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WRITTEN TO
THE FINAL
AUSTRALIAN
CURRICULUM

mark easton

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Using Oxford Big Ideas Geography

Oxford Big Ideas Geography is a brand-new series developed and written to meet the requirements of the Australian Curriculum: Geography across Years 7 to 10. Based on the big ideas framework, it follows an inquiry-based approach that encourages students to develop deep, transferable skills and understanding in Geography.

Big questions

Each chapter of Oxford Big Ideas Geography is structured around key inquiry questions from the Australian Curriculum: Geography – supporting teachers and students as they implement an inquiry-based approach to Geography.

Stunning full-colour photography generates discussion and interest



Engaging learning

Each chapter of the student book combines a range of engaging source materials – maps, photographs, data tables, satellite imagery, graphs and illustrations – all with supporting questions and activities.

The learning sequence in each chapter is clearly set out under key inquiry questions. Students are encouraged to activate their prior knowledge and make predictions at the start of each new topic.



Stunning full-colour source materials inspire a sense of wonder about the world and encourage even the most reluctant learners to engage in geographical inquiry.

Australian Curriculum: Geography 8— Scope and sequence

Level description and key inquiry questions	
Level description	<p>There are two units of study in Year 8: Landscapes and landforms and Changing nations.</p> <p><i>Landforms and landscapes</i> focuses on investigating geomorphology through a study of landscapes and their landforms. This unit examines the processes that shape individual landforms, the values and meanings placed on landforms and landscapes by diverse cultures, hazards associated with landscapes, and management of landscapes. <i>Landforms and landscapes</i> develops students' understanding of the concept of environment and enables them to explore the significance of landscapes to people, including Aboriginal and Torres Strait Islander Peoples. These distinctive aspects of landforms and landscapes are investigated using studies drawn from Australia and throughout the world.</p> <p><i>Changing nations</i> investigates the changing human geography of countries, as revealed by shifts in population distribution. The spatial distribution of population is a sensitive indicator of economic and social change, and has significant environmental, economic and social effects, both negative and positive. The unit explores the process of urbanisation and draws on a study of a country of the Asia region to show how urbanisation changes the economies and societies of low- and middle-income countries. It investigates the reasons for the high level of urban concentration in Australia, one of the distinctive features of Australia's human geography, and compares Australia with the United States of America. The redistribution of population resulting from internal migration is examined through case studies of Australia and China, and is contrasted with the way international migration reinforces urban concentration in Australia. The unit then examines issues related to the management and future of Australia's urban areas.</p>
Key inquiry questions	<ul style="list-style-type: none"> • How do environmental and human processes affect the characteristics of places and environments? • How do the interconnections between places, people and environments affect the lives of people? • What are the consequences of changes to places and environments and how can these changes be managed?

Geographical knowledge and understanding	
Unit 1 – Landforms and landscapes	<ul style="list-style-type: none"> • The different types of landscapes and their distinctive landform features • The aesthetic, cultural and spiritual value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples • The geomorphic processes that produce landforms, including a case study of at least one landform • The human causes and effects of landscape degradation • The ways of protecting significant landscapes • The causes, impacts and responses to a geomorphological hazard
Unit 2 – Changing nations	<ul style="list-style-type: none"> • The causes and consequences of urbanisation, drawing on a study from Indonesia, or another country of the Asia region • The differences in urban concentration and urban settlement patterns between Australia and the United States of America, and their causes and consequences • The reasons for and effects of internal migration in Australia • The reasons for and effects of internal migration in China • The reasons for and effects of international migration in Australia • The management and planning of Australia's urban future

Geographical inquiry and skills

Observing, questioning and planning	<ul style="list-style-type: none"> • Develop geographically significant questions and plan an inquiry, using appropriate geographical methodologies and concepts
Collecting, recording, evaluating and representing	<ul style="list-style-type: none"> • Collect, select and record relevant geographical data and information, using ethical protocols, from appropriate primary and secondary sources • Evaluate sources for their reliability and usefulness and represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies • Represent the spatial distribution of different types of geographical phenomena by constructing appropriate maps at different scales that conform to cartographic conventions, using spatial technologies as appropriate
Interpreting, analysing and concluding	<ul style="list-style-type: none"> • Analyse geographical data and other information using qualitative and quantitative methods, and digital and spatial technologies as appropriate, to identify and propose explanations for spatial distributions, patterns and trends, and infer relationships • Apply geographical concepts to draw conclusions based on the analysis of the data and information collected
Communicating	<ul style="list-style-type: none"> • Present findings, arguments and ideas in a range of communication forms selected to suit a particular audience and purpose, using geographical terminology and digital technologies as appropriate
Reflecting and responding	<ul style="list-style-type: none"> • Reflect on their learning to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations, and predict the expected outcomes of their proposal

Year 8 achievement standard

By the end of Year 8, students explain geographical processes that influence the characteristics of places and explain how places are perceived and valued differently. They explain interconnections within environments and between people and places and explain how they change places and environments. They propose explanations for spatial distributions and patterns among phenomena and identify associations between distribution patterns. They compare alternative strategies to a geographical challenge and propose a response, taking into account environmental, economic and social factors.

Students identify geographically significant questions from observations to frame an inquiry. They locate relevant information from a range of primary and secondary sources to answer inquiry questions. They represent data and the location and distribution of geographical phenomena in a range of appropriate graphic forms, including maps at different scales that conform to cartographic conventions. They analyse geographical data and other information to propose explanations for spatial patterns, trends and relationships and draw reasoned conclusions. Students present findings, arguments and ideas using relevant geographical terminology and graphic representations in a range of appropriate communication forms. They propose action in response to a geographical challenge taking account of environmental, economic and social considerations and predict the outcomes of their proposal.

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A satellite-style map of East Asia, Southeast Asia, and Australia. The map shows topographical features like mountains and rivers, as well as land cover variations. The text is overlaid in white on the blue ocean background.

Landforms and landscapes
Changing nations

The geographer's toolkit

Geography is the study of the world around us. Studying geography helps us understand how the Earth works. This includes natural processes (such as volcanoes, floods and the weather) as well as human activities (such as mining, tourism and cultural practices).

Geographers use a range of key concepts and skills to study the world. Each of these concepts and skills is a tool that you can use to better understand your world. As you master each of these concepts and skills you will gradually fill your toolkit with a range of useful geographical tools.

Geographers are curious. They look at the Earth's features and always want to know more about them. For example, when they look at Uluru in Uluru-Kata Tjuta National Park, Northern Territory, shown in Source GT.1, they wonder about many aspects of this natural feature. They want to know about:

- its size
- its location
- what it is made of
- how it formed
- the types of plants and animals in the area
- its significance to Indigenous Australians
- the way it is used by people
- the way it is changing.

This curiosity and wonder gives geographers a special view of the world. You can share that view. Welcome to the wonderful world of Geography!



GT.1

Concepts for geographical understanding



Source GT.1 Uluru – an enormous sandstone rock formation in Uluru-Kata Tjuta National Park in the Northern Territory

GT.2

Geographical inquiry and skills

GT.3

Fieldwork in geography

GT.1 Concepts for geographical understanding

Geographers use seven concepts to help investigate and understand the world. At times you will use several of these at once, while at other times you may focus on just one. As you learn to use each of the key ideas you will begin to think like a geographer. The seven key concepts in geography are:

- place
- space
- environment
- interconnection
- sustainability
- scale
- change.

Place

Places are parts of the Earth's surface that are identified and given meaning by people. Your home and your school are important places for you because they are the places where you live and spend most of your time. A place can be as small as your bedroom or as large as the entire planet!

Places play an important role in the lives of every person on Earth. Places can be natural (that is, shaped by the environment and largely unchanged by humans) or built (that is, constructed by humans).

The life of every person and animal on Earth is influenced by place. Places determine our relationships with one another. Our closest relationships are likely to be with people in the same place. The environmental and social qualities of a place all influence the way we live. Climate, landscapes, types of plants and resources, transport networks, entertainment venues and workplaces all have a major impact on the way we live.

For Indigenous Australians, place also has a deeper spiritual meaning. Their sense of identity comes from their relationship with place. Aboriginal people have lived in the Kakadu region of Northern Territory for over 50 000 years. The region contains approximately 5000 rock art sites, some of which are over 20 000 years old. They represent the longest historical records of any group in the world. This was one of the reasons Kakadu National Park was World Heritage listed. Aboriginal people refer to their place as 'Country' and believe that they have a responsibility to look after it.



Source GT.2 An aerial view of Manhattan Island, New York City – an example of a built environment

Geographers use the concept of **place** when conducting any geographical inquiry. For example, a geographer visiting New York City in the United States (Source GT.2) would use the concept of place to help understand why people originally settled there, how the city was built and how it has changed over time.

They would also use place to investigate the important role the city plays in the lives of New Yorkers, Americans and people all over the world.

Just as place influences people, people also influence place. The ways in which we live, and the actions we take, change the places in which we live. Geographers investigate the outcomes of these changes. For example, by investigating the way in which human actions have altered the Brazilian Rainforest, geographers can learn how to better manage and care for our natural resources.

Space

To most people **space** means the empty universe but to a geographer it has a different meaning. Geographers investigate the way that things are arranged on the Earth's surface. They look for patterns and try to explain them. The concept of space helps them to do this. It has three main elements:

- location – where things are located on the Earth's surface
- spatial distribution – the shapes and patterns in which things are arranged on the Earth's surface
- organisation – how and why things are arranged and managed on the Earth's surface by people.

The concept of space can also be used to investigate some other important aspects of the world around us.

Geographers investigate the way that people use and change the space in which they live. They recognise that different groups of people use space in different ways and that this changes over time. They also investigate the ways that improvements in transport and communication have made links between places quicker and easier and the ways that this is changing the world.

The city of Shimabara in the south of Japan (Source GT.3) illustrates the concept of space well. The city has been built on a flat coastal area at the foot of an active volcano, Mount Unzen. Houses, schools and office buildings in Shimabara are linked by roads leading to nearby farms closer to Mount Unzen. The volcano clearly presents a danger to people living in the town. As Source GT.3 shows, the flow of superheated ash and rock from the volcano has buried part of the city as it makes its way to the sea. At first glance it may not be clear why anyone would risk living this close to a volcano, but closer analysis of the area reveals that the fertile volcanic soil in the area makes it ideal for growing crops.

The concepts of place and space can be difficult to separate, but it will help if you remember that places



Source GT.3 An aerial photograph showing the path of the hot ash and rock that flowed to the sea from Mount Unzen, an active volcano on the island of Kyushu in Japan. Part of the city of Shimabara (shown in the foreground) has been buried by the eruption.

can be divided into spaces. For example, a small place, such as your school, has different spaces. Each of these spaces has its own purpose. There are spaces for learning (such as classrooms and computer rooms), playing (such as playgrounds and play equipment), eating (such as the cafeteria or canteen) and running the school (such as staffrooms and administration buildings).

Larger places (such as your suburb, town or city) are also organised into different spaces. There are spaces for housing (such as homes for families), businesses (such as shops and offices), industry (such as factories and warehouses), entertainment (such as concert halls and theatres) and sport and recreation (such as stadiums, parks and gardens).

Our understanding of the location, patterns and planning of spaces helps geographers to make sense of our world.

Environment

The world in which we live is made up of many different **environments**. Some environments are natural (or physical), such as deserts, grasslands, mountains, coral reefs, forests, oceans and ice caps. In order for an environment to be considered natural its soils, rocks, climate, plants and animals must remain largely untouched by humans. Today there are very few truly natural environments left on Earth.

Other environments have been so altered by humans that very few natural features remain. These environments are known as built (or human) environments and include large cities, towns, suburbs and vast areas of farmland. Human environments not only affect natural features (such as soil, plants and animals) they also affect the climate. A large city, such as New York, has its own microclimate. It will often be a few degrees hotter than the surrounding areas because concrete in the buildings traps the Sun's heat. Skyscrapers also catch and funnel the wind, increasing its speed.

Most environments on Earth are now a combination of natural and human features. For example, Antarctica,

the harshest environment on the planet, is considered a natural environment despite humans having altered some areas of it. These changes have included the building of a number of permanent research bases and the carrying out of various scientific studies both on land and sea. The McMurdo research base, for example, operated by the United States (Source GT.4), has three airfields, a harbour and more than 100 buildings. In addition to these built structures other human influences have affected this environment. The warming of the planet has contributed to the increased melting of ice shelves, and pollution of our oceans has had an impact on sea and land animals in Antarctica.

The study of different environments helps geographers to better understand and appreciate natural processes, such as how weather works, how mountains are formed and how rainforests and coral reefs grow. The concept helps geographers to analyse the changes humans make to natural environments and better appreciate their impact so that they can be managed more wisely.



Source GT.4 A scientist looking out over McMurdo Station at Observation Hill in Antarctica. The line between the natural and built environment is clearly illustrated in this photograph.



Source GT.5 Bangladesh is one of the countries most vulnerable to climate change because of a number of interconnected processes that are causing sea levels to rise. It is estimated that 15 million of the poorest people living in Bangladesh, like those living in this slum, will be affected by a 1-metre rise in sea levels.

Interconnection

No place or thing on Earth exists in isolation. All environments on Earth and every living and non-living thing found within them are connected. These connections can be on a local level or a global level.

Geographers use the concept of **interconnection** to better understand the complex links between natural and human processes that shape our Earth. Places and people can be linked in many different ways that can be categorised as:

- natural processes, such as the water cycle and food chain
- human activities, such as the movement of people, the production and trade of goods and the flow of investment and money within and between different countries.

It helps to think of the Earth as a single living organism, much like your body. Your brain, heart, lungs, stomach, arms and legs all work together

as a single system to keep you alive and healthy. In much the same way, the Earth's living systems (such as the climate, plants, animals, oceans, soils, and the atmosphere) all function together and are interconnected. Even a slight rise in the Earth's temperature, for example, will have an effect on the oceans (such as damaging coral reefs and affecting the populations of fish and other sea creatures), the land (such as failure of crops and drought) and the polar ice caps (such as increasing sea levels and forcing millions of people to relocate their homes). Source GT.5 shows a slum in Bangladesh, the most densely populated country in the world. Bangladesh is slightly larger than England in size, but is home to 150 million people; this is three times the population of England. Its coastal zone has a very low elevation above sea level, making it one of the countries most vulnerable to climate change through rising sea levels.



Source GT.6 A Minke whale and her one-year-old calf are being dragged on board the Japanese factory ship *Nisshin Maru*. Anti-whaling activists argue that the number of whales hunted by the Japanese each year is unsustainable.

Sustainability

The concept of **sustainability** relates to the ongoing capacity of Earth to maintain all life. This means developing ways to ensure that all resources on Earth are used and managed responsibly so they can be maintained for future generations.

Sustainable patterns of living meet the needs of the current generations without compromising the ability of future generations to meet their own needs. Many of the world's resources (such as oil, coal and natural gas) are non-renewable. This means that if we continue to use them they will one day run out. Other resources (such as wind, forests, solar and water) are renewable. This means that they replace themselves naturally, or can be replaced to meet the needs of society. Sustainability encourages us to think more closely about these different types of resources – the ways in which they are formed and the speed at which they are being used. It also encourages us to look more closely at renewable options and take greater care of the Earth. Actions to improve sustainability can operate at a number of levels:

- **Local** – Recycling of paper and plastics by individuals, schools and households reduces the amount of trees that need to be cut down and oil that needs to be drilled to produce plastic bottles and bags.
- **National** – In Australia the government has begun to encourage sustainable use of energy through the establishment of wind farms and hydroelectric power plants and measures to promote the use of solar panels.
- **International** – Efforts to protect endangered whale species around the world have attracted media attention and focused public opinion on maintaining breeding grounds free of large whaling vessels (Source GT.6).

Sustainability is an important concept for geographers. They use it to investigate how natural and human systems work, and understand how resources can be managed in such a way that they will be sustained into the future.

Scale

The concept of **scale** is used to guide geographical inquiries. Geographers study things that take place on many different spatial levels – meaning from small areas (such as a local park) to very large areas (such as the use of oil and coal all over the world). They use the concept of scale to look for explanations and outcomes at these different levels. A geographic inquiry of the ways in which people use parks, for example, may be carried out at a range of scales (from smallest to largest):

- local – such as an inquiry into the daily visitors to a neighbourhood skate park, the types of facilities there and whether these facilities meet the needs of visitors
- regional – such as an inquiry into the types of visitors staying at campsites and tourist parks in the Grampians region of Victoria
- national – such as an inquiry into the yearly tourist numbers visiting national parks in Australia (such as Kakadu National Park and Christmas Island National Park), including the impact these visitors have on our National Parks, the way in which these parks are managed, and on what levels Indigenous people are involved
- international – such as an inquiry into animal poaching in national parks and wild game reserves in different countries across Africa (such as South Africa, Kenya, Tanzania and Madagascar)
- global – such as an inquiry into the use of all marine parks around the world and their effectiveness in protecting different species of marine animals.



Source GT.7 Geographical inquiries can be carried out on a number of different spatial levels – local (e.g. at a nearby skate park); regional (e.g. at a campsite in the Grampians region of Victoria); national (e.g. at national parks across Australia); international (e.g. in different countries across Africa); and global (e.g. at marine parks all over the planet).

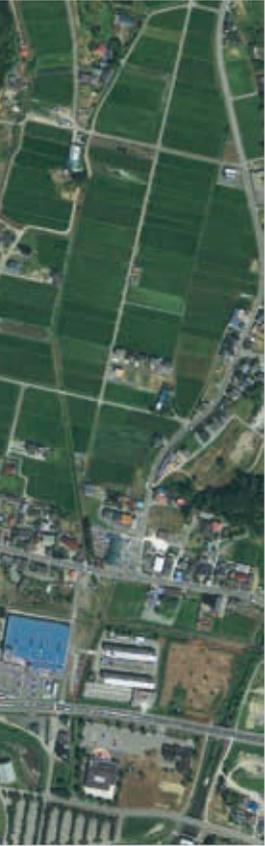
Change

The Earth is constantly changing. Some changes occur very rapidly and are easy to see, while others take place over millions of years and are almost undetectable to us. The concept of **change** is important in geography because it helps us to understand what is happening around us and see the world as a dynamic place. Over millions of years, the Earth has been shaped and changed by natural forces, such as climate, earthquakes, volcanoes, running water and storms to name just a few. In more recent times humans have shaped and changed the Earth to suit their own needs, but events such as volcanic eruptions and tsunamis are a reminder that powerful natural forces continue to alter the face of the Earth regardless of what humans do.

Changes take place on many different levels, from personal and local right through to national and global. Small local changes that happen quickly, such as a tree falling over on your street or a creek flooding, are often easy to observe and explain. Larger regional or national changes, such as an earthquake or tsunami, can happen quickly and their effects can be widespread and have devastating impacts on places and people (see Source GT.8). Changes that take place on a global scale can take much longer to occur. Global warming, for example, is a long-term change that happens slowly. Global warming has widespread effects that are not easily explained.

Observing and understanding changes that are natural and/or are made by humans and have occurred over time is an important part of any geographical inquiry. Geographers need to look at different types of changes, why they have occurred, over what time period they have occurred and what further changes may take place as a result. Sometimes changes can be positive, such as the conservation of plants and animals in national parks, while other changes can have negative consequences, such as the deforestation of native rainforests in Indonesia. Geographers play an important role in ensuring that change is managed in a sustainable way.





Source GT.8 The changes that took place in a Japanese coastal suburb of Rikuzentakata as a result of a tsunami in March 2011 were devastating and very rapid. The top image shows the area before the tsunami and the bottom image shows the same area after it had struck.

Check your learning GT.1

Remember and understand

- 1 Examine the photo of Uluru (Source GT.1). Is this a natural or built environment? Give reasons for your answer.
- 2 New York City (shown in Source GT.2) is one of the world's largest cities. List five ways in which this built environment would affect how people live and work.
- 3 Look carefully at Source GT.3. Why have people settled in this location? Describe the pattern formed by the houses in the township.

Apply and analyse

- 4 Here are some examples of changes that may be occurring on Earth at any given time:
 - a new supermarket is being built near your house
 - trees are being planted on your street
 - the polar ice caps are melting
 - a tornado is destroying a town in the USA
 - the Great Barrier Reef is being damaged by the Crown-of-thorns starfish.
 - a Conduct some research online in order to rank these changes from the slowest to the most rapid.
 - b Which of these changes are caused by human activities and which are caused by natural processes?
 - c Identify the scale at which each of the above changes takes place; that is, local, regional, national, international or global.
- 5 Using Source GT.5, explain the chain of events that would lead to flooding in this slum area of Bangladesh. Describe how and why slum dwellers would be more affected by this event than the wealthy.
- 6 List three ways in which your school or household is addressing the concept of sustainability. Which of these do you believe is most successful? Why?
- 7 Examine Source GT.6. Work with a partner to conduct research on the importance of the Southern Ocean Whale Sanctuary in conserving endangered whale species.
- 8 Study Source GT.8. Identify the major changes to the Japanese coastal suburb as a result of the tsunami. How might an understanding of the concept of change be useful in guiding the rebuilding or relocation of the suburb?
- 9 Your class is undertaking research on the Great Barrier Reef. Develop one question for each of the seven geographical concepts discussed in the text.

Evaluate and create

- 10 Create a diagram, such as a flow chart, to show the interconnection between the natural and built environment at Antarctica's McMurdo Station (Source GT.4). Include information on such aspects as climate, landforms, wildlife and human settlement (especially waste management and change to the natural environment).
- 11 Choose one of the key concepts that has been discussed. Design a poster for your geography classroom to help you and your classmates remember this concept and use it in geography.

GT.2 Geographical inquiry and skills

Geography has been described as the ‘why of where’. Geographers examine the world and try to explain what they see. Like a detective at the scene of a crime they follow a line of inquiry – they ask questions, collect evidence, analyse the evidence to find an answer, communicate their findings, reflect on what they have found out and, finally, decide on a course of action.

To follow a line of inquiry geographers need a range of skills. By studying geography you will gradually master each of these skills. Some of them you will find easy to master; others may take a little longer. As you develop each new skill you will have gained another important tool for explaining the natural processes and human activities that shape our amazing planet.

Each of the skills you will learn over the course of this year is explained in this section. It might help you to think of each of these skills as individual tools in your toolkit. For some geographical inquiries you may only need to use one tool; for others, you may need to use many.

Observing, questioning and planning

Observe the world and its geographical characteristics

Developing an awareness and understanding of our world begins by observing the processes that are taking place in it. Geographers look at people, land, air, water, plants and animals and the connections between them to understand what is happening. They also seek to investigate where, why and how natural and built environments are formed and changed. These observations often include identifying any problems or issues that need to be investigated and resolved.

Seeing the world through a geographer’s eyes

All good geographical inquiries begin by observing something in the natural or built world around you.



Source GT.9 The skills needed by every geographer. Think of each of these skills as a tool in your geographer’s toolkit.

If you look out the window of your classroom you will become aware of your surroundings. Is it a sunny day? Is it windy? Can you see any buildings or trees? Are there any clouds?

Even though you may look out this window on most days and take what you see for granted, these simple questions can easily become the basis of a number of different geographical inquiries. If the sun is shining, you might like to begin an inquiry into the hours of sunlight and the pattern of temperatures in your area. If it is windy, you might like to begin an inquiry into what direction the wind is coming from, how strong it is and why. If you can see lots of trees or buildings, you might like to begin an inquiry into what type of environment you are in and the different forces that have shaped it. Once you have observed what is around you, the next stage is to develop some geographical questions to focus your inquiry.

Develop geographical questions about the human and environmental processes shaping places

Geographers ask lots of questions. Geographical questions can be as simple as 'What is it?' and 'Where is it?', or more complex, such as 'What is the connection between these two things?' and 'How and why have things changed over time?'

As a geographer, no longer will you look at something in your world, such as Uluru, and only think of it as an interesting place to visit. Instead, you will begin to ask questions about how it was formed and came to look the way it does. You will also start to ask questions about the area in which it is located, its vegetation, how it is used and managed and its significance for Indigenous Australians.



Source GT.10 Developing geographical questions is an important part of a geographical inquiry

skilldrill

Developing geographical questions

Study Source GT.10. This visitor to Uluru is asking some important geographical questions. You can learn to do this too by starting your questions with the words 'what', 'where', 'how', 'why', 'what impact' or 'what should' when thinking about a particular feature or place.

Your questions should deal with ideas such as:

- Where is it?
- How many are there?
- How big is it?
- What pattern or shape is it?
- Why is it like this? Is it like this because something else is at this location?
- How does it interact with other things in this place?
- Who interacts with it?
- Is it changing? If so, why is it changing and what will it look like in the future?
- How should people best manage this change?

The very best questions open up an exciting area for you to explore. For example, the visitor might ask a simple question, such as 'How big is Uluru?' This is a question with a relatively simple answer. A better geographical question for the visitor to ask would be 'Why is Uluru so big?' This question opens up a whole new area for her to explore.

Apply the skill

- 1 Why would it be better to ask 'Why is Uluru so big?' rather than 'How big is Uluru?'
- 2 Where could you look to find answers to the question 'Why is Uluru so big?'
- 3 Examine the photograph of Uluru at the beginning of this chapter. Work with a partner to develop geographic questions about this landscape.

Plan and implement a simple geographical inquiry

Once you have asked a range of more general questions about a geographical feature or issue, it is time to select one question that will become the focus of your inquiry. When you have chosen this, it is useful to decide what data is needed to answer the question and how to collect the data.

Planning a geographical inquiry about Uluru

Having chosen to investigate the key inquiry question 'Is it a good thing that so many tourists visit Uluru?', you need to decide what data is needed to answer the question and how to collect the data.

Source GT.11 A guide for planning the direction of a geographical inquiry into Uluru

Key inquiry question	Data needed	Possible sources of data
Is it a good thing that so many tourists visit Uluru?	<ul style="list-style-type: none">Information on the importance and significance of Uluru to the Anangu, who are the Indigenous people in the areaInformation on the management and maintenance of the park	<ul style="list-style-type: none">Conduct fieldwork into visitor numbersCreate surveys and questionnaires for visitors to completeContact Parks Australia and Uluru-Kata Tjuta National Park for information on how the park is managedDownload resources from the Parks Australia website; for example, podcasts, maps, visitor guides, geological reports, audio tours and images

Check your learning GT.2

Remember and understand

- 1 Good geographers are like detectives. Why is this?
- 2 On your way to school you notice that bulldozers are clearing an area of bushland.
 - a How could this observation form the basis of a geographical inquiry?
 - b Write five different types of questions to assist you in your geographical inquiry into the clearing of this bushland.

Apply and analyse

- 3 There is a proposal to build a new shopping centre.
 - a Describe how a geographer would be able to find out what local people thought about the proposal.

- b What two additional issues may be linked to this geographical inquiry into the construction of a new shopping centre? One issue should relate to the natural environment and one should relate to the built environment.

Evaluate and create

- 4 Develop five questions that may assist a geographer in conducting an inquiry into the proposed development of a new shopping centre within his or her local area. Create a planning table similar to that used in the text for the inquiry into Uluru (Source GT.11).

Source GT.12 Kata Tjuta in the Northern Territory



Collecting, recording, evaluating and representing

Collect, record and evaluate primary and secondary data

Good planning and preparation will ensure that your geographical inquiry will run smoothly, be relevant and give you the answers you are looking for:

- collect and record the information you think you will need to answer your key inquiry question
- evaluate this information and data to determine that it is accurate and relevant
- represent your findings in an interesting and appropriate way (such as tables, graphs, maps and sketches).

Geographers find answers to their questions in many places. They may collect information themselves by interviewing people, taking photographs, making sketches out in the field or conducting surveys and questionnaires. This kind of information will generally only be relevant to a particular inquiry and is called **primary data**.

Often a geographer collects information that supports his or her inquiry but has not been specifically collected or designed by the geographer for the inquiry. This type of information is called **secondary data**.

Source GT.13 Examples of primary and secondary data

Some examples of primary data	Some examples of secondary data
<ul style="list-style-type: none">• Hand-drawn maps and field sketches• Photographs and images taken for the inquiry• Questionnaires and surveys designed and created for the inquiry• Graphs created from data (such as number of visitors, number of cars counted, and temperature and wind statistics) taken by the geographer for the inquiry	<ul style="list-style-type: none">• Information from textbooks, atlases, maps, graphs, reports and websites that were not created specifically for the inquiry• Data that was collected by a government department (such as census data), the media, companies and other organisations and was not collected specifically for the inquiry

Distinguish between quantitative and qualitative data

Primary and secondary data provide either **quantitative data** or **qualitative data**. Quantitative data includes anything that can be recorded as numbers (for example, Uluru is 3.6 kilometres long and 1.9 kilometres wide and has a circumference of 9.4 kilometres). Qualitative data, on the other hand, includes anything that can be recorded in words (for example, Uluru, one of Australia's best-known natural landmarks, is very large).

Source GT.14 Examples of quantitative and qualitative data

Some examples of quantitative data	Some examples of qualitative data
<ul style="list-style-type: none">• Climate and temperature statistics• Tourist numbers• Population figures (including birth and death rates)• Types and amounts of food grown• Plant and animal species and wildlife in certain areas• Forest clearance rates• Numbers of people killed in natural disasters• Numbers of volcanic eruptions and earthquakes	<ul style="list-style-type: none">• Opinions• Points of view• Personal stories• Likes and dislikes• Feelings

Good geographical inquiries will always be based on a combination of primary and secondary data that is both quantitative and qualitative. Even though qualitative data is an important part of any geographical inquiry, quantitative data is considered to be more valuable because it is less open to personal interpretations and can be more accurately represented in graphs and charts. Before you move to the next stage of your inquiry, it is important to check that you have recorded all your data without errors and that it is balanced and fair. Your data should not reflect your personal opinions, emotions or attitudes; instead it should present the facts in a clear and concise way.

Create maps and other graphic representations

Geographers often present the information they gather during their inquiries in a number of different ways. They often make maps, create graphs and tables or even draw diagrams to help them look for patterns in the data they have gathered. These tools also help people who were not involved in the inquiry (such as the general public, the government or people in the media) understand the work that has been done.

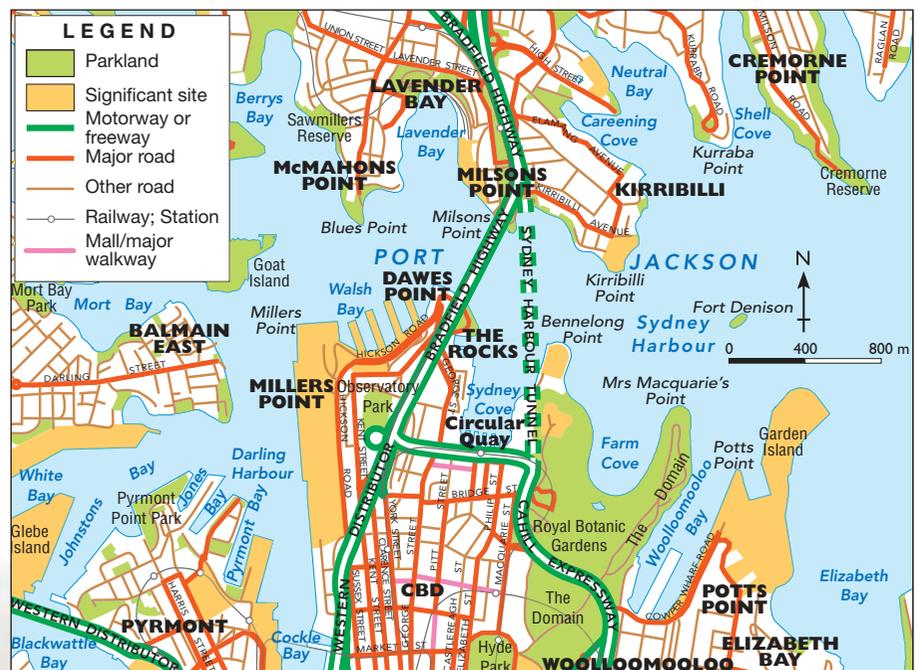
Creating maps

One of the most useful tools that geographers use to process information is a **map**. A map is a simplified plan of an area. Maps are drawn in the plan view (directly from above) because this ensures the scale will be the same across the entire area. If maps were drawn from an angle, some parts of the mapped area would look distorted and so it would not be an accurate representation of the area. When properly used, maps can reveal a great deal about our planet and the ways in which we use it.



