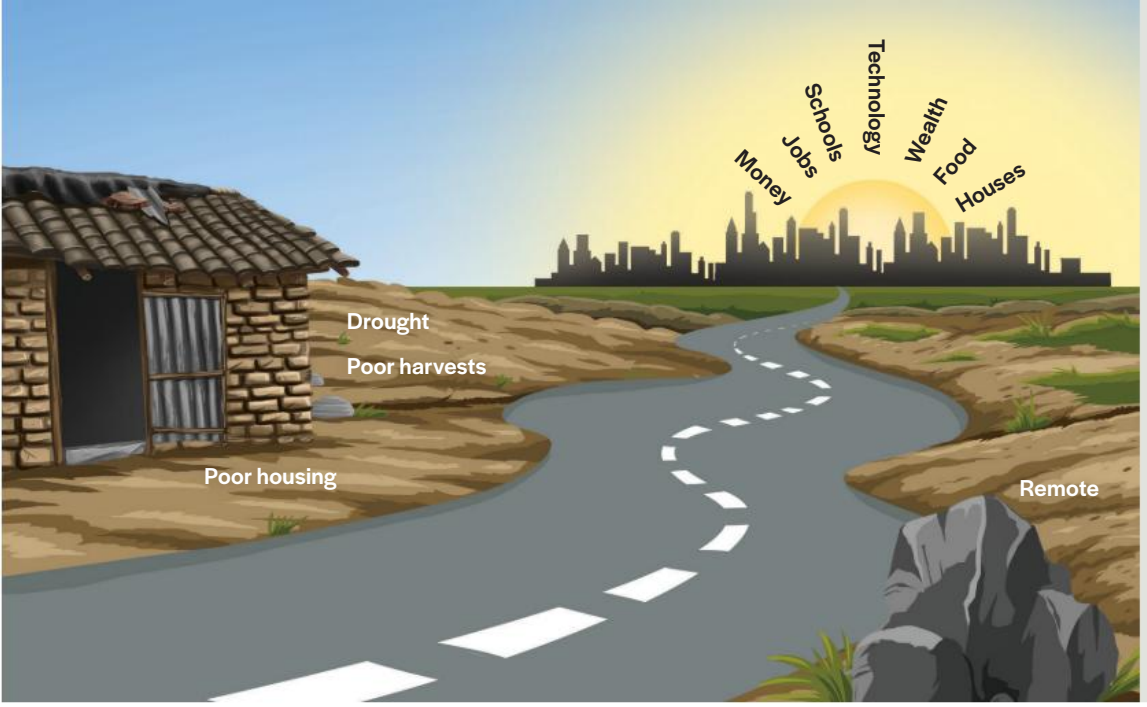
Urbanisation

The push factors from rural areas and the pull factors to urban areas have seen millions of people migrate to cities in a process called **urbanisation**. Rapid urbanisation can lead to issues such as overcrowding and shortages in jobs, housing and services. Many new arrivals in cities in **less economically developed countries (LEDC)** cities are forced to live in tightly packed **slum** communities.



Source 1

The crowded streets of Kolkata in India. Rural to urban migration in India has seen cities like Kolkata become some of the most densely populated areas in the world. More than 24 000 people live in each square kilometre of the city. One-third of the city's population lives in slums and shantytowns, which house up to 28 000 people per square kilometre.



Source 2

The perceived advantages of urban life versus some perceived disadvantages of rural life

Push factors

- Few services
- Lack of job opportunities
- Poor transport links
- Natural disasters
- Wars
- Shortage of food

Pull factors

- Access to services
- Better job opportunities
- More entertainment facilities
- Better transport links
- Improved living conditions
- Hope for a better way of life
- Family links

Learning ladder G3.6

Show what you know

1 Outline the difference between push and pull factors.

2 Source 1: What issues are faced by rural migrants when they arrive in cities such as Kolkata?

Interconnections

Step 1: I can identify and describe interconnections

3 Source 2: Describe the interconnection between migration and better job opportunities.

Step 2: I can explain interconnections

4 How might push and pull factors differ for people living in more or less economically developed countries?

Step 3: I can identify and explain the implications of interconnections

5 What are the implications of large numbers of rural migrants arriving in large cities in less economically developed countries?

Step 4: I can evaluate the implications of significant interconnections

6 Write a short narrative of a person who is wanting to move from a rural to an urban area in an LEDC. In the narrative, highlight the push and pull factors for the place they want to leave and the location they want to move to and how the change of *place* will impact them physically, emotionally and financially.

What is a megacity?

Urbanisation is leading to the development of more megacities – cities with 10 million people or more. Most megacities are found in Asia, where fast-growing cities are causing headaches for planners.

The world's largest cities

Although measurements of urban boundaries can vary, in 2011, the United Nations stated there were 22 **megacities** in the world. By 2025, the UN predicts there will be 35. One in eight people lived in one of the world's 33 megacities in 2018.

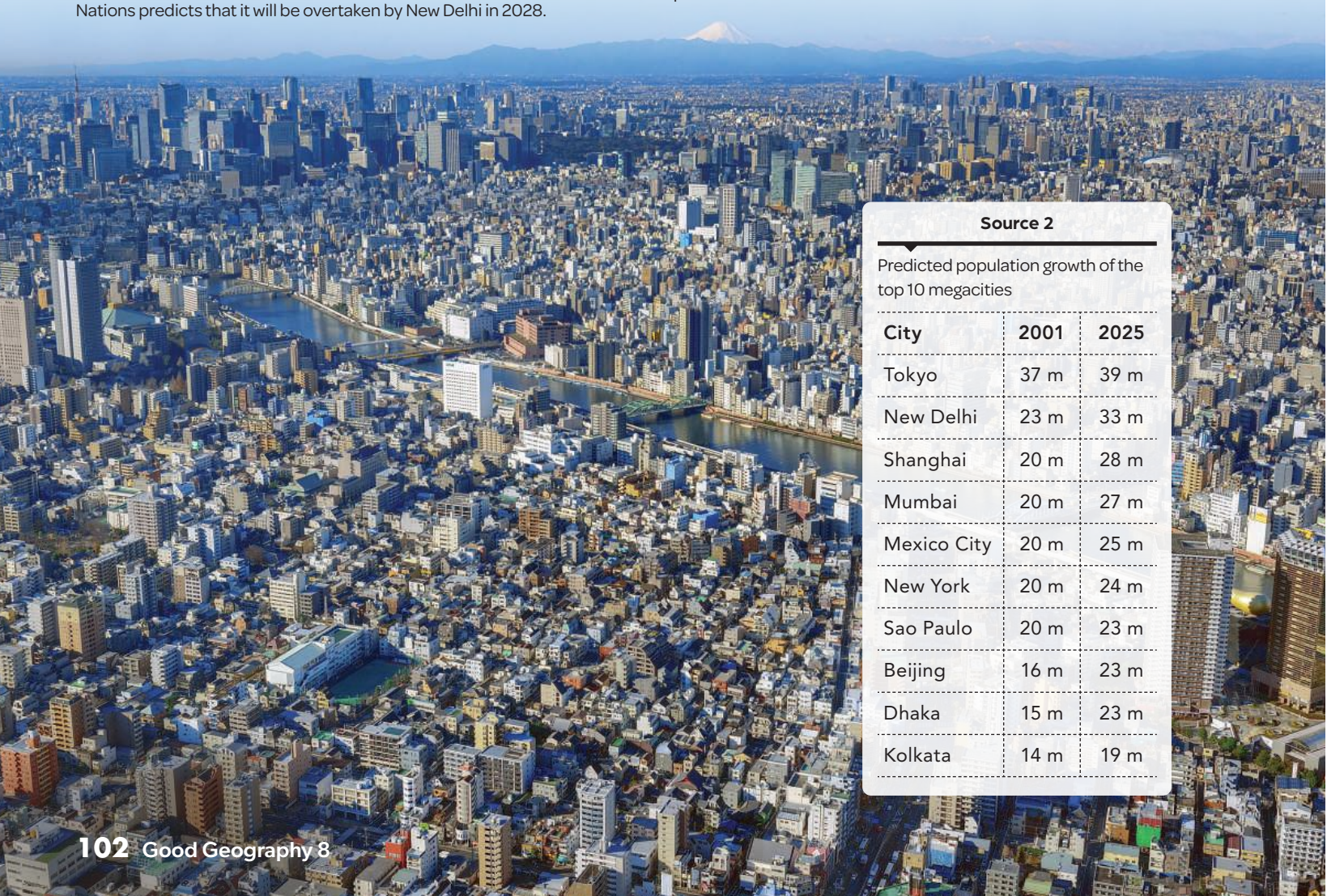
Source 1

Tokyo is currently the world's largest megacity but the United Nations predicts that it will be overtaken by New Delhi in 2028.

Where are megacities?

Nearly 60 per cent of all megacities are found in Asia, including the five largest. Australia is the only continent with no megacities.

Tokyo in Japan is the world's largest city, with 37 million people – if it were a country, the city would be the 31st largest in the world. It is growing slowly and will only increase its population by 5 per cent from 2001 to 2025.

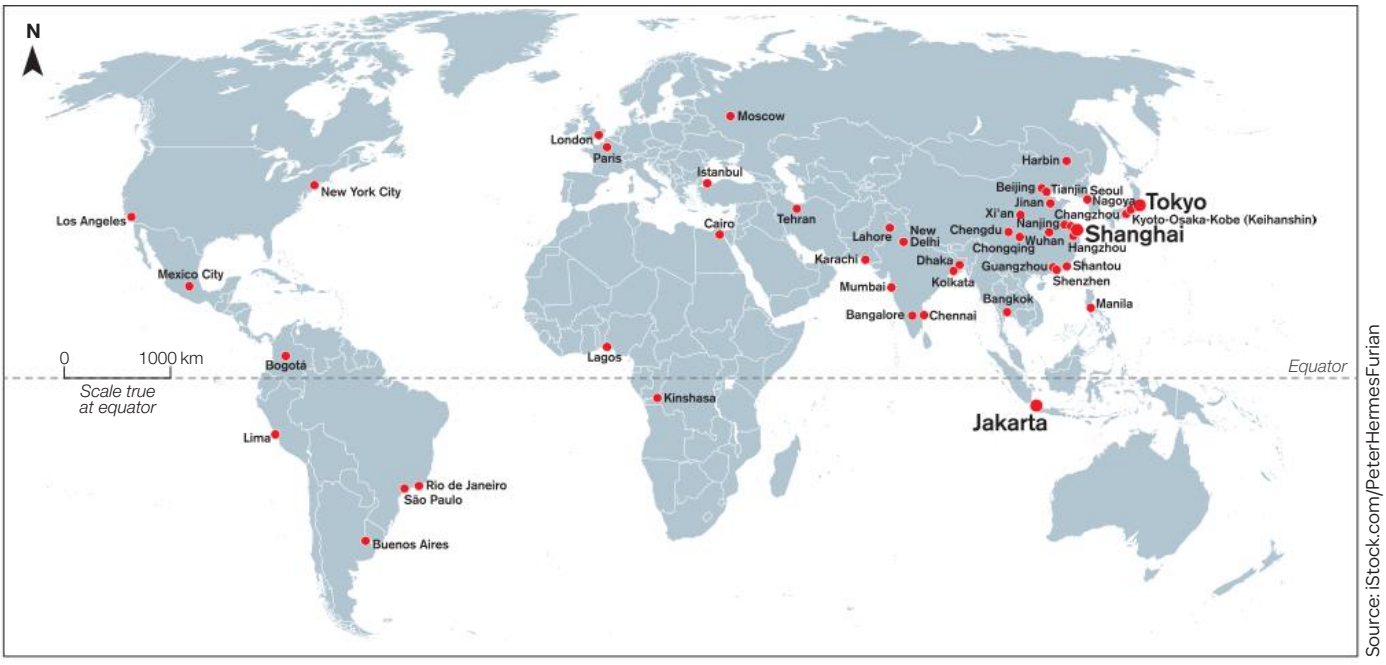


Source 2

Predicted population growth of the top 10 megacities

City	2001	2025
Tokyo	37 m	39 m
New Delhi	23 m	33 m
Shanghai	20 m	28 m
Mumbai	20 m	27 m
Mexico City	20 m	25 m
New York	20 m	24 m
Sao Paulo	20 m	23 m
Beijing	16 m	23 m
Dhaka	15 m	23 m
Kolkata	14 m	19 m

Megacities of the world



Source: iStock.com/PeterHermesFurian

Source 2

Megacities of the world – including three of the biggest: Tokyo, Shanghai and Jakarta.

Challenges for New Delhi

New Delhi in India is the world's second largest city, with 29 million people. It is growing rapidly and based on current growth will increase to 33 million people by 2025. New Delhi is projected to become the world's largest city in 2028, as more migrants move to the city.

It is difficult to keep pace with the massive increase in population in New Delhi. Each year its population grows by 700 000. Since 2005, the government has managed to build 43 000 new homes for the poor, but in the same time the population rose by more than 10 million people. Many new rural to urban migrants are forced to live in slums without clean drinking water or toilets.

Source 3

A crowded street in Dhaka, the world's most densely populated megacity

Learning ladder G3.7

Show what you know

1 Define the term 'megacity' using real-life examples and quantitative data.

Analyse data

Step 1: I can use geographic terminology to interpret data

2 Source 4: Define the term 'density' with reference to the population of Dhaka.

Step 2: I can describe patterns and trends

3 Rank the megacities in Source 2, according to the largest population increases from 2001 to 2025.

Step 3: I can explain the reasons behind a trend or spatial distribution

4 Based on your rankings from Question 3, draw some conclusions about the location, growth rate and change in megacities over time.

Step 4: I can analyse relationships between different data

5 Compare Source 1 to a satellite image of Melbourne. How do they differ in scale and geographic characteristics?

What are the effects of urbanisation?

As the pace of urbanisation increases, urban areas in less economically developed countries (LEDCs) often struggle to cope with large numbers of additional people, leading to problems supplying housing and basic services to the new arrivals.

Positive effects of urbanisation

Businesses and industries are mainly located in **urban** areas to take advantage of the availability of a workforce, power, water, communication, transport and other services.

People are attracted to cities for the employment opportunities and the convenience of access to education, health, entertainment and social services. Urban areas also enjoy more advanced communication and transportation networks than rural areas.

Negative effects of urbanisation

Urbanisation brings with it a number of problems, particularly if it occurs over a short period of time, as rapid change means the government does not have the opportunity to plan for large numbers of extra people.

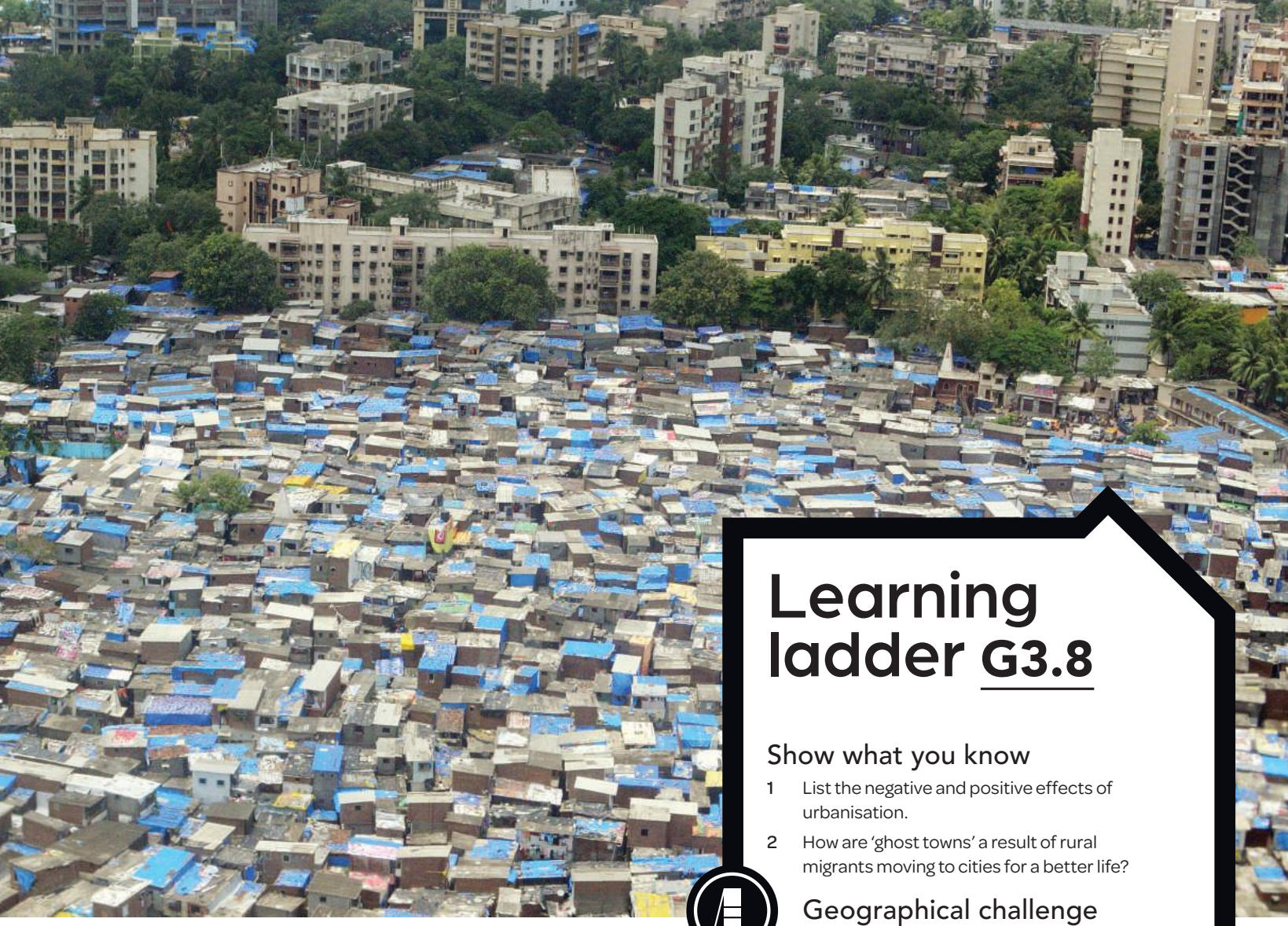
Rapid urbanisation can create problems with meeting the cost of living and providing adequate housing as well as difficulties around obtaining access to clean water and proper sanitation.

Housing problems

The increased population in cities often leads to a shortage of space for housing, particularly affordable housing. In many of the cities of LEDCs, large numbers of **rural to urban migrants** live in **slums**. Conversely, when rural communities are abandoned, this can create the problem of ghost towns.

Source 1

As people leave rural areas in great numbers, they can leave ghost towns behind, such as Novo-Tishevoye on the outskirts of Moscow, Russia. Ghost towns are now found all around Moscow, as the rural inhabitants look for greater economic opportunities in cities.



Source 2

Mumbai is one of the world's megacities, with a population of 20 million people. More than half of the population is made up of migrants who come to the city in search of a better life. Around 42 per cent of Mumbai's population lives in slums. Half of Mumbai's slums are not connected to water, sewerage or electricity.

Cost of living

Incomes in urban areas are usually higher than in rural areas, but the cost of living in urban areas is much higher. As more migrants arrive in cities, there is more competition for jobs, which can make it even harder for people to live.

Water and sanitation problems

Water shortages can occur in cities with rapidly increasing populations. Sewerage facilities also struggle to cope and human waste increases the pollution of local rivers, lakes and seas. Poor water quality leads to increases in diseases such as typhoid and diarrhoea.

Learning ladder G3.8

Show what you know

1 List the negative and positive effects of urbanisation.

2 How are 'ghost towns' a result of rural migrants moving to cities for a better life?

Geographical challenge

Step 1: I can identify responses to a geographical challenge

3 Refer to Source 2. Identify why people would move to an urbanised area, only to live in a slum environment.

Step 2: I can compare responses to a geographical challenge

4 Imagine you are an immigrant who has recently moved into a new urbanised region. List the challenges you may face given the existing high-density population in that place.

Step 3: I can compare strategies for a geographical challenge

5 Brainstorm the stakeholders involved in planning urban areas. Take on the role of one of these stakeholders and write a short narrative explaining the three most important features to improve local wellbeing in an urban environment.

Step 4: I can evaluate alternatives for a geographical challenge

6 As a class, discuss the following statement: 'Given high levels of population density in urban environments, we need to revitalise rural places rather than expand megacities'.

How is urbanisation changing Indonesia?

Just 50 years ago, Indonesia was mainly a rural society, with just 17 per cent of Indonesians living in urban areas. Rapid urbanisation has seen massive growth in Indonesian cities, which has led to problems such as housing shortages, congestion and pollution.