Source GT.15 An aerial photograph of Sydney Harbour and the city

SYDNEY: HARBOUR AND CBD



Source GT.16 A map of Sydney Harbour and the city (as shown in GT.15)

Source: Oxford Atlas



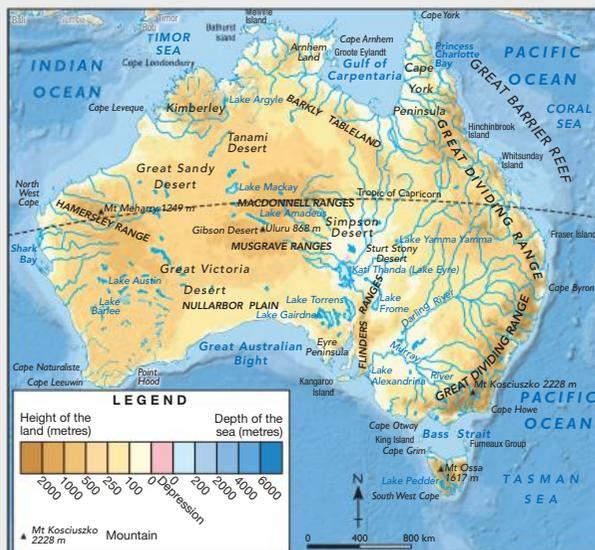
Simple maps

Geographers use different types of maps to show a whole range of different natural and built features – and the connections between them. This year you will be learning how to create a number of different types of maps and interpreting the information that they provide. These maps include:

Physical maps

Physical maps show the locations and names of natural features of the Earth. These may include deserts, mountains, rivers, plains, oceans, reefs, volcanoes and lakes.

PHYSICAL MAP OF AUSTRALIA SHOWING OCEANS AND MAJOR MOUNTAIN RANGES, RIVERS, LAKES AND DESERTS



Source GT.17

Source: Oxford Atlas

Political maps

Political maps show the locations and names of built features of the Earth. These may include country borders, state and territory borders, cities and towns.

POLITICAL MAP OF AUSTRALIA SHOWING STATE AND TERRITORY BORDERS, CITIES AND TOWNS



Source GT.18

Source: Oxford Atlas

Dot distribution maps

Dot distribution maps use dots (or shapes) to represent (and sometimes compare) a range of different features. The dots show the location of the chosen feature. The size and colour of the dots on the map can show different characteristics of that feature. For example, in GT.19, small towns are shown as small green dots and big cities are shown as big red squares. Other dot distribution maps show the location of a single feature, such as shops or hospitals. Dot distribution maps help to show patterns and links between features – geographers refer to this as spatial distribution.

DOT DISTRIBUTION MAP OF AUSTRALIA SHOWING POPULATION



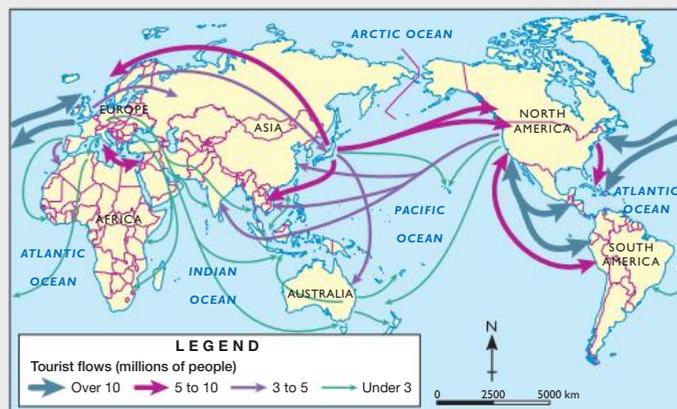
Source GT.19

Source: Oxford University Press

Flow maps

Flow maps show movement from one place to another. Arrows of different thicknesses and colours are used to show where different things (such as people or goods) are moving to and from, and compare the numbers involved in the movement.

FLOW MAP SHOWING THE FLOW OF TOURISTS WORLDWIDE



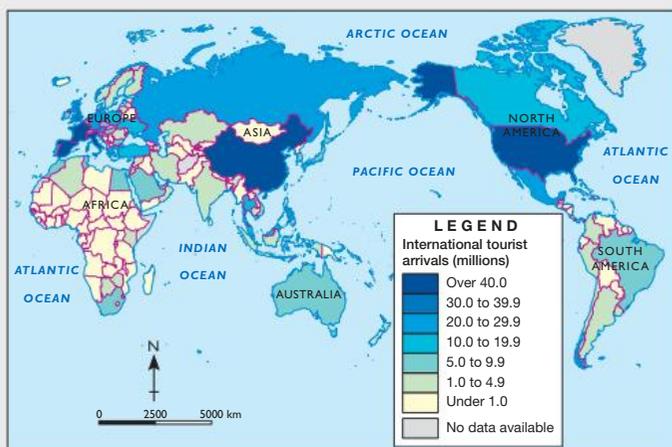
Source GT.20

Source: Oxford University Press

Choropleth maps

Choropleth maps use different colours or different shades of the same colour to give a quick impression of the pattern formed by the data being shown. Darker shades show the highest values or the greatest amounts, while lighter shades show the lowest values or the least amounts.

CHOROPLETH MAP SHOWING INTERNATIONAL TOURIST ARRIVALS WORLDWIDE

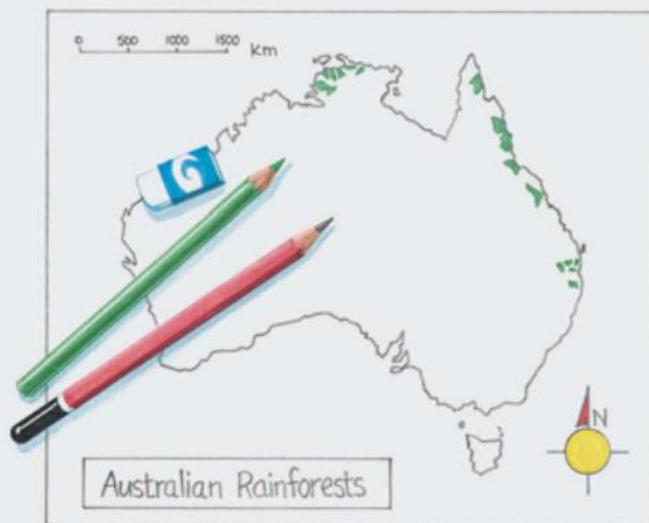


Source GT.21

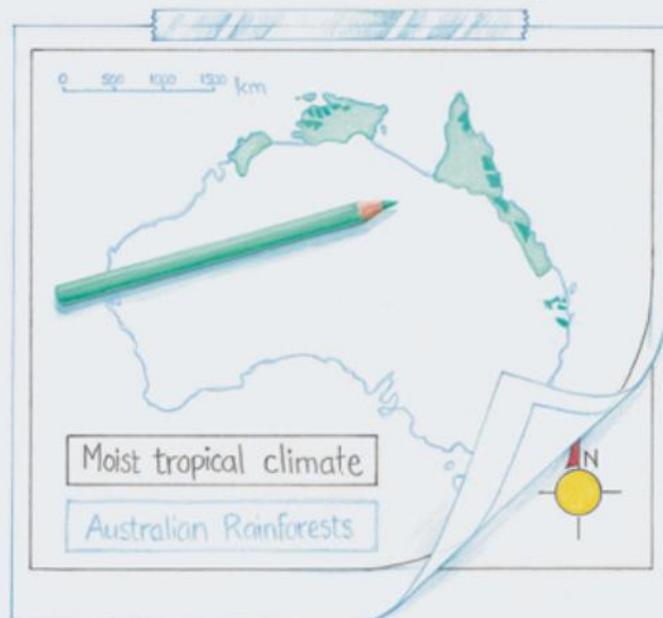
Source: Oxford Atlas

Overlay maps

Overlay maps show how features on the Earth's surface may be related to each other. To create an overlay map you first need to produce a base map showing one feature (such as the location of Australian rainforests) and then place a piece of tracing paper or plastic sheet over this base map showing the other feature you are investigating (such as areas with a moist tropical climate).



From Mongabay.com



From Mongabay.com

Source GT.22 An overlay map showing the location of Australian rainforests on a base map (top) and areas with a moist tropical climate on an overlay (bottom)

More complex maps

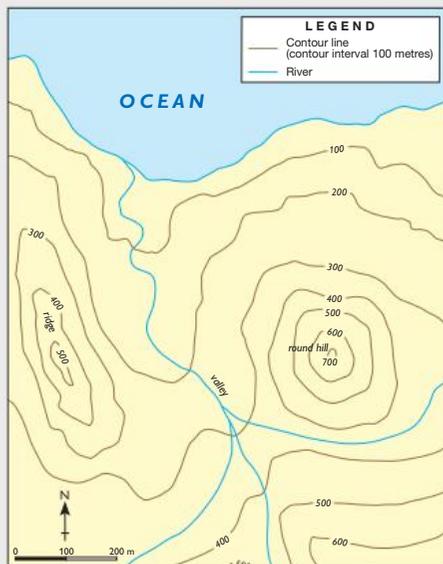
Over the course of the year you will also be working with a number of other, more complex maps. You won't necessarily be creating these maps yourself, but you will be learning how to make sense of the information they provide. These maps include:

Topographic maps

Topographic maps show the shape of the land (such as the shapes formed by valleys, hills and ridges) by using **contour lines**. Numbers on some of the contour lines show the height of the land above sea level. The closer together the contour lines are, the steeper the land. Symbols and colours are also used on topographic maps to show other natural features (such as forests, rivers and lakes) and built features (such as towns, roads and mines).

The contour patterns of three common features are shown below the topographic map in Source GT.23.

TOPOGRAPHIC MAP SHOWING A ROUND HILL, A VALLEY AND A RIDGE



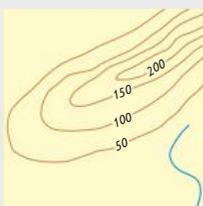
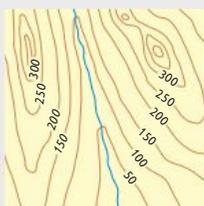
A ROUND HILL



A VALLEY



A RIDGE



Source GT.23

Source: Oxford University Press

Weather maps

Weather maps show conditions in the atmosphere, such as air pressure, wind speed and wind direction. They also show the size and location of warm and cold fronts. Weather maps are also known as synoptic charts. They are most commonly seen on the nightly news.



Source GT.24 Weather maps feature in the nightly news on television

Thematic maps

Thematic maps show a particular theme or topic; for example, the distribution of resources (such as coal and gas), the different types of forests around the world, access to safe drinking water, or the types of crops and animals farmed in Australia.

THEMATIC MAP OF AUSTRALIA SHOWING TYPES OF ANIMALS AND CROPS GROWN



Source GT.25

Source: Oxford University Press

Geographic Information Systems (GIS)

Geographic Information Systems (GIS) are a way of creating, viewing, organising and analysing geographical information with the use of a software application. GIS is an exciting new development in the world of geography because it allows geographers to access and share an incredible amount of data and look at the world in new ways. GIS are made up of three elements:

- digital base maps
- data that is layered over the base map (such as a chart, overlay or table)
- a software application or platform that links these elements together and allows the user to interact with all of this information.

GIS combine satellite images, graphs and databases to allow you to identify patterns and trends so that you can gain a better understanding of the world around you. They allow you to turn different layers of data on and off in order to isolate exactly what you are looking for. You can even create and share your own maps, look at 3-D models of areas and record video simulations, known as flyovers.

GIS is already a part of many people's everyday life. Governments, companies and individuals all around the world use GIS. There are a number of GIS platforms available today, but one of the most commonly used and free GIS is Google Earth.

Essential features of maps

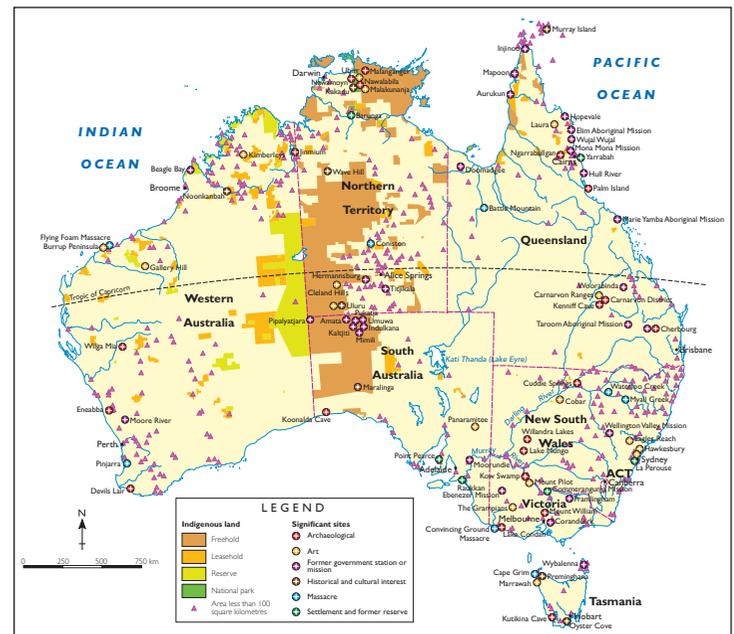
BOLTSS

Regardless of the type of maps you are creating or interpreting, all will share some common features. There are six features that ensure every map is drawn in a clear, concise and accurate way. To help you remember these features, remember you can use a mnemonic (memory aid) that consists of the first letter of each of the features. Together, these six letters make up the word **BOLTSS**:

- B** **Border** – an outline or box drawn around the map
- O** **Orientation** – an indication of direction, usually shown with a north arrow or compass rose
- L** **Legend** – an explanation of the symbols, colours and patterns used on the map (also known as a key)
- T** **Title** – a heading that describes the map and what it is showing
- S** **Scale** – a way of indicating what distances on the map represent in the real world. Scale can be shown in three different ways: as a written scale, a line scale or a ratio. Source GT.29 shows the three ways scale can be represented on a map.
- S** **Source** – where the information used to create the map came from. If these details are not known, simply write 'Source: unknown'. If you have created the map from your own data, simply write 'Source: own map' or 'Source: [add your name]'.

Source GT.26 shows a map of Australia that is held together with BOLTSS.

AUSTRALIA: INDIGENOUS LAND AND SITES, 2006



Source: *Oxford Atlas*

Source GT.26 A map of Australia showing all the features of BOLTSS

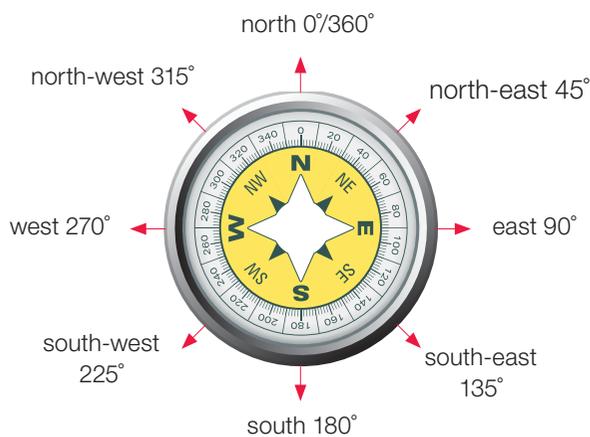
Direction

Direction must always be shown on maps because it enables the user to work out the location of features shown. Direction is shown on maps by the use of compass points. A compass is an instrument with a magnetised needle that will always point to the Earth's magnetic field near the north pole (known as **magnetic north**). The face of a compass shows a circle made up of 360 degrees (see Source GT.27).

The four main directions on a compass are north, south, east and west. These are known as **cardinal points**. Most maps are oriented to north. Once north has been established you can find the other points of the compass.

Using compass points is an accurate way of giving directions because the compass always points to magnetic north no matter which direction you are facing.

Compass bearings provide an even more precise way to give directions. A bearing is an angle that is measured clockwise from magnetic north. The bearing of magnetic north can be either 0 degrees or 360 degrees, the bearing of south is 180 degrees, the bearing of east is 90 degrees and the bearing of west is 270 degrees. These bearings are shown in GT.27.



Source GT.27 A compass face showing cardinal points and compass bearings

Scale

We use **scale** to shrink or increase real-world features so they will fit into a space. Model cars are scaled down in size and proportion from real cars.

The model shown in GT.28 looks like the real car, only smaller. It is a 1:35 scale model.

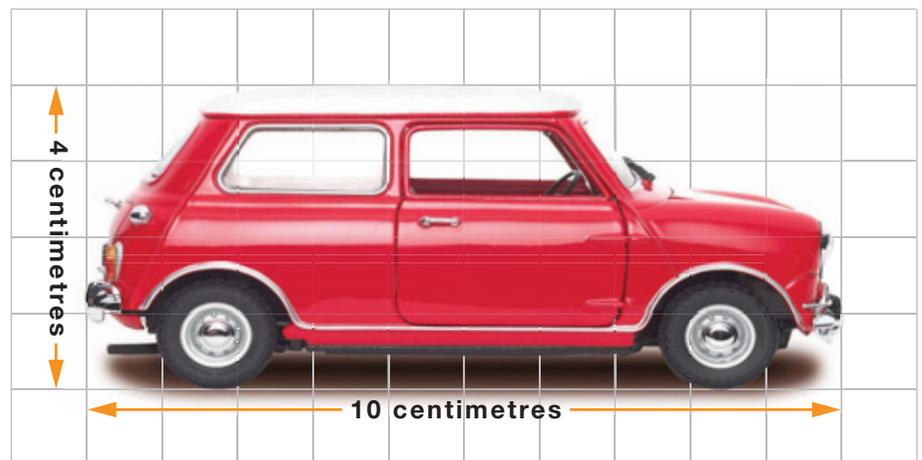
This means that 1 centimetre on the scale model is equal to 35 centimetres on the real car. If 1 centimetre represents 35 centimetres, then 10 centimetres (the total length of the model) represents a total length of 350 centimetres (or 3.5 metres) on the real car.

Scale on maps

Maps are scaled representations of real areas. These representations have been designed to fit on a piece of paper or on a computer screen. Maps look the same as the real areas they are representing, just reduced to a size you can work with. Scale on maps allows you to work out the distances in the real world.

Look at the map of Tasmania (Source GT.29). In the bottom left-hand corner it shows the three types of scale that can be used on maps and how they work:

- **Written scale** – A written scale tells you how much a distance on the map represents on the ground. The written scale on Source GT.29 is '1 centimetre on the map measures 30 kilometres on the ground'. Using this information we can easily work out that 5 centimetres on the map would be equal to 150 kilometres on the ground, and so on.
- **Line scale** – A line scale is a numbered line that acts like a ruler. You can use it to measure distances on the map. The Source GT.29 line scale shows 1 centimetre is equal to 30 kilometres.
- **Ratio scale** – A ratio scale shows scale in numbers. The ratio scale for Source GT.29 is 1:3 000 000, so 1 unit (that is, 1 centimetre) on the map represents 3 000 000 centimetres on the ground. Of course, 3 000 000 centimetres is equal to 30 kilometres.



Source GT.28 This model car is 35 times smaller than the real car. This is expressed as 1:35.

skilldrill

Using line scale to measure distances

Scale is a handy tool to help you study the world around you from inside your classroom. Look at Source GT.29. You will notice that all the features on the map have been shrunk by the same amount so that they fit on the page.

You can use the line scale to measure the distance between two points 'as the crow flies' (that is, in a straight line) by following these steps:

- Step 1** Place the straight edge of a sheet of paper over the points you wish to measure.
- Step 2** Mark the starting and finishing points on the paper.
- Step 3** Hold the edge of the paper against the line scale to work out the real distance between the two points.

Apply the skill

- 1** Use Sources GT.29 and GT.30 to answer the following questions:
 - a** How far is it from the peak of Cradle Mountain to the centre of Hobart as the crow flies?
 - b** How far is it from Devonport in the state's north to Queenstown in the west as the crow flies?
 - c** How long is Lake Gordon from north to south?
 - d** How wide is the state of Tasmania at its widest point?

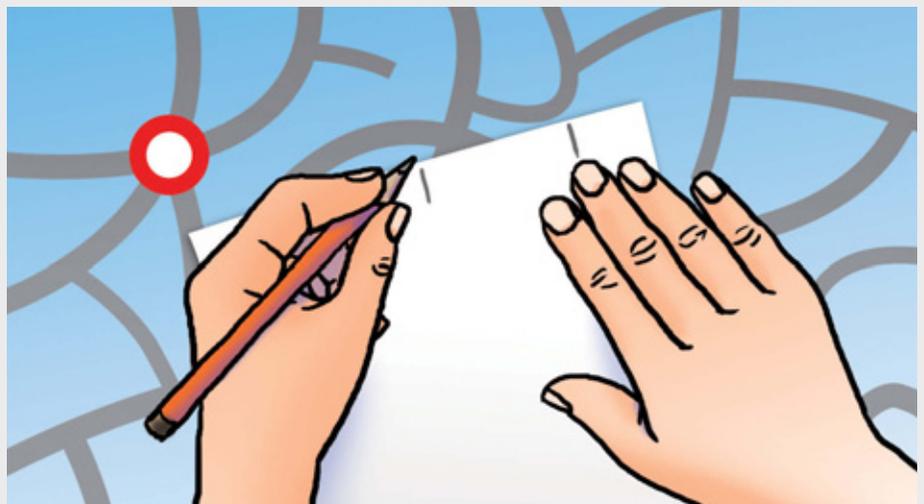
Source GT.30 Measuring straight distances on a map using a sheet of paper

TASMANIA



Source GT.29

Source: Oxford Atlas



Comparing map scales

Maps are often shown at different scales depending on the amount of detail they need to show. Source GT.31 shows three maps at different scales:

- Map 1 is a large-scale map. It shows a large amount of detail but only a small area. You can see the city area (in pink) and Lake Burley Griffin.
- Map 2 is a medium-scale map. It shows a medium amount of detail and a medium area. You can see the whole of the Australian Capital Territory (ACT).
- Map 3 is a small-scale map. It shows a small amount of detail but a large area. You can only just see the border of the ACT.

ACT AND EASTERN AUSTRALIA



Large-scale maps show detailed information about a small area.

Small-scale maps show general information about a large area.

Source GT.31

Source: Oxford University Press

Remember:

- Large-scale maps show a **large** amount of detail, but a **small** area.
- Small-scale maps show a **small** amount of detail, but a **large** area.

Locating places on maps

Maps are used for many different purposes, but the most commonly used maps help us to find things we are looking for. These maps are often overlaid with a set of lines that form a grid. These gridlines divide the map into smaller areas and help us find places more easily. There are a number of ways in which you can locate things on maps and a number of methods you can use to help other people find these places. Some of these methods will give you a general idea of where something is, while others can help you pinpoint the exact location of something.

SURFERS PARADISE STREET MAP



Source GT.32

Source: *Brisway*

Grid and area referencing

Alphanumeric grid referencing

In maps that use alphanumeric grid referencing the spaces between gridlines are labelled with letters and numbers. The letters appear along the bottom (or top and bottom) of the map while the numbers appear down the left-hand side (or both sides) of the map. For example, in Source GT.32 the grid reference for the Paradise Centre is J6.

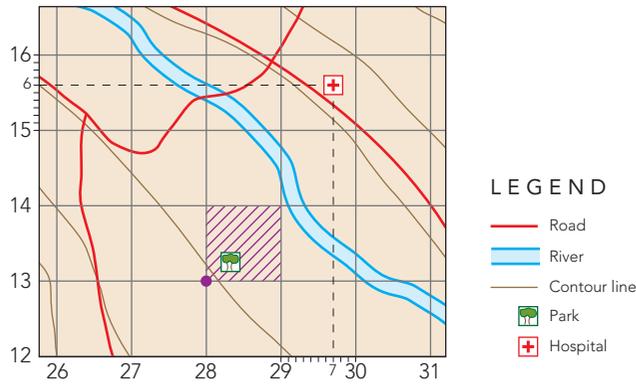
Area referencing (AR)

The area referencing (AR) method is used on topographic maps that have gridlines. Each line is given a two-digit number. The lines that run up and down the map are known as **eastings** (because the numbers increase as you move east). The lines that run across the map are known as **northings** (because the numbers increase as you move north). A four-figure area reference will pinpoint the bottom left-hand corner of the grid square in which you will find the feature. The eastings are given first then the northings. For example, in GT.33 the park is located in AR2813.

Six-figure grid referencing (GR)

Six-figure grid references (GR) help locate exact points on a topographic map. The area between each easting is divided into 10 further parts (tenths), as is the area between each northing. This is just like adding a finer set of gridlines over the existing gridlines, allowing you to be very specific about where things are within each grid square. As with area referencing, the eastings are given first then the northings. The difference is that one more figure is added to the easting and one more figure is added to the northing. This makes six figures in total. For example, in GT.33 the hospital is located at GR297156.

TOPOGRAPHIC MAP EXTRACT SHOWING AR AND GR



Source GT.33

Source: Oxford Atlas Project 3

Latitude and longitude

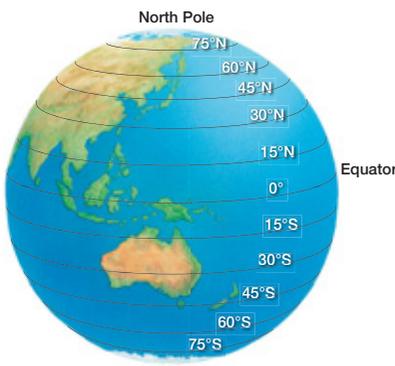
Maps that show large areas of the Earth's surface (such as world maps) use a set of imaginary lines that form a grid. These gridlines, known as **latitude** and **longitude**, help us to locate places accurately.

Lines that run from east to west are known as lines (or parallels) of latitude. Lines that run from north to south are known as lines (or meridians) of longitude. Each of the lines is separated by degrees rather than distance because the world is round, not flat.

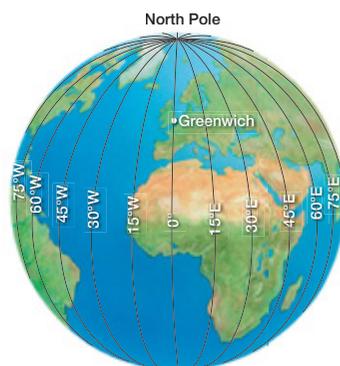
The line of latitude midway between the north pole (90 degrees north) and south pole (90 degrees south) is known as the **Equator**, which is located at 0 degrees latitude. It divides the Earth into the northern hemisphere and southern hemisphere.

Lines of latitude are measured in degrees north and south of the equator.

Lines of longitude are measured east and west of the Greenwich meridian (also known as the Prime Meridian), which is located at 0 degrees longitude.



Source GT.34 Lines (or parallels) of latitude



Source GT.35 Lines (or meridians) of longitude

Remember:

- Latitude – think 'lat is flat'.
- Longitude – think 'long is long'.

Creating graphic representations

In addition to maps, geographers use a range of other visual representations to communicate information they have collected. These include:

- Tables – These allow geographers to present and compare data by organising it under different headings (see Source GT.36).
- Diagrams – These allow geographers to show the features or characteristics of some places or things much more effectively than describing them in words. Certain interesting or complex processes can also be more easily explained and demonstrated with the help of sketches, flow charts or illustrations (see Source GT.34 and Source GT.35).
- Graphs – These allow geographers to compare data and present it in an interesting and attractive way. There are a number of different types of graphs used by geographers for different purposes. The most common of these are explained on the following pages.

Source GT.36 A table showing the populations of Australian states and territories in 2011

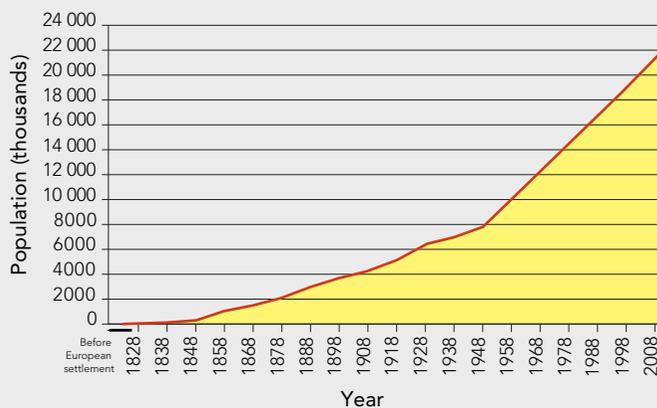
State/Territory	Population	Percentage of Australia's population
New South Wales	7 317 500	32.3
Victoria	5 640 900	24.8
Queensland	4 599 400	20.3
Western Australia	2 366 900	10.4
South Australia	1 659 800	7.3
Tasmania	511 000	2.3
Australian Capital Territory	366 900	1.6
Northern Territory	231 200	1.0
Australia	22 693 600	100.0

Simple graphs

Graphs are one of the most effective graphical representations when it comes to showing numerical (or quantitative) data. Some kinds of graphs are simple, while others are more complex. This year you will be learning how to create a number of different types of graphs and interpreting the information that they provide. Some of these graphs are described below.

Line graphs

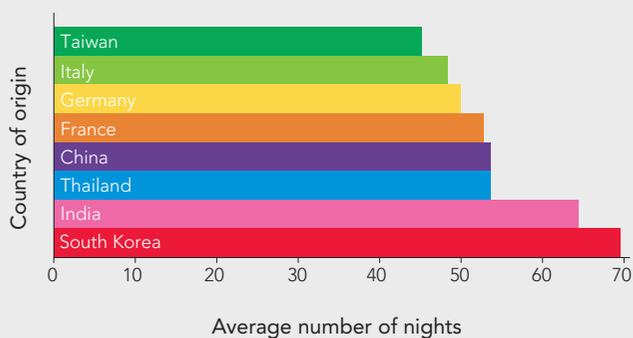
Line graphs show information as a series of points that are joined up to form a line. The line shows a trend or change over time. The horizontal axis (x) will usually show units of time and the vertical axis (y) will usually show amounts.



Source GT.37 A line graph showing the increase in Australia's population, 1828–2011

Bar graphs

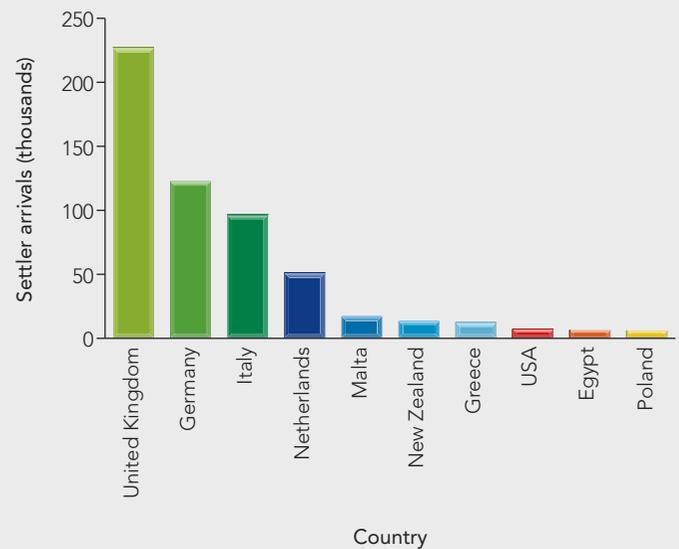
Bar graphs show information as a series of bars that run in a horizontal direction and are stacked one on top of the other. They are usually used to compare quantities.



Source GT.38 A bar graph showing average number of nights spent in Australia by tourists from different countries, 2009

Column graphs

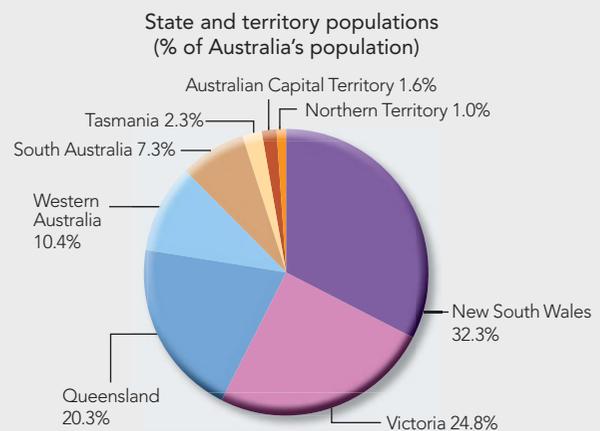
Column graphs are similar to bar graphs, but they show information as a series of vertical columns that are arranged side by side. They are also usually used to compare quantities.



Source GT.39 A column graph showing top 10 countries of settler arrivals in Australia, 2010–11

Pie graphs

Pie graphs are shaped like a circle and are divided up so that the information being shown represents the slices of a pie. The circle of 360 degrees represents 100 per cent and each of the slices is a percentage of that. The slices of the pie are organised from largest to smallest in a clockwise direction starting from 12 o'clock.



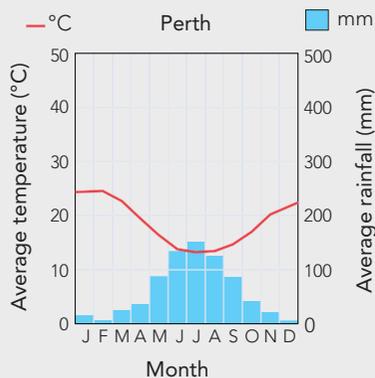
Source GT.40 A pie graph showing state and territory populations as a percentage of Australia's total population, 2011

More complex graphs

Over the course of the year you will also be working with a number of other, more complex graphs. You won't necessarily be creating these yourself, but you will be learning how to make sense of the information they provide. Some of these graphs are described below.

Climate graphs

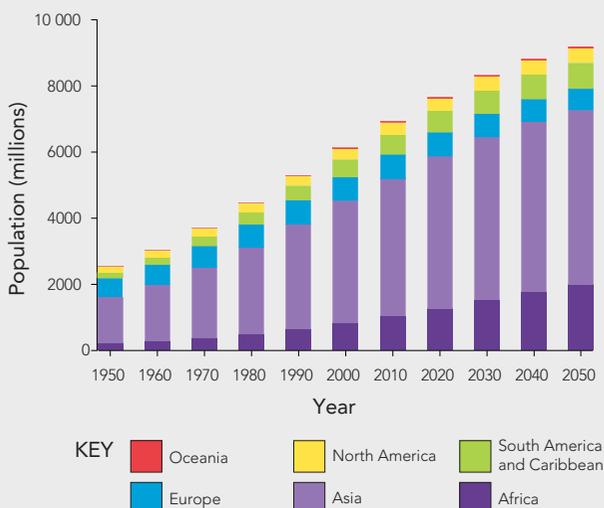
Climate graphs show the average monthly temperature and rainfall for a place over a year. Climate graphs combine line and column graphs. Temperature is recorded as a line graph and rainfall is recorded as a column graph.



Source GT.41 A climate graph showing the average monthly temperature and rainfall in Perth

Compound column graphs

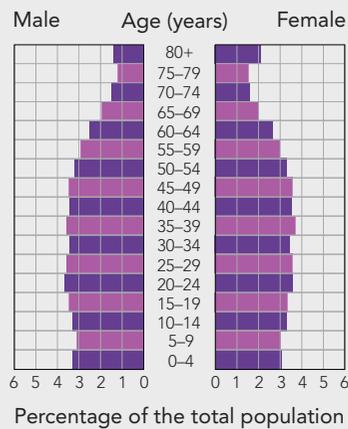
Compound column graphs are a more complex type of column graph in which each column is split into sections so results can be more easily compared.



Source GT.42 A compound column graph showing the increase in world population by region, 1950–2050

Population pyramids

Population pyramids are bar graphs that show the percentage of males and females in different age groups in a population. They help geographers identify trends in population growth in a country. Population pyramids are organised so that younger age groups are at the bottom and older age groups are at the top. Percentages of males are placed on the left-hand side and percentages of females are placed on the right-hand side.



Source GT.43 A population pyramid for Australia in 2009. From it you can see, for example, that there are more females than males over the age of 80

Check your learning GT.3

Remember and understand

- 1 Give two examples of primary data and two examples of secondary data. What is the main difference between these two types of data?
- 2 What is a map?
- 3 What does BOLTSS stand for?

Apply and analyse

- 4 Look carefully at Source GT.29 and answer the following questions:
 - a What is the scale of the map? Give your answer in the form of a ratio.
 - b If you were flying from Marrawah to Port Arthur in which direction would you be travelling?

Evaluate and create

- 5 On a piece of graph paper, draw a simple map of your bedroom. Be sure to include all the furniture (for example, your bed and desk) in the correct location and to the correct scale. Make sure it has BOLTSS.
- 6 Look at Source GT.36 and construct a bar or column graph to represent this data graphically.

Interpreting, analysing and concluding

Use methods to identify trends, patterns and relationships in geographical data and draw conclusions

Once you have collected, recorded, evaluated and represented your data, it is time to identify any trends, patterns or relationships in the information. You will have used questionnaires and surveys to gather visitor statistics, drawn sketches and diagrams, created graphs and tables and taken photographs (all of which are primary data). You will also have collected information from various other sources, such as textbooks, websites, GIS and atlases (all of which are secondary data). Now it is time to look at this information, identify any possible links and relationships and draw conclusions.

There are a number of methods that geographers use to help them during this stage of their inquiries. These include the:

- PQE method
- SHEEPT method.

Using the PQE method

PQE is a tool used by geographers to analyse the data they have gathered (such as maps, tables, graphs and diagrams) and reach conclusions. The letters PQE stand for pattern, quantify and exceptions.

Pattern (P)

In this step, you need to give a general overview of any patterns you may identify.

When looking at any form of data, look for things that stand out or form patterns. A pattern may be a group of similar features on a diagram, a concentration of a particular colour or feature on a map, or a particular shape that is created by data on a column graph. For example, when looking at a physical map of Australia (see Source GT.44) you might say, 'Most mountains run along the coast in the east.'

Quantify (Q)

In this step, you need to add specific and accurate information to define and explain the patterns.

Quantifying involves using statistics, amounts, sizes and locations to give specific details. For example, rather than just saying 'Most mountains run along the coast in the east,' you would need to quantify this statement. You might instead say 'A mountain range known as the Great Dividing Range extends more than 3500 kilometres along the eastern coast of Australia from Queensland to Victoria. It is the third longest mountain range in the world.'

Exceptions (E)

In this step, you need to identify anything that does not fit your patterns.

Often you may find that there are things in your data that do not fit into a pattern you have identified. These are called exceptions. They also need to be identified and quantified. For example, you might say 'There are a number of other mountain ranges that are not on the east coast. These include the Flinders Ranges in South Australia and the MacDonnell Ranges in the Northern Territory.'

Using the SHEEPT method

SHEEPT is a tool used by geographers to help them consider the many factors that may contribute to the patterns identified in their data. When you are examining issues related to your inquiry, it is useful to think about them in terms of these six factors and rank them in order of importance. This will help you reach your conclusions. The letters of SHEEPT stand for:

- social (S) – factors relating to culture and people
- historical (H) – factors relating to past events
- environmental (E) – factors relating to the natural environment (including climate, landforms and vegetation)
- economic (E) – factors relating to the earning or spending of money (including income earned from industry and tourism and the cost of building a dam or highway)
- political (P) – factors relating to governments (including laws, regulations and policies)
- technological (T) – factors relating to the availability and use of different types of technology (including the development of greener technologies, alternative energy sources and GIS).

PHYSICAL MAP OF AUSTRALIA SHOWING OCEANS AND MAJOR MOUNTAIN RANGES, RIVERS, LAKES AND DESERTS



Source GT.44

Source: Oxford Atlas

Check your learning GT.4

Remember and understand

- 1 What do the letters PQE stand for?
- 2 What do the letters in SHEEPT stand for?
- 3 How can the PQE and SHEEPT methods assist us to identify trends, patterns and relationships in geographical data and draw conclusions?

Apply and analyse

- 4 Look at Source GT.44. Use the PQE method to think about Australia's lakes.
 - a Can you identify a pattern?
 - b Can you quantify this pattern?
 - c Are there any exceptions to this pattern?

Evaluate and create

- 5 Conduct your own Internet research on the way in which Uluru is managed and use the SHEEPT method to think more closely about the factors that impact on Uluru.
 - a List at least one point for each of the SHEEPT factors.
 - b What conclusion(s) can you make about the way in which Uluru is managed?
- 6 Create a colourful and informative pictogram (by adding an image or picture to each of the letters in the word SHEEPT) to help you and your classmates remember what each of the letters in SHEEPT stands for.

Communicating

Present conclusions using a range of communication forms and digital technologies

Geographers use a wide range of methods to inform other people about what they have found over the course of a geographical inquiry. After carefully considering their audience and the purpose of the inquiry they may choose to communicate their conclusions in a number of different ways. Some of the methods that geographers use to communicate their findings include:

- written methods, such as essays or reports
- oral forms, such as oral reports, presentations, discussions and debates
- graphic forms, such as maps, graph and diagrams
- visual forms, such as **annotated visual displays (AVDs)**, photographs, sketches, satellite images and posters
- digital forms, such as Wikis, Geographic Information Systems (GIS), databases, 3-D models and simulations, and multimedia presentations.

skilldrill

Creating an annotated visual display (AVD)

One of the most popular ways of presenting and communicating the findings of a geographical inquiry is to construct an annotated visual display (AVD). An AVD combines written text with visual images (such as photographs) and other graphic representations (such as maps, graphs, tables, sketches and diagrams).

To create a successful AVD there are a few steps to follow:

Step 1 *Gather your data*

Make sure that you have collected all the pieces of information and data that you have found and/or created throughout your inquiry. Print your photographs, tidy up your sketches and process any data that you have collected. Tables of raw data are usually much more effective when they are made into graphs (for example, bar graphs or pie graphs). Ensure that all your maps, including sketch maps, have BOLTSS. Each resource (such as a graph, map, sketch, photograph, cross-section or written explanation) must also have a title and, in the case of photographs, a caption.

Step 2 *Organise your results*

On a large sheet of poster paper, lay out all your information and data. All written descriptions and answers should be typed, or neatly printed, on separate sheets of white paper, not written directly onto the poster paper. This will allow you to arrange them on the poster paper in the most logical and relevant way before you glue them down. The key inquiry question that began your geographical inquiry may guide your final layout. In the following example, the focus question, 'Is it a good thing that so many tourists visit Uluru?', suggests that there will be three main parts to the AVD:

- information about Uluru and its physical features
- tourist statistics and other data that show the effects that visitors are having on Uluru and its surroundings
- an analysis of the data. A conclusion that answers the key inquiry question.

Step 3 *Present your results*

When you are happy with your layout, design a main heading and other smaller headings. Don't forget to write your name in small, neat letters next to the heading or at the bottom of the AVD. Use glue to stick your resources onto your AVD. You may like to draw borders around some information.

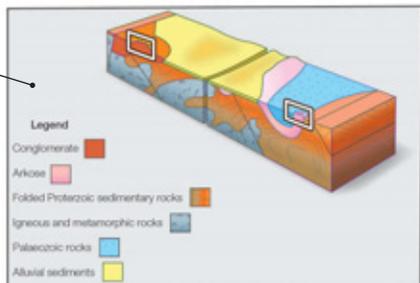
Step 4 *Acknowledge your sources*

If you have used books or other resources (such as websites) these need to be acknowledged in a bibliography or list of references. This can be stuck on the back of your AVD.

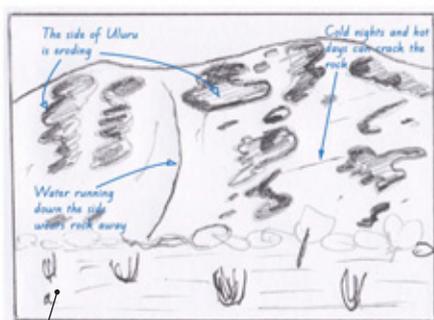
All diagrams, sketches, photographs and graphs must have a heading and a caption

Is it a good thing that so many tourists visit Uluru?

NATURAL PROCESSES



EROSION OF ULURU



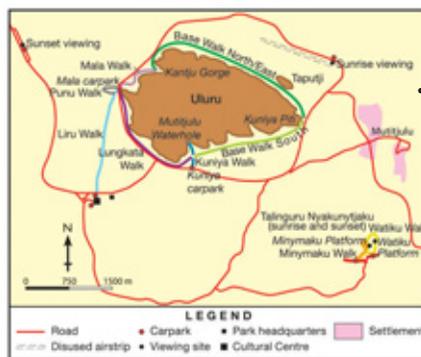
TOURISM AT ULURU

- _____
- _____
- _____
- _____
- _____
- _____

EROSION



LOCATION MAP



Name: _____

Make the heading stand out

Always include a location map; remember BOLTSS

A simple sketch can break up lots of writing

Lists may be better than long paragraphs

Source GT.45 An annotated visual display (AVD)
 Natural processes illustration © Director of National Parks (Parks Australia) www.parksaustralia.gov.au

Apply the skill

- 1 Imagine that your class is exploring the Great Barrier Reef as a geographic inquiry, with a particular focus on the impact of tourism on this natural environment.
 - a Discuss with a partner some geographic questions about this place.
 - b Select one of these questions that could be used to complete an AVD.
 - c Gather some data in response to this question. There is no need to explore this topic in great depth, but just to practice your communication skills. Your data could be sourced from the Internet, books, magazines or from your own personal experience. You should try to find about three or four images and some writing, such as a newspaper article.
 - d Work with your partner to design your AVD on a piece of A3-sized paper.
 - e Complete your AVD by following steps 3 and 4 of the skill drill.
 - f Display your AVD on the classroom wall and compare it with those of your classmates.

Use correct geographical terminology

Just like scientists, geographers share a common language. They use geographical terminology to clarify what they are talking about and to share their findings.

Source GT.46 lists and defines some commonly used geographical terms; additional geographical terms can also be found in the glossary at the end of this book.

Source GT.46 Some useful geographical terms

Term	Definition
BOLTSS	The six essential features that should be included on every map: border, orientation, legend, title, scale and source
direction	A way of orienting a map, usually shown by the use of compass points, such as north
distance	The amount of space between two objects or places, generally measured by using the scale on a map
distribution	The way in which things are arranged on the Earth's surface; the pattern formed by the way objects or places are distributed across a space
exception	A feature that falls outside a usual pattern or does not follow an observed pattern
geographical inquiry	The stages that geographers follow to guide their investigations
key inquiry question	A question that helps geographers to plan and focus their geographical inquiries
primary data	Data collected for a geographical inquiry by a person conducting an inquiry, such as survey data, hand-drawn maps or photographs
region	An area of the Earth's surface with a feature that makes it different from surrounding areas
scale	A line that indicates the distances on a map as represented in the real world
secondary data	Data collected for a geographical inquiry from another source, such as textbooks, atlases and government websites
spatial pattern	The distribution of features on the Earth's surface that may form particular patterns, such as linear (in lines), clustered or radial (like spokes on a wheel)
trend	A general direction in which something is developing or changing (e.g. the trend in population in Australia is positive because the population is growing)

Check your learning GT.5

Remember and understand

- 1 What do the letters AVD stand for?
- 2 Make a list of the things you need to gather before creating an AVD.
- 3 Why is it important to spend time on the layout of the written and visual information that will be shown on your AVD?

Apply and analyse

- 4 Do you think an AVD is an effective way to communicate the findings of a geographical inquiry? Why or why not?
- 5 As part of a geographical inquiry looking at the key question 'Is it a good thing that so many tourists visit Uluru?' your teacher has asked you to take part in a class debate. List three points for the affirmative and three points for the negative. Which side would you rather be on? Why?

- 6 Which form (such as written, oral, graphic, visual or digital) do you think would be most appropriate for presenting the findings of a geographical inquiry into tourism at Uluru? Why?

Evaluate and create

- 7 Your geography class has been asked by the principal to complete a geographical inquiry into the issue of recycling at your school. The principal hopes that by raising awareness of recycling, the school community may be willing to change their behaviour and make the school more sustainable. Conduct a class discussion on the most effective way to conduct the inquiry. At the end of your discussion, make a decision about the best way in which your findings could be presented to the whole school in order to convince them to participate.

Reflecting and responding

Reflect on what you have learned

The final stage of a geographical inquiry is to reflect on what you have learned and decide whether any action needs to be taken. Reflecting involves not only looking at what you have learned but also how it has been learned. It involves asking critical questions about the way in which your geographical inquiry was conducted and your role in it. One of the best ways to reflect on your progress is to complete a self-evaluation checklist rating your performance at each stage and adding comments.



Source GT.47 A geographical inquiry found that cigarette butts were a leading cause of litter at Uluru. One of the responses was the introduction of personal ashtrays. These ashtrays are available from the Cultural Centre and carry the logo 'Don't let the ranger see your butt'. Park authorities reduced the number of butts littering the area and believe this has also reduced the risk of bushfires.

The title of my geographical inquiry is:		
My geographical inquiry set out to investigate:		
GENERAL POINTS	My rating	Comments
I was able to complete all stages of my geographical inquiry	1 2 3 4 5	
I was able to answer all my key inquiry questions	1 2 3 4 5	
I was able to plan my inquiry effectively	1 2 3 4 5	
My maps, graphs, tables and diagrams were clear and accurate	1 2 3 4 5	
I was able to analyse my data and reach a conclusion	1 2 3 4 5	
I was able to communicate my findings in an interesting and appropriate way	1 2 3 4 5	
AREAS OF STRENGTH	Comments	
My areas of strength are:		
I'm getting much better at:		
AREAS NEEDING IMPROVEMENT	Comments	
The part I found most difficult was:		
I need the most help with:		
IMPORTANT ISSUES HIGHLIGHTED BY MY INQUIRY	Comments	
The most important thing I learned from my inquiry was:		
This issue is important to me because:		
This issue is important to my community/country/world because:		

Source GT.48 A self-evaluation checklist

Justify possible methods of response

After reflecting on what you have learnt, you may discover that action is needed in order to respond to the issue you have been investigating. There are a number of different ways that geographers can take action to make a change. These include:

- creating a fact sheet or multimedia presentation about the issue to inform your class, school or community
- using social media to raise awareness and gather support
- emailing your local government representative or Member of Parliament about the issue
- inviting an expert speaker to present at your school assembly
- planning a campaign to raise money for the issue.

Our geographical inquiry into Uluru based around the key inquiry question 'Is it a good thing that so many tourists visit Uluru?' may lead us to actively campaign for tourism at Uluru to be managed in a more sustainable way so that this important landmark can be enjoyed by future generations. In particular, one of the negative effects discovered in the inquiry was litter, and a good example of a campaign to combat this is shown in Source GT.47.

Check your learning GT.6

Remember and understand

- 1 Name two ways in which you could 'reflect' on what you have learnt throughout a geographical inquiry.
- 2 Give two reasons why it is important to be able to self-evaluate your work.

Apply and analyse

- 3 Which do you think are the two most important questions to ask yourself in the self-evaluation checklist? Why?

Evaluate and create

- 4 The completed self-evaluation checklist can look very different depending on what you are investigating. Are there any areas that you think could be improved in GT.48? What questions could be changed or added so that you could improve on the reflection process?

GT.3 Fieldwork in geography

What is fieldwork?

Fieldwork is any geographical study that takes place outside the classroom or, as geographers say, 'in the field'. The 'field' is the source of geographical information (primary data). It can be conducted at a number of scales – in your school grounds, within your local community, in another state or even in another country. Fieldwork is an essential part of geography because the world outside the classroom is the geographer's 'laboratory'. Working in the field provides opportunities for first-hand investigation of both natural and built environments.

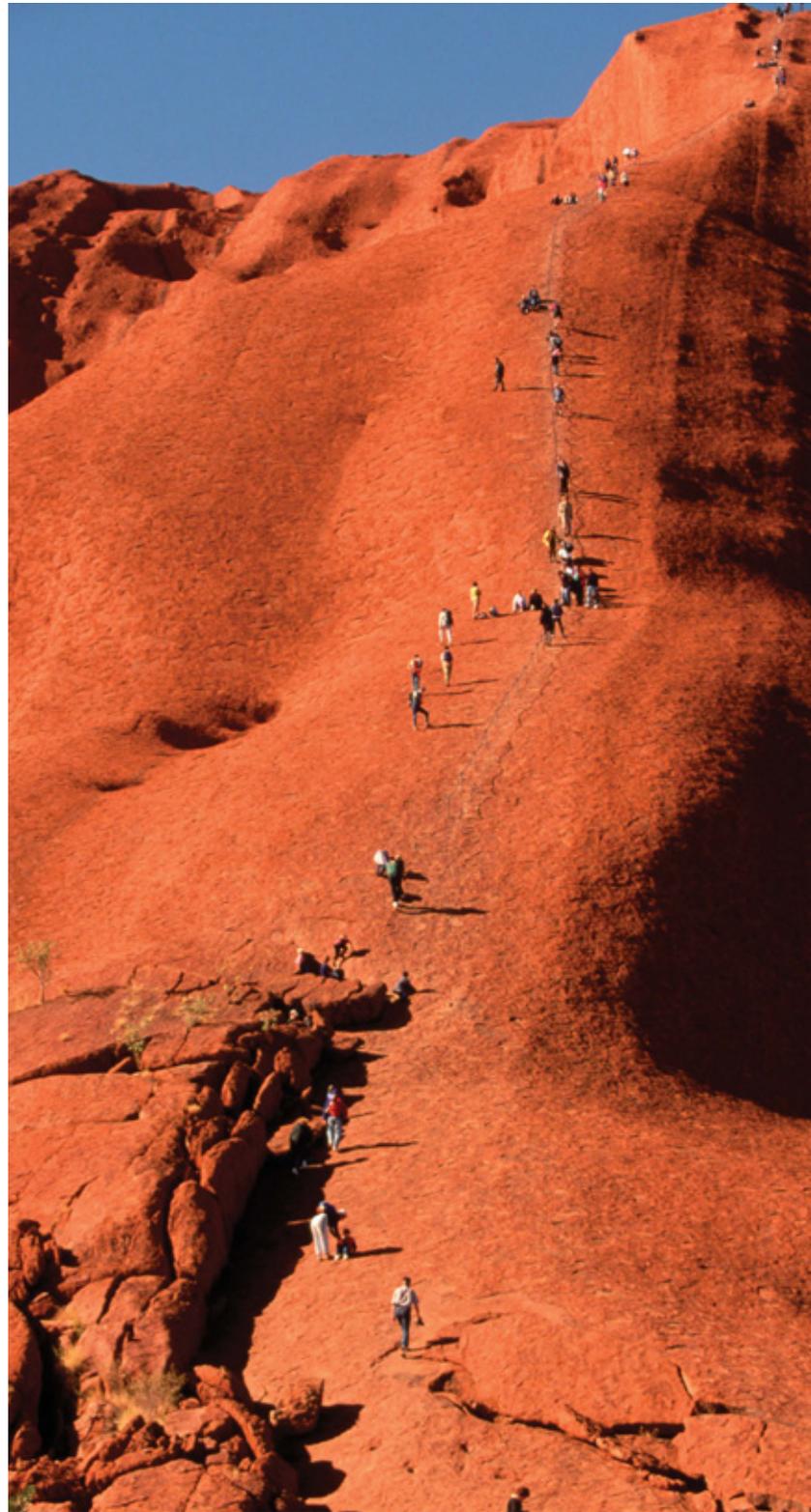
Fieldwork also provides an opportunity to develop skills associated with observing, measuring and recording. Different forms of geographical data can be collected and then analysed to find relationships between the natural and human (built) environments. The results of a fieldwork investigation are presented and communicated in a fieldwork report.

Fieldwork also involves identifying issues or problems and finding possible solutions. It is a way to engage with the real world and make a contribution to developing more sustainable and fair ways to manage the Earth's resources.

Fieldwork often looks at a key feature, issue or conflict. For example, many tourists visit Uluru each year with the intention of climbing 'The Rock.' In doing so, they ignore the wishes of the traditional owners of the land, the Anangu people (see Source GT.49). They also put themselves and others at risk. About 35 people have died while climbing Uluru and countless others have been injured or rescued. Geography students visiting Uluru may try to find out why people continue to climb it, and study the impacts of this activity on people and the natural environment.

Different types of fieldwork

Most topics you learn about in class can also be studied during fieldwork. The types of fieldwork you conduct will differ according to your topic and the places you visit, but all these activities will help you to better understand your world. Source GT.50 provides examples of fieldwork locations and activities for a range of topics.



Source GT.49 Every tourist that climbs Uluru must pass a sign asking them not to climb the rock out of respect for the traditional owners, the Anangu.

Source GT.50 Examples of fieldwork locations, activities and key inquiry questions for a range of topics

Topic	Possible locations	Sample fieldwork activity	Possible key inquiry questions
Mountain landscapes and processes	A local mountain range, peak or rock formation	Taking geographical photographs	How are mountain landscapes used by people? Why are some mountains higher than others? How do mountain landscapes change over time?
Mountain hazards		Asking geographical questions	Why are some mountain landscapes hazardous? Why do some volcanoes erupt while others lay dormant? How many people are affected by mountain hazards?
Coastal landscapes and processes	A local beach, harbour or inlet	Field sketching	How are coastal landscapes used by people? How do waves change coastal landscapes? Why do some coastal areas erode more quickly than others? How will this coast change in the future? How have human activities interfered with natural coastal processes?
Coastal hazards		Sketching a cross-section	How has coastal erosion affected people living near the coast? Why are some coastal landscapes more dangerous than others? How many people are affected by coastal hazards?
Natural features of rivers	A local river, creek or stream	Observing and describing	Why do rivers bend? How do rivers change over time? How do rivers change other features of the natural environment?
Human interaction with rivers		Water sampling	How do human activities interfere with natural river processes? How do people respond to the risk of flooding? How have natural river processes affected built structures?

Conducting successful fieldwork

Fieldwork is a type of geographical inquiry, so whenever you take part in fieldwork you will need to follow the stages that are outlined in this toolkit, namely:

- 1 Observing, questioning and planning
- 2 Collecting, recording, evaluating and representing
- 3 Interpreting, analysing and concluding
- 4 Communicating
- 5 Reflecting and responding.

The first stage is vital as this gives you a focus for your fieldwork. It also allows you to judge whether your fieldwork investigation has been successful.

Stage 1: Observing, questioning and planning

Begin by looking at an issue or location and compile a set of related inquiry questions that you would like to answer. Plan what information you will need and how you will collect it.

Stage 2: Collecting, recording, evaluating and representing

Plan your fieldwork so that you can collect the evidence and data that you will need. For example, take photos, draw sketches, conduct tests, construct questionnaires and survey and gather data. You may need to consider members of the public, including Indigenous people and their beliefs and feelings about places in the landscape. If your class is planning a field trip to a natural environment, such as a forest or beach, you will need to ensure you do not damage the environment by trampling on plants or animals or by dropping litter.

Stage 3: Interpreting, analysing and concluding

Interpret and analyse the data you have collected and look for patterns or clues that will help you to answer your key inquiry question. There are a number of different tools and methods you can use to do this, including PQE and SHEEPT.

Stage 4: Communicating

Communicate what you have found to an audience in the form of a report, a presentation or an annotated visual display (AVD).

Stage 5: Reflecting and responding

Think about your fieldwork findings and reflect on ways to improve your investigation process. Finally, decide on a course of action, if this is appropriate.

A fieldwork example: Westside Park investigation

In the following example, Year 8 geography class at Gumtree College (8B) decided to conduct fieldwork on how a park in their local area (Westside Park) was being used. Their aim was to make suggestions about how the park could be improved for the local community and environment.

Stage 1: Observing, questioning and planning

To begin with, the class discussed some of the issues and problems they might be able to investigate. During a brainstorming session a range of possible inquiry questions were raised by 8B. These included:

- Who is Westside Park used by?
- What activities is Westside Park used for?
- How does the local community feel about Westside Park?
- Is Westside Park safe for all park users?
- What environmental impacts are people having on Westside Park?

As a group, 8B decided that these questions were all suitable for a geographical inquiry because they would allow students to explore a topic in depth by gathering data, drawing conclusions and developing possible responses. After further discussion, the class decided to focus on the last question about environmental impacts.

Most students in the class thought that this issue was important because a number of articles and letters published in the local newspaper over the last year had expressed concerns about the levels of litter and tagging (spray painting of letters and symbols) in the park.

Next, students in 8B planned the types of information and data they would need to investigate this issue. They decided that they should visit Westside Park a few times

to gather data about who was using it and how it was being used. They decided they would visit once during a busy period and once during a quiet period. Visiting the park during a busy period would allow them to record how many people were using the park, what they were using it for and what impacts these users were having on the environment. Visiting the park during a quiet period would allow them to take photographs, measurements and sketches without disturbing park users.

Stage 2: Collecting, recording, evaluating and representing

To investigate the ways in which the local park was affecting the environment, students in 8B set out to collect and record a range of geographical data:

- Before their first visit, they designed a questionnaire for users of the park to fill in. This asked park users to list how and when they use the park.
- During their first visit, students created data tables and recorded the numbers of people using the park. They also divided these users into a number of categories; for example, parents with children, dog walkers, skateboarders and picnickers.
- The students measured the boundary of the park and its key features with measuring wheels and tape measures and created a simple sketch map of the park.
- They took a number of photographs documenting a range of environmental issues in the park, such as tagging, litter in garden beds, dog poo, trampled grassed areas and damaged vegetation due to use of cars and motorbikes in the park.



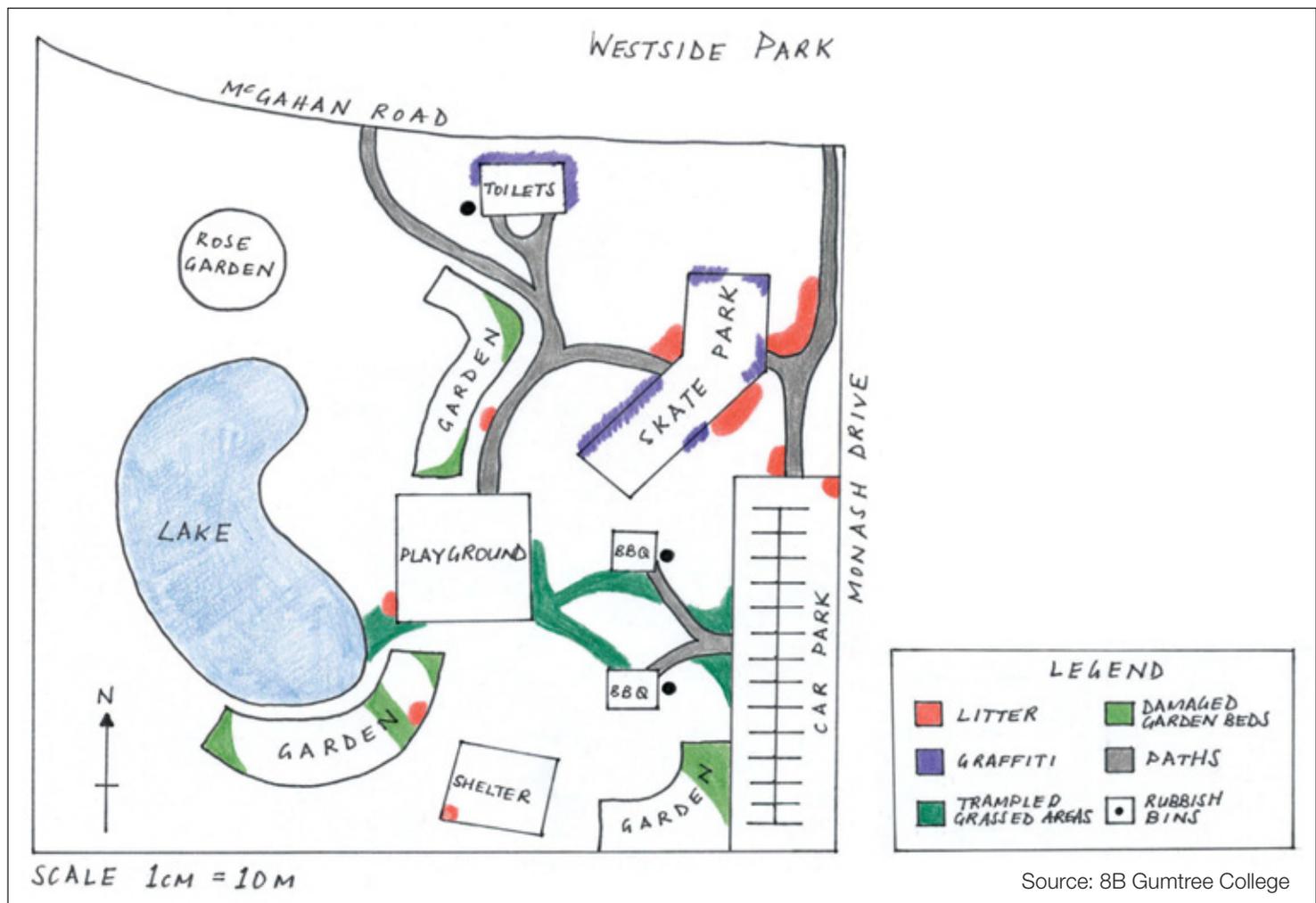
Source GT.51 Students from Gumtree College measuring and recording features to be mapped at Westside Park

After collecting and recording this data, they returned to school and used it to create some graphical representations:

- They used the measurements they had recorded to create a second, more detailed sketch map of the park – this time to scale.
- Using the records and photographs they had taken, they marked the locations of the three most serious environmental impacts on the map.
- They collated the information from the questionnaires and created a pie graph showing the number of people using the park during busy and quiet periods. They also created a bar graph showing the different activities that people used the park for.