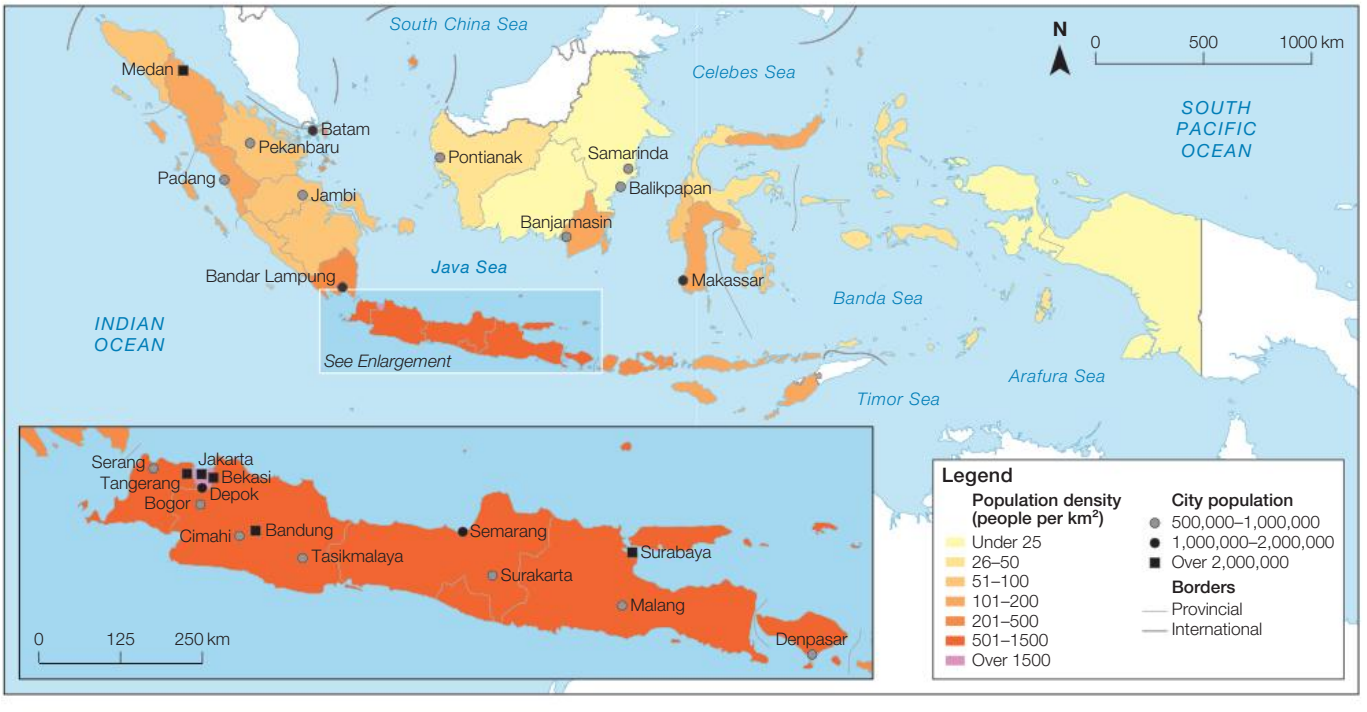
Indonesia's growing cities

Indonesia is the world's fourth most populous country and 60 per cent of Indonesia's 268 million people live on the island of Java. Indonesia has quickly transformed from a rural society to an urban one. In 2018, 55 per cent of all Indonesians lived in urban areas.

In 1950, only Indonesia's capital city, Jakarta (see pages 108–09), had more than one million people. Today Indonesia is home to 11 cities with populations over one million as well as two megacities – Jakarta and Surabaya.

Indonesia's city populations are growing at a rate of 4.1 per cent per year – faster than any other Asian country. By 2025, Indonesia is estimated to have 68 per cent of its population living in cities.

Population density in Indonesia



Source 1

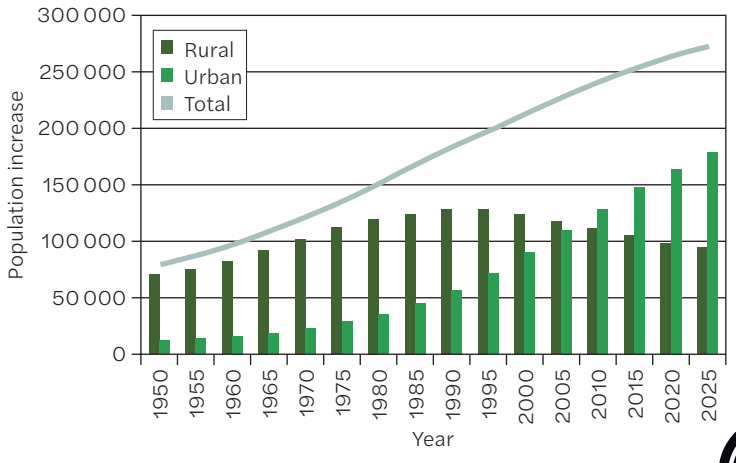
Population density in Indonesia

Source: Matilda Education Australia, Statistics Indonesia

Source 2

A heavily polluted river runs through a Jakarta slum. Twenty-six per cent of all Indonesians live in slums.

Urbanisation of Indonesia



Source 3

Urbanisation of Indonesia

Source: Indonesia Statistical Bureau (BPS) Proyeksi Penduduk, 2005

Rural to urban migration in Indonesia

The Indonesian government has placed few restrictions on rural to urban migration. Most internal migration in Indonesia consists of the rural poor moving into cities for better wages, education and healthcare access. Most rural migrants are young people seeking stable jobs and a more modern life in Indonesia's large cities.

Almost 80 per cent of Indonesia's 140 million farmers are now aged 45 or older. Officials worry that future food supplies might be affected as the rural population continues to age.

The infrastructure in Indonesia's cities is not keeping pace with growing populations. New arrivals to cities will often live in poor housing in city slums, battle traffic jams and suffer high levels of air and water pollution.

Learning ladder G3.9

Show what you know

1 Source 1: What is the population density of Jakarta?

2 Source 1: Imagine you are a rural migrant from near Pekanbaru who moves to Jakarta. Describe the different environments in terms of density. How might the rural migrant feel when they arrive to live in Jakarta?

3 Source 3: Quantify the change in rural and urban dwellers in Indonesia between 1950 and 2020.

4 What problems is urbanisation causing for Indonesia's rural areas?

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

5 Look at the comparative bar chart in Source 3. When did there become more urban dwellers than rural dwellers in Indonesia?

Step 2: I can recognise and use different types of data

6 Is Source 2 a primary or secondary source of data? Justify your response.

Step 3: I can choose, collect and display appropriate data

7 Imagine you are a geographer conducting a social study in Indonesia. What primary data would be useful to understand the growing population density and urbanisation?

Step 4: I can use data to support claims

8 What does Source 2 indicate about living conditions in this Jakarta slum? Why do people choose to live here?

What is the impact of Jakarta's population growth?

Jakarta is the capital city of Indonesia, and a megacity with a population of more than 30 million. The sprawling city has expanded into all usable space.

Large areas of Jakarta sit below sea level, so flooding is a constant problem. The rapid pace of Jakarta's urbanisation has introduced multiple problems such as a lack of affordable housing, traffic congestion, and health problems associated with polluted air and water. Poor rural migrants are forced to settle in slums along riverbanks. The new arrivals cannot access health, education and other public services because they don't have official Jakarta identity cards.

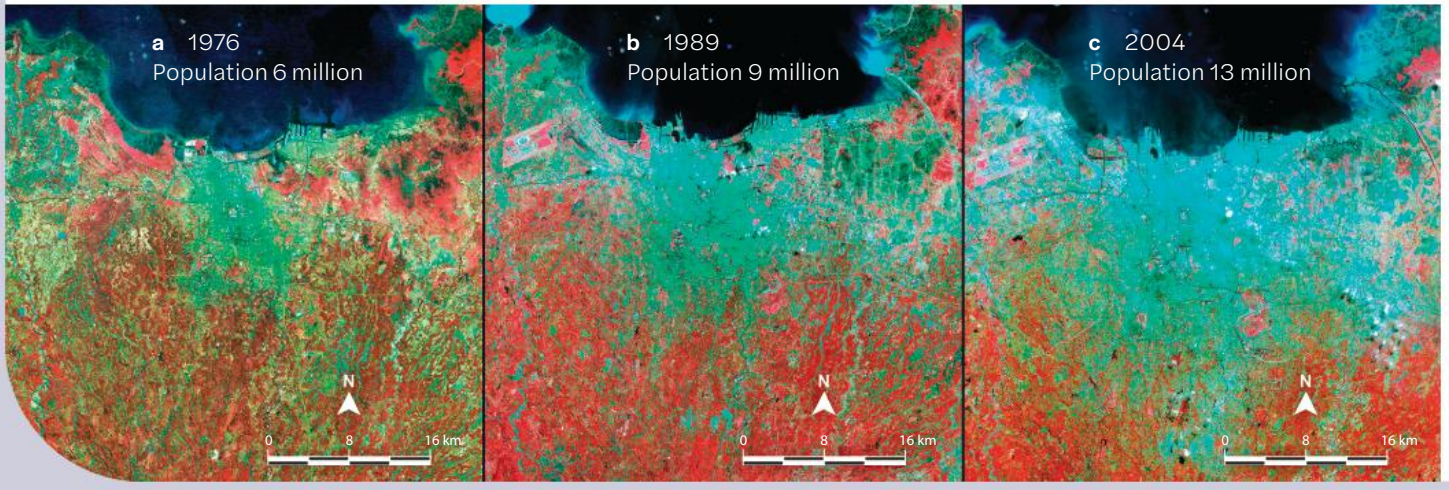
Life in the slums

Five million people live in slums in Jakarta, and 60 per cent of the population suffers breathing problems from the polluted air. Ninety-six per cent of Jakarta's river water is severely polluted and dangerous to drink. The government provides some clean water, but it can be too expensive for the poor to afford, so they use river water.

Source: Science Photo Library

Source 1

Satellite images of Jakarta from 1976 to 2004. The green area shows the expanding urban area, while the red shows areas of vegetation such as farms and forest.



Source 2

Each day, 15 million motorbikes and 5 million cars try to use Jakarta's gridlocked roads. Just 18 per cent of commuters use public transport.

Source 3

Children play and collect materials in a downtown slum in Jakarta.

Learning ladder G3.10

Show what you know

1 Describe the relative and absolute location of Jakarta.

2 Why is Jakarta a megacity?

3 Outline the positive and negative impacts of urbanisation in Jakarta.

Geographical challenge

Step 1: I can identify responses to a geographical challenge

4 Source 3: Why are slums an example of a response from rural migrants to survive in their new urban environment?

Step 2: I can compare responses to a geographical challenge

5 Source 1: Use the satellite images to describe the growth of Jakarta between 1976 and 2004.

6 Source 1: The northern part of the city on Jakarta Bay is constantly flooding and below sea level. What response can the government make to protect the city from flooding?

Step 3: I can compare strategies for a geographical challenge

7 Source 2: Suggest different strategies to help ease Jakarta's traffic problem.

Step 4: I can evaluate alternatives for a geographical challenge

8 In 2019 the Indonesian government announced it would move the administrative centre of Indonesia from overcrowded Jakarta to a new site on the island of Borneo. Evaluate the merits and problems associated with this plan.

HOW TO

Satellite images, page 149

How is China changing?

The Chinese government controls where its people work through the *hukou* system. Workers must obtain a permit to work outside their home village.

Internal migration in China

The largest **internal migration** in human history is occurring in China. Its people are migrating from inland **rural** villages to work in large coastal manufacturing cities such as Dongguan in Guangdong province. In 2015, there were 278 million migrant workers in China – 36 per cent of China's total workforce.

Under China's *hukou* system everyone must be registered in their home town or village to be able to access education, housing and welfare. Individuals are categorised as either rural or **urban**, and they are required to work within their designated area. China allowed people to move to other provinces to work in 1984 to provide the cheap labour required for China's booming manufacturing industries.

Under the *hukou* system, people moving from rural areas to cities must buy a work permit. Most permits only allow for temporary work of up to 12 months. There is great demand for these permits and they can be difficult to obtain.

Different living standards

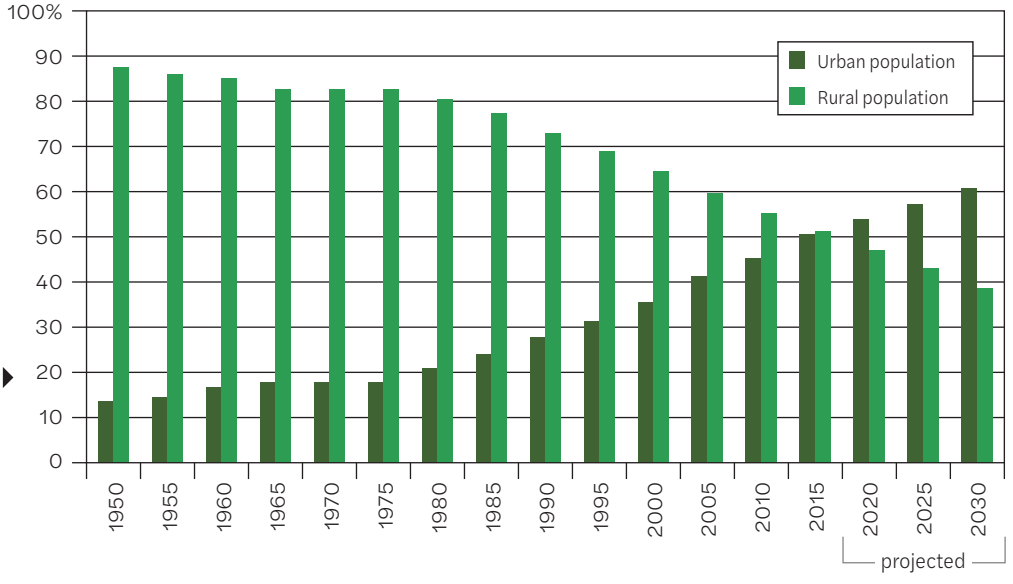
Differences in living standards are so great between rural and urban areas in China that **migration** is a very attractive prospect for rural workers. Rural incomes are less than 40 per cent of urban ones. Farmers move to the large industrial centres where they can earn far more money than they could growing crops or tending cattle.

Problems for migrant families

Migrant workers often leave their children behind so they can work in urban areas to earn a better income. Good quality housing is difficult to find and rents are expensive. Migrants also struggle to get access to services such as education and health.

Migrants can spend many years away from their family. More than one-third of children in rural China are left behind in their villages under the care of their grandparents or other relatives.

China's urban population growth, 1950–2030



Source 1

China's urban population growth 1950–2030

Source 2

China's population 23 May 2019. Guangdong province, in the south, accounts for 27 per cent of China's temporary migrants.

People's Republic of China Population

Source: iStock/Rainer Lesniewski

Source 3

Smartphone assembly line in Dongguan, Guangdong province. China produces 60 per cent of all mobile phones and about half of them are manufactured in Guangdong province.

Learning ladder G3.11

Economics and business

Step 1: I can recognise economic information

1 Consider your existing knowledge of China's trade and economy. Along with some research, create a list of China's main imports and exports.

Step 2: I can describe economic issues

2 Comment on how internal migration in China can affect the local economy of a *place*.

Step 3: I can explain issues in economics

3 Discuss the statement: 'The *hukou* system is a successful method of ensuring that all Chinese people gain equal access to resources and employment opportunities.'

Step 4: I can integrate different economic topics

4 Relative scarcity is where we do not have enough resources to satisfy all our wants and needs. Discuss the concept of relative scarcity in terms of China's population growth and associated resource demand.

Step 5: I can evaluate alternatives

5 Suggest an alternative system allowing Chinese residents to move freely but not overpopulate and compete for resources in megacities.

How is migration changing Australia?

Half of Australia's population growth comes from immigration. Permanent migrants come to Australia to join family members, or as skilled workers or **refugees**. Most migrants come from China, India or New Zealand, and settle in Sydney or Melbourne.

Growth through migration

Australia's population is growing much faster than most countries in the world. Between 2006 and 2016 Australia's population grew by 1.7 per cent each year compared to a growth rate of just 0.3 per cent in other **MEDCs**. Half of the growth in Australia's population came through **international migration**.

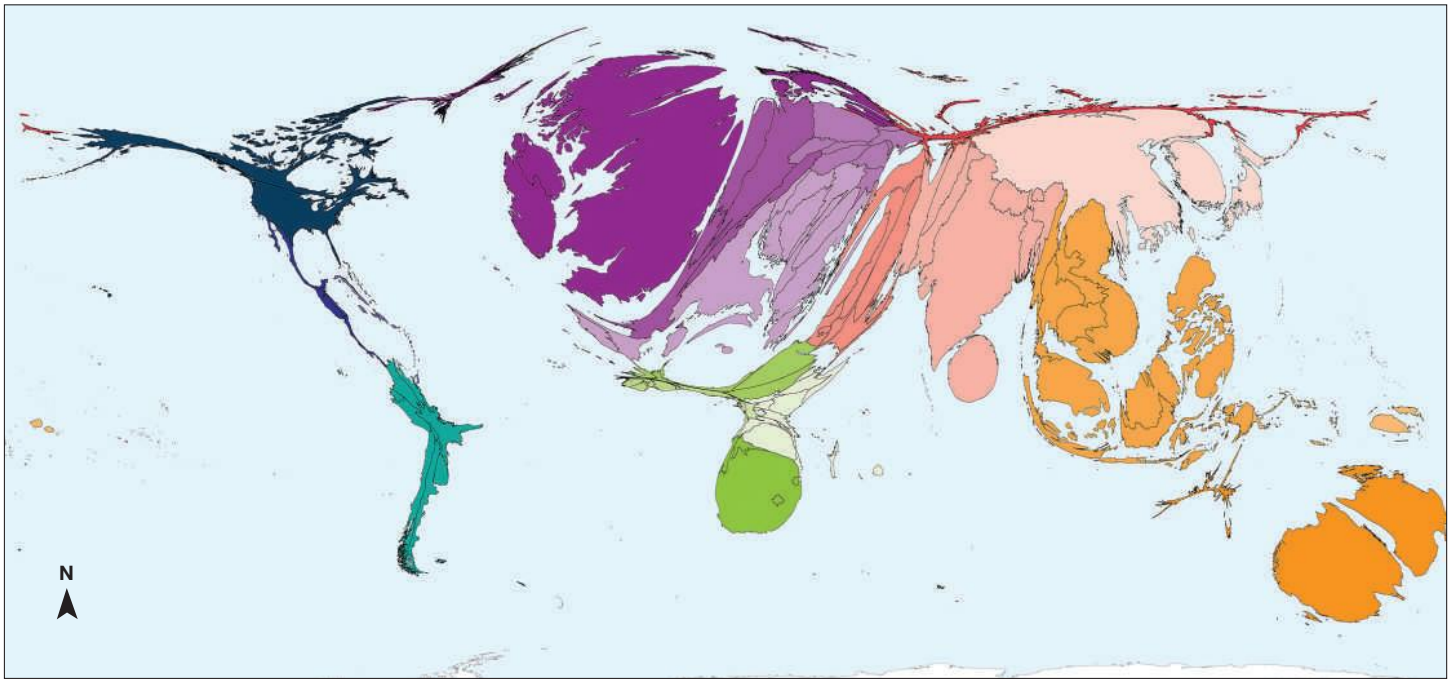
In 2018, immigration into Australia was around 330 000 people. Most immigrants come to Australia as students or **skilled workers**. The Department of Immigration publishes lists of skilled occupations Australia requires and people from overseas can apply for them.

Following the end of World War II, most Australian migrants came from the United Kingdom and Europe. Today, the fastest growing populations of migrants come from China, India and New Zealand. Around half of new arrivals to Australia settle in Sydney or Melbourne, which can add to urbanisation problems such as a lack of housing, traffic congestion and greater demands on infrastructure such as schools and hospitals.