Source GT.53 Students measuring an area of trampled grass to be added to their sketch map



Source: 8B Gumtree College

Source GT.52 A sketch map of the local park identifying the locations of a range of environmental issues

Stage 3: Interpreting, analysing and concluding

Once they had converted their primary data into a range of graphs and maps, the students analysed it much more easily and looked for patterns and trends that would help them answer their key inquiry question: How do people using the local park affect the environment?

Students identified that the two main groups of park users were parents with children and skateboarders. The three main environmental problems were litter, tagging and the trampling of grass and gardens in the park.

Based on these findings, the students of 8B concluded:

- About 80 per cent of the litter was located at or near the skate park. Data gathered showed a lack of rubbish bins close to the skate park. Students concluded that lack had led to the build-up of litter and that the skate park users were most probably responsible. The grass was trampled primarily near the car park and paths leading to the playground. These areas were mainly used by families. They concluded that families with prams and small children trample grass while moving between the car park and the playground.
- There were six observed pieces of tagging – five on the walls of the skate park and one on the toilet block. They concluded that the skate park area was a key target for taggers, but could not draw conclusions about who actually did the tagging.

Stage 4: Communicating

Students prepared a group field report based on their findings. It included their maps, photographs and observations. Each student also made recommendations about ways in which the park could be used more sustainably to resolve these environmental issues. The report was sent to the local newspaper and a number of the findings were published. The students also sent their report to members of the local council.

Stage 5: Reflecting and responding

Following the submission of their field report and recommendations for change, students reflected on their findings and the methods they used to reach their conclusions. They decided that the key inquiry question they had chosen was a good one because it allowed students to work as a team but in different areas of the park and on things that interested them most. Many of the students commented that fieldwork helped them better understand this local issue more than if they read about it in the newspaper.

A few months after 8B had completed their geographical inquiry, the local council installed bins near the skate park and put up signs around it asking park users not to litter. They also commissioned an artist to create a graffiti-style mural, to discourage taggers.

Check your learning GT. 7

Remember and understand

- 1 Why is fieldwork an essential part of geography?
- 2 Why are rivers and coasts popular for fieldwork?
- 3 What activities did the Gumtree College students complete in order to collect information?

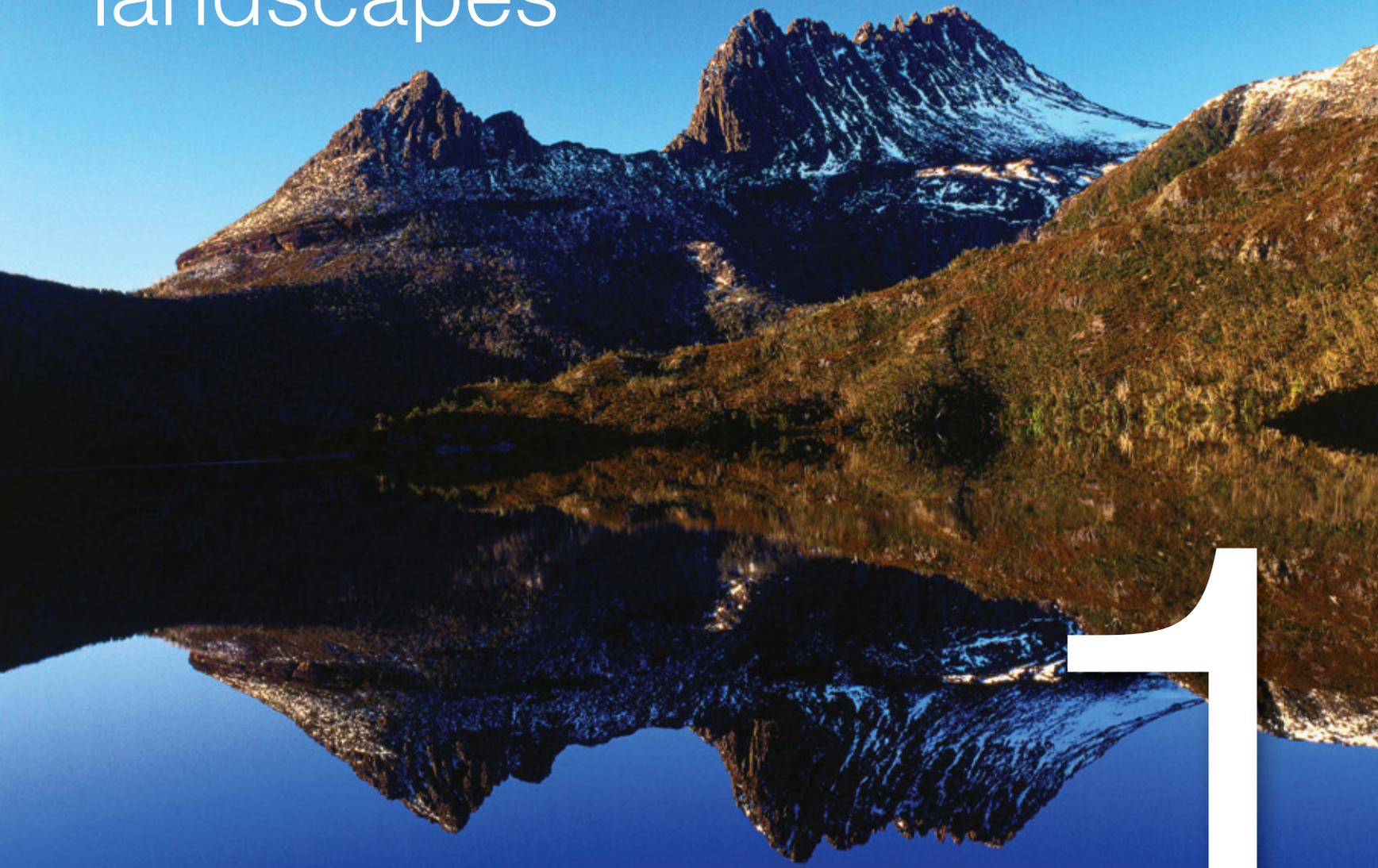
Apply and analyse

- 4 What are some inquiry questions that could be explored with a field trip to a large amusement park?
- 5 Do you prefer working in a classroom or working in the field? Discuss your response with the class.

Evaluate and create

- 6 Select one of the key inquiry questions listed in Source GT.50. Using the Gumtree College example as a guide, explain the steps you would undertake to explore this question using fieldwork.

Landforms and landscapes



unit

1

Landforms and landscapes

The Earth's surface is made up of a vast number of elements that have been brought together to create amazing shapes and formations. To study and understand all these formations, geographers organise them into groups based on characteristics that are similar. These different groups are referred to as landscapes. There are many different types of natural landscapes on Earth – including mountain landscapes, coastal landscapes and riverine landscapes. Landscapes created by people are called human landscapes. Natural landscapes are made up of a variety of geographical features known as landforms such as hills, caves and valleys.



1.1

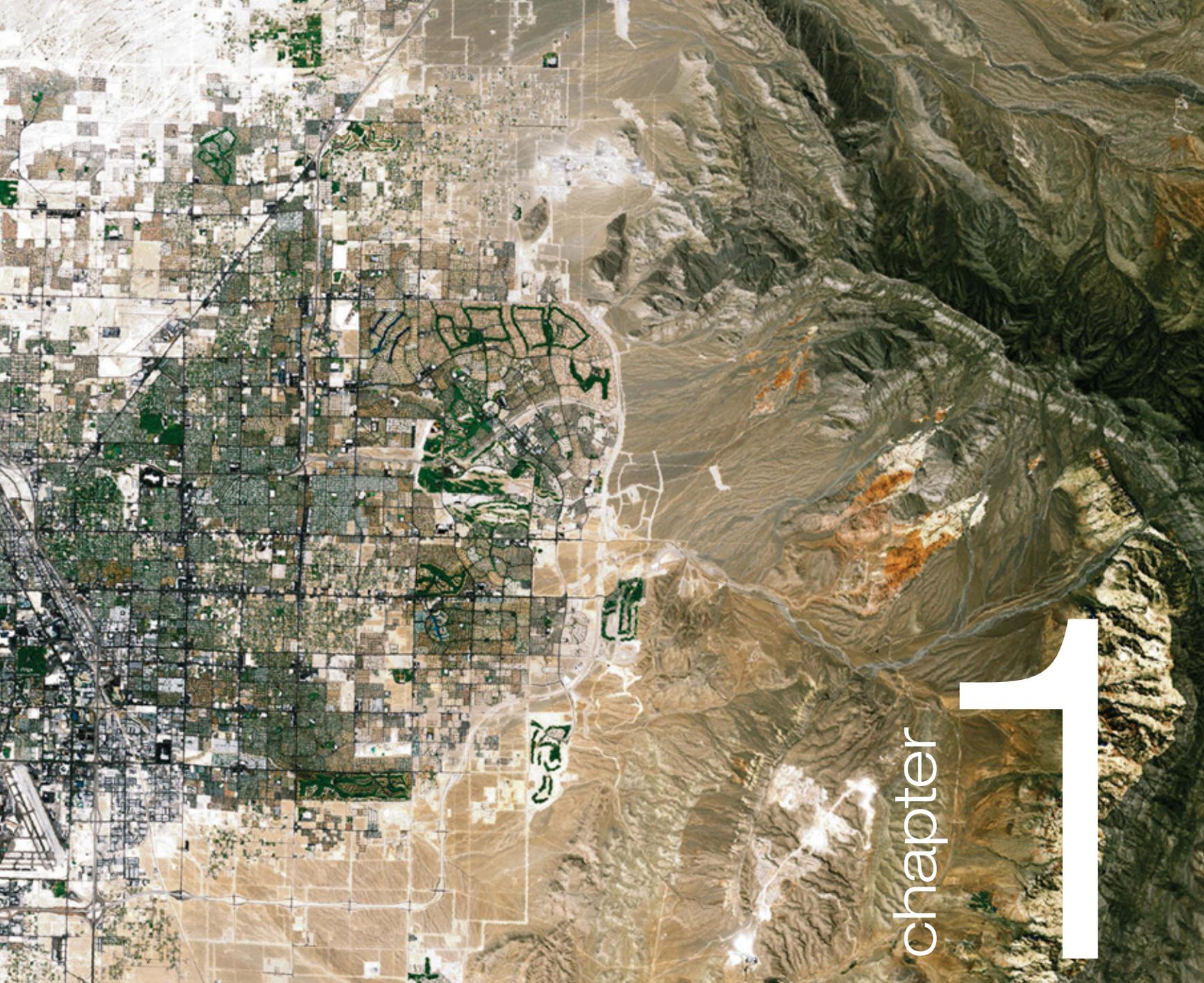
What are landforms and landscapes?

- 1 Use Source 1.1 to identify two different landforms and two types of landscapes.
- 2 Think about the place in which you live. Can you identify two different landforms and two types of landscapes that you see every day?

1.2

How are landforms and landscapes valued by people?

- 1 What value do you think landscapes and landforms have for people?
- 2 Think about one of the landscapes mentioned above. Describe why this landscape is important to you.



chapter
1

Source 1.1 This satellite image of Las Vegas shows many different landscapes and landforms.

1.1

What are landforms and landscapes?

The Earth's landscapes

A **landscape** is part of the Earth's surface. It consists of a variety of geographical features that are characteristic of an area. Landscapes are divided into two main categories – natural and human. Natural landscapes (for example, mountains and deserts) are mainly unaffected by human

activity and typical to particular areas of the world. Human landscapes (for example, cities and farms) have been created and modified by people. Human landscapes are sometimes also referred to as cultural landscapes. Some different types of landscapes are described below.

WORLD: EXAMPLES OF DIFFERENT LANDSCAPES



Source 1.2



Source 1.3 The Himalayas in Asia are an example of a mountain landscape.

1 Mountain landscapes

Mountain landscapes are formed by **tectonic plates** on the Earth's surface pushing against each other. This movement and pressure causes the shape of the land to change. The land is pushed up in a vertical direction and over time forms mountains. Mountains rise high above their surroundings. Mountains can stand alone, be grouped in ranges, or form ridges. We will explore mountain landscapes in more detail in Chapter 2.

2 Coastal landscapes

The coast is where a land mass meets the sea. Coastal landscapes are shaped by the natural forces of the wind and waves. These geographical forces erode (wear away) or construct (build up) the natural environment, constantly changing its shape. Features of coastal landscapes include beaches, dunes, bays, cliffs, platforms, spits and lagoons. We will explore coastal landscapes in more detail in Chapter 3.



Source 1.4 Peggy's Cove in Nova Scotia, Canada, is an example of a coastal landscape.



Source 1.5 The Whanganui River system in New Zealand is an example of a riverine landscape.

3 Riverine landscapes

A riverine is a landscape formed by the natural movement of a water system such as a river. A riverine landscape includes the **ecosystems** (all living things including plants and animals) in and around the area of a river. A riverine may also be defined as a network of rivers and the surrounding land. Riverine landscapes are excellent for agricultural uses such as farming because the land is rich and fertile. They are a valuable resource for growing food.

4 Desert landscapes

A desert is defined as an area of land which receives no more than 250 millimetres of rain per year. Deserts cover about one-third of the Earth's surface and contain some of the most uninhabitable regions on Earth. There are two types of deserts – hot deserts and cold deserts. Hot deserts are located along the tropics of Cancer and

Source 1.6 The Sahara desert in North Africa is an example of a desert landscape.



Capricorn (the latitude lines to the north and south of the Equator). Cold deserts are located closer to the Arctic and Antarctic Circles (the circles of latitude in the far north and far south). Because of the lack of rain they have little vegetation (plant life). Instead deserts are characterised by sand dunes, rock and gravel.

5 Karst landscapes

A karst landscape is formed when easily dissolvable bedrock (the rock below the surface of the land, such as limestone) is worn away by slightly acidic water, from an underground source or a source on the Earth's surface. These flows of water form unique features such as caves, stalactites, springs and sinkholes. Karst landscapes are extremely unstable areas of land. Sinkholes are formed when rock beneath the Earth's surface has eroded away and sections of land on the surface collapse. Sinkholes can range in size from a few metres to over 1 kilometre deep and have been known to occasionally collapse, swallowing up everything on the surface including cars and buildings.



Source 1.7 The Skocjan Caves in Slovenia are an example of a Karst landscape.

6 Tropical rainforest landscapes

Tropical rainforests are lush forests which can be found along the Equator. Rainforest landscapes receive lots of sunlight and rainfall – at least 1500 millimetres per year. This abundance of rainfall and sunlight means that vegetation grows rapidly. Rainforest ecosystems are complex and highly productive. They are home to a wide variety of species of flora (plants) and fauna (animals), about 50 to 70 per cent of all the species on Earth. Tropical rainforests cover about 6 per cent of the Earth's surface.

7 Human landscapes

Unlike the types of naturally occurring landscapes described above, human landscapes are created by people. Human landscapes provide evidence of human settlement and occupation of an environment. Features of human landscapes include elements of infrastructure such as buildings, roads, transport, energy, sewerage and telecommunication systems. The construction of human landscapes often results in the damage or destruction of natural landscapes but commonly incorporates some natural geographical features in its design, for example harbours and mountains.



Source 1.8 The capital city of China, Beijing, is an example of a human landscape.



Source 1.9 The Amazon is an example of a tropical rainforest landscape.

Check your learning 1.1

Remember and understand

- 1 What is the meaning of the geographical term 'landscape'?
- 2 Which types of landscapes are found around the Tropics of Cancer and Capricorn?
- 3 Why do you think human landscapes are included in the definition of the word 'landscape'?

Apply and analyse

- 4 Look carefully at Source 1.2
 - a How many different types of landscapes are shown on this map?
 - b What types of landscapes can you identify in Australia?
 - c Write a description of the location of desert landscapes. Give possible reasons to explain why they are found there.

Evaluate and create

- 5 Research one landscape that interests you. Your chosen landscape might be on the World Heritage List (such as karst in The Skocjan Caves Regional Park) or in your local area. Investigate what makes this landscape unique, and provide information about how it is used. Present your research in the form of a brochure, poster or webpage.

The Earth's landforms

A **landform** is a natural geographical feature or shape that appears on the Earth's surface. Large landforms include mountains, plains and rivers, while small landforms include hills and billabongs. Landforms are created and shaped by geographical forces of nature, such as **tectonic plate** movement and **erosion**. Natural landscapes are made up of a variety of landforms. Often landforms are not unique to a single landscape; for example, a hill can be found in many different landscapes.

Source 1.10 Some common landforms found in different landscapes, with an Australian example

Landscape type	Some common landforms found in that landscape	An Australian example
Mountain landscape	<ul style="list-style-type: none"> • Mountain – a large elevation on the Earth's surface • Ridge – a long, narrow, elevated surface • Valley – a low area enclosed by mountains 	<p>At a height of 2228 metres above sea level, Mt Kosciuszko in NSW is the highest mountain in Australia</p> 
Coastal landscape	<ul style="list-style-type: none"> • Stack – a vertical column of rock • Beach – a sandy or pebbly shore • Headland – a high, rocky outcrop of land 	<p>The Twelve Apostles is a group of limestone stacks off the shore of the Port Campbell National Park in Victoria. They were created by erosion.</p> 
Riverine landscape	<ul style="list-style-type: none"> • Flood plain – a low-lying area regularly flooded by a river • Riverbed – the channel in which the river flows • Billabong – an arm of a river which forms a pool, only joining with the river in times of flooding 	<p>The Riverina area in NSW is made up of flat flood plains irrigated by the Murrumbidgee, Edward and Lachlan rivers. It is a key food-producing area in Australia.</p> 

Landscape type	Some common landforms found in that landscape	An Australian example
Desert landscape	<ul style="list-style-type: none"> • Inselberg – an isolated steep-sided rock hill on a plain • Oasis – a supply of groundwater in the desert • Grassland plains – a large, flat area sparsely covered with grasses 	<p>Uluru is a large sandstone rock formation in the southern part of the Northern Territory, known as an inselberg. It has great spiritual significance for the local Aboriginal people and is a popular tourist attraction.</p> 
Karst landscape	<ul style="list-style-type: none"> • Spring – a basin in the rock allowing water to come to the Earth's surface • Cave – a large hollow underground with an opening • Stalactite – a formation that hangs from the ceiling of a cave, formed by dripping water and minerals 	<p>The Wombeyan Caves in NSW consist of nine limestone caves with spectacular stalactites and other formations.</p> 
Tropical rainforest landscape	<ul style="list-style-type: none"> • Mountain – a large elevation on the Earth's surface • Valley – a low area enclosed by mountains • Wetlands – a swamp or similar area of land that stays wet 	<p>The Daintree Rainforest is a tropical rainforest on the north-east coast of Queensland. It is approximately 1200 square kilometres in size. Mountains, valleys and wetlands are all found in this landscape.</p> 

Check your learning 1.2

Remember and understand

- 1 What is the meaning of the geographical term 'landform'?
- 2 In which two landscape types would you find valleys?
- 3 In which Australian location would you find an inselberg?

Apply and analyse

- 4 Look carefully at Source 1.10.
 - a How many different types of landforms are included in this table?
 - b Why do you think Australia has so many different landforms?

- c Write a short description of the image of the Riverina flood plain in NSW. Describe the advantages and disadvantages of living in this area.

Evaluate and create

- 5 Create a travel brochure for the Tourist Authority in your state or territory promoting one of the landforms listed in Source 1.10. Conduct some research to provide a description of this landform, including information about how it was formed. You should include a persuasive text that aims to encourage tourists to visit your chosen landform type.

1.1 bigideas: broadsheet

Uluru: an iconic Australian landform

Uluru is an iconic symbol of the Australian outback and one of the most visited landforms in Australia. Part of the desert landscape and close to the continent's geographical centre, Uluru attracts around 200 000 visitors a year.

Uluru rises approximately 348 metres above the ground and measures about 10.6 kilometres around its base. It is a sacred place for the local Aboriginal people, the Anangu.

Although the Northern Territory has the smallest population of any Australian state or territory, it has by far the highest percentage of Indigenous Australians. Around one in three people there (33 per cent) are of Indigenous heritage.



Source 1.11 Uluru is Australia's most recognisable landform.

skilldrill

Constructing a population pyramid

In order to better understand a group of people living in the same place (i.e. a population), geographers often need to analyse and compare the different groups within that population (for example the number of men versus women, or young people versus old people). They do this by representing population data visually on a population pyramid.

Although population pyramids are a type of bar graph, they are a little different. While standard bar graphs have one horizontal axis (or x-axis) and one vertical axis (y-axis), population pyramids have one y-axis and two x-axes, like graphs back to back. The y-axis runs vertically through the middle separating the data for males on the left and females on the right.

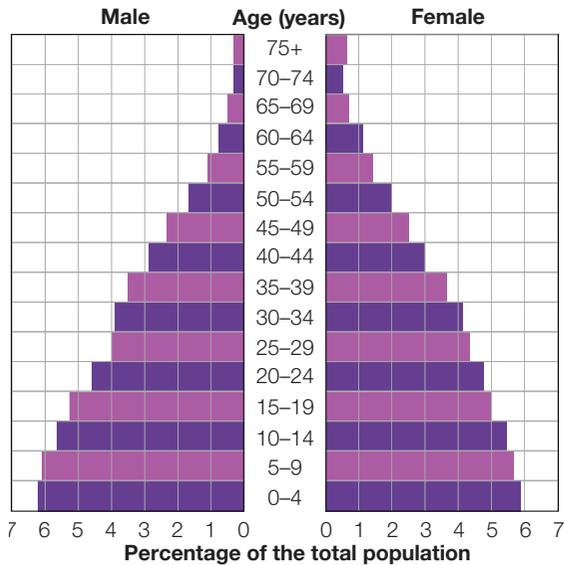
Rather than show the actual numbers of men and women at each age group, population pyramids show each of these groups as a percentage of the total population. This makes it easier for geographers to identify trends and changes in different areas of the population.

Population pyramids are created from a table of data. Source 1.12 is the data for the Northern Territory's Indigenous Population and Source 1.13 is the population pyramid. For more information on population pyramids refer to section GT.1 of The geographer's toolkit.

Source 1.12 The Northern Territory's Indigenous population

Northern Territory	Indigenous population %	
Age group (years)	Males	Females
0–4	6.2	5.9
5–9	6.1	5.7
10–14	5.7	5.4
15–19	5.3	5.0
20–24	4.7	4.8
25–29	4.0	4.3
30–34	3.9	4.1
35–39	3.5	3.7
40–44	2.9	3.0
45–49	2.3	2.5
50–54	1.7	2.0
55–59	1.1	1.4
60–64	0.8	1.1
65–69	0.5	0.7
70–74	0.3	0.5
75+	0.3	0.6

Source 1.13 Population pyramid for the Northern Territory's Indigenous population



The steps to construct a population pyramid using the statistics in Source 1.12:

Step 1 Using 5 mm grid paper, rule your axes as follows:

Vertical y-axis: There are 16 age groups in our example. The age groups start at the bottom, with the 0–4 age group, and finishing at the top with the 75+ age group. Keep this in mind while completing your y-axis, because the table shows the age groups from lowest to highest going down the page. However, the population pyramid shows the age groups from lowest to highest going up the page. Label the top of your y-axis, 'Age (years)'.

Horizontal x-axes (left and right): Find the highest percentage of both Males and Females. In our example, this is 6.2. Round this up to the nearest whole number, which is 7. Use two 5 mm grids per unit to create two 7 cm axes. Rule your x-axes with a scale from 0 to 7 from each side of the central y-axis to the left and right. Label the left side 'Male' and the right side 'Female' and write 'Percentage of the total population' along the bottom.

Step 2 Using a sharp lead pencil, create your bar graphs for each gender – first Males, then Females. Be as accurate as you can, and use the millimetre marks on a clear plastic ruler. First draw 5 mm high vertical strokes to end each individual bar. You can rule up the horizontals of each bar later.

Step 3 Choose two different colours; alternate with one colour and then the other. This makes it easier to read the graph.

Step 4 Give your population pyramid a title.

Apply the skill

- 1 Construct a population pyramid using the second set of data (Source 1.14) on Northern Territory's non-Indigenous Population, following steps 1–4.

Source 1.14 The Northern Territory's non-Indigenous population

Northern Territory Age group (years)	Non-Indigenous population %	
	Males	Females
0–4	3.5	3.3
5–9	3.4	3.1
10–14	3.4	3.2
15–19	3.2	2.9
20–24	3.9	3.5
25–29	4.3	4.2
30–34	4.6	4.3
35–39	4.6	4.2
40–44	4.6	4.0
45–49	4.4	3.9
50–54	4.0	3.5
55–59	3.7	2.8
60–64	2.4	1.7
65–69	1.5	1.0
70–74	0.7	0.5
75+	0.8	0.8

Extend your understanding

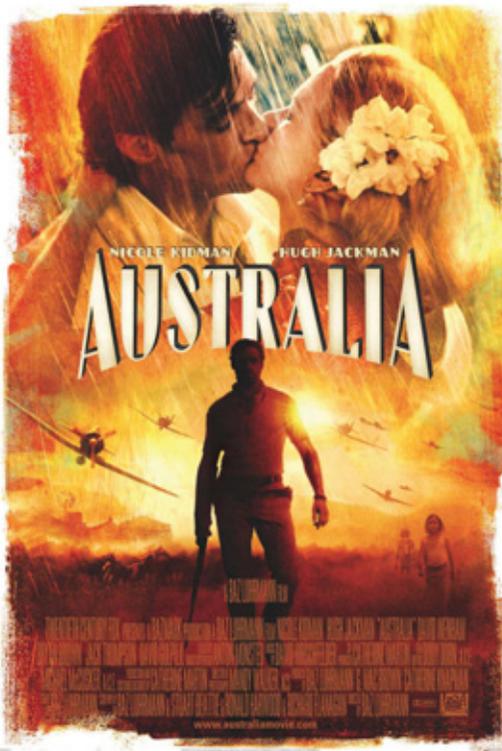
- 1 Use your population pyramid to answer the following questions:
 - a Which age group has the largest percentage for both males and females?
 - b Which is the smallest age group for each gender?
 - c What is the total percentage for the 0–4 age group?
 - d What is the total percentage for the 35–39 age group?
 - e What is the total percentage for the 70–74 and 75+ age groups?
- 2 Compare your population pyramid with Source 1.13 and answer the following questions:
 - a Describe the key differences that you can see between the population pyramids. What does this tell you about the Indigenous and non-Indigenous populations in the Northern Territory?
 - b Research the 'standards of living' and 'life expectancy' of Indigenous people in Australia. Does this help to explain the differences in the shapes of the population pyramids?

1.2 How are landforms and landscapes valued by people?

Valuing landforms and landscapes

Landforms and landscapes around the world are valued by many different people for many different reasons. Some people may feel a deep personal connection to a particular landscape, while others are more interested in the money that can be earned from it. The value a person attaches to a particular landscape often depends on factors such as their age, occupation, education, cultural background and experiences. In general, geographers divide the ways in which people value landforms and landscapes into four categories:

- cultural value
- spiritual value
- aesthetic value
- economic value.



Source 1.15 This poster for the film *Australia* reflects the colours of the Australian outback. It is an example of how the Australian landscape has cultural value.



Source 1.16 Karlukarlu (also known as The Devil's Marbles) is sacred to Indigenous Australians. This is an example of how landforms can have spiritual value.

Cultural value

Cultural value is linked to the importance of landforms and landscapes as expressed by people through creative means such as poetry, literature, art and films. Australia's landscapes and landforms have shaped Australian culture and identity. The film *Australia*, shown in Source 1.15, was a box-office hit in Australia. Set in northern Australia at the start of World War II, the film features the vast, unforgiving landscapes of the outback, as well as the tropical landscape of the Far North. These unique landscapes have a transformative effect on the English Lady Sarah Ashley, and by the end of the film she feels Australian.

Indigenous Australians express the importance of the land to them through Dreamtime stories, song and dance, and their art. Nearly all Aboriginal art relates to the landscape and maps the landscape and the landforms of importance to the Indigenous community.

Spiritual value

For Indigenous Australians the spiritual value of land is expressed through the concept of 'Country'. Indigenous peoples believe that the myths of their Dreamtime bind them to the land. They also believe that their ancestors live on through the land and ensure their continued connection with it. Landscapes contain many sacred sites of spiritual importance. Uluru, for example, is a sacred place to the Anangu people who live in the area. They believe that in the Dreamtime, a great sand hill was transformed into this rock along with the Kunia people who lived there.



Source 1.17 Unique and beautiful landscapes along the Australian coast are an example of aesthetic value.

Aesthetic value

The aesthetic value of a landscape is closely linked to its beauty and uniqueness. The aesthetic value attached to a place is always subjective (personal). People are drawn to places for many reasons. Being surrounded by the beauty of the landscape may give someone a sense of freedom, stability and wellbeing. An individual might be drawn to a particular landform because of its overwhelming majesty, creating a personal connection to that place.

The aesthetic value of the landscape to the community has been recognised through the creation of national parks, where land has been set aside for the public's use and enjoyment. The first national park in Australia, the Royal National Park, south of Sydney, was established in 1879. There are now 516 national parks.

Economic value

Economic value is a measurement of how financially important landscapes and landforms are. Economic value is particularly relevant to the tourism and mining industries in Australia. Tourism Victoria, for example, wants regular visitors to its state because people who travel spend money on accommodation, transport, food, souvenirs and activities. This money provides income for the tourism and hospitality industries and the State of Victoria. The Great Ocean Road is a landscape in Victoria with a high economic value due to its popularity with tourists.

Mining is the process of extracting natural resources from within the earth. These resources are sold, processed and used to manufacture a variety of goods – from jewellery to toys, to construction materials. The mining industry attaches economic value to landscapes that contain sought-after metals and minerals like coal and gold.



Source 1.18 Landscapes with high mineral and metal deposits are an example of economic value.

Competing values

The same landscape can be valued by different people for different reasons. To a mining corporation, the economic value of a landscape might be most important. To an Indigenous Australian community, however, the spiritual value may be most important. Then again, an artist might appreciate the aesthetic value of a landform. All these values are important to consider when deciding on how a landscape is best put to use.

Check your learning 1.3

Remember and understand

- 1 Describe the concept of 'value'.
- 2 What does it mean for a landscape to have aesthetic value?
- 3 What does it mean for a landscape to have cultural value?

Apply and analyse

- 4 Look carefully at Source 1.18.
 - a Which value is being attached to this source?
 - b What groups of people are most likely to have a different opinion as to the value of this landscape? Create a table to show the groups and their possible opinions.
 - c What reasons might you list to account for, or explain, these differences of opinion?

Evaluate and create

- 5 Research a book, poem, movie or website that has cultural value for Australia, or a country or place that you feel connected to. Create a digital poster on Glogster (<http://edu.glogster.com/>) or use another design program to present your findings. Include the title of the work, its author, a blurb about it and an image to represent it. Most importantly, provide three reasons why you feel it has particular cultural significance.

1.2 bigideas: broadsheet

The Chinese tourism boom in Australia

The unique landscapes and landforms in Australia attract tourists from around the world. Landscapes and landforms such as Uluru, the Great Ocean Road, Kakadu National Park and Sydney Harbour not only have cultural, spiritual and aesthetic value, they also have an economic value to Australia because of tourism.

In recent years, there has been a significant increase in the number of tourists coming to Australia from China. In 2012, China became Australia's second-largest tourism market, after New Zealand. Many of these tourists come because they want to see landforms and landscapes that are different from those they see at home.



Source 1.19 Chinese tourists in Australia enjoying the aesthetic value of the Twelve Apostles on the Great Ocean Road.

In terms of economic value, Chinese tourists are the biggest spenders in Australia, contributing \$3.5 billion a year to the Australian economy. Tourism researchers are predicting that the number of Chinese visitors coming to Australia will continue to increase, and that by 2020 this number will exceed 850 000 a year.

skilldrill

Analysing statistics

Many organisations collect information that geographers can use to describe and explain human activities. Sometimes this information is in the form of numbers, known as statistics. By learning a few simple techniques you can use this information to better understand changes and trends. Follow these steps to learn how to identify maximum and minimum in order to rank entries as well as calculate averages.

- Step 1** Look carefully at the title of the statistics so you understand exactly what has been measured. Note the date in particular.
- Step 2** Consider the source of the information. Statistics collected by government agencies such as the Australian Bureau of Statistics are generally more reliable than those collected by individuals and companies.
- Step 3** To identify the maximum and minimum, list the statistics in order from the largest to the smallest. This list is known as the rank, and the position of each country within it is known as a ranking or rank score.
- Step 4** To calculate the average, add all the numbers together and divide this total by the number of countries in the table. Take note of the title of each column in the table as this will inform you of the quantities being counted – for example, it may be in thousands (000) or billions of dollars (\$ billions).
- Step 5** You can calculate averages of each row as well as each column. For example, by dividing the economic value of each country by the number of visitors from that country you will find out the average value to Australia of each person from that country.
- Step 6** Use the numbers you have calculated – average, rank, maximum and minimum – to make some statements about the statistics. In particular, focus on trends or changes that you can identify as these can be used to make predictions about future changes.

Source 1.20 Tourist arrivals in Australia from the top 10 countries, 2011

Country of origin	Economic value to Australia (\$ billions)	Number of tourists (000)	Change in visitor numbers from 2010 (%)
China	3.5	542	+19.5
United Kingdom	2.6	608	-6.0
New Zealand	2.0	1173	+0.9
USA	1.8	456	-3.4
Japan	1.1	333	-16.5
South Korea	1.1	198	-7.6
Singapore	1.0	318	+3.4
Malaysia	0.9	241	+1.7
India	0.9	148	+6.9
Germany	0.7	154	-4.0

Source: Australian Bureau of Statistics and Tourism Research Australia.

Apply the skill

- The statistics in Source 1.20 are for which year?
- What is the source of these statistics? How do you think they were collected?
- Rank the 10 countries in Source 1.20 from most tourists to Australia in 2011 to least tourists.
 - What is the rank score of Singapore?
 - Which country contributed the most number of tourists?
 - Of the top 10, which contributed the least tourists?
- Calculate the average economic value to Australia of these 10 countries.
- Which country's visitors contribute the highest economic value per person?
- What are Australia's two fastest growing tourism markets?

Extend your understanding

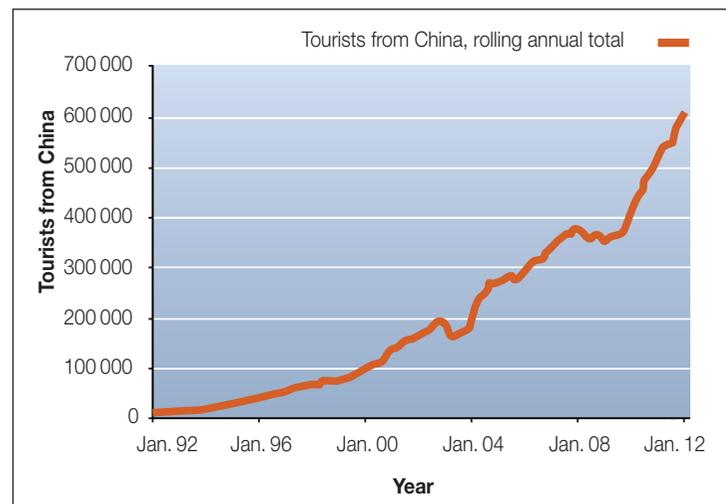
- Using Source 1.22 describe the growth in the number of Chinese tourists visiting Australia from 1992 to 2012.
- Brainstorm possible reasons for this growth.
- Tourist researchers classify international tourists into groups so that people who work in the tourism industry, such as hotel owners and tour operators, can better understand their clients. The following five groups have been identified among Chinese tourists:

Source 1.21 Types of Chinese tourists to Australia

Name of group	Description	Percentage of Chinese tourists
Self-challengers	An inner drive to learn about other cultures through travel	22
Family connections	Holidays are driven by family connections beyond all other reasons for travel	13
Sightseers	The guarantee of seeing world famous sights in a comfortable, secure fashion	18
Ready to leave	Keen to see more of the world beyond South East Asia	25
Close to home	Somewhere familiar and welcoming to relax and feel safe	22

Source: Tourism Research Australia: *The Chinese Traveller* (2005)

- Which of these five groups do you believe are the biggest spenders in Australia? Give some reasons for your answer.
- Which do you believe are the lowest spenders? Give some reasons for your answer.
- Tourism Australia is keen to attract more Chinese visitors to Australia. On which of these five groups do you think they should focus?
- Create a poster, brochure or web page that is designed to attract this group to Australia.



Source 1.22 Growth in numbers of Chinese tourists to Australia

Mountain landscapes

A mountain is an elevated landform that rises above the surrounding landscape. Mountain landscapes appear on every continent on Earth. Mountains are created by the movement of the Earth's **tectonic plates**.

The imposing form of a mountain in a landscape has made mountains significant in the spiritual and cultural lives of many groups, including Indigenous Australians.

Weather conditions at high elevations are harsh and changeable. Humans and animals that live in the mountains have adapted their lifestyles to suit these extreme conditions. For those living close to mountains, there are also risks from volcanic eruptions, landslides and avalanches. In this chapter we will explore these mountain landscapes in detail.



2.1

What forces shape mountain landscapes?

- 1 Yosemite National Park is one of the world's most popular rock-climbing destinations because of the type of rock found there. What features of the rock do you think might be important to this climber?

2.2

How are mountain landscapes used and managed?

- 1 This climber has no safety ropes. Do you think this type of climbing should be allowed?
- 2 What effect does the presence of Yosemite National Park have on the region in which it is located? Name some Australian national parks.



chapter 2

Source 2.1 A rock climber in Yosemite National Park, California, United States. This type of climbing — without ropes — is known as free climbing.

2.3

Are mountain landscapes hazardous places?

- 1 Which natural hazards do you think might be common in mountainous regions?
- 2 Do you think some of the mountains in this region are likely to be active volcanoes? Give some reasons for your answer.

2.1 What forces shape mountain landscapes?

The world's mountains

Mountains are defined by most geographers as 'large natural elevations of the Earth's surface'. Although everyone generally agrees on this definition, there is some disagreement about exactly how elevated (high) the land must be in order for it to be classified as a mountain. In some countries, any land 1000 metres or more above sea level is classified as a mountain, while in other countries the minimum height is closer to 2500 metres. If we go by this second definition, Australia's highest mountain, Mount Kosciuszko, at 2228 metres, is not really a mountain at all.

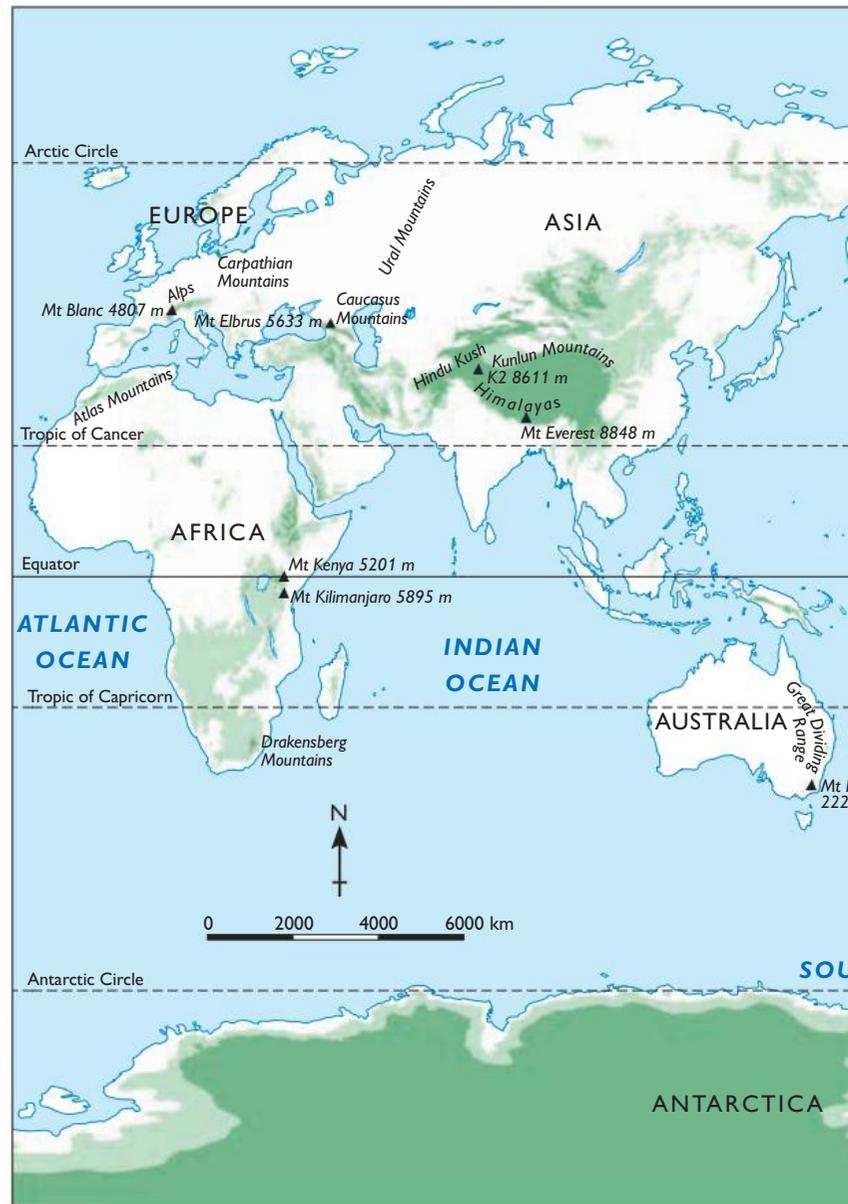
Some countries, such as Nepal and Lesotho, are very mountainous, while others, such as Australia and Egypt, are relatively flat. Lesotho (in southern Africa) is the only country in the world that is entirely more than 1 kilometre above sea level.

The Transantarctic Mountains (in Antarctica) make up one of the world's longest mountain ranges. Due to the huge volume of ice covering the land, Antarctica holds the record for the greatest average height above sea level of any continent (as shown in Source 2.3).



Source 2.2 The Himalayas contains nine of the world's ten highest mountains, including the highest, Mount Everest.

Source 2.4 The Sierra Nevada Mountains in the United States. Their sheer sides are a result of parts of the Earth's crust lifting and dropping away steeply.



Source 2.3



WORLD: MAJOR MOUNTAINS AND MOUNTAIN RANGES



Source: Oxford University Press



Check your learning 2.1

Remember and understand

- 1 Study Source 2.3. There are seven continents. Can you find the highest mountain in each? Which continent has the highest mountain of all? Which has the lowest?
- 2 What is the highest mountain in the world that is not part of a mountain range (a long line of mountains)? Where is it?

Apply and analyse

- 3 Mountains are often part of a mountain range. Why do you think this is the case?
- 4 Why do you think some places are mountainous and others are not?
- 5 Study Source 2.3. Select a continent other than South America or Antarctica. Describe the distribution of mountains on this continent using this description of South America as an example: 'Most of South America is relatively flat. However, a long, high mountain range – the Andes Mountains – extends along the western edge of the continent, from the very north to the very south.'



Source 2.6 Mount Kilimanjaro is Africa's highest mountain. It is also the highest mountain in the world that stands alone, rather than being part of a mountain range.

Source 2.5 The Blue Mountains in New South Wales are the worn away remains of a much larger and higher plateau. This plateau was lifted up by forces within the Earth's crust.

Mountain landscape stories

The legend of the Glasshouse Mountains: a creation story from Australia

According to the Gubbi Gubbi people, Mount Tibrogargan, the father, and Mount Beerwah, the mother, had many children, the eldest of whom was Mount Coonowrin. One day, Mount Tibrogargan was looking out to sea and saw a great wave approaching. He called out to his eldest son, Coonowrin, to help his mother, Mount Beerwah, who was pregnant with child.

In the meantime, Tibrogargan gathered up his other children and began to run towards higher land. When Tibrogargan looked back to check that Coonowrin was helping his mother, he was angered to see him running off alone. He chased his son and, in a great rage, smashed him on the head with his club, dislocating his neck.

Later, when the floods had gone, Coonowrin begged his father for forgiveness, but all his father could do was weep in shame, creating the streams that still run in the region. He asked his son why he had not helped his mother. Coonowrin – not knowing his mother was pregnant – replied that Beerwah was the biggest of all of them and could look after herself. This angered Tibrogargan even more. He turned his back and vowed never to look at his son again.

Even today, Tibrogargan gazes out to sea and Coonowrin hangs his head and cries, his tears running off to the sea. His mother Beerwah is still pregnant as it takes a long time to give birth to a mountain.

The legend of Mount Tongariro: a creation story from New Zealand

According to the Māori people, the mountains of New Zealand were once warriors and gods who moved about the landscape. In the centre of the North Island stood seven great mountains. Six of the mountains were male; Mount Pihanga was the only female. Clothed in native trees and vegetation, she was a great beauty and all the other mountains loved her deeply. One night they decided to fight for her and a fierce battle erupted. The land shook. Smoke, fire and hot rocks filled the sky.



Source 2.7 Mount Coonowrin sitting beside his pregnant mother, Mount Beerwah, Queensland

keyconcept: place

Links between people and the natural landscape

Not all people think about and see the same place in the same way. These differences result from many factors, such as cultural background, education and life experiences. Scientists such as geologists and volcanologists have studied mountains and revealed a great deal about their formation. Local Indigenous people, too, have their own stories relating to the creation of these landscapes. For many Indigenous people around the world, mountains are much more than lifeless rocks.

Many Indigenous people believe that the mountains were alive in the time before humans walked the Earth. They believe that the shapes and locations of mountains can tell us about ancient events. Learning these stories helps us to appreciate that we do not all see the same place in the same way. For many people there is a deep spiritual link between the landscape and themselves.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.

Eventually, Tongariro was proven to be the supreme warrior and won the right to stand beside Pihanga. The losers were given one night to move away or else they would be turned to stone. Taranaki, filled with anger and jealousy, fled to the coast, gouging out a mighty valley as he went. Reaching the sea, he slept. When the day broke he was trapped, and he still hides beneath a cloak of cloud.



Source 2.8 Mount Taranaki wearing a cloak of clouds

The legend of Mount St Helens: a creation story from North America

According to the Puyallup Tribes, long ago two tribes lived across the river from one another. They were friendly and peaceful tribes, and the Great Spirit built a bridge across the river for them. Then the tribes began to quarrel. The Great Spirit became angry. To punish the tribes he took away fire. The tribes prayed to the Great Spirit to return fire to them and eventually he agreed.

To restore fire, the Great Spirit had to go to an old woman named Loo-Wit who, because of her goodness, still had fire. She promised to share her fire with the tribes if the Great Spirit could make her young and beautiful forever. Fire was restored and the two tribes were peaceful for a short time. However, the chiefs both fell in love with Loo-Wit and went to war. In anger, the Great Spirit turned them into mountains: Mount Hood and Mount Adams. The Great Spirit made Loo-Wit into Mount St Helens, clothed in white and beautiful forever.



Source 2.9 Mount St Helens clothed in white with the Toutle River valley shown in the foreground

Check your learning 2.2

Remember and understand

- 1 Examine Source 2.7. Which of these mountains is Beerwah and which is Coonowrin? Give reasons for your answer.
- 2 According to the creation story from New Zealand, why did the volcanoes fight?
- 3 Why do you think many Indigenous people have legends to explain landscapes?

Apply and analyse

- 4 Compare the three legends.
 - a What features do all three have in common?
 - b What is unique about each legend?
- 5 As well as helping people to understand their natural environment, each of these legends contains advice about how to live and behave. What is this advice?
- 6 What did you learn about the Indigenous people of these three regions by reading their legends?

Evaluate and create

- 7 Examine the image of the Blue Mountains in Source 2.5. Imagine that you lived in Australia thousands of years ago, before there were scientific explanations for this landscape. Write and illustrate a legend that explains how this landscape was created.

Traditional Aboriginal land use and mountains

Aboriginal people have a special connection with the land. They see themselves as being responsible for looking after the stories, places, resources and culture of their land. In this way, they seek to live sustainably. This concept is sometimes called Caring for Country and applies to all landscapes, including the forests, deserts, wetlands and mountains.

The Mountains are very old and an ongoing life force that strengthens the ancestral link of our people. We have a living, spiritual connection with the mountains. We retain family stories and memories of the mountains, which makes them spiritually and culturally significant to us. Our traditional knowledge and cultural practices still exist and need to be maintained.

Kosciuszko Aboriginal Working Group

The Bogong moth, a prized food source, can be found in great abundance in the Australian Alps. In early summer, tribes would travel great distances into neighbouring tribal areas to feast on the moth. Rich in fat content, they also provide an important food source for alpine animals, such as the mountain pygmy possum (see

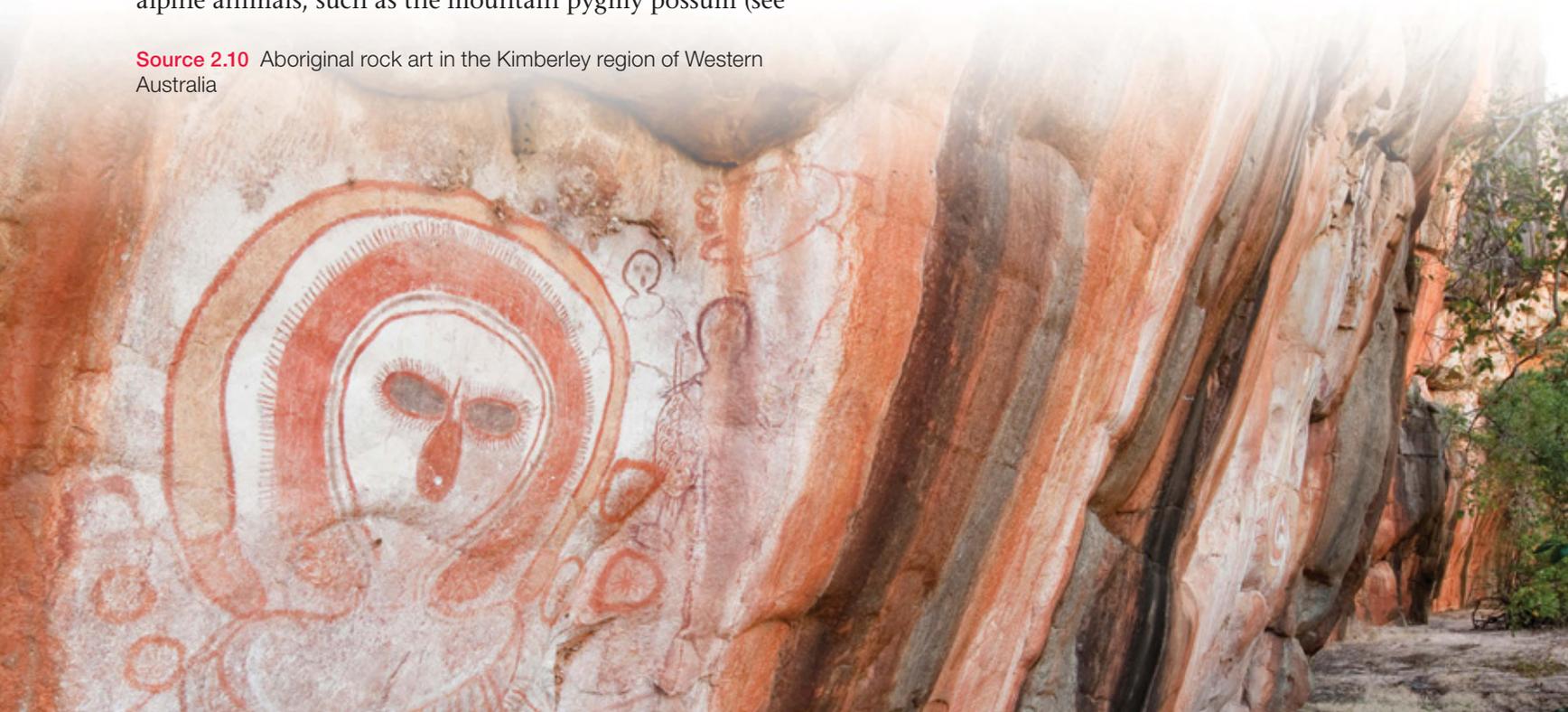
Source 2.10 Aboriginal rock art in the Kimberley region of Western Australia



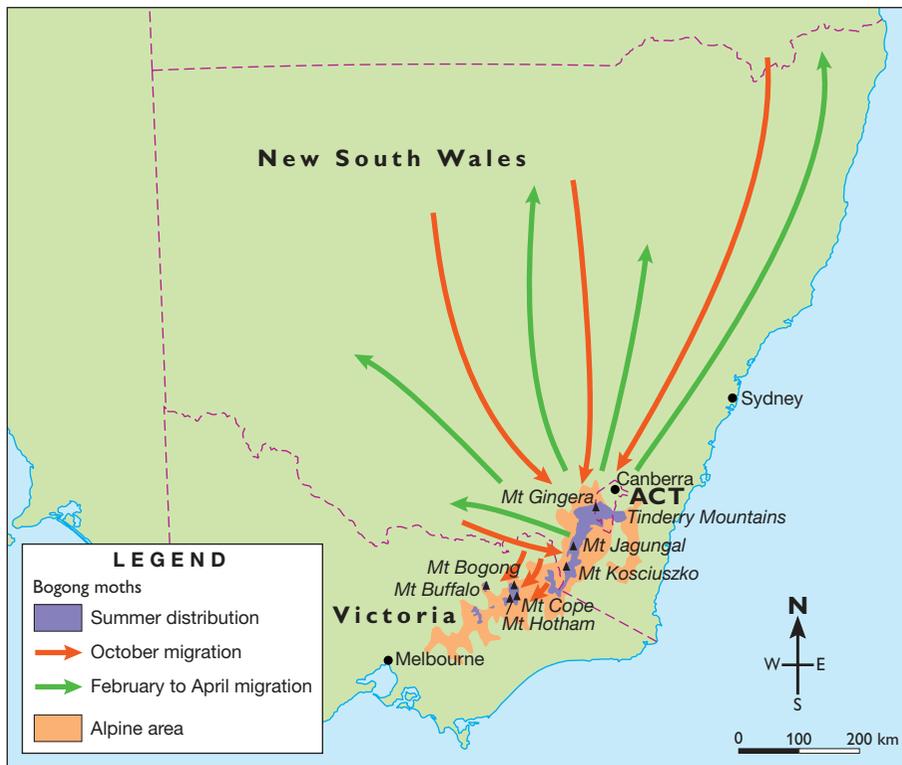
Source 2.11 A Bogong moth

Source 2.43), lizards, birds and fish. Each year millions of these brown moths migrate up to 1000 kilometres to the mountain tops of the Great Dividing Range. As the moths sleep in huge colonies during summer they are easy to catch. Thrown into the ashes of a fire to burn off their wings and legs, they were then roasted and eaten.

Important as food, the moths also served an important social purpose. As hundreds of people met at each nesting site, links between tribes and language groups were made and strengthened. Up to 1000 people may have converged at some sites, representing some of the largest gatherings of Aboriginal people. These feasts were an opportunity for people to share or swap food and other resources from their own Country and to learn more about the customs and languages of other tribal groups.



BOGONG MOTH MIGRATION ROUTES



Source 2.12

As well as providing food, the mountains provided traditional Indigenous people with other resources. Some alpine plants, for example, were used in medicine and others were used in important ceremonies. The Bangalow palm, which grows in the rainforests of the eastern Australian coastal mountains, was used for thatching roofs and making water carriers.

The rocks of the mountains also had their uses, and Indigenous tribes would travel to particular stone quarries to collect rocks for tools such as axes and hatchets. Often they would trade other goods for these rocks and this strengthened the ties between and within tribal groups. One of the most important of these quarries was Mount William in central Victoria, which was the source of greatly prized greenstone hatchet heads.

Source: Oxford University Press



Source 2.13 Stone tools made using greenstone from Mount William in central Victoria

Check your learning 2.3

Remember and understand

- 1 Why was the Bogong moth an important resource for Indigenous Australians?
- 2 Why did people travel to Mount William?
- 3 How do you think the tools shown in Source 2.13 were used?

Apply and analyse

- 4 Examine Source 2.12.
 - a Describe the migration patterns of the Bogong moth. Include compass directions, distances and times of the year in your description.
 - b How did these migration patterns influence the movement of some Indigenous people?

- 5 Imagine that you are an Indigenous Australian and have travelled hundreds of kilometres to reach the nesting site of the Bogong moths. When you arrive the harvest is well under way.
 - a Describe what you see, smell and hear as you arrive.
 - b What would you bring with you?
 - c Explain why your trip is an important annual event for you and your tribe.

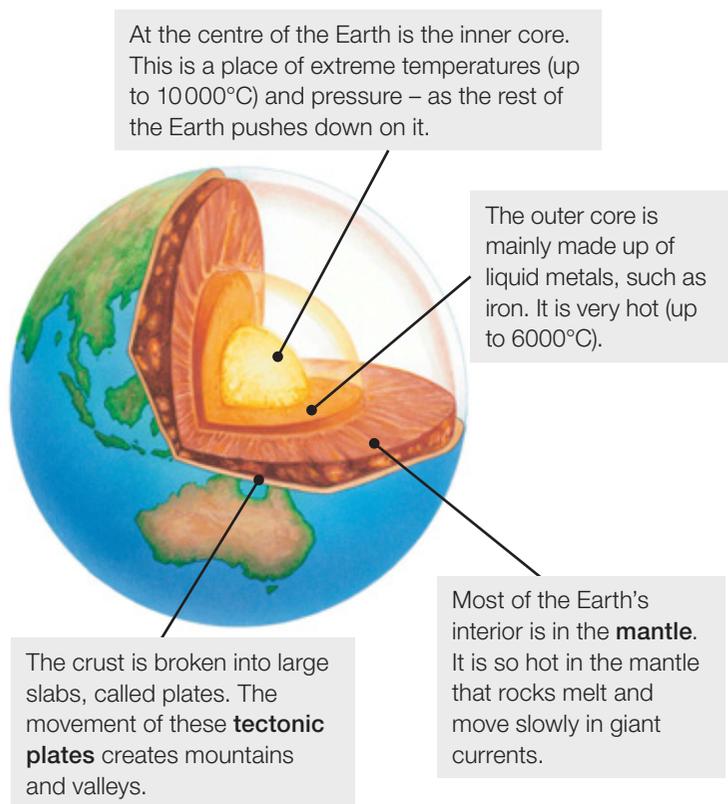
Evaluate and create

- 6 Was the harvesting of the Bogong moth a sustainable use of this resource?
- 7 What questions could you ask to help you decide if the quarrying of stone at Mount William was a sustainable use of this resource?

How mountains are formed

Mountains are formed where the surface of the Earth has been pushed upwards. Tremendous forces inside the Earth can crumple the surface into long mountain chains, such as the Andes or Himalayas, or punch right through the surface to create volcanoes, such as Kilauea on the island of Hawai'i and Mount Kilimanjaro in Tanzania. To understand how this happens you need to know about the world beneath your feet.

You may be used to thinking of the Earth as a solid ball like a giant shot-put, but this is far from the reality. The Earth is more like a giant peach with a thin skin and a core at the centre surrounded by soft flesh. Scientists believe that the Earth is made up of four layers (see Source 2.14).



Source 2.14 The Earth's layers

Tectonic plates

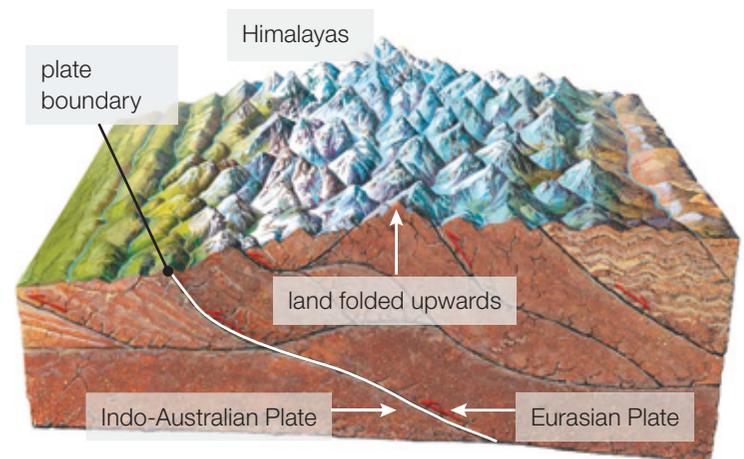
The outer layer of the Earth's surface (known as the crust) is broken into large pieces called **tectonic plates**. These plates are around 100 kilometres thick and fit together like enormous pieces of a jigsaw puzzle. Currents in the

red-hot molten material (**magma**) under these tectonic plates cause them to move about (see Source 2.14).

In some places, they are being pushed into one another (converging). This process creates mountain ranges. The world's highest mountain ranges such as the Himalayas and the Andes are located along a converging plate boundary.

In other places, tectonic plates are being pulled apart from one another (diverging). This process creates rifts in the Earth's surface that allow hot magma to ooze to the surface and create new land. The world's longest mountain range, the mid-Atlantic Ridge, is an undersea mountain range formed along a diverging plate boundary.

The movement of tectonic plates is also responsible for many other features and natural events on the Earth's surface, such as volcanoes and earthquakes. Volcanoes are formed when magma is pushed through an opening in the Earth's crust. Earthquakes are caused when the edges of tectonic plates push and grind against one other.



Source 2.15 The collision of tectonic plates caused the formation of the Himalayas.

Types of mountains

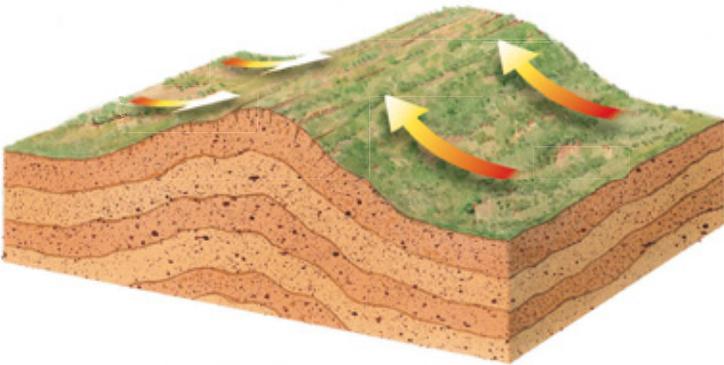
Mountains are classified according to how they were formed. There are three main types of mountains:

- 1 fold mountains
- 2 block mountains
- 3 volcanic mountains.

1 Fold mountains

Fold mountains are created by upward pressure where two tectonic plates collide. As the plates converge, layers of rock are buckled and pushed upwards creating fold mountains. Most of the world's highest mountain ranges are fold mountains.

The world's largest fold mountains are the Himalayas, which separate southern Asia from central Asia. They have been formed by the collision between the Indo-Australian plate and the Eurasian plate over the last 55 million years. Currents within the mantle are moving the Indo-Australian plate northwards, and its front edge is bulldozing into the Eurasian plate, folding the edges of both plates upwards.



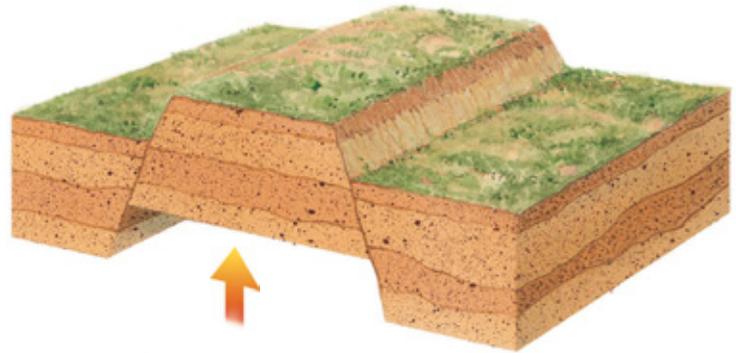
Source 2.16 Creation of a fold mountain



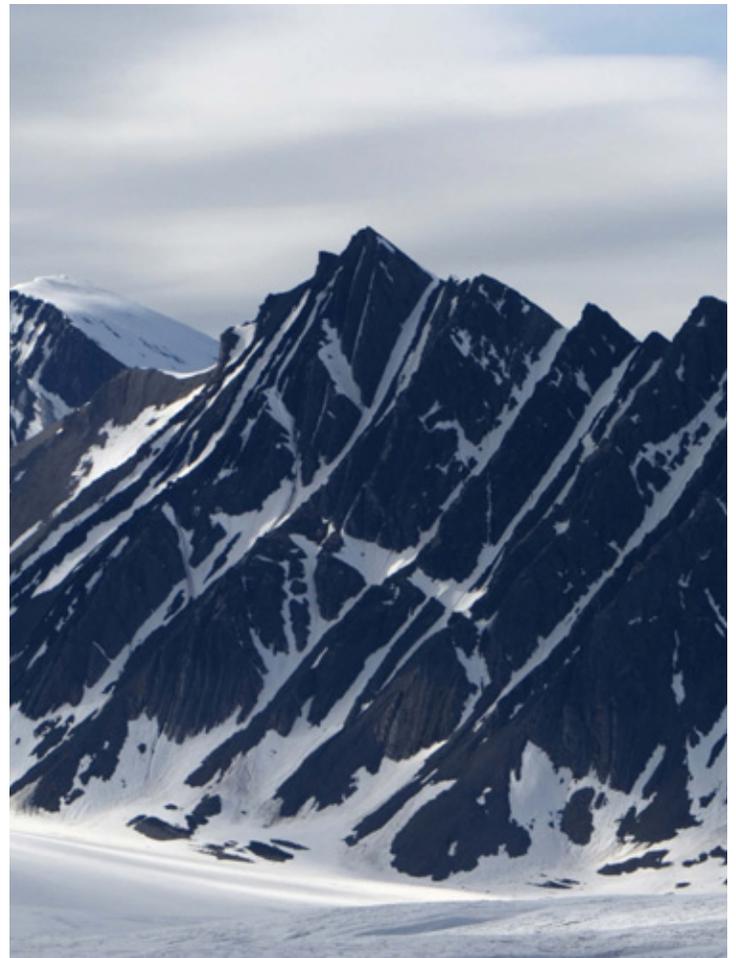
Source 2.17 These mountains on the edge of the Zaskar Valley in Ladakh, India, are clearly distinguishable as fold mountains.