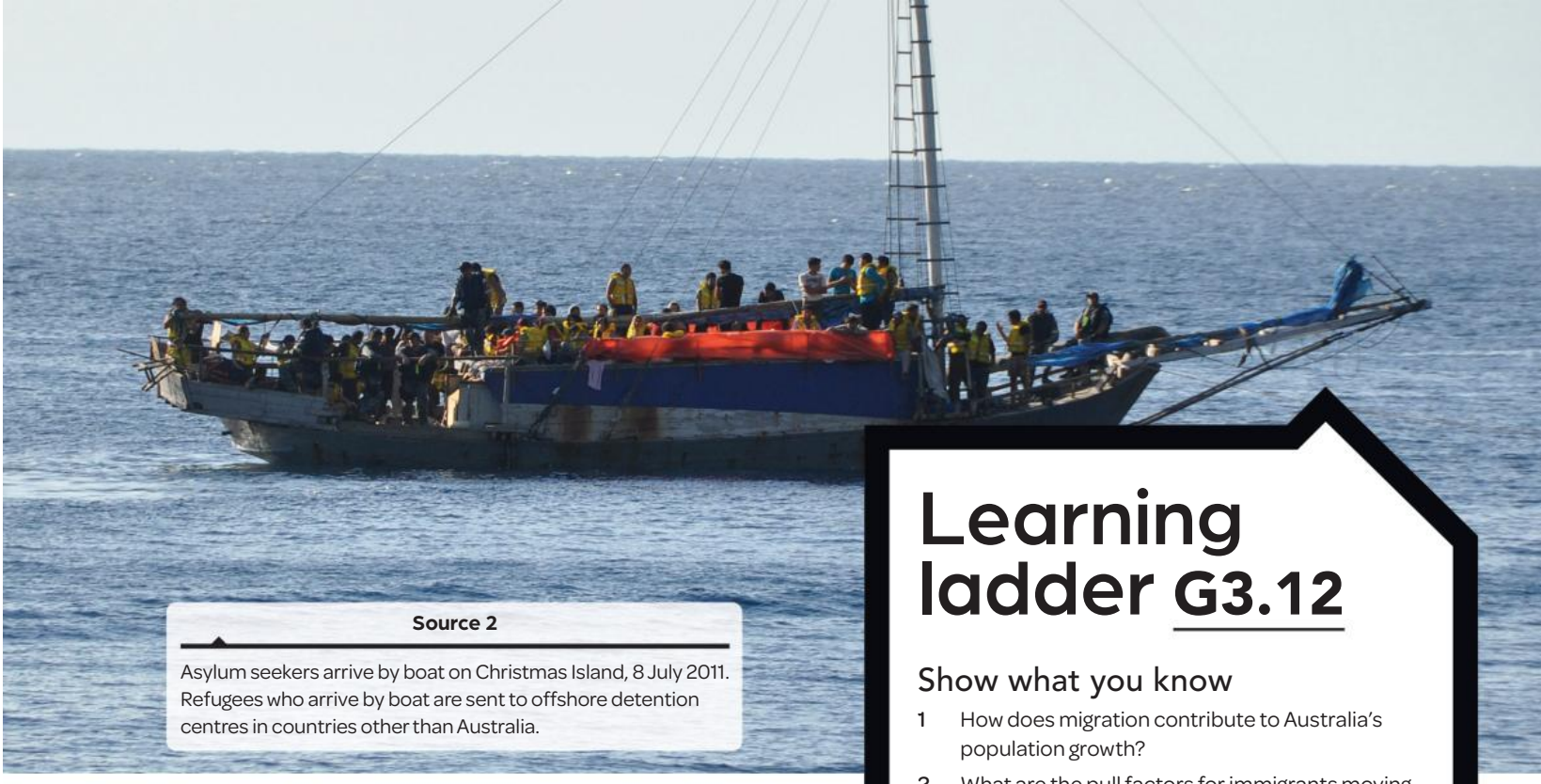
Source 1

Migration to Australia, 1990–2017. The relative thickness or thinness of a country represents the proportion of migrants from that country.

Migration to Australia, 1990–2017



Source: Worldmapper, map no. 367



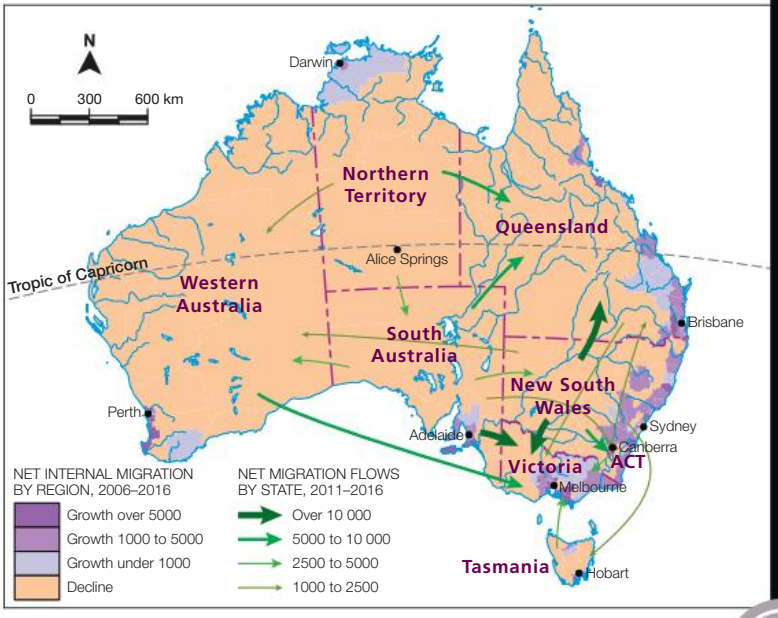
Source 2

Asylum seekers arrive by boat on Christmas Island, 8 July 2011. Refugees who arrive by boat are sent to offshore detention centres in countries other than Australia.

Internal migration

Internal migration within Australia is important to relocate skills and labour resources from one part of the country to another. During Australia's mining boom from 2005 to 2015, large numbers of internal migrants moved to mining centres in Western Australia and Queensland. Between 2006 and 2016, Queensland and Victoria were the only states to record net gains of internal migrants, with other states recording net losses.

Internal migration in Australia 2011–2016



Source 3

Internal migration in Australia 2011–2016

Source: Matilda Education Australia

Learning ladder G3.12

Show what you know

1 How does migration contribute to Australia's population growth?

2 What are the pull factors for immigrants moving to Australia?

3 Source 3: Comment on how people migrate within Australia.

Collect, record and display data

Step 1: I can collect, record and display data in simple forms

4 Source 1: Use an atlas to help identify five countries where most Australian migrants come from. Remember that the shapes in Source 1 are distorted like blown-up balloons.

Step 2: I can recognise and use different types of data

5 Conduct a survey of your class or broader school community and identify the percentage of Australian-born students compared with those born internationally. Display the data you collect in a table or graph.

Step 3: I can choose, collect and display appropriate data

6 Were you surprised by the results of the survey conducted in Question 5? Explain whether you think a survey is a relevant method of primary data collection to investigate the rate of migration. How could the government use surveys to collect national scale data on population change?

Step 4: I can use data to support claims

7 Source 2: What dangers do refugees face when trying to come to Australia by boat? Research the government policies that apply to people who arrive by boat. Then research the case against these policies.

HOW TO Surveys, page 132

How can the movement of people turn deadly?

The consequences of living in a highly connected world turned deadly in 2020 when the COVID-19 pandemic swept around the world, killing hundreds of thousands of people. Many governments moved quickly to shut down borders and restrict people's movement internationally and domestically.

The COVID-19 virus has spread to more than 180 countries since it was first identified in Wuhan, China, at the end of 2019. By January 20 in 2020, the virus had spread from China to neighbouring countries of Japan, South Korea and Thailand. In just two months, it spread to nearly every country in the world.

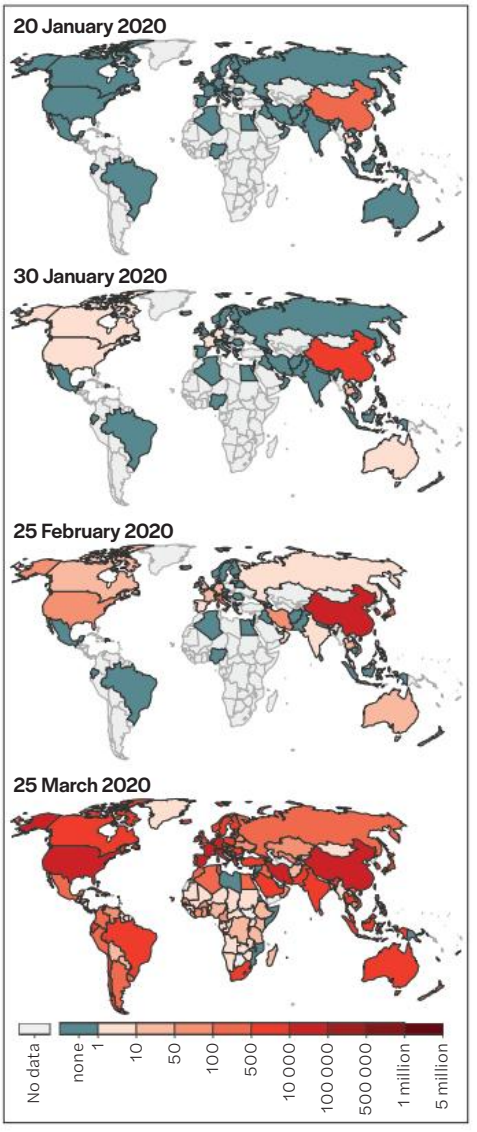
The World Health Organization (WHO) declared the coronavirus COVID-19 a **pandemic** on 11 March 2020. A pandemic is a disease that spreads in multiple countries around the world at the same time, usually affecting a large number of people.

As the pandemic spread, different **epicentres** for the disease sprung up. As the rise in new COVID-19 cases slowed in China, outbreaks in other countries soared. By mid-March 2020, Europe became the epicentre for the spread of the virus, with Italy and Spain recording tens of thousands of cases and thousands of deaths. At the end of March 2020, the US had become the new epicentre with more than 100 000 cases recorded, most of these in New York. By mid June 2020, the USA had 2.1 million confirmed cases and almost 120 000 deaths. Brazil was another epicentre, with 920 000 total infections and 45 000 deaths.

Slowing the spread of coronavirus

The COVID-19 pandemic sparked a public health emergency around the world, with severe restrictions placed on the movement of people. By 20 March 2020, only Australian citizens could travel to Australia. All travellers arriving in Australia were required to undertake a mandatory 14-day quarantine period at a hotel. The Australian government also restricted all cruise ships from entering Australia, following a number of outbreaks on cruise ships.

Total confirmed COVID-19 cases, Jan–Mar 2020



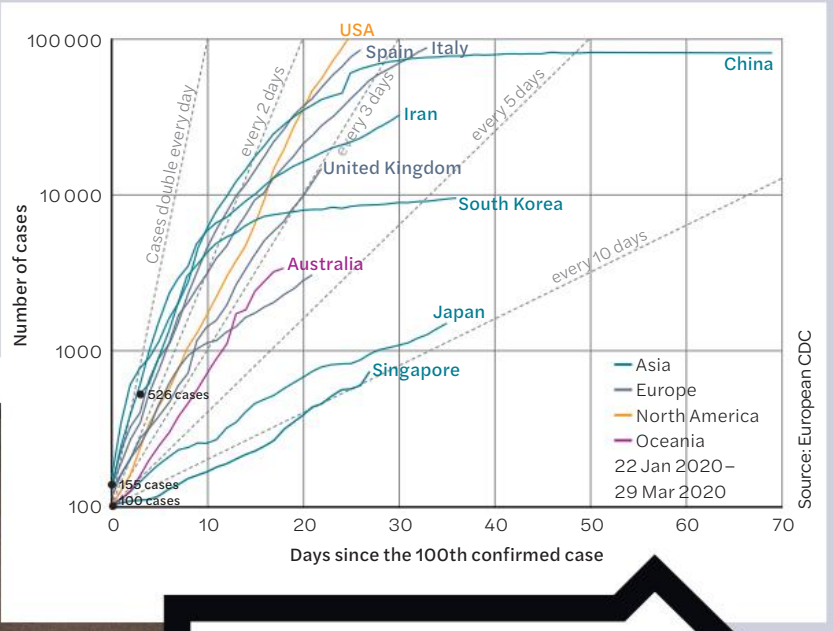
Source 1

Global spread of COVID-19 virus in the early months of 2020

Source 2

Confirmed cases of COVID-19 for select countries and regions on 29 March 2020. This chart uses a logarithmic scale to compare the widely ranging values. The scale is nonlinear, so numbers 100 and 1000 and 10 000 are equally spaced. The graph also begins on the first day total confirmed deaths reached 0.1 per million for each country to make the growth of the pandemic easier to compare.

Total confirmed COVID-19 cases: how rapidly were they increasing?



Source 3

Officials at Vietnam's Van Don airport check details of returning citizens from Wuhan on 10 February 2020. Wuhan was the province in China where the outbreak of the COVID-19 pandemic originated.

Learning Ladder G3.13

Show what you know

1 What is an epicentre during a pandemic?

2 Source 1: Use PQE to describe the global spread of coronavirus.

Geographical challenge

Step 1: I can identify responses to a geographical challenge

3 Source 3: What is happening in this scene and why?

Step 2: I can compare responses to a geographical challenge

4 Source 2: Which country do you think was most successful at controlling the spread of the virus by the end of March 2020 and why?

Step 3: I can compare strategies for a geographical challenge

5 Australia restricted travel from coronavirus hotspots before eventually closing its border to international visitors. What other action could it have taken?

Step 4: I can evaluate alternatives for a geographical challenge

6 Research the action taken by the Australian government to restrict the movement of people within Australia. Why did the government take this action?

HOW TO

PQE, page 138

How do we plan for urbanisation?

Governments need to plan far into the future to successfully manage Australia's growing urban populations. The government wants to ensure we have enough affordable housing and that infrastructure for health, education, transport and communications keeps pace with changes. Strategies to redevelop underused areas and to encourage people to move to regional areas also helps authorities deal with rapid urbanisation.

Planning for the future

Australia is one of the world's most highly urbanised countries, with nearly four in every 10 people living in Sydney or Melbourne. Half of all jobs growth is concentrated within two kilometres of these two cities. In 2018, Australia's population reached 25 million.

By 2050 it is projected that Australia will have a population of 36 million people. Nearly all of the growth will come from **international migration** and more than 70 per cent of this growth is likely to be in the major cities. Melbourne and Sydney will each have populations of eight million and Brisbane and Perth will each have populations of more than four million.

Future Melbourne

Melbourne hit the five million population mark in 2018 and on average is growing by 1800 people a week because of a high level of international migration. Melbourne's population growth is the equivalent of adding the population of Darwin to Melbourne each year.

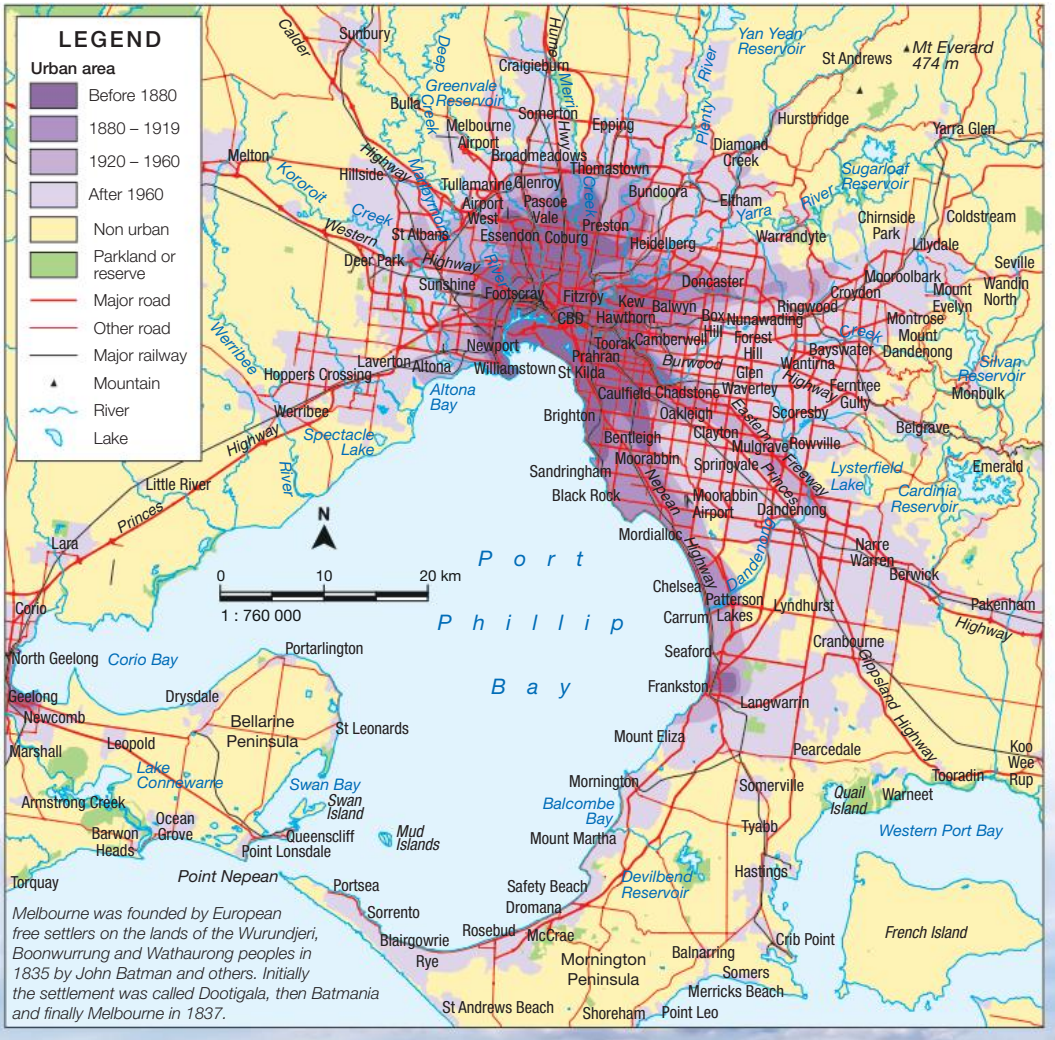
Based on current growth rates, Melbourne will overtake Sydney as Australia's largest city in 2026. Careful planning needs to be undertaken to ensure that population growth is **sustainable**. Already planners are suggesting that by 2050 Melbourne will need:

- 1.6 million new homes
- 8 new hospitals
- 67 new secondary schools
- 222 new kindergartens.

Source 1

At 2500 square kilometres, Melbourne is one of the world's largest cities by area.

Melbourne's urban growth, from before 1880 to after 1960



Source: Matilda Education Australia

Source 2

Melbourne's urban growth, from before 1880 to after 1960

When planning for Melbourne's future growth, governments consider three key trends:

1. **Suburbanisation** – where land on the city's outer edge is made available for housing. The suburbs grow outwards as new houses and services are constructed. Expanding cities through suburbanisation replaces natural environments or land previously used for farming.
2. **Counterurbanisation** – when people move from an **urban** area to a **rural** or coastal area to escape urban problems such as expensive housing, traffic and pollution. The **decentralisation** of the population helps take pressure off the urban centre.
3. **Reurbanisation** – when people move back into inner city areas that have been improved through **urban renewal** to attract people who enjoy the advantages of being near the city centre.

Source 3

Melbourne's growth corridors

Source: Matilda Education Australia

Suburbanisation in Melbourne

At 2500 square kilometres, Melbourne is already one of the world's largest cities by area – and it is still expanding. More than 50 suburbs have been added to Melbourne since 2005.

In 2017, the Victorian government attempted to provide more affordable housing by rezoning areas on the edge of the city to create 100 000 new housing blocks and 17 new suburbs in Melbourne's key growth corridors:

Corridor	Houses	Population
West	170 000	480 000
North	117 000	330 000
South east	103 000	110 000
Sunbury	32 000	90 000

The major advantage of suburbanisation as a strategy is that affordable housing estates can be quickly established and designed.

The disadvantages of suburbanisation are that open land is sacrificed to build new urban areas and expensive new **infrastructure** has to be built. With most jobs available near the city centre, many residents in outer suburbs face long commutes to get to work.

Counterurbanisation in Melbourne

A total of 77 per cent of Victoria's population lives in Melbourne and about 90 per cent of population growth occurs in the state capital. Apart from capital cities, coastal communities are the fastest growing regions in Australia. Victoria's Surf Coast, centred on Torquay, is also rapidly growing in size and population. The region is 90 minutes from Melbourne, enabling residents to commute for work.

Source 4

Sky Park takes up 25 per cent of the new Melbourne Quarter commercial, retail and residential project and is an example of a reurbanisation project. The park provides city residents and workers with new green space. Designers have also added high-speed public wi-fi, power outlets and USB charge points to the park.

Governments encourage population growth and job creation in areas outside major cities in a process known as **decentralisation** or counterurbanisation. Businesses are given financial benefits to move from capital cities to regional centres. Governments also establish or relocate departments and authorities to towns and cities outside of Melbourne.

Reurbanisation in Melbourne

As Melbourne continues to grow, many areas are being reimagined as 21st-century suburbs. Through the process of urban renewal, old industrial areas and docks are being redeveloped to provide new homes, offices and entertainment spaces.

The advantage of redeveloping existing areas is that infrastructure such as power, water and transport already exists. Higher density developments of townhouses and apartment blocks allow more people to be housed in established suburbs. New green spaces can also be created for entertainment and leisure. Melbourne's Docklands and new Fisherman's Bend project (see pages 120–21) are examples of urban renewal projects.

Learning ladder G3.14

Show what you know

1 Source 1: In which direction did Melbourne expand after 1960?

2 Source 3: In which direction will Melbourne grow in the future? Why do you think it is expanding in these areas?

Geographical challenge

Step 1: I can identify responses to a geographical challenge

3 What are the three key trends that governments need to consider when planning for Melbourne's future growth?

Step 2: I can compare responses to a geographical challenge

4 What new infrastructure will Melbourne need by 2050 to support its growing population? How is reurbanisation one solution to providing infrastructure more quickly and cheaply?

Step 3: I can compare strategies for a geographical challenge

5 Source 4: Look at the photograph of Sky Park. Compare this to the usual land use in high-rise buildings in the centre of cities. How does it differ and what benefits might this bring to the community?

Step 4: I can evaluate alternatives for a geographical challenge

6 What is counterurbanisation and what benefits does it offer? Why might counterurbanisation be difficult to introduce?

G3.15

thinking locally

How is Fisherman's Bend changing?