2 Block mountains

Block mountains are created when cracks in the Earth's crust known as faults force blocks of land upwards. Rocks that are cooler because they are close to the surface tend to crack and break apart when compressed from the sides. Rather than folding, they are often lifted up in giant blocks along fault lines to create block mountains. Geologists refer to this mountain-building process as faulting.



Source 2.18 Creation of a block mountain



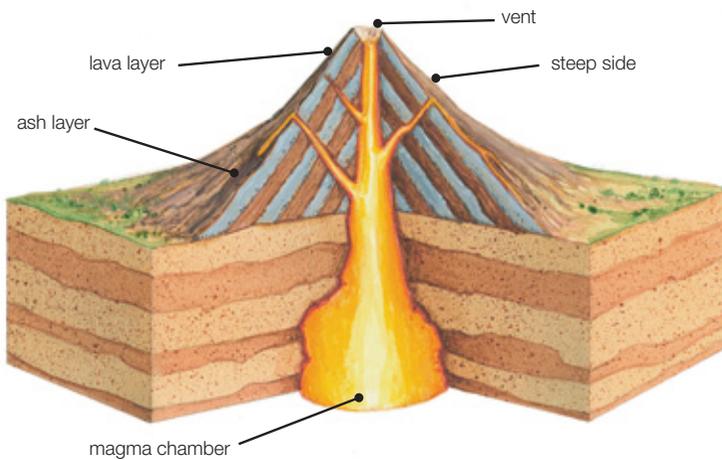
Source 2.19 Block mountains in the Arctic region of Norway

3 Volcanic mountains

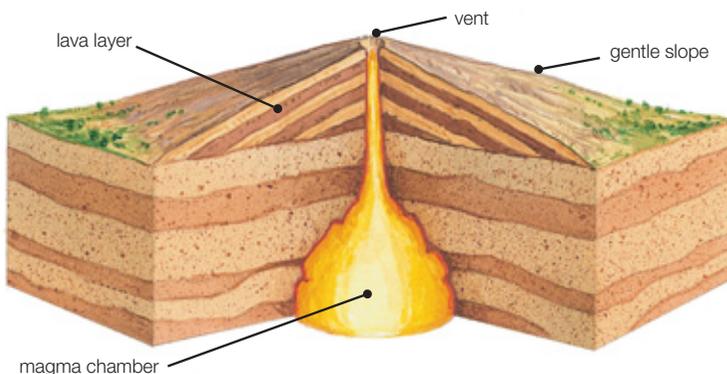
Volcanic mountains are created by volcanoes, as the name suggests. They are created when magma pushes its way from beneath the Earth to the crust. The material that comes out of a volcano builds up the Earth's surface, creating new land and new landforms.

Each eruption brings new material to the surface, as ash or **lava** or both. As lava flows across the surface it covers the rocks from previous eruptions and builds up the height of the land in layers. Runny lava can travel many kilometres from the crater and leave behind a shallow layer of new rocks over a wide area. These types of volcanoes are known as **shield volcanoes** (see Source 2.21).

The Hawaiian volcanoes and Mount Kilimanjaro in Tanzania are examples of shield volcanoes. The more familiar steep-sided volcanic cones (see Source 2.20), such as New Zealand's Mount Taranaki and Mount Fuji in Japan, are formed when lava and ash do not travel far from the crater. These materials are then left as a new layer on the sides of the cone, building it higher.



Source 2.20 A cutaway diagram of a volcanic cone



Source 2.21 A cutaway diagram of a shield volcano

Most of the world's volcanoes are located on or near plate boundaries where plates collide and one plate is forced downwards into the mantle. This causes pressure to build up and molten rocks, called magma, to rise to the surface and force their way out through a weakness in the crust. This is what we see as an eruption. Other volcanoes are located in **hot spots**, which are areas that are often in the centre of a plate where the mantle is particularly hot. In these places molten rock from the mantle is forced upwards through the moving crust.

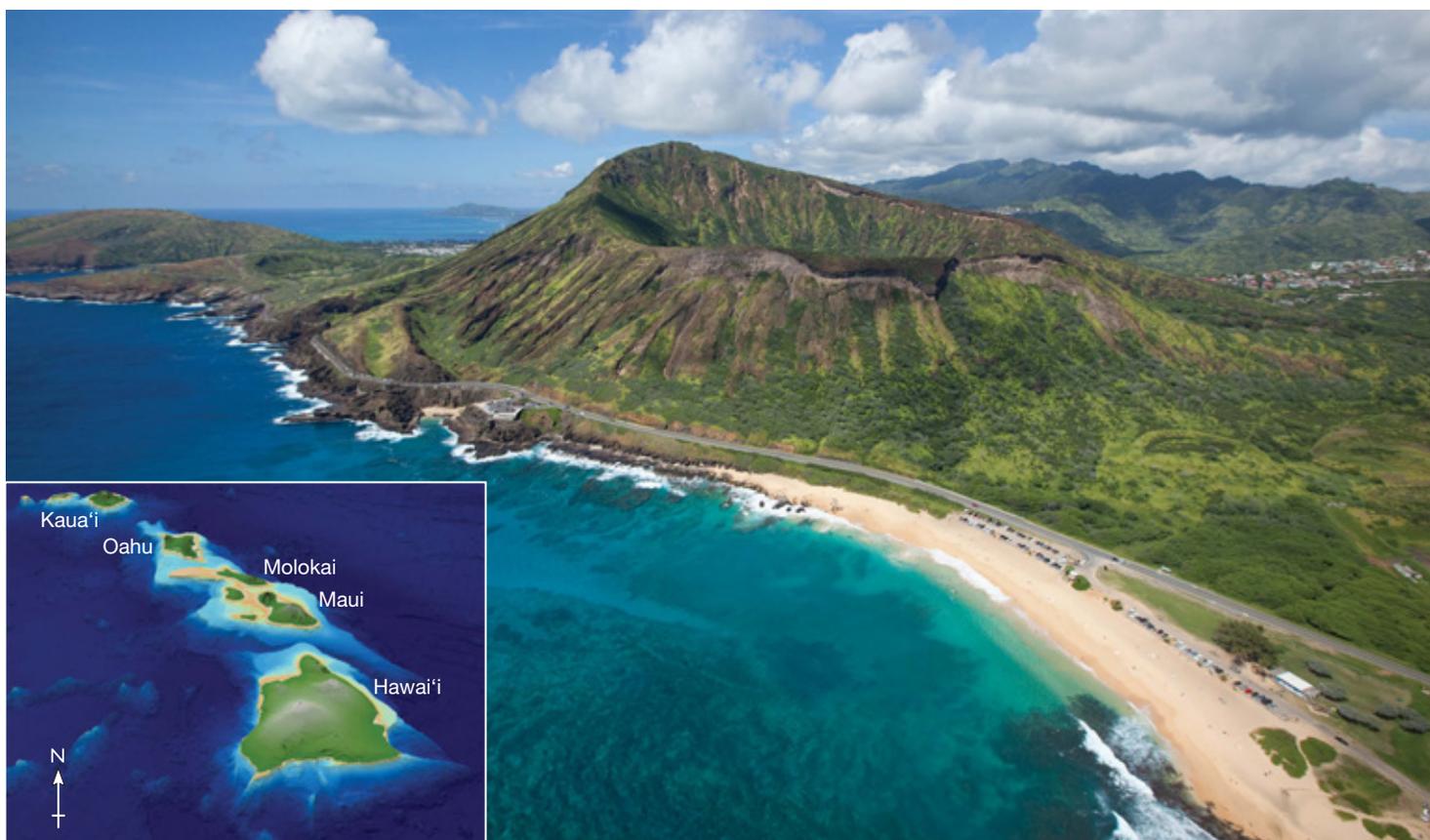
The Hawaiian Islands have been formed above a hot spot. As the Pacific Plate moves over the hot spot a line of volcanoes has been created. The oldest volcanoes have been eroded so that little remains above sea level. The newest island, Hawai'i, has many active volcanoes and is increasing in size every year.



Source 2.22 Mount Fuji in Japan is an example of a volcanic cone.



Source 2.23 Rangitoto Island in Auckland, New Zealand, is an example of a shield volcano.



Source 2.24 The Koko Crater on Oahu (main) and a digital terrain model of the Hawaiian Islands showing them sitting on top of a chain of massive volcanoes (inset)

Check your learning 2.4

Remember and understand

- 1 What are the four layers of the Earth?
- 2 In this section, the Earth is described as being more like a peach than a shot-put. In what ways is the Earth like each of these objects: an inflated balloon, an apple and an egg?
- 3 How do the Earth's tectonic plates move?
- 4 Describe the process of folding.
- 5 How does a volcanic eruption change the shape of the land?

Apply and analyse

- 6 What are the similarities between folding and faulting? What are the important differences?
- 7 Sketch and label a diagram of the block mountains in Norway (Source 2.19) to show how they are formed.
- 8 Explain why some volcanoes are steep-sided cones and some are not.
- 9 Why is every volcano in the world a different shape?

Evaluate and create

- 10 Scientists have been able to work out the age of the lava flows on each of the Hawaiian Islands. Here is their data with the age of lava in millions of years.

Island name	Age of lava (million years)
Kaua'i	3.8–5.6
Oahu	2.2–3.4
Molokai	1.3–1.8
Maui	0.8–1.3
Hawai'i	0.7

- a On which island is the oldest lava found?
- b On which island is the newest lava found?
- c How does this data support the theory that the islands formed as they passed north over a hot spot?
- d Which of these islands is the smallest?
- e Which of these islands is the largest?
- f Suggest a possible reason for this difference.

Tectonic plate boundaries

Source 2.28 shows the Earth's tectonic plates. The plate boundaries are shown to be either converging (pushing into each other) or diverging (pulling apart). This activity on the boundaries has a number of effects on the Earth's surface.



Source 2.25 In North America, two plates are sliding past each other creating the San Andreas Fault.



Source 2.26 In South America, four plates are colliding with each other creating the Andes.



Source 2.27 In Africa, three plates are moving apart creating the Great Rift Valley.

skilldrill

Using overlay maps

An overlay map is a transparent, or semi-transparent, sheet that lies over another map to show the link between different features or events and how they may be related to each other. Follow these steps when reading an overlay map:

- Step 1** Look carefully at the base map to understand what it is showing.
- Step 2** Apply the overlay map to see if there are any links with the base map.
- Step 3** Describe the degree to which patterns are connected.
- Step 4** Try to suggest reasons for the connection between the two patterns.

Apply the skill

Look at Source 2.28:

- 1 What features are shown on the overlay?
- 2 What relationship is there between the pattern of the overlay map and the pattern on the base map?
- 3 Suggest why there is a relationship between these patterns.
- 4 Use the Internet to locate five major cities situated near active volcanoes. Mark these cities on the overlay.

Check your learning 2.5

Remember and understand

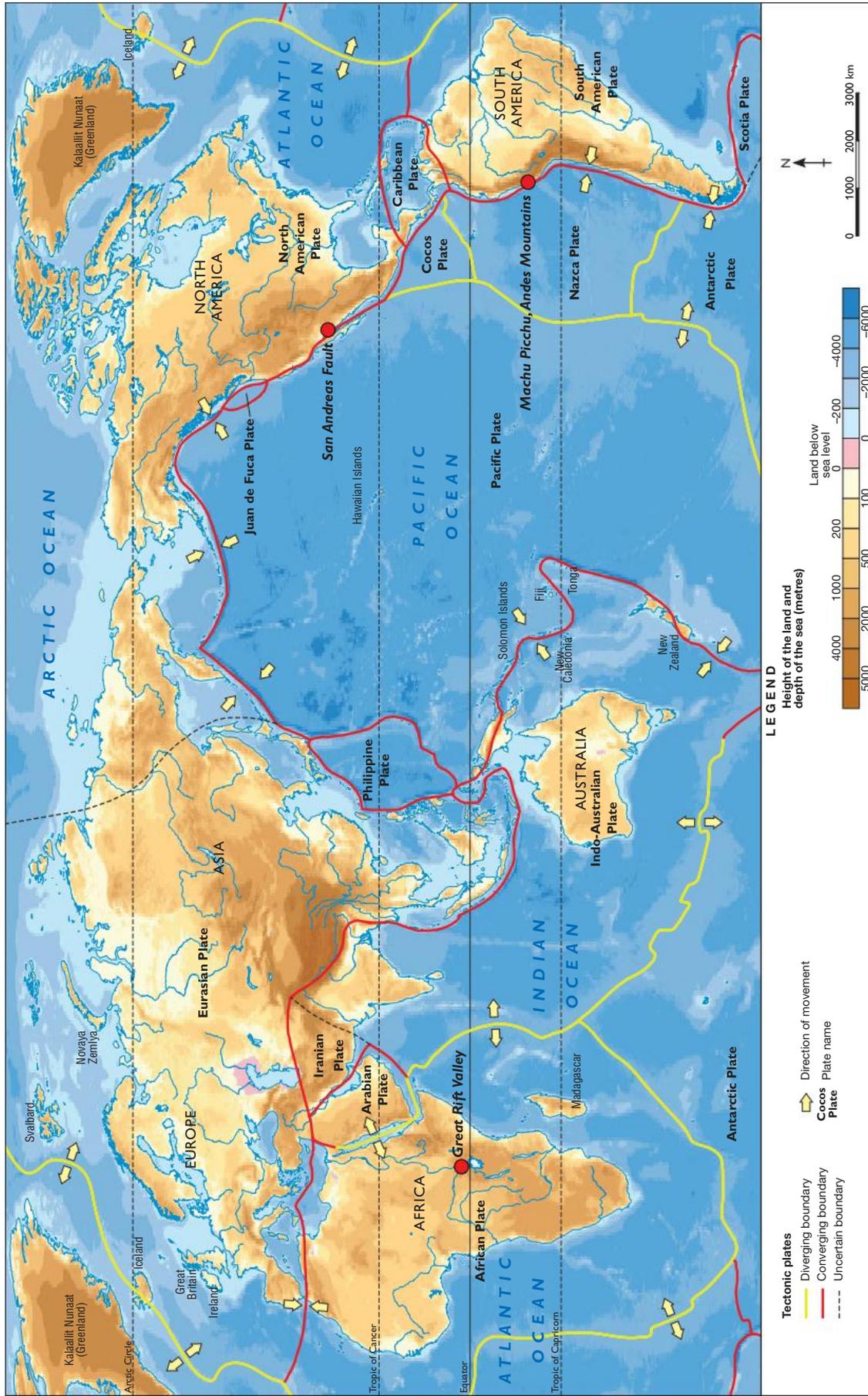
- 1 Which of these statements are true and which are false?
 - a Africa is moving away from Europe.
 - b Australia is moving closer to Antarctica.
 - c South America and Africa are moving further apart.

Apply and analyse

- 2 Carefully examine Source 2.28.
 - a On which plate is Australia located?

- b In which direction is this plate moving?
- c What is the main difference in terms of plate boundaries between the location of New Zealand and the location of Australia?
- d Identify any possible links you notice between plate boundaries and:
 - i mountain ranges
 - ii volcanoes
 - iii earthquakes.

WORLD: MAJOR TECTONIC PLATES



Source: Oxford University Press

Source 2.28



Volcanoes and earthquakes

- ▲ Volcano
- Earthquake

2.1 bigideas: broadsheet

The mountains of Antarctica

Antarctica is the world's highest continent. Its average height above sea level is 2500 metres whereas Australia's is about 340 metres.

Antarctica's great height is largely due to the two enormous ice sheets that cover virtually the whole continent. Up to 4 kilometres thick, these ice sheets hold 90 per cent of the world's ice and 70 per cent of its fresh water. Antarctica is also home to vast mountain ranges. Most of its mountains lie hidden beneath the ice, but some are tall enough to poke through the ice. One range, the Transantarctic Mountains, is over 3000 kilometres long and tall enough to hold back the world's largest ice sheet.



Source 2.29 A section of the Transantarctic Mountains in Antarctica

skilldrill

Interpreting a cross-section

Maps are useful tools for showing where places are located, but they don't usually show the height of the land. This is because they show a view from above, rather than from the side. Some maps, such as Source 2.31, show the height of the land through contour lines. These lines help us to visualise the shape of the land. One of the most useful tools that geographers use to see a landscape from the side are cross-sections.

Step 1 Look at the map of Antarctica in Source 2.31.

Find the line that runs from A to B on the map. This identifies the section of land to be shown as a cross-section.

Step 2 Look at the cross-section of Antarctica shown in Source 2.30. This shows the section running A – B – C as a cross-section.

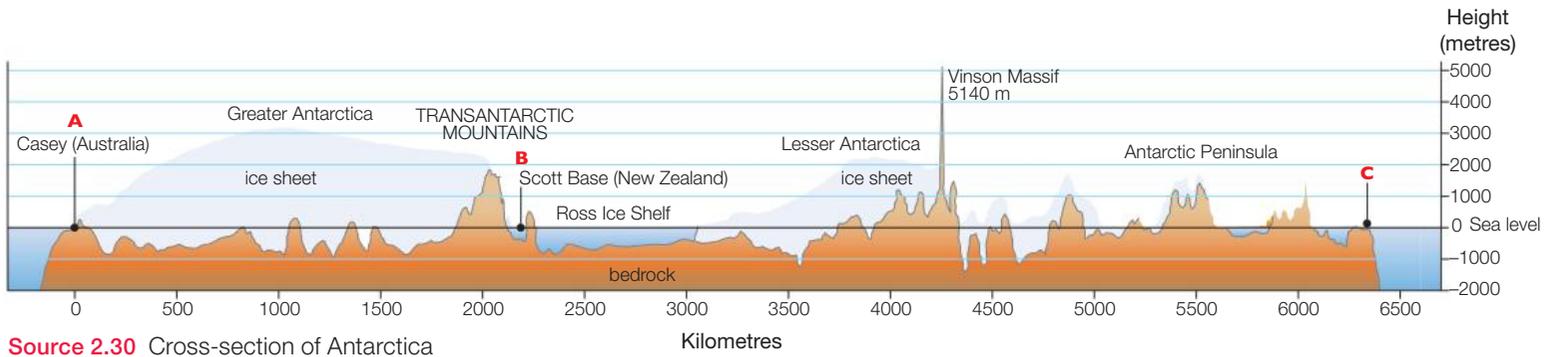
Step 3 Use the cross-section to estimate the height of the mountains and the thickness of the ice that covers them.

Apply the skill

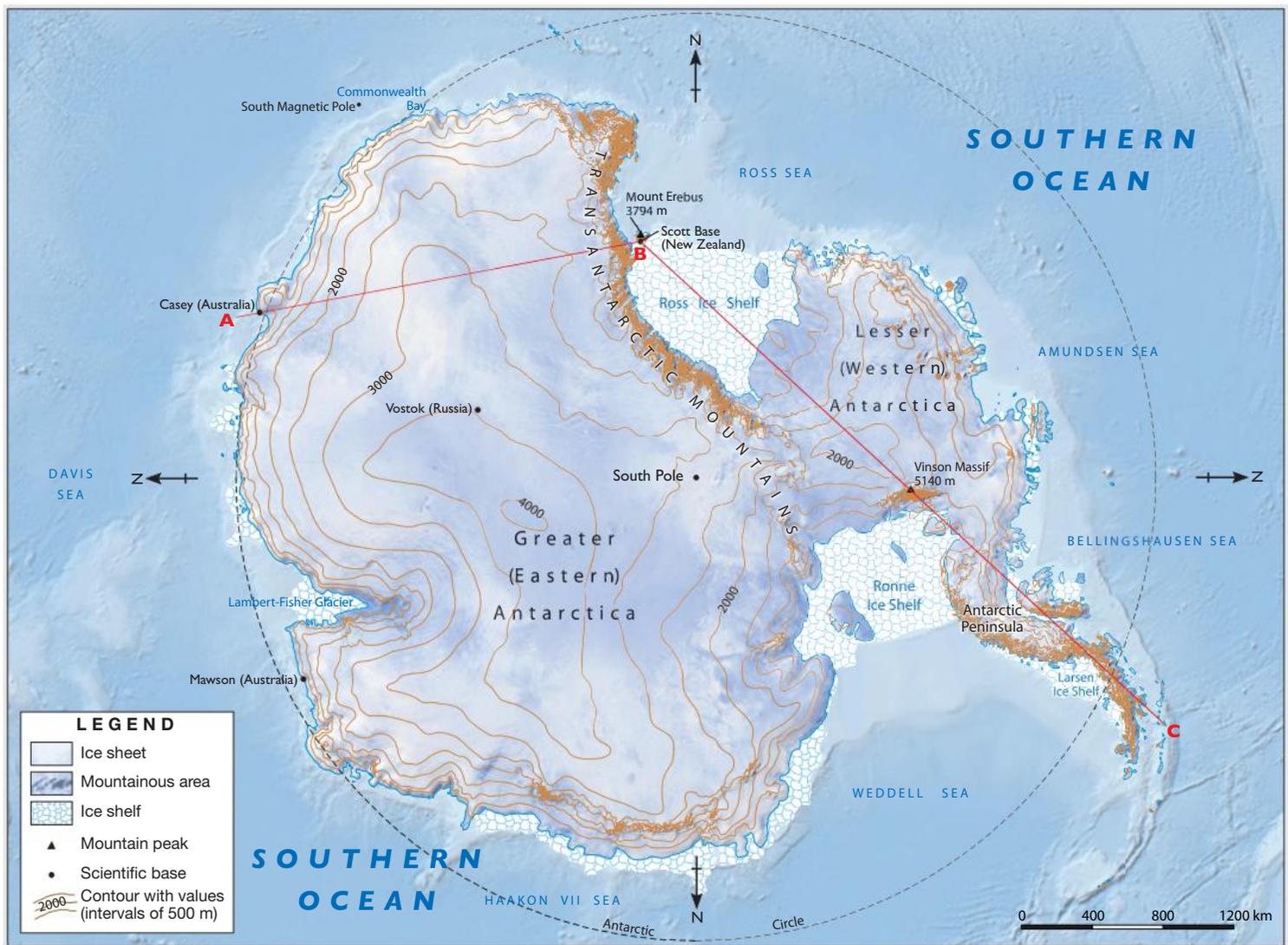
- 1 Why can't we see most of Antarctica's mountains?
- 2 Which of Antarctica's two ice sheets is the highest?
- 3 Describe the shape of the landforms beneath Antarctica's ice sheet.
- 4 How high above sea level is the Ross Ice Shelf?
- 5 When explorers first began to try to reach the South Pole they used the Ross Ice Shelf as a way to access the interior of Antarctica. Use the cross-section to explain why this was both a good idea and a bad idea.

Extend your understanding

- 1 Use the map of Antarctica (Source 2.31) to describe the distribution of mountains on that continent.
- 2 How do you think the Transantarctic Mountains were formed? Give some reasons for your answer.
- 3 Mount Erebus, located on the edge of the Ross Ice Shelf, is an active volcano. Do you think it is located over a hot spot? Give some reasons for your answer.



ANTARCTICA



Source: Oxford Atlas

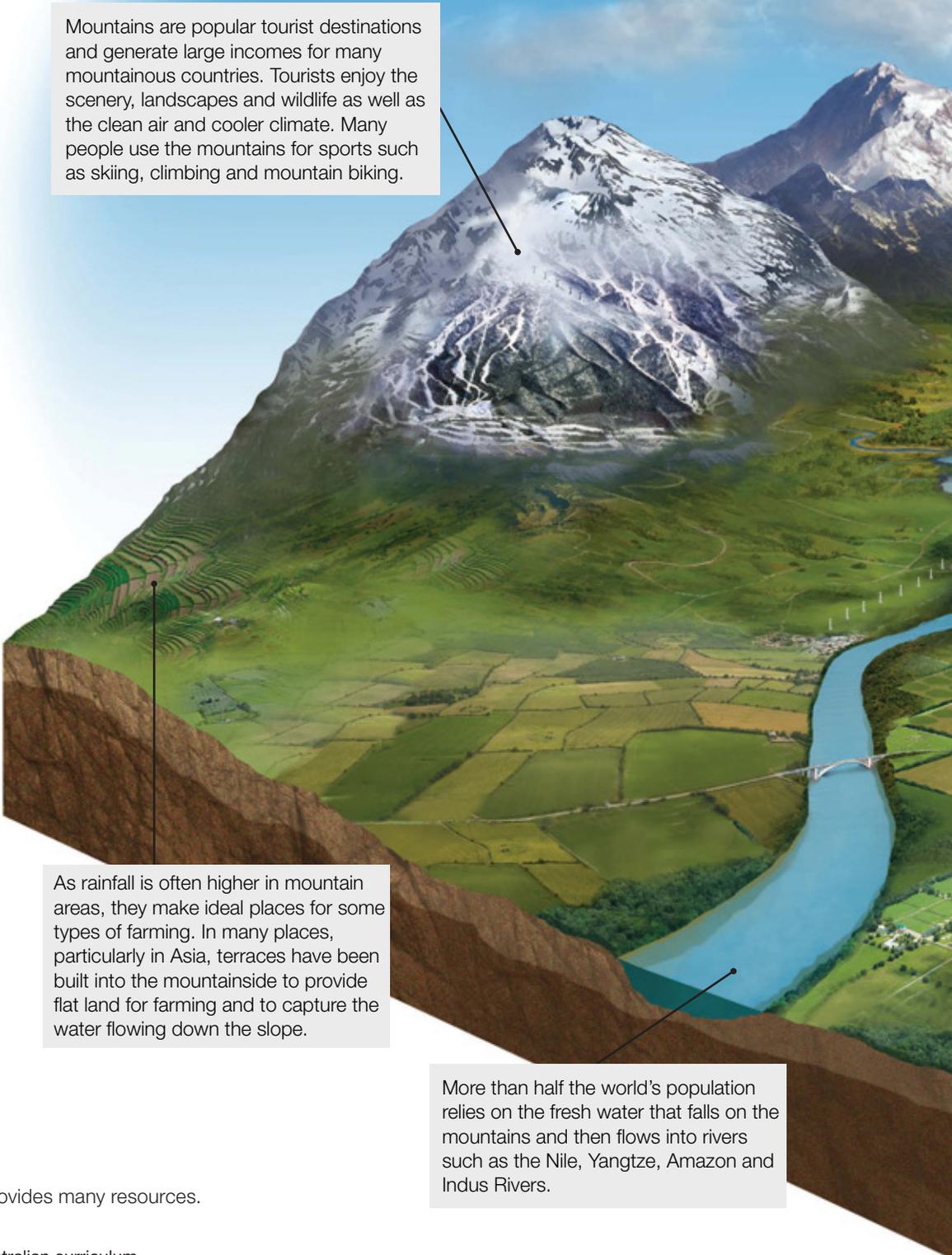
2.2 How are mountain landscapes used and managed?

One landscape, many uses

Like many of the world's landscapes, mountains are used by people as a resource. Billions of people rely on them to satisfy certain needs and wants. Some of the ways in which we use mountains do not change them at all, while others can affect them dramatically.

Mountain landscapes are often fragile. Small changes caused by human activities can greatly affect the plants and animals, soil and even the climate in these areas.

Depending on the society and culture into which people are born, and their personal circumstances, they will view and value different parts of the natural world in very different ways. For example, a tribesman from the highlands of Papua New Guinea may value mountains as a place to live and grow crops; an Indian farmer may value mountains as a source of fresh water for irrigation; and an Australian city-dweller may value mountains as a holiday destination for skiing and snowboarding.



Mountains are popular tourist destinations and generate large incomes for many mountainous countries. Tourists enjoy the scenery, landscapes and wildlife as well as the clean air and cooler climate. Many people use the mountains for sports such as skiing, climbing and mountain biking.

As rainfall is often higher in mountain areas, they make ideal places for some types of farming. In many places, particularly in Asia, terraces have been built into the mountainside to provide flat land for farming and to capture the water flowing down the slope.

More than half the world's population relies on the fresh water that falls on the mountains and then flows into rivers such as the Nile, Yangtze, Amazon and Indus Rivers.

Source 2.32 The mountain landscape provides many resources.

Check your learning 2.6

Remember and understand

- 1 Which use of mountain landscapes shown in Source 2.32 do you think has the greatest impact on the natural environment? Justify your answer.
- 2 List three uses that have little or no impact on the natural environment.
- 3 In what ways do you use mountains as a resource?
- 4 Can you think of any other uses of the mountains not shown in Source 2.32?

Apply and analyse

- 5 In what ways does tourism change the natural environment?
- 6 How might tourism benefit people who live in mountainous places?

Evaluate and create

- 7 Select two uses of mountains that can co-exist without affecting each other. Explain why there is no conflict in these uses.
- 8 Select two uses that conflict or compete with each other. Explain why there is this conflict. Can you think of any real-life examples of this type of conflict?
- 9 In small groups, rank the uses of mountain landscapes shown from most to least harmful to the environment. When you have decided on the most harmful, brainstorm exactly what these impacts might be. Share your brainstorm with the rest of the class and be prepared to add to your list of potential impacts.

Mountains provide a range of habitats for plants and animals. One-quarter of the world's forests, including much of the remaining rainforest, exist in mountainous regions. Mountains are a storehouse of biodiversity.

About one-tenth of the world's population lives in mountainous areas, particularly in central Asia and Africa. They support their lifestyle by using the resources of the mountains, such as fertile soils and high rainfall.

Minerals and metals (such as coal, gold, silver and tin) are often found in mountain landscapes. As rock layers are folded upwards, to create mountains, minerals are carried closer to the surface and are easier to mine.

Fast-flowing mountain rivers provide a source of power. They are dammed to capture their energy and the water is fed through turbines in a power station to generate electricity.

The impacts of living in the mountains



Source 2.33 Lhasa is located on a flat area in the bend of the Kyi River.

One of the world's highest cities is Lhasa in the region of China known as Tibet. Lhasa is located high up in the Himalayas at an altitude of 3.5 kilometres above sea level. This is more than 1 kilometre higher than the top of Mount Kosciuszko — Australia's highest mountain. The city is located in a small river basin and is surrounded by high mountains. This meant that for centuries the people who lived in the city had very little contact with people from other places. Due to their isolation, the people of Lhasa have developed a unique way of life.

Most people who live in Lhasa are ethnic Tibetans. Virtually all Tibetans are Buddhists and recognise the Dalai Lama as their spiritual leader. For hundreds of years the region of Tibet has been a 'disputed territory'. At times the Chinese have ruled the region, at other times the Tibetans have ruled the region under the leadership of the Dalai Lama. At present, Tibet is officially recognised as part of China.

Getting to and from Lhasa

Living in such a mountainous place brings unique challenges to the people of Lhasa. One of these challenges is accessing other places. The high mountains that surround the city have made it difficult to build and service reliable roads. For many years the only way into Lhasa was to walk across one of the mountain passes and into the valley. The Chinese Government has spent



Source 2.34 The world's highest bridge helps to link Lhasa to China's Sichuan province.

billions of dollars in recent years to connect Lhasa to other parts of China. This has been spent on new highways and bridges, an airport and a railway line. Some of these new structures (see Sources 2.34 and 2.35) are among the most amazing pieces of engineering on Earth.



Source 2.35 The world's highest railway links Lhasa to Shanghai, China's largest city. About 550 kilometres of the line are built on permafrost, which freezes solid in winter and turns to mud in summer.



Source 2.36 Perhaps the greatest climber of all, Apa Sherpa has climbed Mount Everest a record 20 times.

Living with less oxygen

It has long been a medical puzzle why many visitors to Lhasa suffer mountain sickness, while most Tibetans seem to be largely unaffected by the oxygen-thin air that causes this condition. Symptoms of mountain sickness range from mild problems, such as headaches and shortness of breath, to severe symptoms, such as a coma. It was long thought that Tibetans have larger lungs than outsiders and so can cope with less oxygen, but scientists now believe that it is the Tibetan's genes that protect them from this condition. It appears that people who live at high altitudes for generations, such as the Tibetans, have undergone a genetic change in their blood that allows them to live comfortably with less oxygen.

Other ethnic groups who live in the Himalayan Mountains also cope well with less oxygen. The Sherpa people of Nepal and Northern India, for example, are renowned as mountaineers. Most climbers who try to scale mountains in this region (such as Everest, K2, Kanchenjunga, Lhotse and Makalu) use Sherpas as guides, porters and fellow climbers. The first men to climb Mount Everest, for example, were New Zealander Edmund Hillary and his Sherpa climbing companion Tensing Norgay.

Check your learning 2.7

Remember and understand

- 1 What are some of the problems faced by people who live in mountainous regions?
- 2 What difficulties do people face reaching Lhasa?
- 3 How have some of these difficulties been overcome?

Apply and analyse

- 4 Look closely at Source 2.33.
 - a Why do you think Lhasa was built in this place?
 - b In what ways do you think the people of Lhasa use the river shown in the foreground?
 - c How do you think these mountains were formed?
 - d How are natural forces changing these mountains?
 - e How are human activities changing these mountains?

Evaluate and create

- 5 Why do you think the Tibetan region is a disputed territory? Discuss with your classmates why different groups can come into conflict over control of land.
- 6 With new road and rail links, Lhasa is being visited by more outsiders than ever before. While some people in Lhasa welcome the new arrivals, many are concerned about their influence on their way of life. Complete a PMI (plus, minus, interesting) chart on the impacts of this increased accessibility.

The impacts of farming on mountain landscapes

Farming in mountainous areas has many advantages, such as reliable rainfall and fertile soils, but it also brings many challenges. These difficulties include accessing raw materials (such as grain for planting) and getting crops to market for sale. There are also many natural hazards to overcome, such as landslides and earthquakes. Despite all these obstacles, a lack of flat land is perhaps the greatest challenge for many mountain-dwelling farmers. Flat land allows farmers to irrigate their fields without the water draining away and also makes it easier to use animals or tractors for tasks such as ploughing.

Rice terraces

Throughout much of Asia, flat land has been carved out of steep mountains by creating steps on the hillsides known as terraces. These terraces have a dramatic impact on the natural landscape as shown in Source 2.37.

Terraces are built in three stages:

- Stage 1 – The farmer selects a good site with a reliable source of water, such as a stream or spring. A wall of large stones is then laid down across the slope of the hill.
- Stage 2 – Using the stream to carry material down the slope, the farmer fills the area behind the wall with gravel and then topsoil. The stone wall is built up as more gravel and soil are added.
- Stage 3 – Once the terrace is large enough, it is flooded with water so that rice can be grown. The flow of water down the terraced slope is controlled by removing and replacing stones from the wall.

Some terraces, including those shown in Source 2.37, are thousands of years old and farmers often spend many hours a day maintaining them. The crop most often grown in these terraces is rice, which is the staple food of half the world's population.

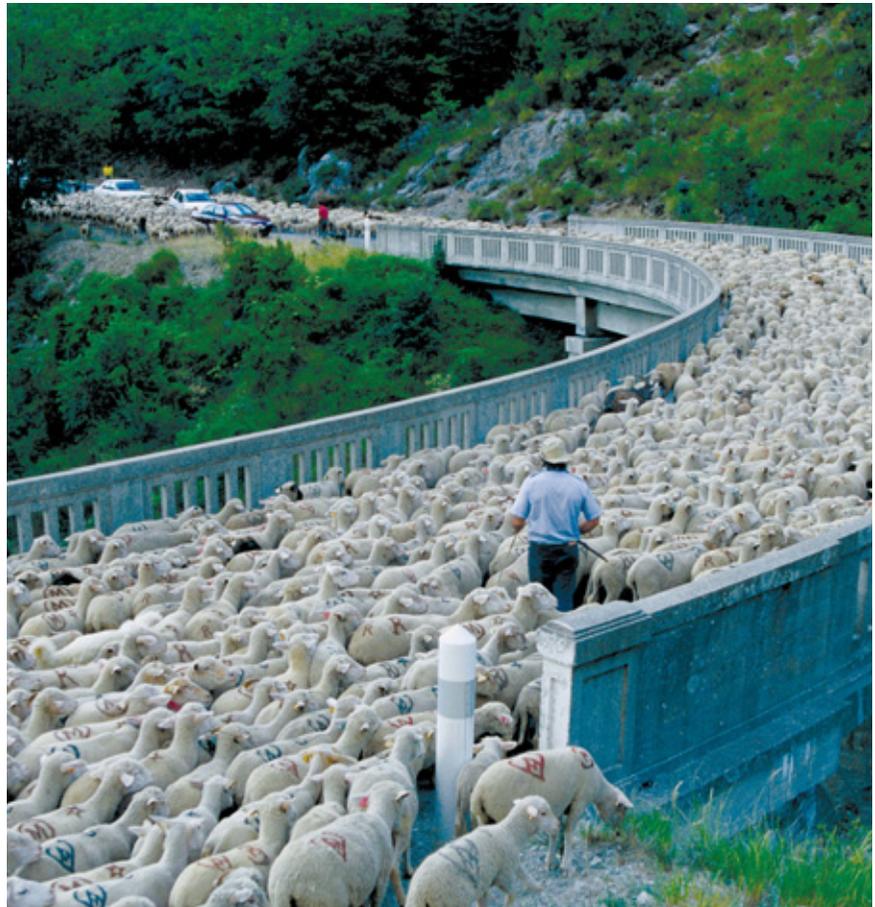


Source 2.37 The rice terraces of Luzon Island in the Philippines are a World Heritage site. Built by the native Ifugao people, some of the terraces are more than 2000 years old.

Moving with the herd

In mountainous areas there can be dramatic differences between summer and winter. In winter, snow blankets the grass on the ground and animals (including farm animals, such as sheep, goats and cows) cannot feed. As temperatures rise in spring, the snow melts and the grass recovers. The warmer temperatures also allow moss, lichens (fungi) and wildflowers to flourish, providing food for grazing animals. Farmers respond to these seasonal changes by moving their herds between summer pastures in the mountains and winter pastures in mountain valleys and the plains below.

In some parts of Asia and Europe, including the French Alps (see Sources 2.38 and 2.39), this type of farming is centuries old. An Australian equivalent is the summer movement of cattle into the Australian Alps in parts of Victoria and New South Wales, a practice that has now largely been stopped because of the damaging effects it can have on the landscape.



Source 2.38 A shepherd takes his flock of sheep into the French Alps for summer.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Average low temperature (°C)	-3	-3	-2	0	5	8	10	11	7	4	-1	-3
Rainfall (mm)	164	100	84	125	127	72	42	52	153	232	225	167

Source 2.39 Climate data for the town of Mende in the French Alps

Check your learning 2.8

Remember and understand

- 1 Why is rice often grown in terraces?
- 2 What is often the most challenging problem facing people farming in mountainous areas?
- 3 Why do many farmers in Europe live some of the year in the mountains and some of the year on the plains below?

Apply and analyse

- 4 Using the information provided, together with Source 2.37, complete the following tasks:
 - a Create a diagram illustrating the three stages required when constructing a rice terrace.
 - b Name two natural features that make the area shown in Source 2.37 suitable for farming.

Evaluate and create

- 5 Compare the two methods of mountain farming described here. Complete a Venn diagram showing the features unique to each and the features they share.
- 6 Study the climate data for the town of Mende in the French Alps. This town is located near some of the summer pastures used by French farmers. Complete a climate graph for the town of Mende and answer the questions that follow.
 - a In which month do you think farmers bring their herds to the meadows near Mende?
 - b In which month do you think they leave?
 - c What would this mean for shop owners in Mende?

The impact of cattle grazing on mountain landscapes

For many years, people have argued over the use of Victoria's mountain landscapes for grazing cattle in summer. The area, known as the 'high country' (including the Alpine National Park), has been used by cattle graziers for over 100 years. Each summer they bring small herds of cattle into the region from lower altitudes to graze on the grass of the high plains. Over that time they have established a network of mountain huts built near reliable sources of water. As temperatures drop and snow begins to fall in autumn, the cattle return to their lowland pastures. The cattle graziers claim that they are an important part of the heritage of the area, and that their grazing causes little or no environmental damage and may actually reduce the risk of serious bushfires.

There are many opponents of high-country grazing. They claim that scientific studies have shown that cattle cause great environmental damage to the region.

keyconcept: sustainability

High-country grazing

Sustainability refers to the way in which we use the resources of our planet. If we use too much of a resource, or use it too quickly or unwisely, we can affect the quality or amount of that resource. For example, if we take too many fish from the oceans, we make it difficult for the numbers of fish to return to previous levels. This is referred to as unsustainable resource use. If, on the other hand, we only take a few fish then the numbers of fish will quickly return to their previous level. This is a sustainable use of the fish resource.

While this seems simple, it can be very difficult to work out exactly what is sustainable and what is not. A great deal of evidence needs to be collected and analysed to find out if a resource is being used sustainably. In many cases, such as in the example of high-country grazing, there are individuals and groups who strongly believe that their use of this resource is sustainable, while other groups strongly believe it is not. Each side of the issue may interpret scientific data in their own way or they may look only for evidence to support their point of view.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



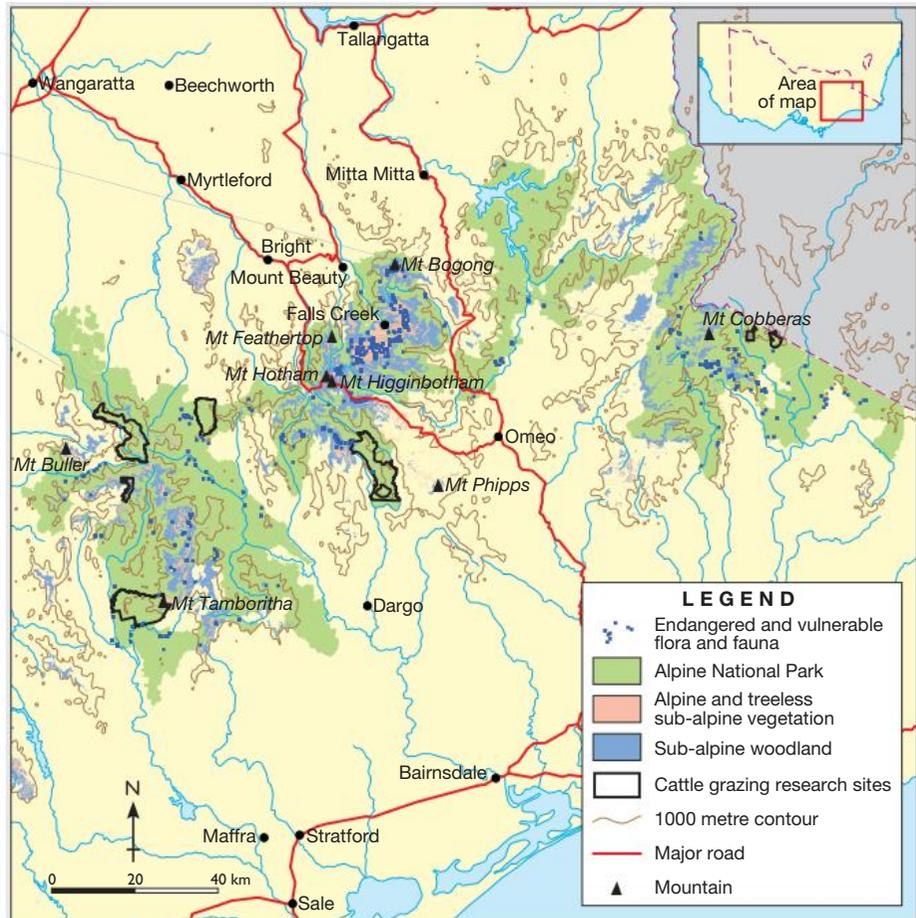
Source 2.41 The Victorian National Park Association organises opposition to stop the high-country grazing

Source 2.40 Farmers take their cattle into the Alpine National Park in Victoria's high country to graze.

This damage includes the trampling of the banks of streams and other sources of water, such as springs, and beds of alpine moss. The cattle also pollute the water, spread weeds and cause soil erosion. The critics of the grazing also believe that there is no evidence that grazing reduces the bushfire risk and that, instead, it may increase the time taken for plants to recover from fire. Opponents believe that grazing should not take place in national parks.

After much consultation, the Victorian Government banned grazing in the high country in 2005, following New South Wales and the ACT which had banned the practice years earlier. In 2010, following a change in government in Victoria, however, cattle were once again allowed into the high country as part of a study into reducing the bushfire risk. This trial ended in 2011 with no real conclusion being reached about the role of cattle in bushfire management.

VICTORIA: HIGH COUNTRY



Source 2.42 Source: Oxford University Press

Check your learning 2.9

Remember and understand

- 1 How do some cattle graziers use the high country in Victoria?
- 2 What are some of the impacts of this use on the natural environment?
- 3 What is the difference between sustainable and unsustainable use of resources?

Apply and analyse

- 4 Look closely at the map showing the location of the grazing research sites within the Alpine National Park (Source 2.42).
 - a Describe the distribution of these six sites.
 - b In establishing these research sites the aim was to establish a variety of sites. Choose two of these sites and list the differences between them.
- 5 Use the SHEEPT (social, historical, economic, environmental, political and technological) method to describe the factors that have led to this debate.

- 6 Source 2.41 is the notice of a public meeting to be held on the issue. Who do you think would attend this meeting? What do you think their point of view would be?

Evaluate and create

- 7 The Alpine National Park is controlled by Parks Victoria. Two of its objectives are to 'conserve park and waterway ecosystems' and 'to protect cultural heritage in parks'.
 - a Which of these objectives could be used by the cattlemen to support their argument? Explain your answer.
 - b Which could be used by environmentalists to support their argument? Explain your answer.
 - c How do you think Parks Victoria feels about high-country grazing?
- 8 Why is it difficult to decide whether this use of the mountains is sustainable?
- 9 Do you think it is a sustainable use of this resource? Give some reasons for your answer.

The mountain pygmy possum: an endangered alpine animal

Living in the high country of Victoria and New South Wales is the mountain pygmy possum, the only Australian mammal whose entire population lives in an alpine habitat. With a lifespan of almost 12 years, it is perhaps the longest living small mammal on Earth. The mountain pygmy possum is one of the very few marsupials that hibernates.

The mountain pygmy possum was thought to be extinct until one was found in a Mount Hotham ski lodge in 1966. It is now considered one of the world's most endangered animals, numbering around 2000 in the wild. There are a number of reasons for its population decline:

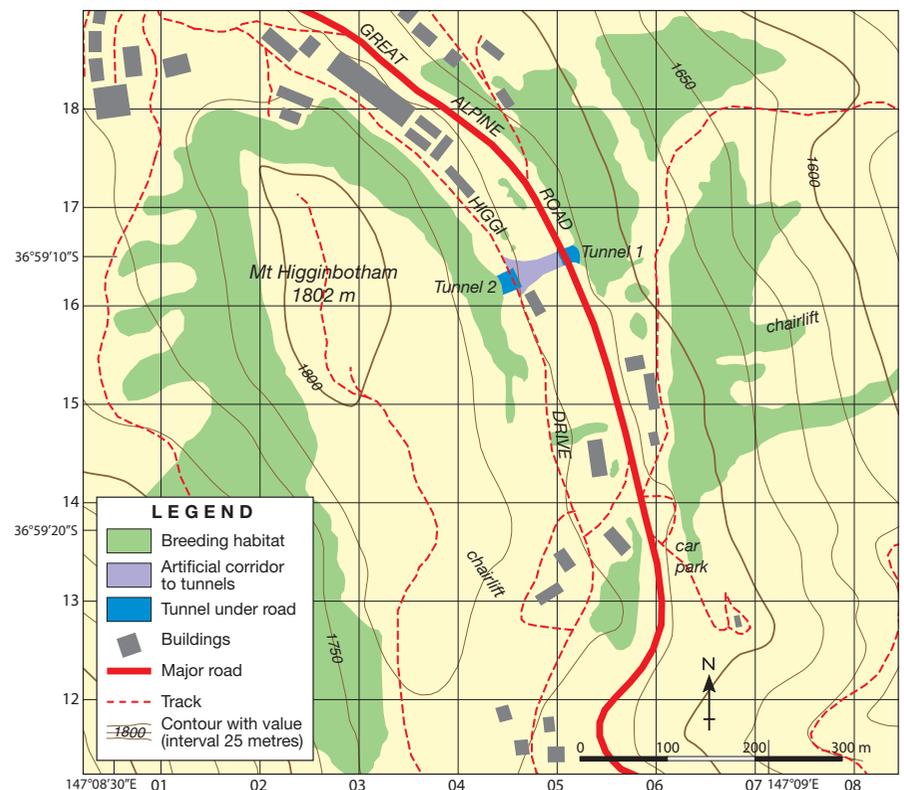
- They share their mountain home with tens of thousands of skiers. The roads and ski runs in this region cut across their habitat, interrupting their breeding cycle and exposing them to being hit by vehicles.
- Bushfires burnt much of the possum's habitat in 2003.
- Foxes and feral cats prey on the few individuals who remain.
- Warmer temperatures have resulted in less snow.

The last of these factors, climate change, may be the pygmy possums' greatest threat. In more recent times, the snow has been melting earlier in the year, meaning that the possums are emerging from hibernation sooner. In many cases, this has meant that they emerge before the arrival of their summer food supplies, Bogong moths (see Source 2.11). The early snow melt also leaves them vulnerable in other ways: snow insulates the possums from temperature extremes and helps to



Source 2.43 About the size of a mouse, the mountain pygmy possum emerges from hibernation at the beginning of summer.

MOUNT HIGGINBOTHAM: MOUNTAIN PYGMY POSSUM HABITAT AND 'TUNNELS OF LOVE'



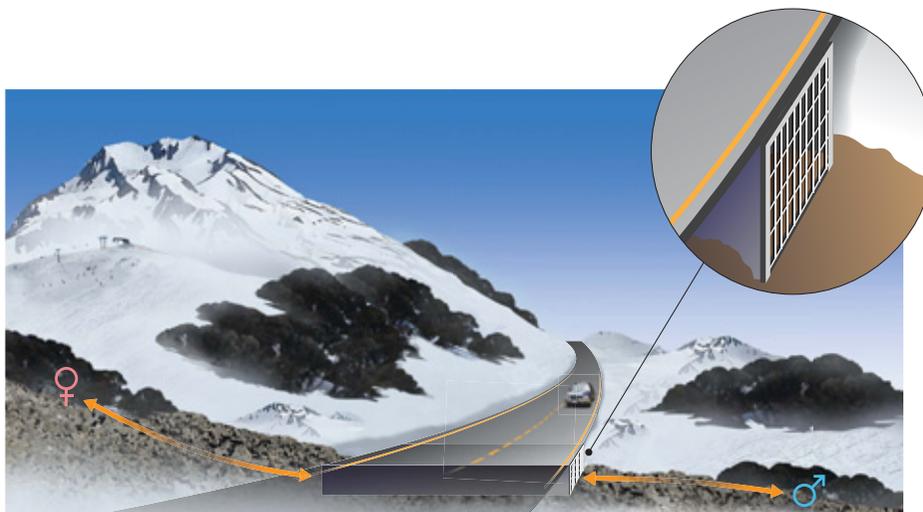
Source 2.44

Source: Oxford University Press

MOUNT HIGGINBOTHAM: LOCATION IN RELATION TO REST OF VICTORIA



Source 2.45 Source: Oxford University Press



Source 2.46 A diagram showing a cross-section of one of the tunnels and (inset) an entrance to the tunnel

control the number of foxes and feral cats, the possum's predators. Put simply, warmer temperatures result in less snow, and less snow means fewer pygmy possums. Some scientists are predicting the extinction of this remarkable animal within a decade.

Tunnels of love

As mentioned, the roads intersecting their alpine home have interfered with the breeding cycle of the pygmy possums. In one location, this problem has been solved in a clever way. Females and males live in separate locations and only come together during the mating season. Females generally live at higher altitudes on Mount Higginbotham and males migrate up the slopes to meet them and mate. Near the Mount Hotham ski resort, the Great Alpine Road runs between the males and females. The males were reluctant to cross the road due to the dangers of passing cars and predator attack.

Following a study by researchers, two tunnels were constructed under the road. The entrances to these tunnels were covered with metal grates to prevent larger animals from entering. The tunnels were then lined with large rocks to provide protection and shelter. Slopes leading to the tunnels were also covered with boulders and rocks. Within a week, males were observed using the tunnels to reach the females. The solution was instantly given the name the 'tunnels of love'. Similar corridors have since been constructed across roads and ski runs at Mount Blue Cow in New South Wales. As virtually all the possums live in ski resort areas more tunnels may yet be needed.

Check your learning 2.10

Remember and understand

- 1 Why are pygmy possums unique?
- 2 How are warmer temperatures brought about by climate change affecting the possums?
- 3 How are the 'tunnels of love' helping to conserve pygmy possum numbers?
- 4 Why are the possums at risk from predators as they cross the road?

Apply and analyse

- 5 Look closely at the topographic map (Source 2.44).
 - a How can you tell that this is a ski resort area?
 - b What threats to pygmy possums can you identify?
 - c In which direction do the males travel to reach the females on the higher ground?
- 6 Study Source 2.46. Describe the design of the tunnels. Why do you think there is a grate on the tunnel opening and why is the tunnel filled with large rocks?
- 7 Why do you think skiers and possums are both located in the same tiny region of Australia?

Evaluate and create

- 8 Design a sign to be displayed in the Mount Hotham ski resort to make skiers aware of the impact of their activities on the endangered pygmy possums.
- 9 Do you think that skiing is a sustainable use of this mountain landscape?
- 10 What other actions could be taken to protect the mountain pygmy possum?

Protecting the mountains

In many places, mountain landscapes are under threat from human activities such as tourism, mining, river damming and wars and other conflicts. Some countries protect their mountains by declaring them to be national parks or nature reserves. Some of these are given further protection by being included on the United Nations World Heritage list. One of these special places is the Tasmanian Wilderness World Heritage Area in south-west Tasmania.

One-fifth of Tasmania is included in this World Heritage area. The Tasmanian Parks and Wildlife

Service claims that the area 'protects one of the last true wilderness regions on Earth and encompasses a greater range of natural and cultural values than any other region on Earth'. While fold mountains dominate in the east of the Tasmanian Wilderness, rugged block mountains dominate the west. Much of the area has been eroded by glaciers and this has led to some spectacular landforms. Most of the area is blanketed by rainforest but there are also areas of mountain vegetation and wetlands. Nineteen endangered animal species are found in the World Heritage area, including the Tasmanian devil.

TASMANIA: TASMANIAN WILDERNESS WORLD HERITAGE AREA



Source 2.47

Source: Oxford University Press

The World Heritage list

The World Heritage list is administered by the United Nations. It is a list of the world's most important natural and human features. Individual countries are able to nominate their most special places for inclusion on the list. If a nominated place meets certain criteria then it can be given World Heritage status. Once the site is listed, the nominating country then has the responsibility to protect and preserve that place for future generations. The United Nations seeks to help countries to protect and preserve their sites by providing technical and emergency assistance, particularly for conservation of the site. There are currently more than 960 World Heritage sites, 19 of which are in Australia.

Many of the world's mountain landscapes have been given this special status. They include the volcanoes of New Zealand, the Blue Mountains, Yosemite National Park and Mount Everest. The United Nations also has a list of World Heritage sites where the special features of the place are threatened by natural disasters or human activities, such as war or tourism. The home of the mountain gorillas, the Virunga Mountains, is on this list, as are rainforests in the mountains of Madagascar and Indonesia.

Source 2.48 Frenchmans Cap in the Tasmanian Wilderness World Heritage Area was carved by glaciers thousands of years ago.

Check your learning 2.11

Remember and understand

- 1 What is the World Heritage list?
- 2 Name some mountain areas that have been included on the World Heritage list.
- 3 Why do you think the Tasmanian Wilderness area has been included on the list?

Apply and analyse

- 4 Look carefully at Source 2.47.
 - a How many national parks are shown on this map?
 - b Using the scale provided in Source 2.47, estimate the total area of the Tasmanian Wilderness World Heritage Area.
 - c Conduct some Internet research to determine the actual area of the Tasmanian Wilderness World Heritage Area. Is this figure more or less than your estimate? Give possible reasons for this difference.

Evaluate and create

- 5 Research the Virunga Mountains, the Atsinanana region of Madagascar or the rainforests of Sumatra to find out why these mountain areas are in danger. Do you think the Tasmanian Wilderness area faces the same threats as these places?



2.2 bigideas: broadsheet

Wolong National Nature Reserve, China

Mountain landscapes are home to some of the world's most endangered animals, including one of the most well known – the giant panda. Once widespread throughout the mountains of southern China, they are now limited to a few bamboo forest reserves. The largest of these reserves is the Wolong National Nature Reserve in Sichuan Province, which is home to about 150 pandas as well as other endangered animals, such as the red panda and the golden monkey.



Source 2.49 A giant panda in the Wolong National Nature Reserve

skilldrill

Six-figure grid references (GR)

In order to communicate the location of different features on topographic maps with pin-point accuracy, geographers use a system known as six-figure grid referencing (GR).

The lines that run from top to bottom (i.e. vertically) across a map are known as **eastings**. The lines that run from left to right (i.e. horizontally) are known as **northings**. In order to create a six-figure grid reference, the area between each easting is divided up into 10 equal parts (i.e. tenths). The area between each northing is also divided up into tenths. This is just like adding a finer set of gridlines over the existing gridlines, allowing you to be very specific about where things are within each grid square.

In order to create a six-figure grid reference, follow these steps:

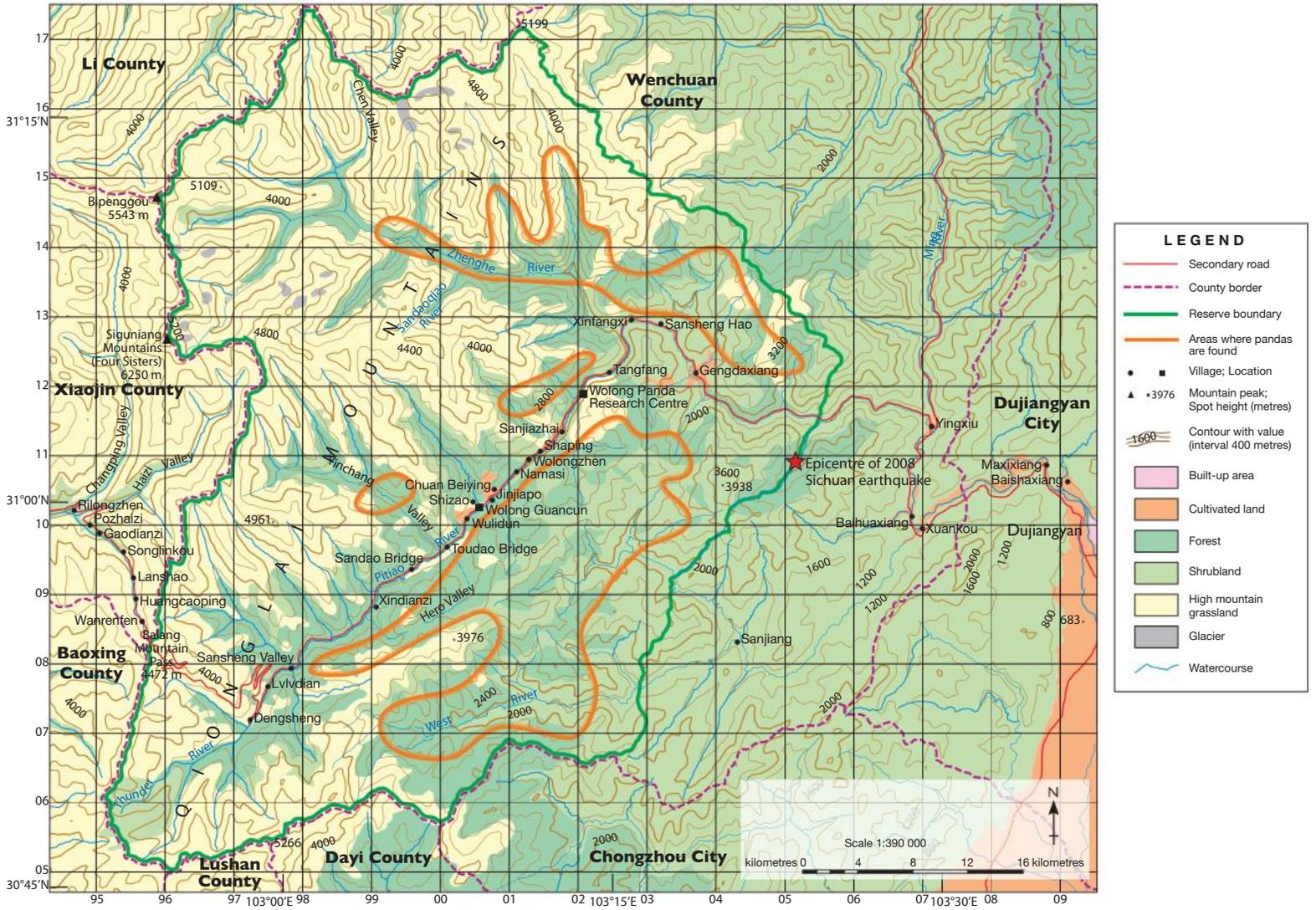
- Step 1** Find any point on the map that you want to communicate the exact location of. Mark this point on the map.
- Step 2** Run your finger from this point to the left until you hit the first easting. Record the number of that easting. This will be the first two numbers in your six-figure reference. Now work out how many tenths from the easting your point is. This will give you the third number in your six-figure grid reference.
- Step 3** Now, run your finger from the same point down until you hit the first northing. Record the number of that northing. This will be the fourth and fifth numbers in your six-figure reference. Now work out how many tenths from the northing your point is. This will give you the final number in your six-figure grid reference.

Apply the skill

- 1 What is the name of the river at GR 992137?
- 2 Give the six-figure grid reference for the epicentre of the 2008 Sichuan earthquake.
- 3 Give the six-figure grid reference for the Wolong Panda Research Centre.
- 4 Complete the following table:

Grid reference	Name of village
072114	Xindianzi
	Dengsheng

WOLONG NATIONAL NATURE RESERVE, CHINA



Source 2.50

Source: Oxford University Press

CHANGE IN PANDA HABITAT IN CHINA OVER TIME



Source 2.51

Source: Oxford University Press

Extend your understanding

- 1 What is the main type of vegetation found inside the area where pandas are found?
- 2 How many towns are located in these areas?
- 3 How much cultivated land is found in the panda areas?
- 4 Study Source 2.51. Describe the change over time between the giant pandas' original and current habitats. Give a possible reason for it.
- 5 Do you think that reserves like Wolong will save the panda from extinction? Give some reasons for your answer.

2.3 Are mountain landscapes hazardous places?

Mountain hazards

Mountains can be hazardous places. The obvious danger in a volcanic area is an eruption, but there are other dangers too. The steep hillsides and unpredictable weather in mountainous regions can contribute to landslides and avalanches which can sweep with terrifying speed and force down the mountain slopes. Earthquakes are also a common hazard in mountainous places as sudden plate movements cause the ground to shake, dislodging rocks and even entire hillsides.

Volcanic eruptions

Volcanoes are dangerous natural features and can erupt without warning, devastating local environments. Lava can flow like a molten river or rain down like bombs many kilometres from the eruption site. Ash can cover the sky and blanket the landscape in a cloud that can kill people and animals alike. Humans are generally powerless in the face of such power and many thousands have died from hazards caused by eruptions. They include ash clouds, lava flows, mudslides, floods and **tsunamis**.

Perhaps the biggest danger in an eruption is the huge clouds of volcanic ash that can be produced. These clouds result from the sudden release of enormous pressure from within the Earth's mantle and crust. When Italy's Mount Vesuvius erupted in 79 CE it covered the nearby town of Pompeii in a thick layer of ash, killing 2000 people. The town lay forgotten beneath the ash for almost 1600 years before being discovered by workmen digging a canal.

The ash produced in an eruption can travel straight up (vertical) and then fall on the surrounding landscape, as in the case of Mount Vesuvius, or it can travel sideways (horizontal). Horizontal eruptions are perhaps the most dangerous as the ash – along with rocks, boulders and gases – can travel at speeds of 700 kilometres per hour and carry material heated to 1000 degrees Celsius. These are called **pyroclastic flows** and are responsible for many of the most devastating volcanic eruptions.