The industrial region of Fisherman's Bend once hosted large car and aircraft factories, but is now the site of Australia's largest urban renewal project. The 4.8 square kilometres of underused land just a few kilometres from Melbourne's central business district (CBD) will be transformed to cater to the city's growth.

The Victorian government has rezoned the former industrial land to provide inner-city homes for more than 80 000 people by 2050. The employment precinct is projected to generate jobs for up to 40 000 people.

Fisherman's Bend will be served by train and tram links to the city and linked by a new bridge across the Yarra River. Other important **infrastructure** to be built includes a new secondary school, primary schools, child care centres, parks and shopping centres to support the growing population.

A key focus of the Fisherman's Bend **urban renewal** is on creating a **sustainable** environment. One quarter of the project area will be dedicated to open space, which will be no more than a 200-metre walk away for any resident or worker. The planners project that 80 per cent of transport movements will be made by walking, cycling and public transport. Waste water will be recycled for use in homes and businesses to reduce the impact on the environment.

Fisherman's Bend urban renewal area

Source: Victorian Department of Jobs, Precincts and Regions.

Source 1

Fisherman's Bend urban renewal area

Source 2

You can see the current Fisherman's Bend district in the foreground of this oblique aerial photograph with the nearby Melbourne CBD in the background.

Learning ladder G3.15

Show what you know

1 Outline three key changes that have occurred in Fisherman's Bend over time.

2 What is urban renewal and how will it affect Fisherman's Bend?

3 Source 2: Why do you think the developers of the project used this oblique aerial photograph to attract investors to the project?

Analyse data

Step 1: I can use geographic terminology to interpret data

4 Source 2: Locate the Fisherman's Bend Urban Renewal Area using the map in Source 1 and describe what the area looks like today.

Step 2: I can describe patterns and trends

5 Source 1: What are the four residential precincts in the Fisherman's Bend Urban Renewal Area?

Step 3: I can explain the reasons behind a trend or spatial distribution

6 Give three examples of features of the Fisherman's Bend urban renewal project that will lead to a more sustainable environment.

Step 4: I can analyse relationships between different data

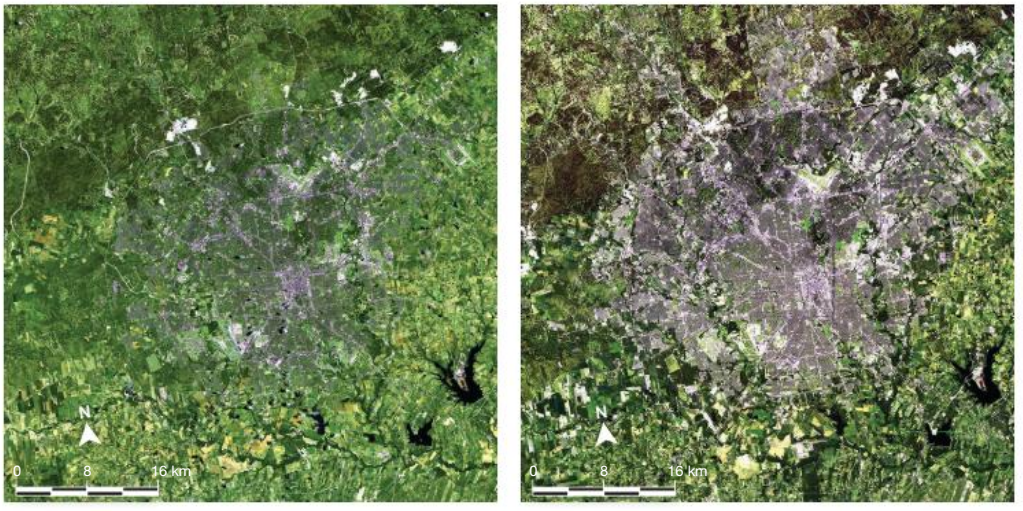
7 Use Sources 1 and 2 to discuss the claims that the Lorimer residential precinct will offer the most expensive apartments.

Masterclass

Learning Ladder

Work at the level that is right for you or level-up for a learning challenge!

Satellite images of San Antonio, Texas, 1991 (left) and 2010 (right)

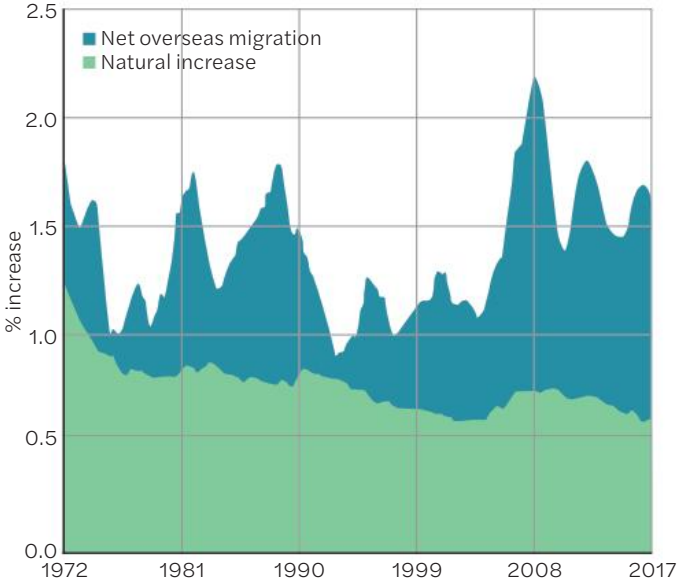


Source 1

Satellite images of the city of San Antonio in Texas, USA

Changes in Australia's population growth

Year-ended contribution

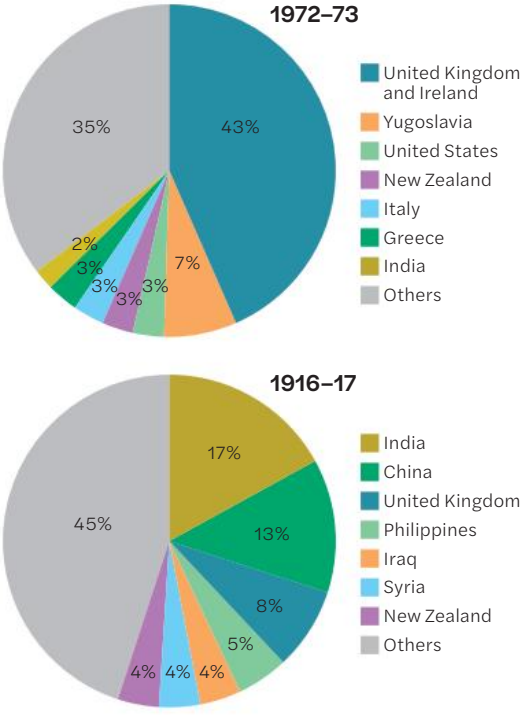


* Total population is the sum of natural increase and net overseas migration

Source 3

Australia's population growth

Change in migrant origins in Australia over time



Source 4

Immigration to Australia by country

Source 2
A downtown slum in Jakarta.

Step 1

a **I can identify and describe spatial characteristics**

Describe the region your school is in. Why would they build a school in that *place*?

b **I can identify and describe interconnections**

How are rural migrants interconnected with job and education opportunities in cities?

c **I can identify responses to a geographical challenge**

Refer to Source 1. Describe how urban sprawl has changed this place over time.

d **I can collect, record and display data in simple forms**

Refer to Source 1. Identify what the different colours represent on these satellite images.

e **I can use geographic terminology to interpret data**

Source 1: In which directions has this city grown the most?

Step 2

a **I can explain spatial characteristics**

Source 1: Discuss how land use has changed in this region over time.

b **I can explain interconnections**

Source 2: Why are rural migrants interconnected with slums in many less economically developed countries?

c **I can compare responses to a geographical challenge**

Source 2: How do rural migrants with little money survive in large cities?

d **I can recognise and use different types of data**

A census is a survey conducted within a state or country to collect data on population dynamics. Suggest other ways governments could collect data on human population movement and changes.

e **I can describe patterns and trends**

Refer to Source 3. Using PQE (page 138), describe how net international migration has changed over time in Australia.

Step 3

a **I can explain processes influencing places**

Refer to Source 2. What push and pull factors do you think might have operated to attract these rural people to the city?

b **I can identify and explain the implications of interconnections**

What are the implications of large numbers of rural migrants arriving in large cities in less economically developed countries?

c **I can compare strategies for a geographical challenge**

Suggest different strategies to help ease traffic jams in large cities.

d **I can choose, collect and display appropriate data**

Refer to Source 4. Using two blank world maps, illustrate the origins of migrants that moved to Australia between 1972–73 and 2016–17. What advantage do the maps have over the pie charts in Source 4?

e **I can explain the reasons behind a trend or spatial distribution**

Refer to Source 4. Explain why the countries of origin of migrants to Australia have changed over time. Hint: You may need to discuss or research world events, MEDC, LEDC or geographical locations to help you answer this question.

Masterclass

Step 4

a **I can predict changes in the characteristics of places**

Megacities are going to become more common in the future. Discuss with reference to the concepts of environment, place and sustainability.

b **I can evaluate the implications of significant interconnections**

Increased migration is *interconnected* with urban sprawl. Do you agree with this statement? Justify your response with examples.

c **I can evaluate alternatives for a geographical challenge**

Refer to Source 4. What changes to towns, infrastructure and facilities would town planners need to consider in 2016–17 with the changing origins of migrants to Australia?

d **I can use data to support claims**

Referring to Source 4, discuss the conclusion that 'Australia's migrant profile has changed dramatically in the last 50 years'. Use evidence to support or refute this statement.

e **I can analyse relationships between different data**

Is there a relationship between Sources 3 and 4? Explain.

Step 5

a **I can analyse the impact of change on places**

Source 2: Why would this slum be located next to a river and what are the health dangers associated with this location?

b **I can explore spatial association and interconnections**

What type of land has been replaced by urban land use in Source 1? Identify an area on the satellite image where urban expansion will be more difficult and explain why.

c **I can plan action to tackle a geographic challenge**

Source 1: This is an example of suburbanisation to cater for a growing population. What other strategies could planners use to cater for an increasing number of people?

d **I can evaluate data**

Referring to Source 1, discuss whether you think satellite images are an appropriate method of displaying urban sprawl and change over time in a location. What other image or method may be more successful?

e **I can draw conclusions by analysing collected data**

Source 3: What is the trend for natural population increase in Australia? What is the trend for international migration to Australia? How can the government increase the rate of growth of the Australian population?

Capstone

How can I understand changing nations?

In this chapter, you have learnt a lot about changing nations. Now you can put your new knowledge and understanding together for the capstone project to show what you know and what you think.

In the world of building, a capstone is an element that finishes off an arch or tops off a building or wall. That is what the capstone project will offer you, too: a chance to top off and bring together your learning in interesting, critical and creative ways. You can complete this project yourself, or your teacher can make it a class task or a homework task.

mea.digital/GHV8_G3

Scan this QR code to find the capstone project online.

G4

Fieldwork

WHAT IS THE PURPOSE OF FIELDWORK?

page 126

fieldwork task 1

page 128

HOW DO WE **DEGRADE** OUR LOCAL **ENVIRONMENT?**

fieldwork task 2

page 130

WHAT ARE THE CHALLENGES OF PLANNING FOR **URBANISATION** IN YOUR PLACE?

fieldwork

page 132

HOW DO **GEOGRAPHERS** USE SURVEYS?

What is the purpose of fieldwork?

Fieldwork is an important part of Geography. We can use fieldwork to discover new things, learn about patterns and relationships, and explore the world around us. In the last three chapters you have been exploring landforms and landscapes, as well as how places change over time. Now you are going to conduct your own research in the local area to answer a research question and write a mini-fieldwork report.

Quantitative and qualitative data

When conducting fieldwork, we collect data. The two main kinds of data are **qualitative** and **quantitative**. Quantitative data tends to be recorded with numbers. Examples of quantitative data would be the height of a building, the number of people in a population and the flow rate of a river. Qualitative data tends to be more observational. Examples of qualitative data include descriptions of a place, a field sketch or photos you may take. Both aspects of data collection are important and you should try to collect both quantitative and qualitative data in your fieldwork.

Research question

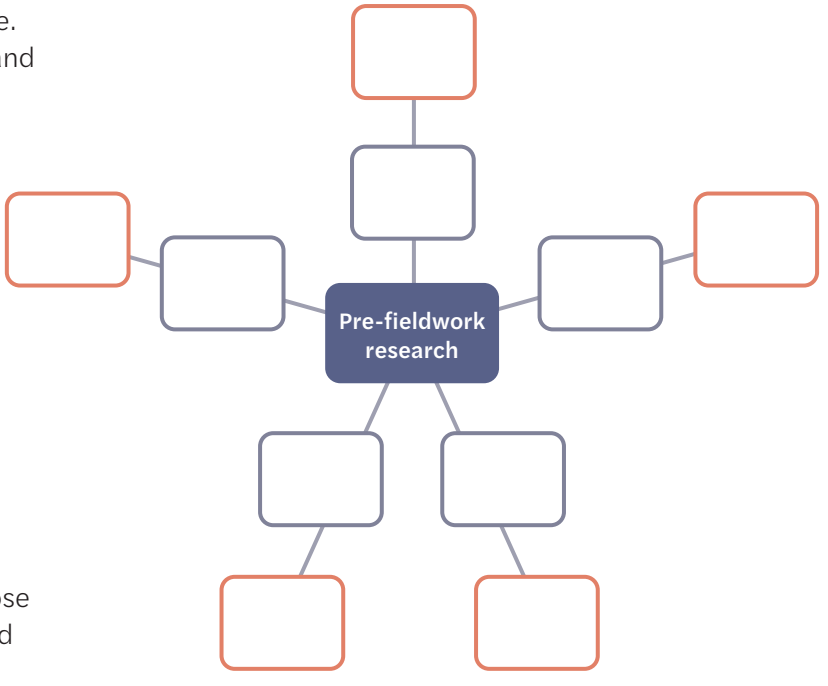
A **research question** is an overarching big idea that we want to investigate. Once you develop a research question, you will need to write a hypothesis. A **hypothesis** is an 'educated guess' about what the answer to the research question may be.

Choosing a fieldwork location

Choosing the right location to conduct your fieldwork is very important. The place you choose will depend upon your question, hypothesis and topic. Ensure you decide the location of your fieldwork before you begin to conduct research and collect data.

Pre-fieldwork research

Before you complete your fieldwork, you need to do some background research so you have an understanding of the field site, its characteristics and other relevant information. Using the internet to start your research is usually the most obvious and accessible source of information, keeping in mind that you must only use reliable websites.



Source 1

Pre-fieldwork research diagram

Government, educational and other approved sites are most useful and usually contain reliable data. Blogs, social media and other public-based sites may be **biased** and not provide you with correct evidence. Books, handouts and other paper resources are also useful when conducting research. Using a template similar to the Source 1, you can record some pre-fieldwork research in the blue bubbles and note the source of your information to make a bibliography in the red bubbles.

Collecting data

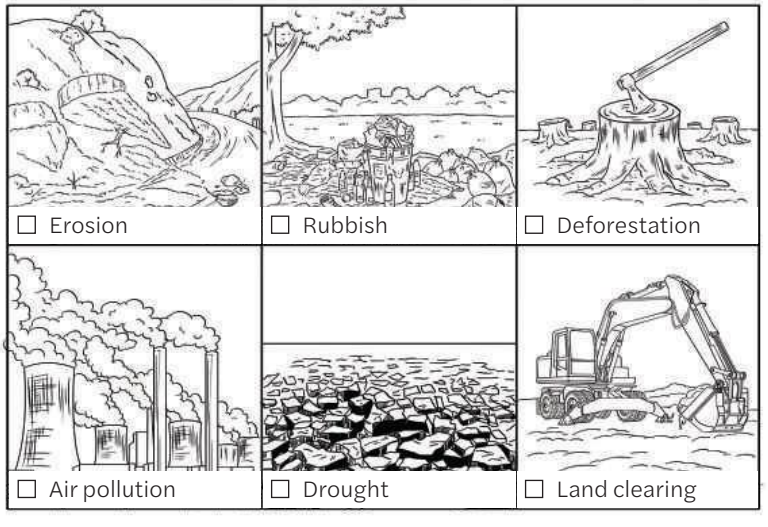
As a class, you need to develop a list of **primary** and **secondary methods**. Primary methods are things that you will do in the field to find evidence to answer your research question and prove or disprove your hypothesis. Secondary methods are ways you can collect data back in the classroom to help you answer the question; for example, researching websites, books or other publications.

Some primary methods are:

- observations
- photographs
- note taking
- surveys (questionnaire or observational)
- field sketches.

Source 2

An observational checklist



Using the table below as a template, as a class discuss some that may be successful in helping you answer your research question

Primary method	This data will help me answer my research question by …	Secondary method	This data will help me answer my research question by …

Preparation for fieldwork

Before you go out in the field, it is important to create a checklist of things you need to bring and data you need to collect. Add to the checklist below according to what you plan to do in the field.

- Clipboard
- Paper (blank and lined)
- Pencils
- Camera
- Survey questions

Be prepared for any weather – sometimes doing fieldwork in the rain gives you a good insight into how water is acting to degrade your local area.

Source 3

Water-resistant notepads can help with wet-weather fieldwork.

Analysing data

Once you have been in the field and collected data using your primary and secondary methods, you need to communicate your findings. You can communicate your research via a report or display it as a visual poster or presentation. When you communicate findings, you need to ensure you highlight any patterns, *interconnections* or significant data that allows you to answer the research question and prove or disprove the hypothesis.

Analysing your results

Once you have collected and presented the data, you need to analyse your results. Use the information in the next section to help you complete your fieldwork analysis.

G4.2

fieldwork task 1

How do we degrade our local *environment*?

Understanding how landforms and landscapes form and change is vital so we know how to sustainably manage our environment for the future. Unfortunately, much of the change we make to the environment tends to affect it negatively or is unsustainable. This means we are not ensuring that the landscapes we enjoy now will be the same for future generations. Fieldwork is an important step in furthering our understanding of the environment and also in helping develop successful and sustainable management strategies.

Research location

Our research question for this fieldwork investigation states that we are considering environmental degradation on the local *scale*. Thus, you first need to decide what location you will work with for this fieldwork task. You may choose a part of your school, a local park or even the street where you live. Once you have decided on a location, you are ready to undertake some pre-fieldwork research.

Source 1

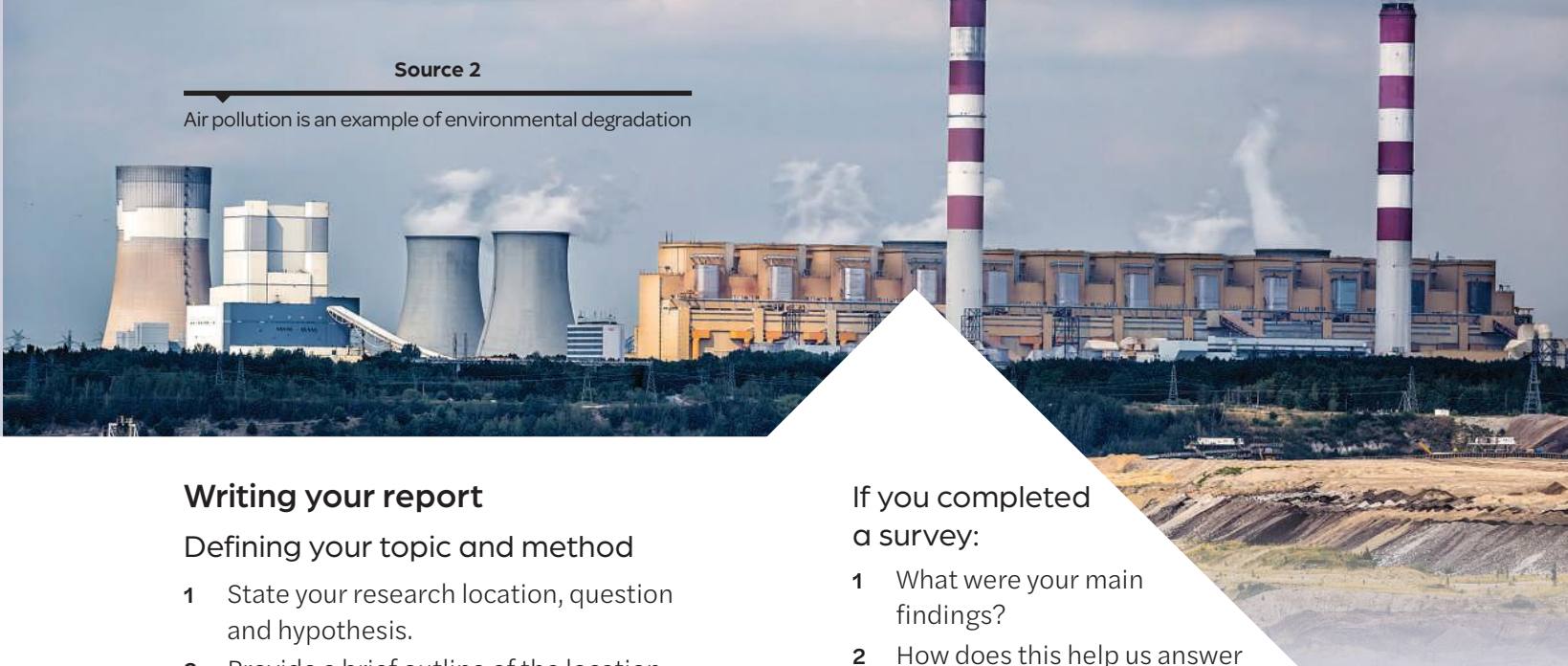
Locate an area that has clear erosion or has been impacted negatively by humans

Research question

Research question: What can we do on a local scale to reduce environmental degradation?

Hypothesis

Even small actions can increase the sustainability of our environment.



Source 2

Air pollution is an example of environmental degradation

Writing your report

Defining your topic and method

1. State your research location, question and hypothesis.
2. Provide a brief outline of the location, characteristics and history of your local region, using around four or five sentences.
3. State two primary fieldwork techniques you used to complete this fieldwork and describe how they were helpful in answering the research question.
4. State two secondary resources you used in the lead-up to the fieldwork and describe how they were helpful in answering the research question.

Presenting your data

As discussed previously, present the data you collected using tables, graphs, sketches with annotations, photographs and so on.

Analysing the data

Answer your research question: What can we do on a local scale to reduce environmental degradation?

Consider:

- What evidence of *environmental* degradation was present in this location?
- Was there large-*scale* or small-*scale* degradation?
- What was causing the *environmental* degradation?
- What evidence of this was there?
- Will the *environmental* degradation at this location have long-term impacts?
- How could the *environmental* degradation be managed sustainably?
- Could small changes to our behaviour reduce the impacts of the *environmental* degradation at this *place*?

If you completed a survey:

1. What were your main findings?
2. How does this help us answer the research question?
3. Were you surprised by these results? Why or why not?

Drawing conclusions

1. Summarise the key findings of your research.
2. Was the hypothesis correct (supported)? Why or why not?
3. Record five key pieces of evidence (such as data, photos, sketches or surveys) that support your answer above.

Evaluating your research

1. Which methods were the most successful for collecting data to answer the research question? Why?
2. Which methods were the least successful for collecting data to answer the research question? Why?
3. What changes to your fieldwork approach would you suggest to future Year 8 students completing the same task?

Handing in your report

Once you have completed all the steps of your fieldwork report, you are ready to collate your work into a folio and take action! What small changes will you make to ensure that your local environment is used sustainably for the future?

G4.3

fieldwork task 2

What are the challenges of planning for urbanisation in your *place*?

As our national population continues to grow, our communities are under pressure to change in order to meet the new demands and needs of their residents. This creates challenges for urban planners, who need to ensure that these areas have access to enough resources and sustainable living practices for both the locals and the new arrivals. Whether you live in a rural or an urban community, it is likely that your *place* has changed significantly over time. Fieldwork is an excellent way to review, monitor and predict change and challenges your area has faced or may face is the future.

Research location

As a class, you will need to determine a field site that has undergone some change over time. This change should be linked with an increase in population and may be obvious, such as a growth in urbanisation, or may be more subtle, such as a reduction in the size of a standard housing block or increased resources or infrastructure such as the appearance of major shopping centres or freeways.

Source 1

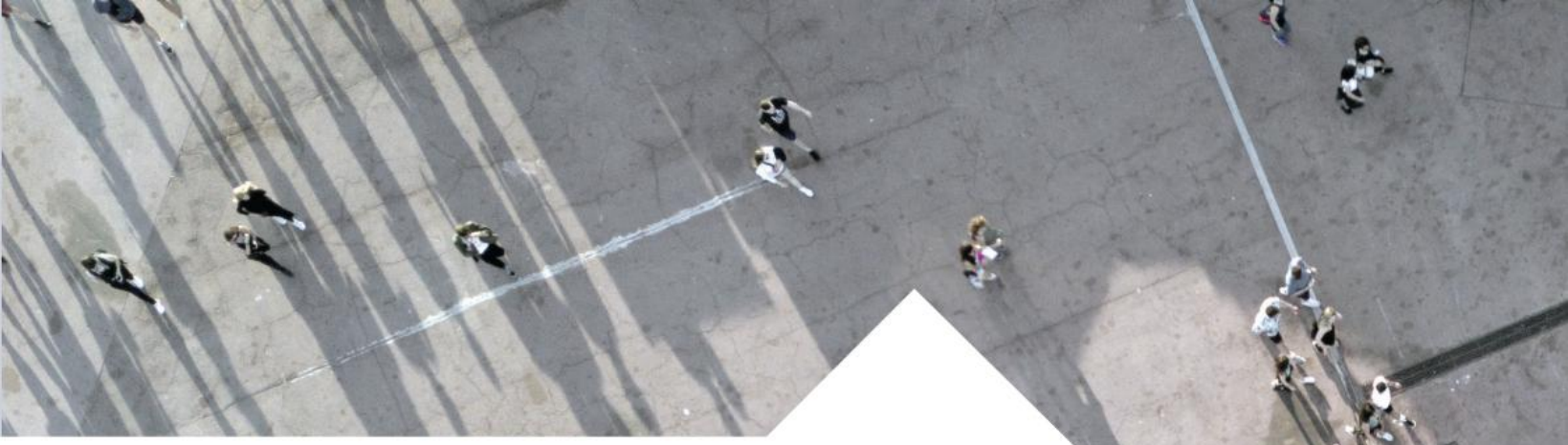
A new freeway in eastern Melbourne, Victoria

Research question

How can we design an urban space that meets the needs of its residents?

Hypothesis

Different people require different resources within the same urban space.



Writing your report

Defining your topic and method

1. State your research location, question and hypothesis.
2. Provide a brief outline of the location, characteristics and history of your local region, using around four or five sentences.
3. State two primary fieldwork techniques you used to complete this fieldwork and describe how they were helpful in answering the research question.
4. State two secondary resources you used in the lead up to the fieldwork and describe how they were helpful in answering the research question.

Presenting your data

Present the data you collected using tables, graphs, sketches with annotations, photographs and so on.

Analysing the data

Answer your research question: How can we design an urban space that meets the needs of its residents?

Consider:

- What is urbanisation and why does it occur?
- When did or will urbanisation occur in your area?
- What new infrastructure will the urbanisation of your community provide?
- What are the different needs of the community?
- How can urbanisation help meet these needs?
- What are some negative impacts of urbanisation?

If you completed a survey:

1. What were your main findings?
2. How does this help us answer the research question?
3. Were you surprised by these results? Why or why not?

Drawing conclusions

1. Summarise the key findings of your research.
2. Was the hypothesis correct (supported)? Why or why not?
3. Record five key pieces of evidence (such as data, photos, sketches or surveys) that support your answer above.

Evaluating your research

1. Which methods were the most successful for collecting data to answer the research question? Why?
2. Which methods were the least successful for collecting data to answer the research question? Why?
3. What changes to your fieldwork approach would you suggest to future Year 8 students completing the same task?

Handing in your report

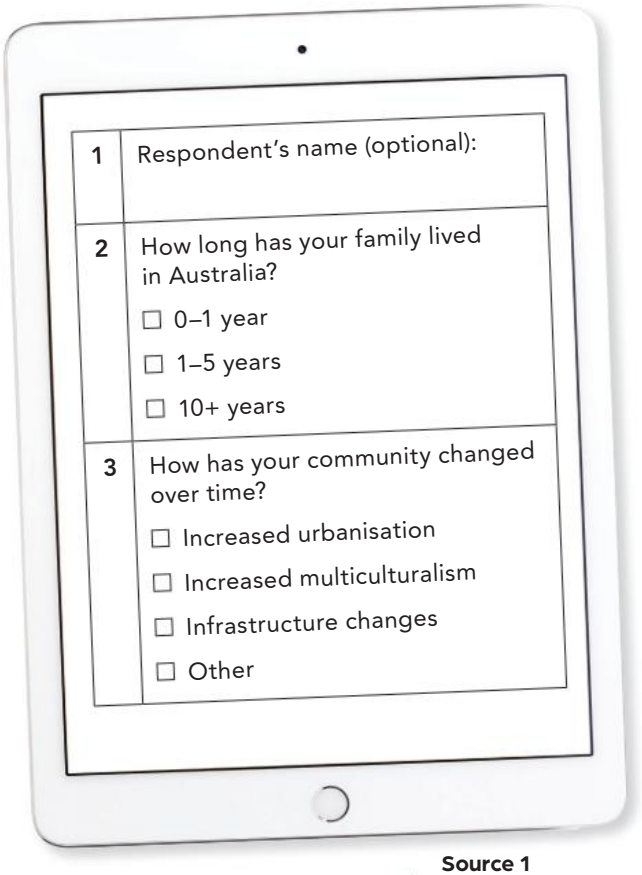
Once you have completed all the steps of your fieldwork report, you are ready to collate your work into a folio and take action! What changes would you make to your local area so it can plan for the challenges it may face in the future as population grows?

How do geographers use surveys?

Surveys are useful in Geography to collect data in the field. Your surveys could be in the form of questionnaires to help gain an understanding of people's perspectives.

You could also do a vehicle survey, where you tally the number of vehicles that pass in a particular amount of time. Surveys provide you with a sample of what is occurring in a natural or human *environment*.

Surveys can be written by hand or prepared on software such as Survey Monkey or Google Forms.



1	Respondent's name (optional):
2	How long has your family lived in Australia? ☐ 0–1 year ☐ 1–5 years ☐ 10+ years
3	How has your community changed over time? ☐ Increased urbanisation ☐ Increased multiculturalism ☐ Infrastructure changes ☐ Other

Source 1

A sample questionnaire

In the field

1 Are surveys a primary or secondary data collection method?

2 The stages of fieldwork include defining the research question, collecting data and analysing that data. In which stage would a survey be a useful tool?

3 Write a survey question that would gather quantitative data about landscapes and urbanisation.

4 Write a survey question that would gather qualitative data about urbanisation.

5 Why are multiple-choice questions often used in surveys?

6 Follow these steps to design a survey on a topic you are passionate about:
- a Write an objective for your survey. Think about who will read the data and what decisions might be made based on the data you collect. Make sure your objective is short and clear.
- b Write a title for your survey.
- c Write two or three sentences to introduce and explain your survey to the people who will be completing it. Decide whether or not your survey will be anonymous.
- d Choose how you will create your survey: on paper, on your computer using Word or Excel, or using an online platform such Survey Monkey or Google Forms.
- e Using the method you chose in part d, write 10 survey questions. Keep your questions short and specific. Try to use multiple-choice questions to make analysing your data easier.
- f Swap your survey with someone else in your class. Proofread and evaluate each other's surveys. Give your classmate appropriate feedback on how they could make their survey more effective.
- g With your teacher's permission, conduct your survey in your class, school or community.

G5

Geo How-To

Knowing the locations of countries, their capitals – and even their flags – can be useful geographic knowledge. However, the key to success in Geography is understanding key skills and being able to apply them in different situations. This chapter will walk you through some of the key skills for Year 8 and provide you with examples of how to use them.

HOW TO

Mapping with BOLTSS (NA)

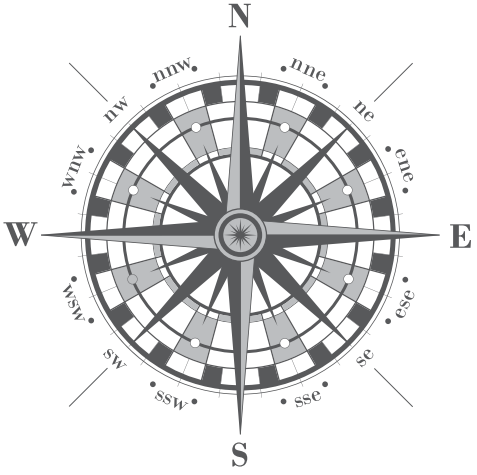
Every map requires BOLTSS in order to be understood by the geographic audience, and some people add (NA) to the acronym as well to remind them to be neat and accurate. When you construct maps, use the following checklist to ensure you have completed your mapping tasks correctly.

B Border

A border is important to show the edges of the mapping field. It provides a clear area for you to construct your map and makes it appear clear and neat to readers.

O Orientation

An orientation, or compass, helps us understand direction when reading the map. Orientations should be drawn as a 16-point compass.



Source 1

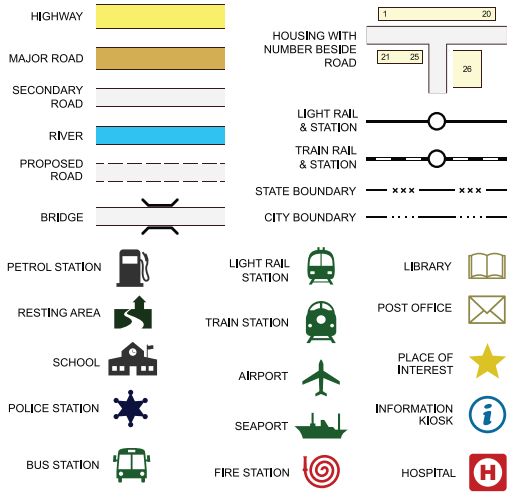
A 16-point compass

Street map of Williamstown, Victoria

Source: Matilda Education Australia, Open Street Maps

Source 2

This map features all aspects of BOLTSS



Source 3

A sample legend

L Legend

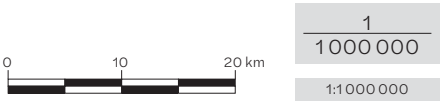
A legend, or key, is vital to understanding the map. Without a legend, colours and symbols would not make sense and we would not be able to interpret patterns or distributions.

T Title

A title gives us an understanding of what the map is showing. If you are drawing a sketch map, you should also provide a date and time. This allows you to monitor change in a location over time.

S Scale

A scale provides us with information on how big something is in real life. While a house on a map may be 2 centimetres across, it may be representing a 15-metre wide three-bedroom home. Scales can come in many forms: linear, ratio or fraction.



Source 4

Map scales: linear, fraction and ratio

S Source

Always acknowledge the source of the information that you illustrate on your map. The source can also indicate whether the map is reputable or not.

(NA) Neatness and Accuracy

Some people add the final letters 'NA'. When we read a map, we rely on it being neat and legible and we expect that its data is displayed accurately. Therefore, when you construct a map it is important you take the time to correctly illustrate the patterns and distributions you see in the data.

Source 5

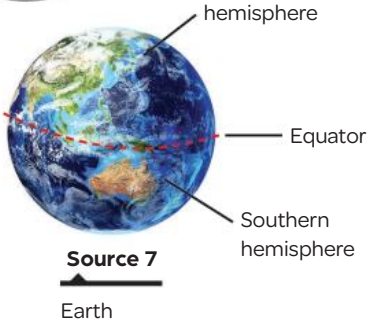
Which sketch map is easier to read?

HOW TO

Mapping skills

Source 6

A compass



Source 7

Earth

Direction

Up until now, direction may have been described to you as 'left' and 'right', 'above' or 'below'. While these words are helpful, in Geography we also need to use compass points: north, south, east and west.

Consider the world globe in Source 7. Around the centre there is a line of latitude called the **equator**. North of the equator is the **northern hemisphere** which includes the continents of North America and Europe. South of the equator is the **southern hemisphere**; this is where we live!

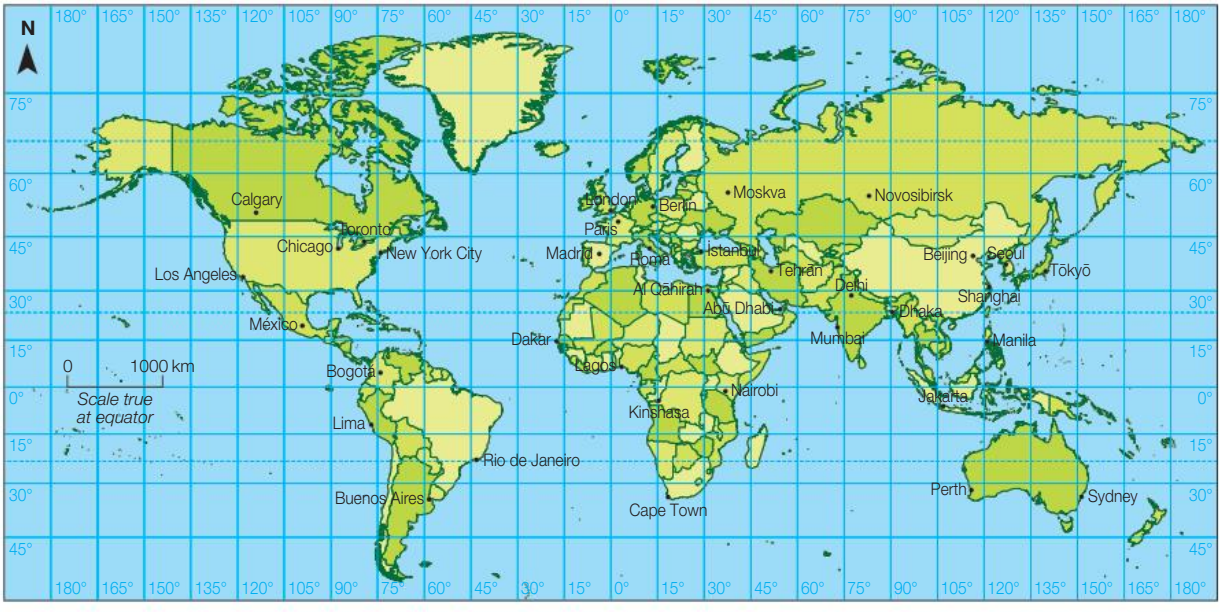
Sometimes, we mistakenly use the word 'above' instead of 'north' or 'below' instead of 'south'. If you say something is 'above' the equator, you are actually saying it is floating in the air over the top of it! If you say something is 'below' the equator, you are describing something buried beneath it! Use directional terms carefully to ensure you are sending people in the right direction.

Latitude and longitude

How do you identify where you live? Most people have an address they can share with you that gives the exact location of their house. However, how do we identify the location for a place that doesn't have an address? Geographers use grid references and latitude and longitude to help them identify these locations.

Source 8

World map with lines of latitude and longitude shown.



Latitudinal lines are shown running around Earth like a series of belts. We use the equator as a reference point, so it represents 0° latitude. Lines north of the equator are numbered 1, 2, 3 etc. degrees north (°N), all the way to 90°N at the North Pole. Lines south of the equator are 1, 2, 3 etc. degrees south (°S), all the way to 90 °S at the South Pole.

Longitudinal lines are like jail bars wrapping around the globe from east to west. These lines are measured starting from the Prime Meridian (the line that passes through Greenwich, in the UK), which is 0° longitude. Lines of longitude east of the Prime Meridian are 1, 2, 3 etc. degrees east (°E) and lines of longitude west of the Prime Meridian are 1, 2, 3 etc. degrees west (°W). On the map in Source 8, Manila can be described as having an absolute location of 15°N and 120°E, as it is north of the equator on the 15° line of latitude and 120° east of the Prime Meridian.

Scale

Look at Source 7 again. Logically, we know that this image of Earth is not to scale. In reality, the Earth is over 12 700 km in diameter!

Scale is important in Geography as it allows us to shrink maps and other images down to a size where we can see patterns, distributions and changes. Typically, scale is displayed using a line that acts like a ruler, showing you how many centimetres on the map represent the real distance.

Scale can also be used to describe changes that occur over time. A 'large-scale change' indicates that something has caused major alterations to a region. A 'small-scale change' indicates that little has been altered. Review the images in Source 10. What is the scale of the city's change?

Source 9

Obviously, this map is not to scale. It is a large area that has been shrunk down to fit on this page. The scale on this map helps us determine how big things are in real life.

Source 10

Change over time to Surfers Paradise, 2007 to 2019

HOW TO

PQE

In geography we use maps and graphs to understand what is happening around us. In many cases, these resources provide us with information on patterns and spatial distributions of phenomena.

The formula PQE helps us describe these patterns and distributions. P stands for pattern; Q stands for quantify and E stands for exception.

P Pattern

A pattern is a trend in the data. When looking for a pattern, read the legend and interpret what the colours or symbols mean. On a graph or map, you may notice that all the data points tend to be clustered in one spot or that there is an uneven distribution of data points. You may need to use the names of places or even your compass points to describe where on the map these clusters appear. For example, when observing Source 11 at the right, we notice that most countries in the northern hemisphere have higher literacy rates than those in the southern hemisphere.

Descriptive words that may help you describe patterns are: *clustered, even, uneven, highly distributed, north, south, east, west, increase, decrease and fluctuate.*

Q Quantify

When we quantify our pattern, we need to use numerical data to provide evidence of what we see. You could gain data by using the legend, measuring using the scale or conducting a count. You need to ensure that the data you provide relates directly to the pattern you recorded earlier. For example, we noticed that countries in the northern hemisphere tend to have higher literacy rates than those in the southern hemisphere: the US, Europe and China all have high literacy levels. To quantify, only seven countries in the southern hemisphere have more than 95 per cent literacy.

E Exception

An exception is a trend on the map or graph that doesn't 'fit in' with our original pattern statement. When we observe an exception, it is also good to quantify it to provide a comparison to our original statement. For example, previously we noticed in Source 11 that countries in the northern hemisphere tend to have higher rates of literacy than those in the southern hemisphere. However, Australia is in the southern hemisphere and has a population with over 95 per cent literacy. This is an exception to the pattern.

What is the difference between qualifying data and quantifying data?

PQE helps us describe patterns and distributions. When we describe, we 'say what we see'. In a PQE analysis, we do not explain or give a reason why we see patterns; this is done in a SHEEPT analysis (page 140).

To quantify means to use percentages, counts, ratios or data to provide details about the patterns you are describing. To qualify a statement means to use general describing words such as 'large', 'many', 'broad' or 'small' to describe a pattern or change.

By using quantifiable data, we can more easily see key differences between locations or monitor change over time. Imagine that your PQE analysis stated: 'The ability to read varies worldwide'. Does this sentence help you show exactly what is happening around the world? Or does this quantified statement provide more detail: 'Seven countries in the southern hemisphere have populations with over 95 per cent literacy'?

How do I start my PQE sentences?

When writing a PQE analysis, start sentences with the following key terms:

Pattern:
Overall …

For example:

Overall, countries in the northern hemisphere tend to have higher literacy rates than those in the southern hemisphere.

Quantify:
To quantify …

For example:

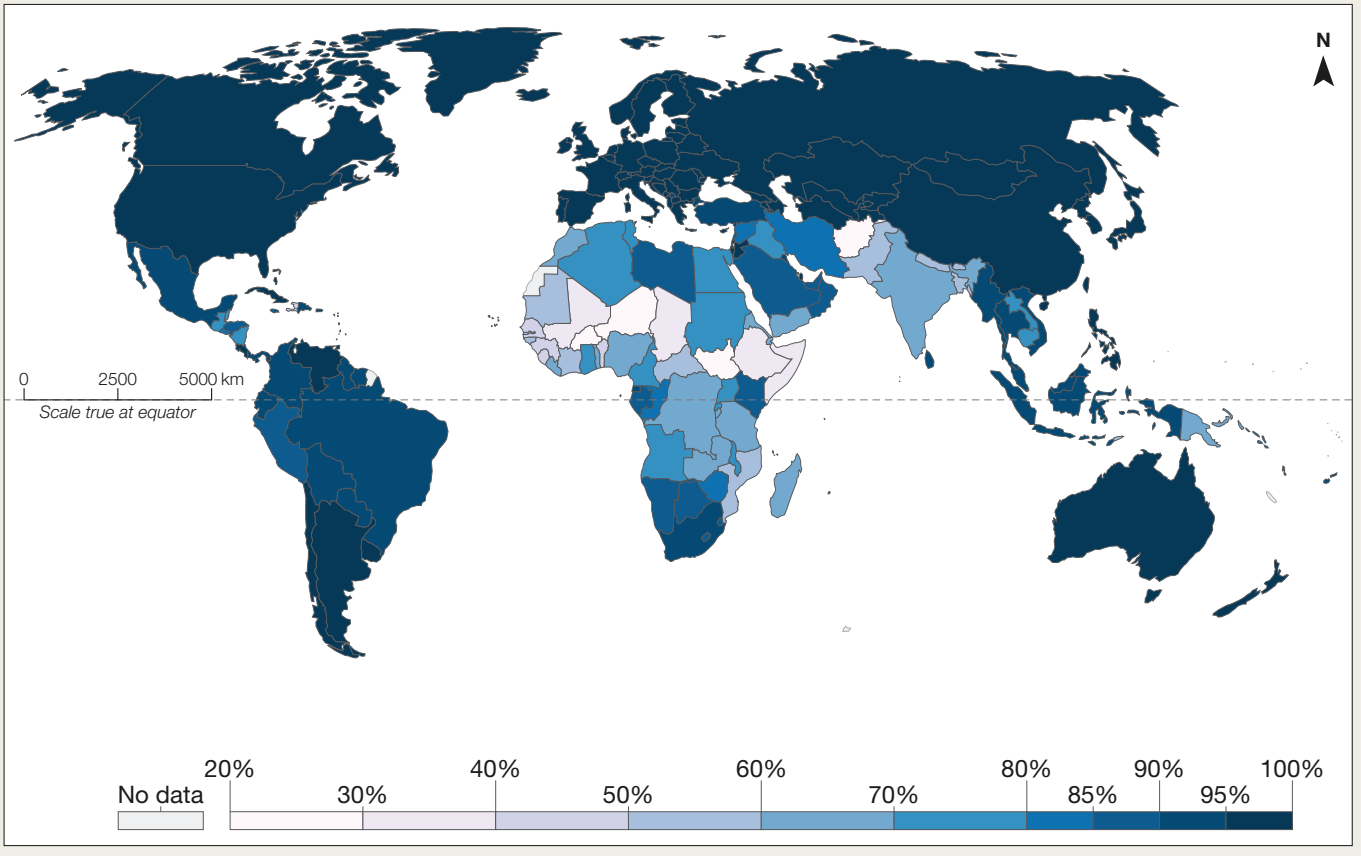
To quantify, only seven countries in the southern hemisphere have more than 95% literacy.

Exception:
However …

For example:

However, Australia is in the southern hemisphere and has a highly literate population.

Literacy rate by country, 2011



Source 11

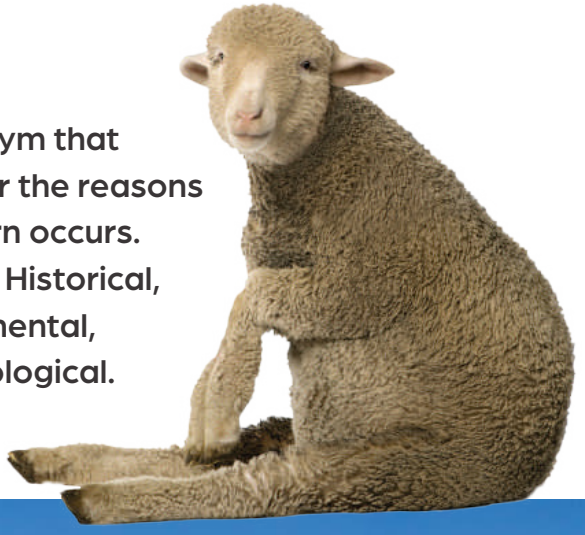
World map of literacy rates

Source: Map created by Our World in Data with data from CIA Factbook (2016)

HOW TO

SHEEPT

SHEEPT is an acronym that helps you remember the reasons why a spatial pattern occurs. It stands for: Social, Historical, Economic, Environmental, Political and Technological.



S Social

1

Social factors are anything to do with people. Social factors include population, culture, language and religion. Here we see social differences between living conditions in India.

H Historical

Historical factors are anything to do with our past. Historical events, buildings, people and changes to climate all influence what we see in our world today. India's urban landscape has changed significantly over time.

E Economic

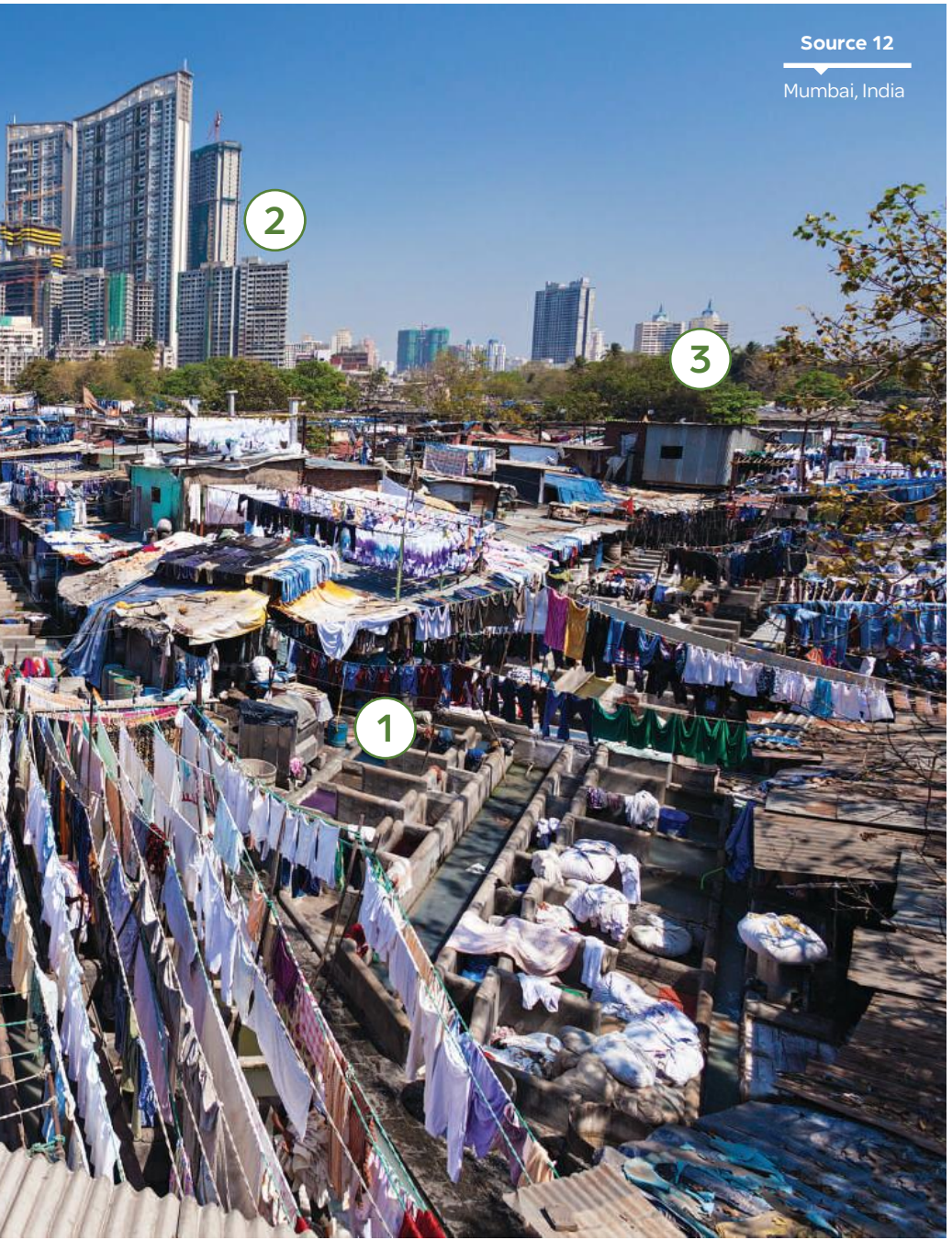
2

Economic factors are those relating to money. In Geography, income, costs of things and how much money is spent can provide us with information on a place. There are large scale economic differences between communities in this place.

How do I write a SHEEPT analysis?

SHEEPT is usually used to explain why patterns or distributions may occur in a particular region. It can also be used to expand our thinking when annotating images or considering new geographical content. The following is an example of how we can write a SHEEPT analysis for an image. The highlighted terms indicate the use of a SHEEPT term. Can you identify all of them? The analysis does not need to include every term.

Source 12 is an image of slums in Mumbai, an Indian megacity of more than 12 million people. Rural-urban migrants come in the hope of better economic conditions but find it difficult to afford housing. In Mumbai, 42 per cent of the population live in slums, built of recycled materials on any available open land. Lack of infrastructure and basic amenities such as a safe water supply and sanitation produce dangerous health conditions for the people living in slums. These are among the most overcrowded and densely populated places to live. Historically, governments have tried to improve services in slums and more recently there have been plans to relocate people to millions of affordable homes away from the city centre.



Source 12
Mumbai, India

E Environmental 3

Environmental factors are those relating to the natural or human environments on Earth. Humans can manipulate the environment to suit their needs. Here we see how parklands have been urbanised to support a growing population.

P Political

Political factors are those to do with the government or leading groups. When we consider political factors, we refer to laws and policies.

T Technological

Technological factors relate to the different kinds of technology that we have access to. This could be in the form of gadgets, **spatial technology**, medical technology or even roads, transport or basic machines used in the home.

HOW TO

Sketches and annotating

Field **sketches** are an excellent way of recording data when you are investigating a research question.

Sketches allow you to annotate movement, patterns or any interconnections you see. Field sketching is not a test of your artistic skills – the idea is to record a simplified version of what you can see.

T Title 1

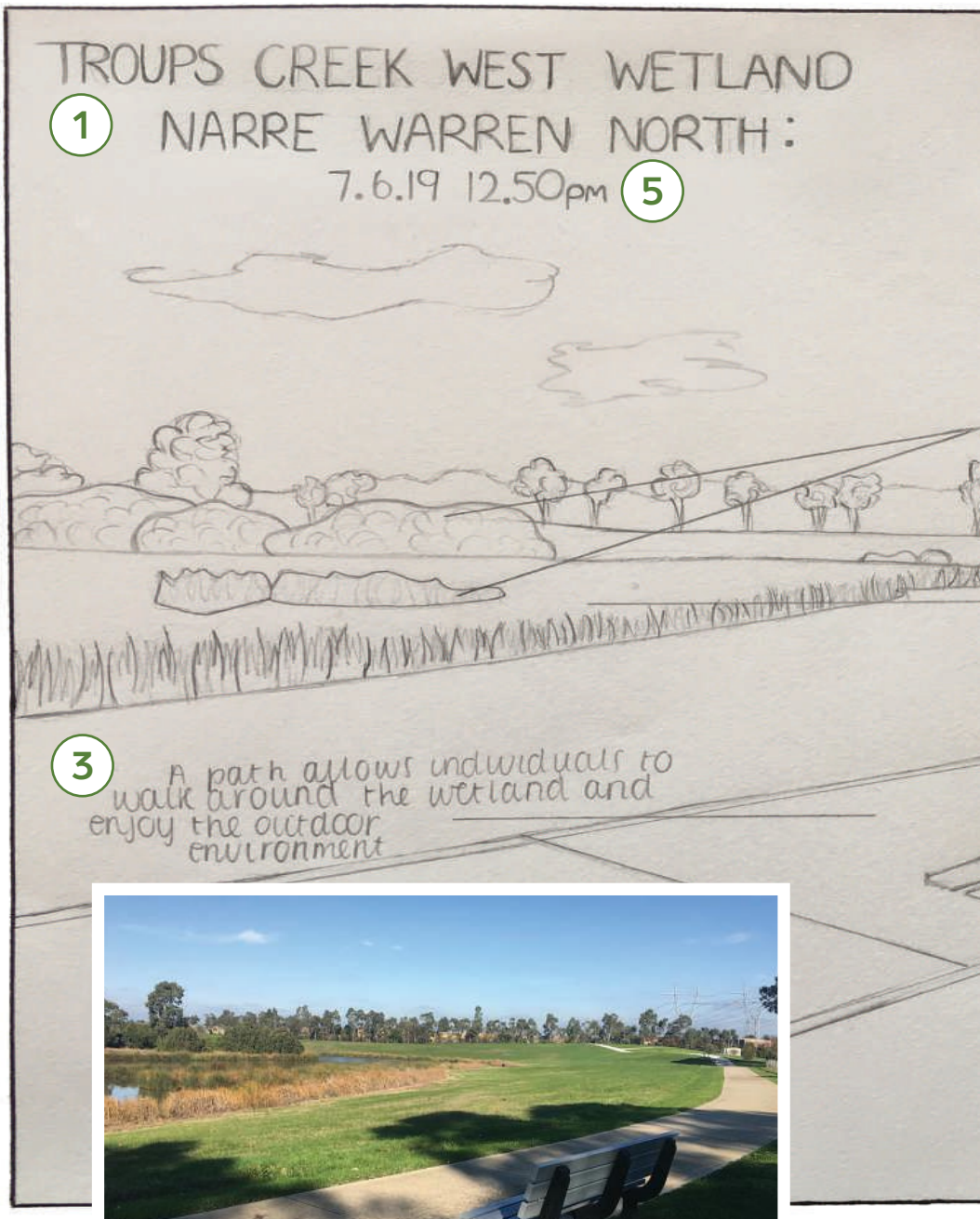
Provide a heading for your sketch that is clear and provides information on the location. You may wish to record both the **absolute** and **relative locations**.

O Orientation 2

An orientation shows the direction that you were facing when you conducted your sketch. In order to record a correct orientation, you need to use a compass.

A Annotations 3

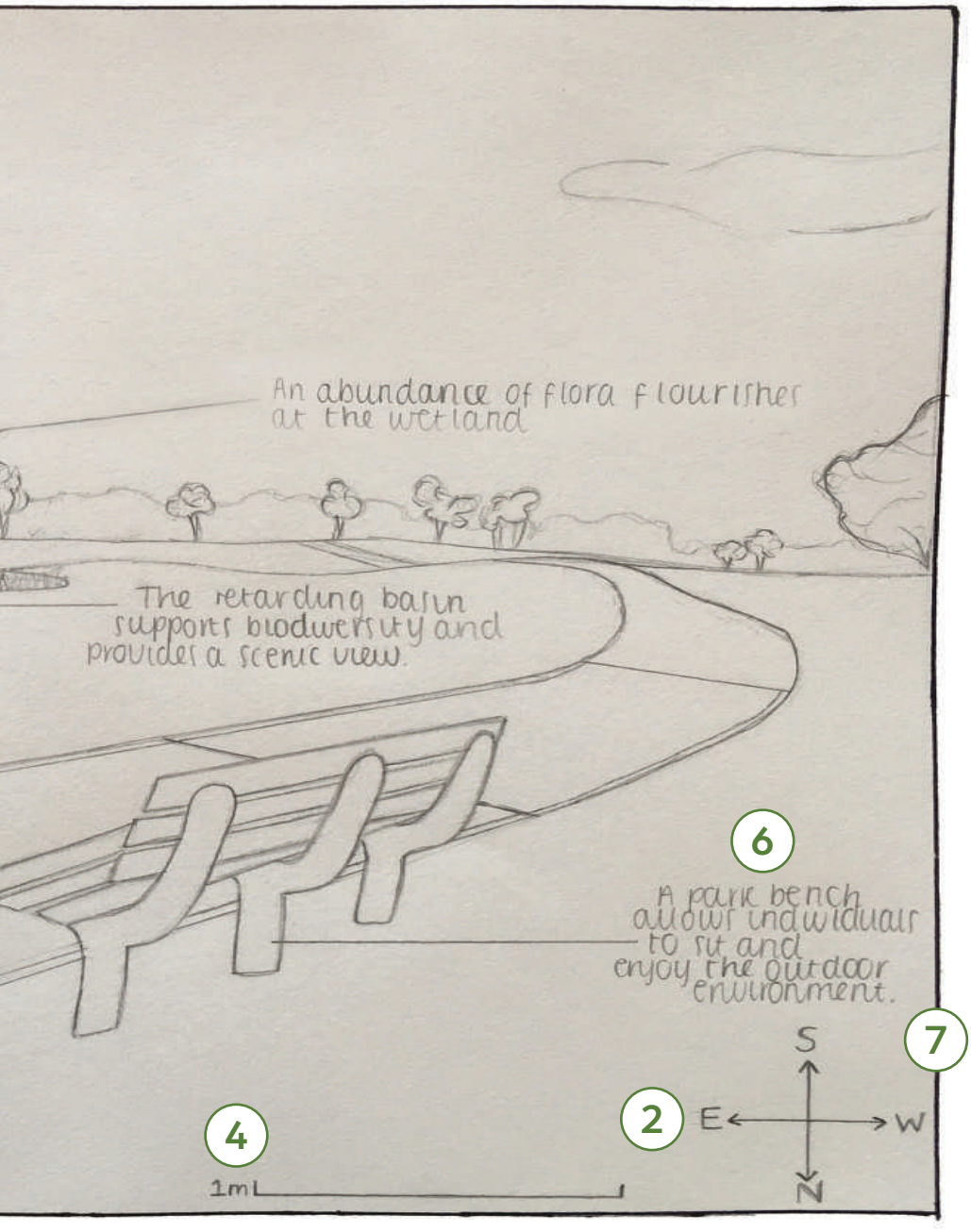
Annotations are the most important thing to complete when drawing a field sketch. Annotations allow you to record details about what you see and explain how elements of your drawing relate back to the research question. Ensure that lines pointing to your annotations are completed with a ruler and do not overlap.



When you are making a field sketch, you need to remember TOASTIE!

TOASTIE will help you remember the key skills when making a field sketch.

It stands for Title, Orientation, Annotations, Scale, Time, Information and Edge.



Source 13

An annotated field sketch

S Scale 4

Most sketches are not to scale. However, all geographical maps and sketches require a scale to give the reader some indication of size. To estimate a scale, use a metre-rule or pace out an area that you have sketched. Then, using a small ruler, identify how large the same area is on your drawing. For example, you may estimate that the path you are looking at is 1 metre wide and when you measure your drawing of the path it is 1 centimetre wide. Therefore, your rough estimated scale is 1 m = 1 cm.

T Time 5

By recording the time your sketch was completed, you can analyse how the environment changes over the course of a day, a month or even years!

I Information 6

Provide more than just one-word annotations on your sketch. Annotations should be at least one sentence and help your reader to identify any patterns.

E Edge 7

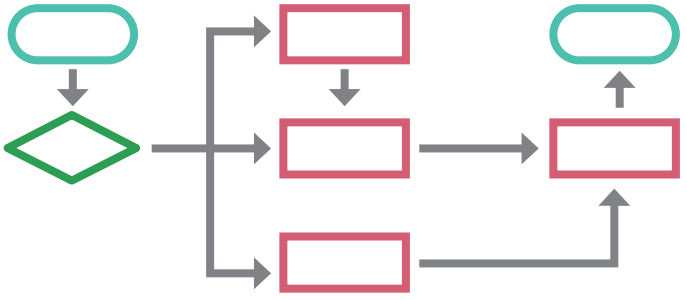
Draw a border so it is clear where your sketch starts and ends.

HOW TO

Visual communication

Flow diagrams

Flow diagrams are helpful to show processes or how different parts of the environment are *interconnected*. The arrows represent the movement between stages or the connection between things.

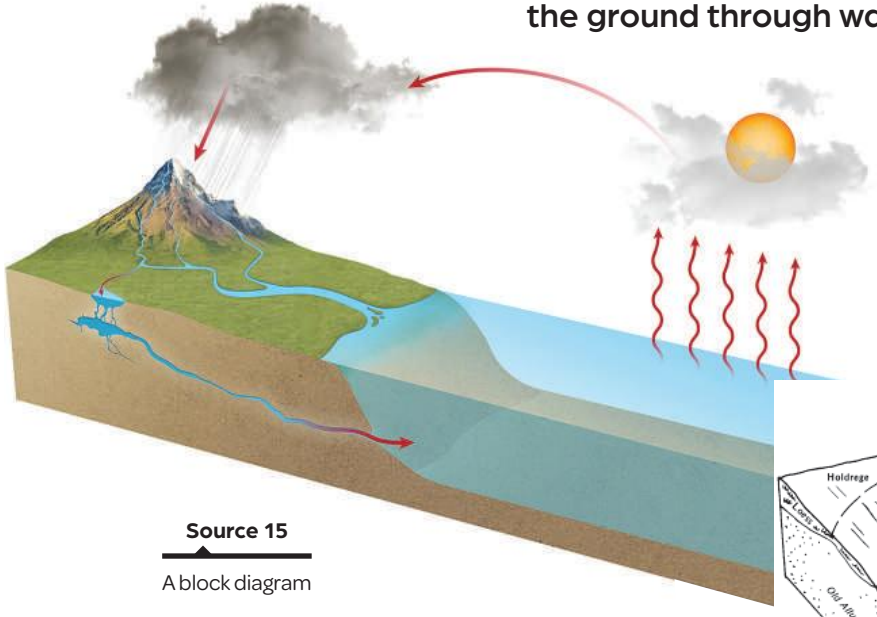


Source 14

A flow diagram

Block diagrams

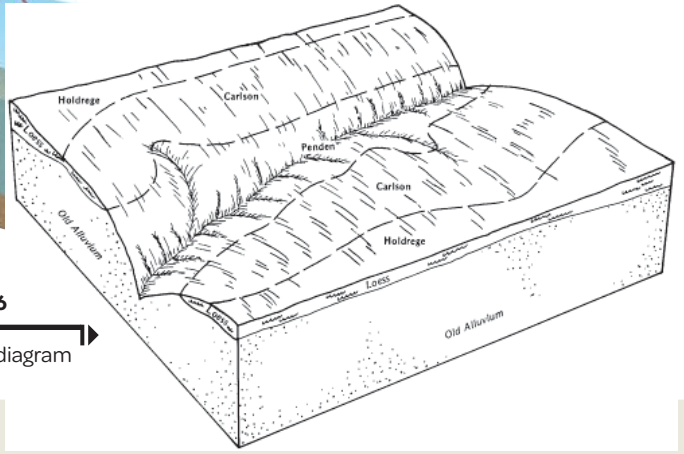
Block diagrams are a useful way of drawing landscapes to show what is happening both above and below ground. For example, when we consider the movement of water, block diagrams help us visualise how water can move both on the surface of the Earth through rivers, oceans and streams, as well as under the ground through water tables and pipes.



Source 15

A block diagram

When you create a block diagram, you need to ensure that you draw it three dimensionally, with equal amounts of drawing room both above and below the surface of Earth. Annotations are important when drawing a block diagram as this is how your audience can interpret your illustration.



Source 16

Sketch of a block diagram

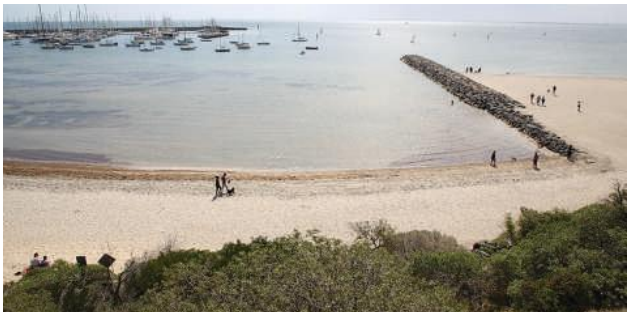
Photo essays

A **photo essay** is a way of presenting information visually to show characteristics of a place or process. A photo essay usually includes a series of photos with specific annotations or captions that provide a brief background into the key features of the image or the meaning behind the image choice.

Source 17

A photo essay

Historical Hampton Beach



Modern-day Hampton Beach

Department of Primary Industries sign at Hampton Beach, which indicates that the intertidal zone is protected to a depth of two metres.

Early boating at Hampton Beach

Hampton Beach bathing boxes and pier c. 1900

Aerial view of Port Phillip Bay, including Hampton Beach

HOW TO

Graphing

Simple graphs

Graphing is an important way to display geographic information. It shows us patterns and changes over time. When creating a graph, think SALTS!

S Scale

The scale of your graph will depend on the data you are trying to visualise. The easiest way to create a graph axis scale is to identify the lowest and highest value (range) and then fill in the numbers in between so you can mark your data points easily.

A Axis

Each graph has an *x*-axis and *y*-axis. The *x*-axis is the horizontal axis and the *y*-axis is the vertical. Make sure you label each axis!

L Legend

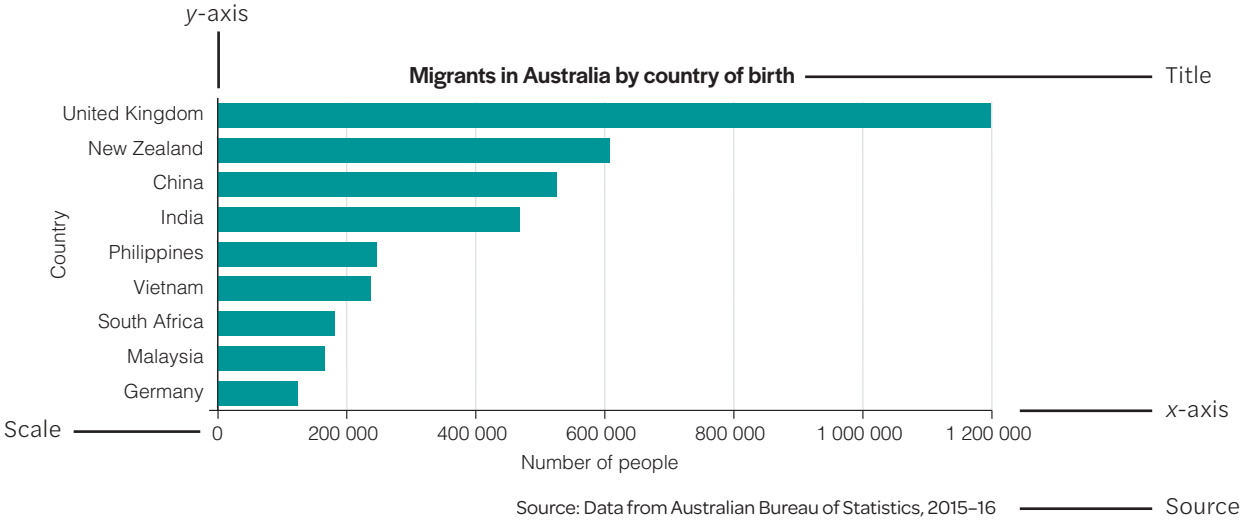
A graph often uses colours to represent data. A legend indicates to the audience what these colours mean and how to read the data.

T Title

A title lets your audience know what your graph is showing.

S Source

When you graph information, it is important to acknowledge where you gained the data from. Maybe you collected it yourself or maybe you sourced it from a website. By stating the source of your information, the reader knows how reliable it is.



Source 18

Graph showing migrants in Australia by country of birth, 2015–16

Climate graphs

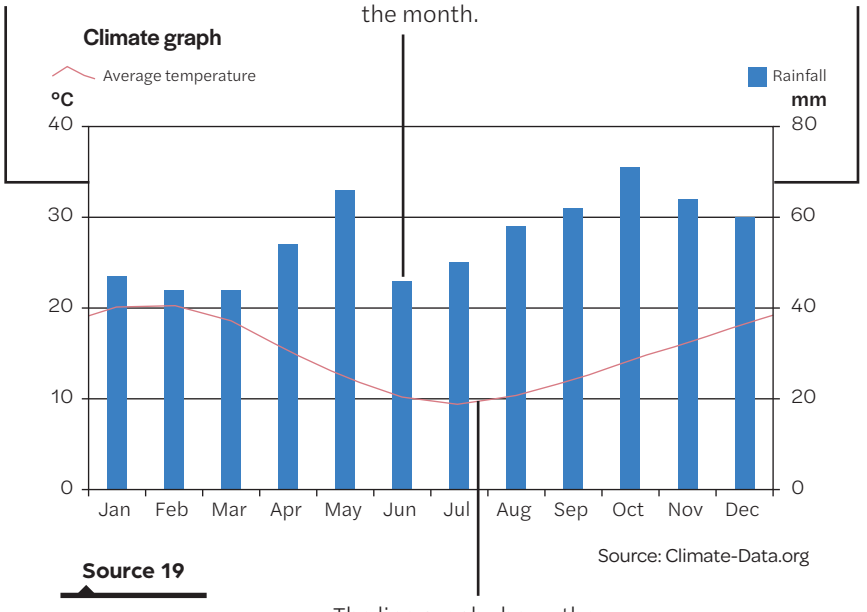
A climate graph is simply two graphs in one.

The graph below shows the temperature (degrees Celsius) on the left *y*-axis, which relates to the red average temperature line; and the amount of precipitation (mm) on the right y-axis, which relates to the blue columns. The horizontal axis or *x*-axis, shows us the months of the year. We notice that the red line, or average temperature, fluctuates throughout the year, peaking in December to March and decreasing from April to July. In a similar way, precipitation also fluctuates. However, it tends to be highest in the spring from August to November, with the exception of another peak in May. Using two PQE analyses (one for temperature and one for precipitation) is the best way to describe the patterns we observe in a climate graph.

Use the left axis to read the degrees of temperature.

The bar graph shows the average precipitation for the month.

Use the right axis to read precipitation levels



Source 19

A climate graph

The line graph shows the average maximum and minimum temperatures for each month.

Here we need to apply SALTS! Label the axes, provide a title and a source. The legend is part of the axis labels: red line denote average temperature in degrees Celsius; blue columns denote rainfall in mm.

What is the difference between weather and climate?

Look outside your window and describe today's temperature and the amount of rainfall. What you have just described is the weather. Weather changes daily but we can usually predict it up to 10 days in advance.

Now close your eyes and describe the 'climate' of Australia. Do you imagine Australia as mostly hot and dry? Just because we can describe Australia as hot and dry, does not mean it is like this everywhere, all year round. Unlike the weather, climate helps us describe the yearly (annual) average temperature and level of precipitation (rainfall, snow etc.) in a region or country. Climate graphs help us visualise the climate of a region or country. Climate change describes how the average temperature and precipitation levels of a location change over time.

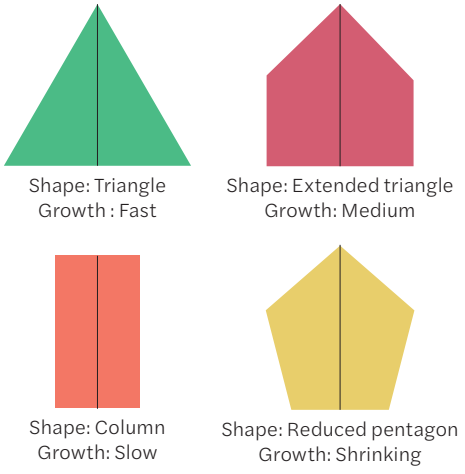
Population pyramids

Population pyramids are graphs that show the number of females and males in particular age groups in a population; they are like bar graphs turned on one side.

Population pyramids can be made on a local, national or global scale. On a population pyramid, female data is normally shown on the right side and male data on the left. The length of each bar represents the number of males or females within that age group.

The shape of the pyramid tells us about the population:

- Triangular means the population is growing, because there are more young people than old
- Box-like means growth is slow or stable, as there are roughly equal numbers of old and young people.
- If the shape becomes wider towards the top, like a reduced pentagon, it represents an ageing or declining population, as there are more middle-aged people than young people.



Source 20

Various population pyramids. The shape of the pyramid tells you about the population.

How do I interpret a population pyramid?

Source 21 shows population pyramids for Australia in 1955 and 2018. In 1955, there were many young people in the age range 0–14. Approximately 5.5 per cent of the population were 0–4-year-old males and 5.3 per cent were 0–4-year-old females. We also had many working-age people. For example, 4.1 per cent of the population were 30–34-year-old males and 3.8 per cent were 30–34-year-old females. In 2018, there are significantly fewer young people and more old people in our population. Our population also grew to 25 million people.

Source 21

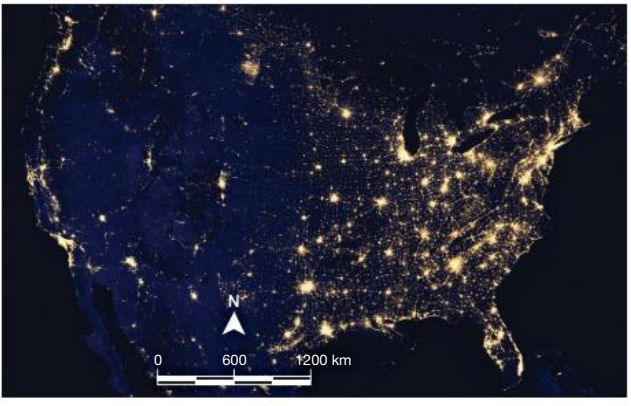
Population pyramids showing Australia's population in 1955 (left) and 2018 (right)

Source: PopulationPyramid

HOW TO

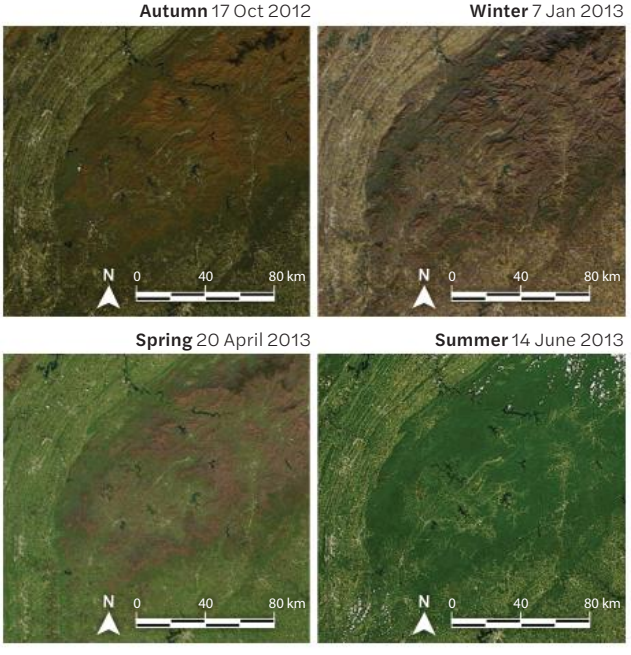
Satellite images

Satellite images are pictures of Earth taken from space. Satellite images give us the most information if taken during the day. Satellites orbit Earth and constantly take images and so we can use this data to see a change over time in land cover or other spatial patterns.



Source 22

Satellite images taken at night provide different information than those taken during the day. This photo of the US shows the extent of its urban areas.



Source 23

This satellite image was taken at the same place over four seasons. Satellite images are useful to show change over time.

When trying to interpret a satellite image, it is best if you look for colour and shapes. Colour can give you an idea of land cover. For example, green usually indicates vegetation, blue is the colour of water and brown is desert or barren land. White can indicate either snow or clouds and so we use shapes to tell them apart. Clouds tend to look fluffy and can sometimes (depending when the images were taken) cast a shadow. Snow usually appears on the tops of mountains and you can observe where it is melting or following the slopes. Looking for shapes is also helpful when identifying rivers or reservoirs, which can be seen as meandering blue lines.

Seasonal variations can sometimes be very clear in satellite images – in spring and summer, green vegetation flourishes, while during winter, white snow may fall or vegetation may die, leaving brown bare ground.

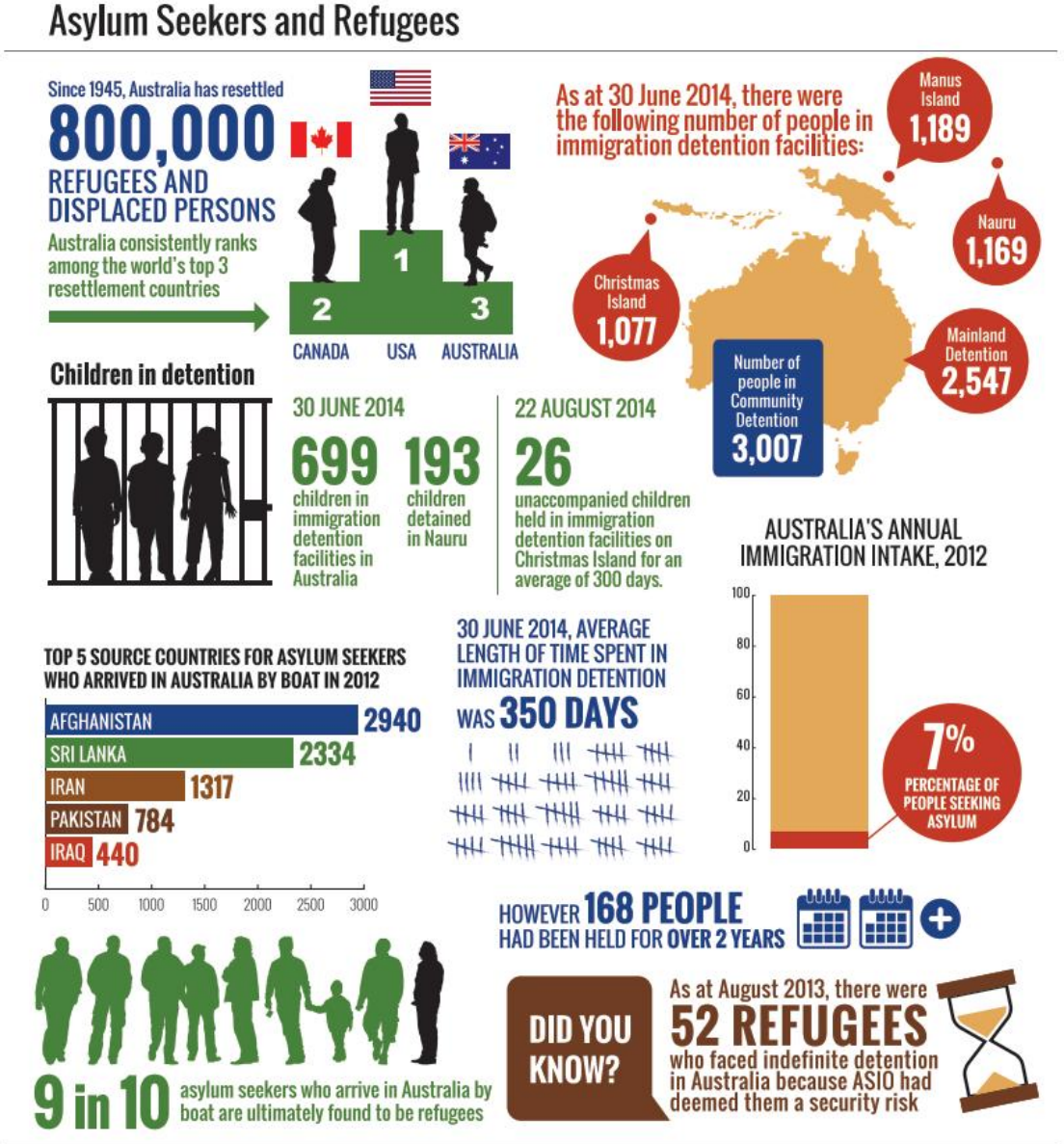
Source 24

Example of an image taken from a satellite that orbits around Earth. We can use this information to answer geographical questions and understand spatial patterns.

HOW TO

Infographics

Collecting and displaying data is an important skill for Geographers. As quantitative data tends to be quite complicated, we can sometimes use infographics to communicate these findings. Infographics are posters that use images, graphs, shapes and colour to illustrate to the audience key patterns and trends. Infographics are an engaging way to present information if used properly.



Source 25

An infographic

HOW TO

Cross-sections

A cross-section shows the shape of a geographical landscape or landform from the side, as if it had been sliced by a knife. The cross-section in Source 26 shows Uluru as you would view it if you were on the ground.

Contour lines are used to construct a cross-section. The overlay on the aerial photograph of Uluru in Source 26 is a contour map. As discussed previously, the contour lines are the numbered lines that join places of equal height. Close contour lines indicate a steep slope and widely spaced contours mean a gentle slope.

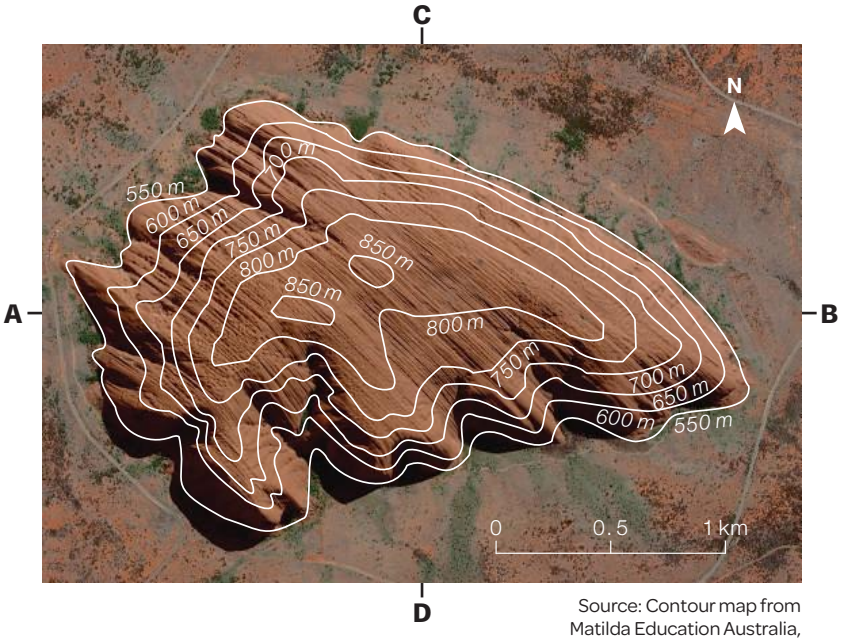
Source 27 shows how to draw a cross section:

a Place a straight edge along the line between points X and Y. Mark each contour line at the point it touches the edge of the paper and record the height.

b Draw a vertical scale similar to the one in Source 27, with one centimetre representing 100 metres. Place the marked edge of the paper underneath and mark the appropriate height directly above with a dot. Join the dots with a smooth line and add labels.

Source 26

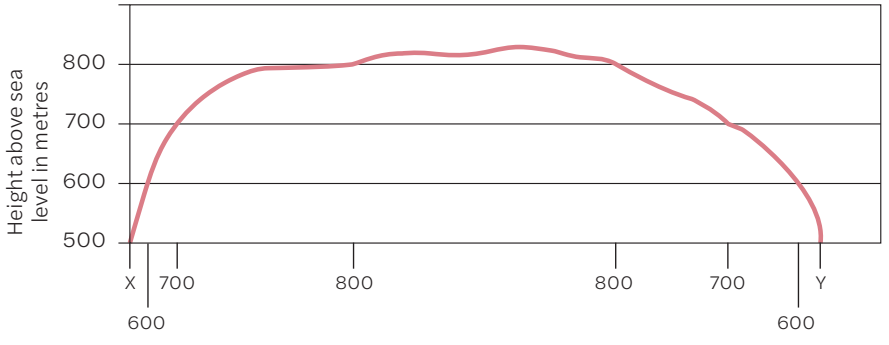
An aerial photo of Uluru with contour lines overlaid. (The ABCD labels are to help students answer question 6 on page 41.)



Source: Contour map from Matilda Education Australia, Geoscience Australia

Source 27

A simple cross-section of Uluru



Glossary

absolute location a location's exact place on Earth, often described in terms of latitude and longitude

active (volcano) a volcano that is erupting or likely to erupt in the future

aesthetic value appreciation of how a place looks and its perceived beauty, uniqueness or connection to a person

backwash water returning to the sea from the beach

basalt dark-coloured volcanic (igneous) rock formed by the cooling of lava

beach nourishment replenishment of a beach by sand from another source

bias to be for or against an idea, a person or a group, especially in a way that could be thought of as unfair

block diagram a three-dimensional diagram that shows how a system or feature works

block mountain a mountain that forms when blocks of rocks are forced upward or downward along faults or cracks in Earth's crust; also known as a **horst**

blowout an eroded bare patch on a sand dune usually created by damage to vegetation that then allows the wind to carve out a crater in the dune

BOLTSS(NA) acronym for Border, Orientation, Legend, Titles, Scale and Source (Neatness and Accuracy); used when constructing maps

breaking wave a wave that is forced to spill forward as the bottom of the wave orbit comes into contact with the sea floor and slows down

breakwater a rock wall built parallel to the beach and located in the water, designed to direct the force of the waves at the wall and not at the beach and sand dunes behind it

butte an isolated hill with vertical sides and a small flat top; smaller than a mesa

chemical weathering when rocks are broken down by a chemical change

civil war war between citizens in the same country

climate the average weather in a certain place, over a period of time

climate graph a graph showing average rainfall and temperature for an area over a period of time

commuter town a town separated from suburbs by farmland and open space, but connected by roads and rail; people in these towns commute to the city for work

constructive wave a small and infrequent wave that deposits sand on the beach rather than scouring it away; responsible for creating depositional landforms such as beaches, sand dunes, sand bars, spits and tombolos

conurbation a process whereby whole cities merge together into a continuous urban area

converging margin an area on Earth where tectonic plates collide

counterurbanisation a process whereby people move from an urban area to a rural or coastal area to escape urban problems such as expensive housing, traffic and pollution

crest the top of a wave; where it peaks

cross-section an image that shows the shape of a geographical landscape or landform as though it has been sliced vertically by a knife

currency a system of money in general use in a country for the exchange of goods and services

decentralisation a process whereby governments encourage population growth and job creation in areas outside major cities

deforestation the clearing of a forest to make room for a different land use such as farming

democracy rule by the citizens, who elect officials and leaders

demonstration a protest by a group of people in support of a cause

desert dry environments that receive less than 250 millimetres of rain per year; they can be hot or cold and be rocky, sandy or even covered in ice

desertification the process whereby land along the edge of a desert becomes damaged by drought and through overuse by humans, and is replaced by desert

destructive wave a large and powerful wave that constantly crashes onto the coastline, wearing away cliffs and digging out areas of beach

direct action using protests, strikes, petitions and other forms of protest to achieve demands

diverging margin where tectonic plates move apart

dome mountain a mountain that forms when magma is injected between two layers of sedimentary rock, causing the top layer to bulge upwards

dormant (volcano) an inactive volcano that may erupt in the future

drainage basin an area of land where precipitation collects and drains into a river, bay or other body of water

dredge to clear or deepen an ocean or river bed by scooping up material with a machine known as a dredger

dune a mound or ridge of sand or loose sediment piled up by the wind, especially on beaches or in deserts

earthquake the sudden shaking of the ground as a result of movement in the Earth's crust

economy how money is made and used in a country or region, including the production and consumption of goods and services

effusive eruption a volcanic eruption where magma flows out of the volcano as a lava

epicentre the central point of a difficult or unpleasant situation, such as an earthquake or a pandemic

equator a geographic coordinate line through the middle of Earth dividing it into the northern and southern hemispheres; the line is at latitude 0°

erosion the process whereby rock particles are moved by flowing air (wind), water (rivers, sea and rain) or ice (glaciers)

exchange rate the value of one **currency** compared to the value of another currency

explosive eruption a volcanic eruption where magma full of bubbling gas explodes as it reaches the surface

extinct (volcano) a volcano that is unlikely to ever erupt again

flow diagram a diagram showing how one thing flows to another; arrows show the movement between stages, or show how different items are connected

fold mountain a mountain that forms when two tectonic plates collide and rock is folded upwards

geographic characteristics occurring feature of a place, such as its landforms and ecosystems

geomorphic hazard a danger that originates at or near Earth's surface, such as a volcanic eruption, an earthquake or a landslide

graben dropped blocks along a fault line in the formation of block mountains

Gross Domestic Product the total value of all goods produced and all services provided in a country over a year

groundswell wave a steep and fast wave formed by a strong wind storm in the open ocean that creates long wavelength waves that move quickly into shallow water before breaking

groyne a wall that extends out from a beach into the sea, designed to trap the sand moving along the beach and also direct waves away from the shore, reducing erosion

headland narrow, high land jutting out into the sea, formed of harder rock that resists erosion

horst uplifted blocks along a fault line in the formation of block mountains

hot spot a location on Earth where tectonic plates move over very hot parts of Earth's mantle and rocks melt to generate magma for volcanic activity

humanitarian aid donated goods such as food, blankets and medicine, and help such as doctors and transport, given to save lives and provide assistance to people following a natural or human-made disaster

hypothesis a proposed explanation used as the starting point for further investigation

inflation a general increase in prices in an economy, leading to an increase in the cost of living

infographic a poster that uses images, graphs, shapes and colour to illustrate key trends and patterns in data

infrastructure physical and organisational requirements needed for the operation of a society; for example, roads and water supplies

inselberg an isolated steep-sided mountain, uncovered as the softer land around it is eroded away

internal migration migration of people within the boundaries of a country or region

international migration migration of people from one country to another

lahar a fast-moving mudflow of volcanic ash and rock that flows down the slopes of a volcano either during an eruption or following heavy rains after an eruption

latitude a geographic coordinate line running east–west parallel to the equator; it measures the position of a place on Earth's surface north or south of the equator in degrees (°), minutes (") and seconds (')

landform a natural feature of Earth's surface such as a mountain, valley, sand dune or cliff

landscape all the visible features of an area of land, including landforms; different types of landscapes include coastal, desert, riverine, mountain and polar

landslide the mass movement of soil, rock and debris down a slope

lava the name given to magma when it reaches Earth's surface

less economically developed country (LEDC) a low-income country experiencing severe barriers to development; also referred to as a developing country

lobby an attempt by individuals or groups to influence the decisions of government and public opinion on issues such as deforestation, pollution and the impact of introduced species

longitude a geographic coordinate line running north–south perpendicular to the equator; it measures the position of a place on Earth's surface east or west of the Prime Meridian (i.e. 0° longitude) in degrees (°), minutes (") and seconds (')

longshore drift the movement of sand in a zigzag fashion along the beach until it meets an obstacle such as a headland or groyne

maar crater a crater formed by the explosive interaction between magma and groundwater; they are usually shallow, with steep sides and often filled with water

magma liquid rock from the mantle beneath Earth's crust that rises through volcanic vents to Earth's surface

mantle the solid layer under Earth's crust in which parts can melt into magma and move to the surface through volcanoes

marketing action to promote the selling of a product or service

mass wasting the movement of rocks downhill due to gravity, such as rock falls and landslides

mechanical weathering a process whereby rocks are broken into pieces by changes in temperature, being split open by expanding roots or ice

megacity a city with 10 million or more people

mesa a broad, isolated flat-topped landform found in desert areas; the eroded remains of a wide plateau

migration permanent or semi-permanent movement from one place to another

monsoon a seasonal wind, occurring in the Asia and Pacific regions, that brings large amounts of rain

more economically developed country (MEDC) a country with a strong economy, in which most people have access to good education, health care and employment opportunities

mountain a large **landform** that sits above the surrounding land, usually in the form of a peak; steeper than a hill

mountain range a series of peaks and high land linked in a line

northern hemisphere the half of Earth north of the Equator

pandemic a disease that spreads in multiple countries around the world at the same time, usually affecting a large number of people

petition signed support of a statement used to lobby national governments and the United Nations to support causes; used to persuade politicians that there is large support for a cause

phenomena things that are observed to exist or happen

photo essay a series of photographs used to visually present information about the characteristics of a place or process

plateau a large flat area of land that is high above sea level

population density a measure of how many people live in a particular region or area

population pyramid a graph showing the number of males and females living in age groups in a population

PQE an acronym for Pattern, Quantify and Exception; used to describe spatial patterns or graphs

primary dune a mound of sand at the rear of a beach

primary method a data-gathering activity undertaken in the field, such as field sketches

pyroclastic flow a huge avalanche of hot gas and tephra that can move at speeds of up to 700 kilometres per hour and heat to temperatures of 1000°C, destroying everything is its path

qualitative data non-numerical data based on qualities or characteristics

quantitative data numerical data based on measurements or counts

reef a long line of jagged rock, coral or sand sitting just above or below the surface of the ocean

refraction a change in the direction of a wave as it approaches land

refugee a person threatened by conflict or a natural disaster who is forced to flee their home to seek safety, food and shelter in another country

relative location the whereabouts of a location described by referring to another place, landmark or even time; for example, the Melbourne is east of Geelong, or Sydney is 878 km from Melbourne

research question an idea to be investigated, or a problem to be solved through research

reurbanisation when people move back into inner city areas that have been improved through urban renewal

rift valley a valley with a wide, flat floor caused by dropped blocks known as graben from the formation of block mountains

rural based in or relating to living in the countryside rather than a city or large town

rural to urban migration a form of migration where large numbers of rural-dwellers move to urban areas with the promise of better job opportunities and services

SALTS an acronym for Scale, Axis, Legend, Title and Source; used in creating a graph

satellite image an image of Earth taken from space

scoria cone a small volcano with relatively steep sides, usually formed as the result of a single volcanic eruption

sea wall a wall that runs parallel to the shore at the back of a beach, designed to stop erosion by waves and storms and protect the paths, roads and houses built along the shore

secondary dune a mound of sand that is further inland behind a primary dune, with more soil to promote vegetation such as shrubs and trees

secondary method a data-gathering activity undertaken outside of field studies, such as research

sedimentary rock a rock that forms when layers of sediment are pressed together by the weight of overlying rock

seismic wave a wave generated from the sudden release of energy in or beneath Earth's crust during an earthquake

SHEEPT an acronym for Social, Historical, Environmental, Economic, Political and Technological factors; used to describe and analyse spatial patterns

sketch a simple drawing made to record data when in the field

skilled worker a worker with specialist training or qualifications

slum a highly populated residential area with densely packed, poor-quality housing with few services, often inhabited by people living in poverty and with few choices of where to live

soil liquefaction when wet soil turns to liquid mud during an earthquake, collapsing buildings

southern hemisphere the half of the Earth south of the Equator

spatial technology computer systems that interact with real-world locations in some way

spheroidal weathering the rounding of rocks caused by chemical weathering where rocks disintegrate along the edges and corners are rounded by water coming from more than one direction

spit a narrow bar of deposited sand linked to the coast

stack a pillar of rock separated from cliffs or created from a collapsed arch

subduction the process whereby a continental plate meets an oceanic plate, and the oceanic crust bends and moves down toward the upper mantle where the edge of the plate melts into magma that feeds volcanoes along the converging margin

suburb a medium-density region of housing that surrounds the central business district of a city

suburbanisation a trend in city development where land on a city's outer edge that was previously used for farming or being kept as a natural environment is made available for housing

sustainable able to be maintained at a certain level, such as energy or air quality

swash water and suspended materials such as sand flowing onto the beach

swell a collection of waves formed by winds that can travel for long distances through the ocean; measured from the crest to the trough

tectonic plate a slab of solid rock that comprises Earth's crust and upper mantle, that can collide with other plates to form mountains and volcanoes, and generate earthquakes, and move apart to form ocean trenches

tephra solid material ejected from a volcano during an eruption, such as volcanic bombs and ash

TOASTIE an acronym for Title, Orientation, Annotations, Scale, Time, Information and Edge

tombolo a landform that forms when waves deposit a bar of sand to link an island to the coast

tourism the business of providing services for tourists such as accommodation, transport, tours and other activities

training walls walls built on either side of a river mouth to stop sand from blocking it

transform margin where the edges of tectonic plates slide past one another; the plates can become stuck and then break free with a sudden movement, triggering an earthquake

trough the bottom of a wave

tsunami a huge ocean wave generated by an offshore earthquake, volcano or landslide

urban based in or relating to a city or large town

urban renewal the redevelopment of an existing urban area, such as the urban renewal of former docklands to create housing

urban sprawl the continual expansion of suburbs at the edges of large cities onto natural or farming land

urbanisation an increase in the proportion of people living in urban areas

volcanic bomb large rocks launched high into the air during an explosive volcanic eruption

volcano a vent in Earth's crust from which lava, gas and ash can pour during a volcanic eruption

wadi a dry watercourse in a deep gorge that divides a plateau

wave when the surface of water moves up and down as energy created by wind (or earthquakes and volcanic eruptions) moves through the water; the wind forces the water to rise and gravity pulls it back down again

wave-cut platform a flat eroded area of rock at the base of a coastal cliff

weathering a process where rock is worn away, broken down or dissolved into smaller and smaller pieces by water, heat and cold; chemical weathering is a chemical change in a rock, while mechanical weathering involves rocks being broken into pieces

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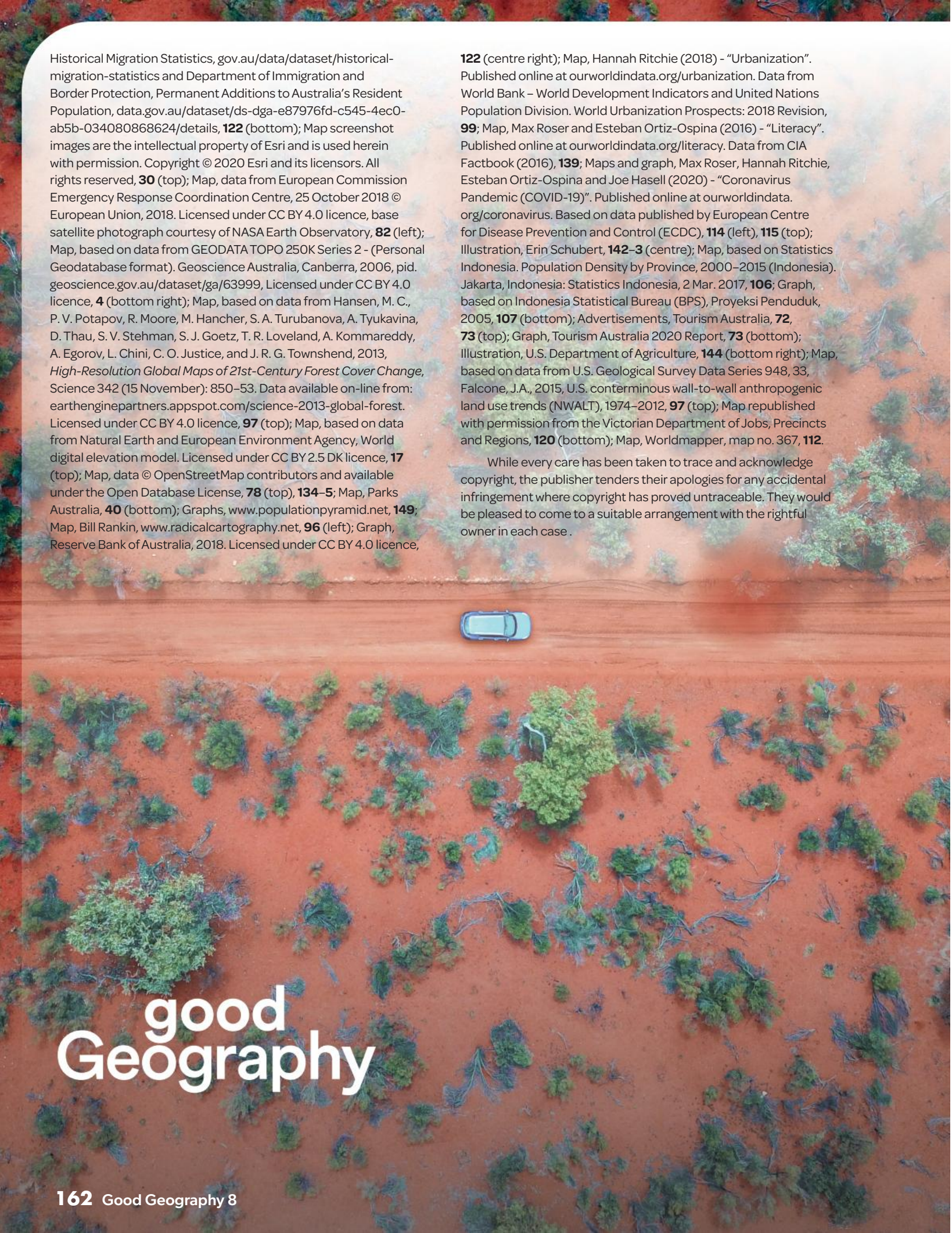

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