Source 2.52 Visitors watch lava from Hawai'i's Kilauea volcano roll downhill to the ocean in 2004

Another danger can be the sudden melting of the snow and ice on the sides of the volcano or the release of water from a crater lake in an eruption. These events can cause huge mudslides called **lahars** up to 50 metres thick to sweep down the sides of mountains. The eruption of Colombia's Nevado del Ruiz volcano in 1985 covered whole villages with thick mud and ash, killing 23 000 people. This makes it the deadliest volcanic eruption of the last 100 years.

Tambora: the world's deadliest eruption

The deadliest volcanic eruption in history took place in 1815 in Indonesia, when Mount Tambora erupted. About 92 000 people were killed by the pyroclastic flow from the eruption and the tsunami that was triggered by the eruption. More than 50 square kilometres of new material (ash and lava) was produced by the eruption and deposited on the Earth's surface.

Located where the Indo-Australian tectonic plate **subducts** (moves down) below the Eurasian plate, Indonesia has been home to more active volcanoes than any other nation over time. Vulcanologists estimate that Indonesia's 76 active volcanoes have produced more than 1000 eruptions.

Check your learning 2.12

Remember and understand

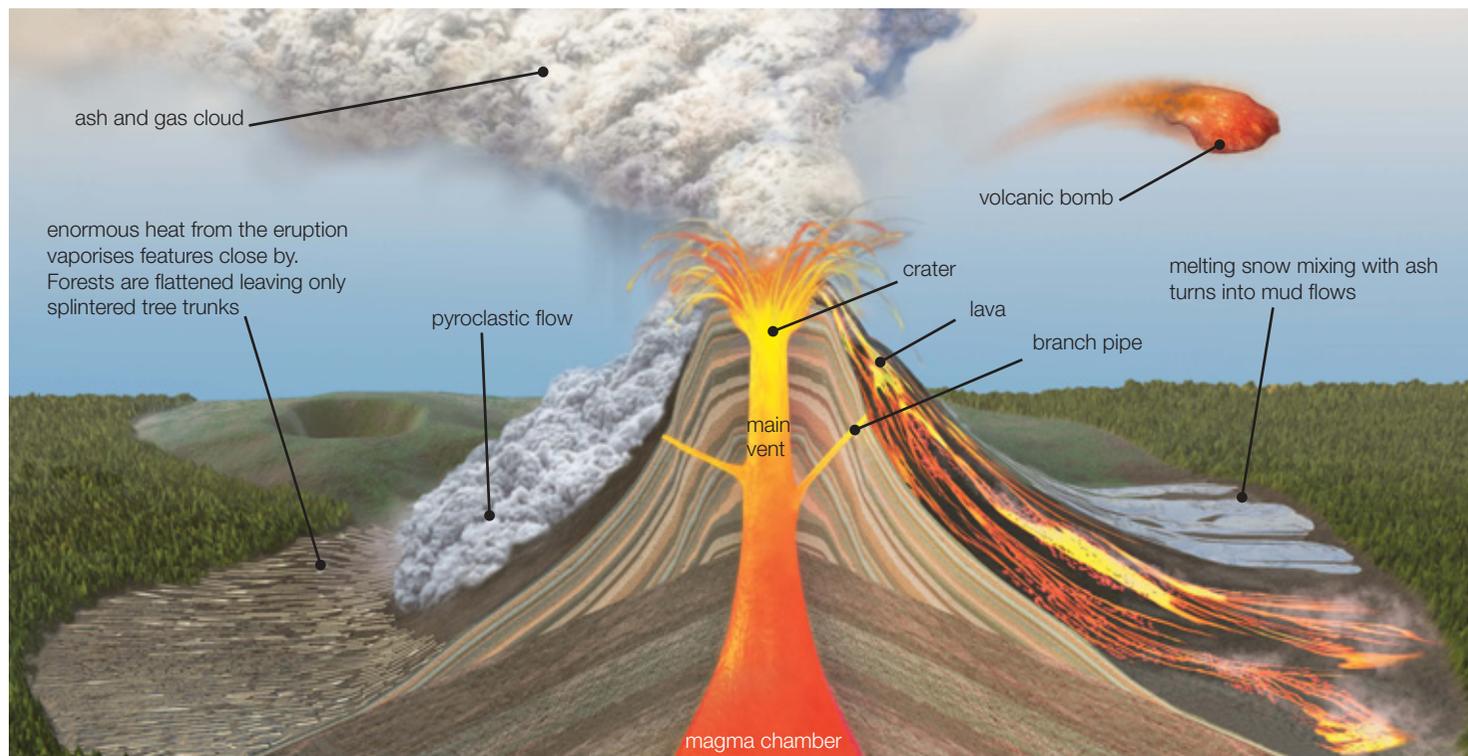
- 1 Make a list of the dangers faced by communities living close to volcanic eruptions.
- 2 Why is a sideways eruption more dangerous than a vertical one?
- 3 What is a volcanic bomb?
- 4 Name two countries close to Australia that experience many tectonic disasters.

Apply and analyse

- 5 Use Source 2.53 to explain how volcanic eruptions take place.
- 6 Almost every resident of Tambora died in the eruption of Mount Tambora. Why do you think that was the case?

Evaluate and create

- 7 Conduct some research on the Internet to find out what people who live near Mount Tambora today could do to protect themselves from the effects of another eruption.



Source 2.53 Features of a volcano and the hazards caused by eruptions

Vesuvius: studying a killer volcano

Mount Vesuvius, near the Italian port city of Naples, is one of the world's most dangerous volcanoes. Over the course of human history it has erupted many times, most notably in 79 CE when an eruption buried the Roman towns of Pompeii and Herculaneum.

Mount Vesuvius erupted releasing a deadly cloud of stones, ash and fumes up to 33 kilometres into the air. With molten rock and pumice coming down at the rate of 1.5 million tons per second, the towns of Pompeii and Herculaneum were quickly buried and few in the towns managed to escape. An estimated 16 000 people died from the eruption, most being killed by the heat of the eruption and ash suffocation.

Since this date, Mount Vesuvius has erupted more than 30 times, with the last eruption taking place in 1944. This eruption destroyed the surrounding villages of San Sebastiano al Vesuvio, Massa di Somma, Ottaviano and part of San Giorgio a Cremano. For the last 70 years it has laid quiet but many experts believe that it is once again due to erupt.

Over time, the city of Naples has grown at the foot of Vesuvius. There are also many other **urban** centres in the area surrounding Vesuvius. Some of these areas have a **population density** greater than 15 000 people per square kilometre, making them some of the most densely populated places on Earth. With more than 4 million people living near Vesuvius, it has the greatest population density of any volcanic region in the world.



Source 2.54 A sensor on the slopes of Mount Vesuvius



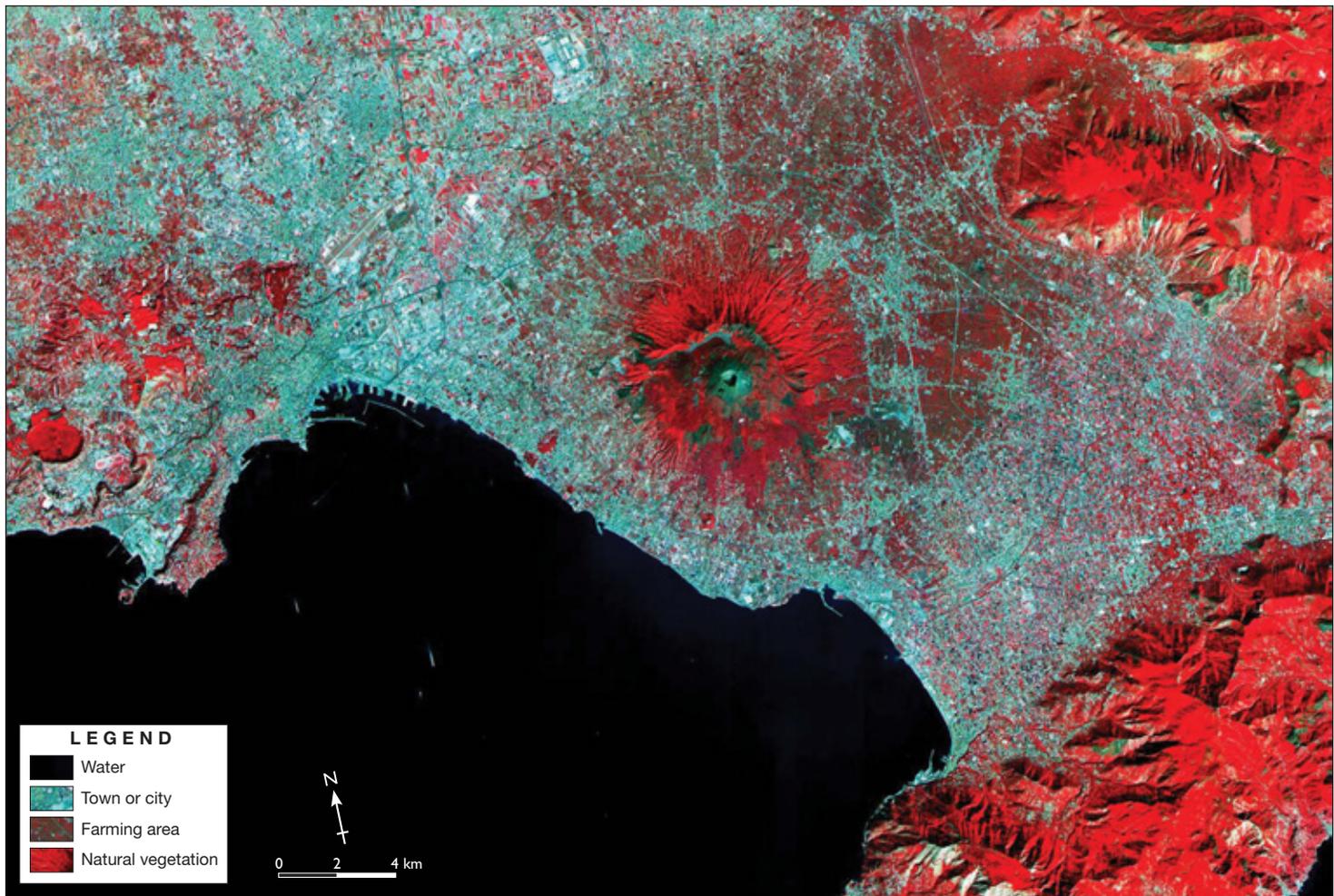
Source 2.55 Mount Vesuvius erupting in 1944. The ash cloud viewed from the nearby city of Naples

Like many volcanoes around the world, Vesuvius is being carefully monitored. It is studied from the ground, from underground, and even from space. **Vulcanologists** are watching for changes in the shape and internal chemistry of the volcano that will reveal when an eruption is about to happen so they can warn people to leave the area.

Preparing for an eruption

A number of measures have been implemented to help reduce the effects of another eruption of Vesuvius:

- An evacuation plan has been developed so that residents can more easily understand the risks faced in the region where they live (see Source 2.57). This will also help authorities to evacuate the area. Experts estimate that 600 000 people now live in the red evacuation zone.



Source 2.56 A false colour satellite image of Mount Vesuvius and the Italian city of Naples highlights the key features of the region.

- People living on the side of the mountain have been offered up to 30 000 Euros to move to safer areas. Their houses will be demolished and no new ones can be built in the same area.
- A national park has been established on the upper slopes so that authorities can stop any further building of homes and other structures. Authorities estimate that 800 structures have been illegally built in the park and will need to be demolished.
- On the side of Vesuvius there are dozens of sensors, such as the one shown in Source 2.54. These record earthquakes, gas temperatures and changes in the shape of the volcano. All these measurements can help vulcanologists predict an eruption. Monitoring the changing shape of a volcano, for example, can tell scientists if the mountain is bulging outwards. A bulge is a clue that lava is rising and may erupt. Signals from these sensors are sent automatically to a volcano observatory in Naples where there are always at least two scientists on duty to analyse the data.
- A satellite from the European Space Agency measures the temperature and shape of the crater and mountain slopes as it passes overhead. Analysis of data showed that an area south-west of Vesuvius had risen by more than 2 centimetres in a year. Satellites are also useful in tracking the movement of ash clouds following an eruption.

NAPLES REGION: MOUNT VESUVIUS EVACUATION ZONES



Source 2.57

Source: Oxford University Press

Check your learning 2.13

Remember and understand

- 1 Examine Source 2.57.
 - a List the dangers that people could face in the event of a volcanic eruption.
 - b How would the wind direction affect ash movement?
 - c What would happen if the wind was blowing to the west during an eruption?
- 2 Why has a national park been established on Mount Vesuvius?
- 3 Why do volcanologists monitor the shape of the volcano?

Apply and analyse

- 4 Describe the pattern of human settlement around this volcano.
- 5 What makes this mountain so dangerous? Consider both natural and human factors in your answer.
- 6 Study Source 2.54. What do you think the object sticking out from the side of the white box is used for?

Evaluate and create

- 7 Despite authorities offering up to 30 000 Euros to thousands of residents in order to move only a few have done so. Why do you think this is the case?
- 8 Surveys have shown that residents of Naples are largely unaware of the danger posed by Mount Vesuvius and most have never heard of the evacuation plan.
 - a Why do you think this is the case?
 - b What is the greatest natural hazard you face?
 - c What preparations have you made in the event of a natural disaster?
- 9 Design a pamphlet that will be distributed to all Naples residents outlining the risks posed by a volcanic eruption. Your pamphlet must include some of the actions that individuals can take to prepare for an eruption, including having an evacuation plan.

Landslides

Landslides are one of the most common types of hazard affecting mountain landscapes. The term landslide is used to describe any type of large-scale movement of soil, mud, rocks or snow carried by the force of gravity downhill. The movement can be as slow as a few centimetres a year or very rapid. Large, rapid landslides have the potential to destroy towns, roads and bridges, block rivers and take human lives. They are among the most dangerous of all hazards in mountain landscapes.

Landslides are often caused by a combination of natural processes and human factors. Natural factors include heavy rain, unstable slopes, an earthquake or volcanic eruption, and erosion by rivers or waves. The likelihood of a landslide happening is often increased by human activities, such as vegetation clearing, road or mine construction that requires cutting into a slope, leaking pipes and vibrations caused by rock blasting or heavy traffic.

Types of landslides

There are five main types of landslides that can affect different mountain landscapes. These include:

Soil creep

Soil creep is the gradual movement of soil, rocks and earth down a gentle slope. This is the slowest-moving type of landslide and can take place over many years. As a result, it is often unnoticeable to people living in the area. Areas affected by soil creep can be identified by features such as leaning telegraph poles and fences, cracked walls and bowed trees.

Slumping

Slumping is the movement of larger sections of soil and rocks down a steep, curved slope. These sections slip down the surface of the slope to different degrees, often creating a number of different levels (called scarps). Slumping is usually triggered by earthquakes, excessive rain, or freezing or thawing of the land.

Mudslides

Mudslides (also known as lahars) are often triggered by heavy rain, quick thawing earth, earthquakes or

volcanic activity. For example, snow on the sides of active volcanoes is caused to melt quickly and combine with soil and rocks to create mud slurry that travels downhill. The mud can be up to 50 metres thick and travel at speeds of up to 80 kilometres an hour, burying entire villages and killing many people.

Avalanches

Avalanches are the rapid movement of snow down steep mountain slopes. They are the fastest-moving type of landslide. Avalanches are triggered by natural movements of the Earth (such as earthquakes and weather events) and human movements (such as skiers and snowboarders).

When landslides strike

As with many natural disasters, people in poorer countries are more at risk. There, homes and other buildings are often poorly made and hillsides are often cleared of trees as timber is needed for fuel and building. With few planning restrictions in place people often live in landslide danger zones, with devastating results.

When heavy rains hit the South American country of Venezuela in late December 1999 they triggered the world's deadliest landslide. The rains were heaviest in the mountainous area in the north of the country. As the swollen rivers swept down from the mountains, they eroded their banks, turning the rivers into raging torrents of mud. Charging towards the coast, the rivers swept through towns and cities perched between the mountains and the ocean, covering them in a sea of mud. Hardest hit were the poorer residents of the country who had built their homes in shanty towns on cheap land on the steep mountain slopes. The mud quickly engulfed the streets and homes of these shanty towns, sweeping them away or burying them.

To try to avoid the danger of disease the dead were quickly buried and so the scale of the disaster will never be fully known. It is believed that more than 30000 people lost their lives in these floods, but some estimates have placed the final figure closer to 50000.

Growth of cities means that people are living in unsafe areas.

Hard surfaces, such as roads, prevent water from soaking into the soil, increasing runoff.



Clearing of forests in the mountains makes river banks unstable.

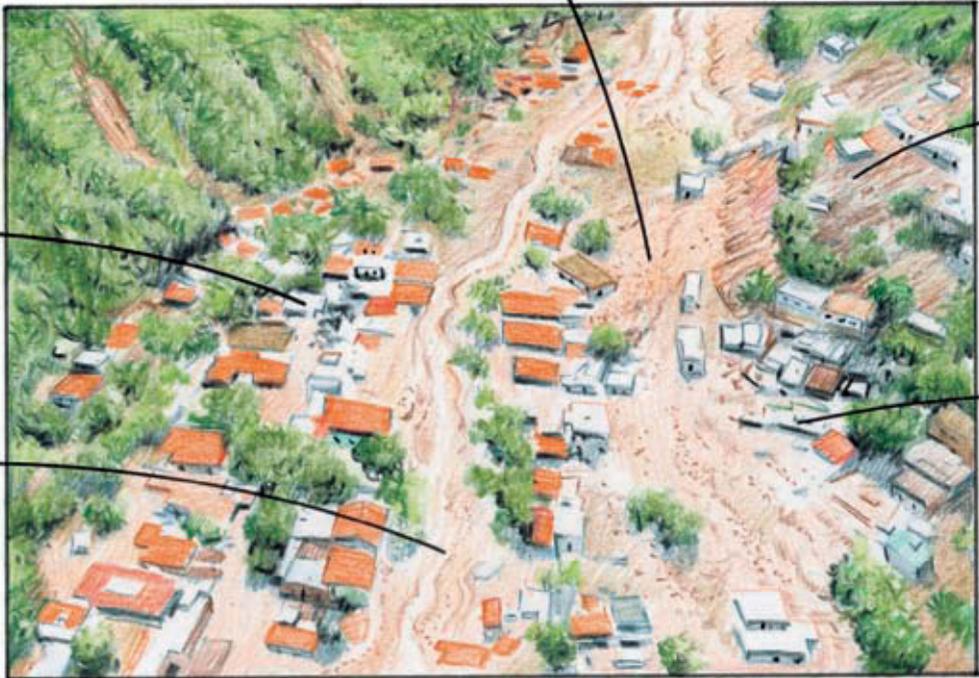
Housing standards in shanty towns are generally poor.

Source 2.58 An oblique aerial image of a mudslide in Vargas, Venezuela, 1999

Mudslide.

Growth of cities means that people are living in unsafe areas.

Hard surfaces such as roads prevent water from soaking into the soil increasing runoff.



Clearing of forests in the mountains makes river banks unstable.

Housing standards in shanty towns are generally poor.

VENEZUELA FLOOD AND MUDSLIDE, 1999

Source 2.59 An annotated sketch of Source 2.58



Source 2.60 A landslide in Haiti, triggered by an earthquake, killed thousands in 2010.

Managing landslide risk

Although landslides can strike with great speed and little warning there are some measures that communities can implement to prepare for them and reduce their effects. Perhaps, most importantly, they can recognise that some human activities make landslides more likely. Careful planning is needed before cutting a road into the side of a hill, for example, as it makes the slope less stable.

keyconcept: scale

Landslide prediction

There are landslides in many mountainous areas around the world but the reasons for them differ from place to place. Geographers who try to predict where there will be a landslide need to study factors at a range of scales:

- At the local scale they need to consider steepness of the slope, soil type and changes made by people.
- At the regional scale they need to consider rainfall patterns and the likelihood of storms.
- At the global scale they need to consider the location of plate boundaries and tectonic movement.

For more information on the key concept of scale, refer to section GT.1 of 'The geographer's toolkit'.

Check your learning 2.14

Remember and understand

- 1 What is a landslide?
- 2 Why are landslides more of a hazard in mountainous areas than in flatter places?
- 3 What can people do to reduce the likelihood of landslides?

Apply and analyse

- 4 Some landslides are so slow they are known as soil creep. How might a very slow landslide affect human activities and structures?
- 5 Which natural processes contributed to the landslides in Haiti? Which human activities contributed?
- 6 Use a series of sketches to explain why digging into a hillside for mining or road building can lead to a landslide.

Evaluate and create

- 7 Use Source 2.59 as a guide to create a geographical sketch of Source 2.60. Label your sketch with those factors that contributed to the landslide.
- 8 Do you think that natural factors or human factors were most responsible for the Venezuelan landslides? Give some reasons for your answer

The Tumbi Landslide, Papua New Guinea

On the night of 24 January 2012 there was a massive landslide in the Southern Highlands of Papua New Guinea. The landslide buried whole villages and killed dozens of people. It was triggered by the collapse of a 150-metre wide section of hillside, and carved a 560-metre long path of destruction through the forests and villages below. More than 3 million cubic metres of rubble thundered downhill in the disaster. The Highland Highway, which runs through the area, was destroyed. Quarry workers and machinery were buried in debris up to 15 metres thick. Rescue efforts were hampered by heavy rain in the hours and days following the landslide. Landslides are a hazard in Papua New Guinea, particularly during the wet season from December to May.



Source 2.61 The landslide that engulfed the village of Tumbi in Papua New Guinea

keyconcept: environment

Possible causes of the Tumbi Landslide

The ways in which humans use and change the natural world is an important part of the key concept of environment. By examining the possible causes of this landslide you will learn how environments are changed by a complex series of human activities and natural processes. As with many disasters such as this, the exact causes are unclear. Initial newspaper reports focused on a nearby natural gas plant under construction and some associated quarrying near the slip site, but the gas company denied any connection. Here are some of the possibilities and some of the evidence.

WAS IT HEAVY RAINFALL?

PNG is experiencing one of the worst wet seasons, which traditionally runs from December to May, ever, local authorities say.

United Nations report

The ground water level rose significantly above its historical levels ... This caused the two minor, and one major, streams to combine, forcing water levels to rise beneath the limestone substructure of the hillside.

Papua New Guinea Government report

WAS IT THE TUMBI QUARRY?

Local people have blamed blasting from nearby quarries, which sent hundreds of tonnes of earth crashing down on the village of Tumbi.

Newspaper report, *Mail Online*, 26 January 2012

WAS IT THE SHAPE OF THE LAND?

[The land where the slip occurred is] characterised by high terrain and precipitous [steep] slopes.

United Nations report on the disaster

WAS IT AN EARTHQUAKE?

The Geophysical Observatory (PMGO) reported no seismic activity within the area in the past two weeks.

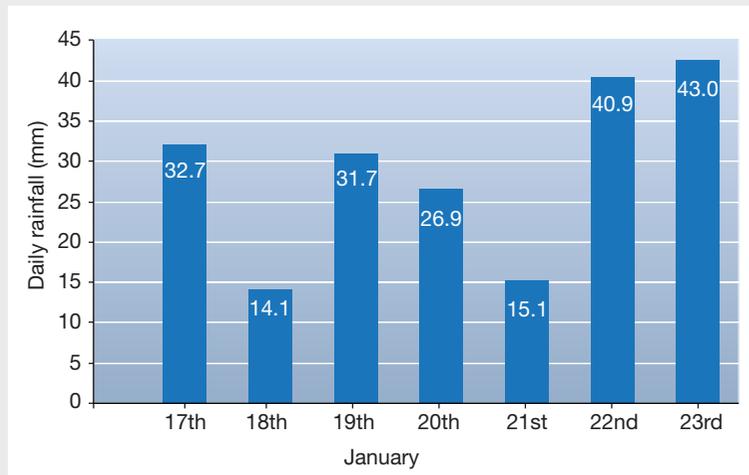
Papua New Guinea Government report

WAS IT THE FARMERS?

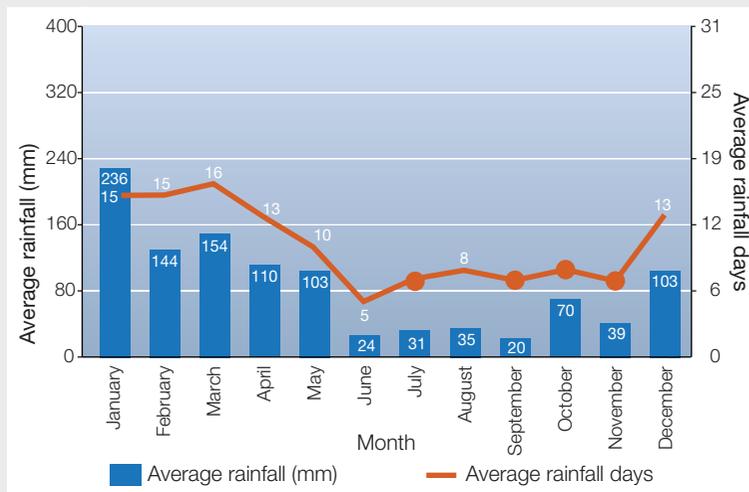
Intensive cultivation of the surrounding land may have also been a contributing factor by denying the ground of its natural vegetation.

Papua New Guinea Government report

For more information on the key concept of environment, refer to section GT.1 of 'The geographer's toolkit'.



Source 2.62 Daily rainfall totals from 17 to 23 January 2012 in Komo, a town near the Tumbi Landslide site



Source 2.63 Average rainfall graph for Komo

Check your learning 2.15

Remember and understand

- 1 Describe the scene in Source 2.61.
- 2 On what date was there a landslide? Is this during the wet season?
- 3 Describe the shape of the land at the site of the landslide.

Apply and analyse

- 4 Study Source 2.62. How much rainfall was recorded in Komo in the seven days before the landslide? Compare this with the weekly average in January of 53.9 millimetres.
- 5 How does a quarry change the shape of a hillside? How might this contribute to a landslide?

- 6 Divide the possible causes of this landslide into two lists: natural processes and human activities.

Evaluate and create

- 7 Rank the possible causes from those that you consider most responsible for the landslide to those that you consider had no influence. Write a few sentences explaining your choice of the top contributor.
- 8 Compare your ranked list with those of your classmates. Is there some general agreement about the leading cause? Why/Why not?
- 9 What further questions could you ask to help you work out the causes of this disaster?

2.3 bigideas: broadsheet

Avalanches

More than 150 people a year, mostly skiers and snowboarders, are killed by avalanches. Avalanches are a type of landslide. They involve the rapid movement of snow down mountain slopes. Some slopes are more likely to produce an avalanche than others, mainly due to their steepness. Snow resting on a layer of slippery ice on a steep slope can easily collapse. The resulting avalanche can reach speeds of up to 130 kilometres per hour. In 2010, a lone snowboarder was killed by an avalanche in Glacier National Park in Montana in the United States. The site of the avalanche is shown in Source 2.68.



Source 2.64 A skier in the path of an avalanche

skilldrill

Constructing a cross-section

Step 1 Identify the cross-section. Find the two points on the map that form the outer edges of your cross-section. In this case, these points are labelled A and B.

Step 2 Mark the outer edges. Place a straight-edged piece of paper across the map so that it crosses both points A and B. Mark these two points on your piece of paper. Be careful not to draw on the map.

Step 3 Mark the contour lines. Working from left to right, put a small mark on your piece of paper at every point that it crosses a contour line. You need to know the height of each of these lines so jot this down on the piece of paper as well.

Step 4 Draw the axes. On another piece of paper draw a set of axes for your cross-section. The horizontal axis is the same width as the distance between points A and B on the map. The vertical scale must begin below the lowest height on your cross-section and extend above your highest point. Put a vertical scale on both the left-hand side and right-hand side of your cross-section.

Step 5 Transfer the contour line heights. Lay your straight-edged piece of paper along your horizontal axis. For each contour height shown on your piece of paper, you must place a dot on your cross-section at the correct height according to your vertical scale.

Step 6 Join the dots. Join the points with a smooth line. Use a graphite pencil and take care to make your sketched line as 'natural' as possible. It should not be a series of short, straight lines but one long, smooth line.

Step 7 Add the finishing touches. Lightly shade the area below your line to show that this is solid land. Label both axes with their correct scales and give your cross-section a title.

Apply the skill

- 1 Construct a cross-section of the avalanche site along the line A–B marked on Source 2.65.

GLACIER NATIONAL PARK, UNITED STATES: SITE OF AVALANCHE IN 2010



Coastal landscapes

Coasts are very dynamic places – they are constantly changing. Crashing waves, strong currents, tidal waters and hazards (such as **tsunamis**) all transform coastal landscapes. Along the east coast of England and Scotland the coast is under constant attack from the sea. In some places large waves wear away the coast at the rate of about 2 metres every year. Roads, buildings and farms tumble slowly into the sea and many villages dating as far back as ancient Roman times have disappeared. People, too, bring about changes to coastal landscapes. These changes range from small human activities, such as walking across a sand dune, to large activities, such as building ports and sea walls.



3.1

What forces shape coastal landscapes?

- 1 What evidence is there in Source 3.1 that this coast is changing?
- 2 What changes do you think will take place here over the next 20 years?

3.2

How are coastal landscapes used and managed?

- 1 How is this coast being used by people?
- 2 What could be done to control this erosion to protect these homes?



chapter 3

Source 3.1 A section of road on the Holderness coast in Yorkshire, England, shows the devastating effect that coastal erosion can have on communities. Many villages in this region have already been lost to the sea.

3.3

Are coastal landscapes hazardous places?

- 1 How could people be injured or killed by coastal erosion in this place?
- 2 What other natural hazards are present in coastal areas?

3.1 What forces shape coastal landscapes?

Coastal landforms

Constant movements of water and wind carve coastal landscapes into an amazing variety of shapes. Geographers, who refer to these shapes as **landforms**, are particularly interested in exploring the forces that create them. To begin your own investigation into coastal landscapes, you should start by finding out the names of the most common landforms, shown in Source 3.4. Some of them you may have heard before but others may be new to you.

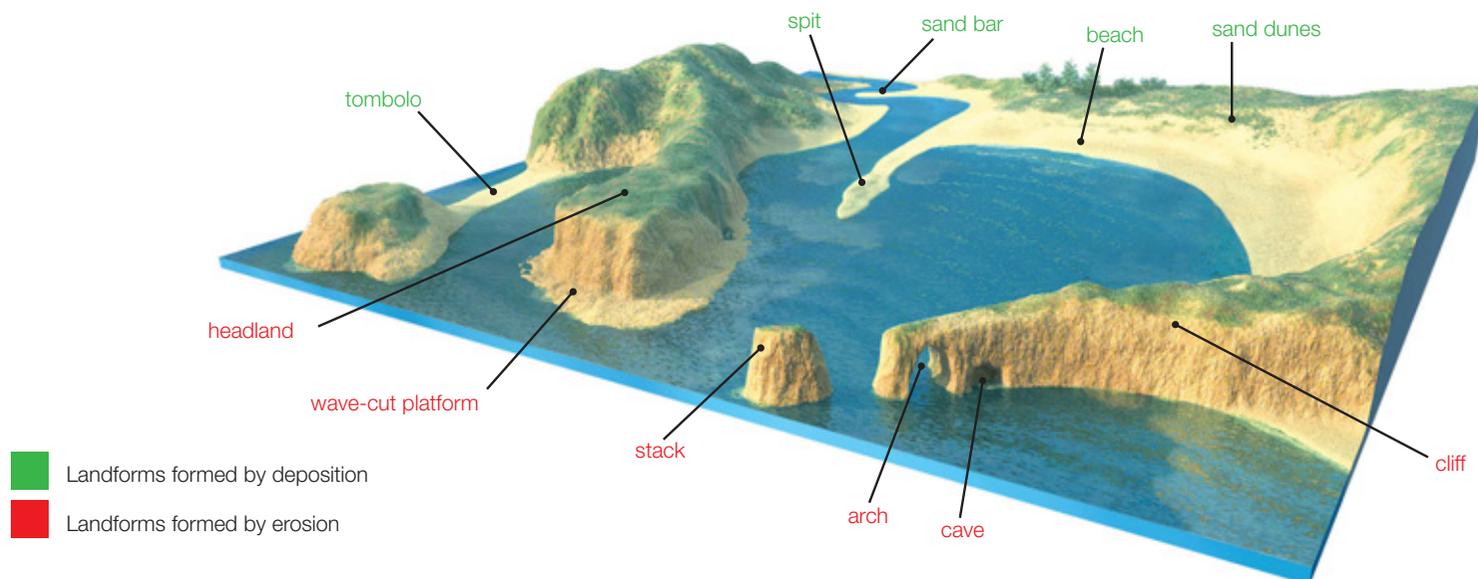
Coastal landforms can be formed in two different ways, either by **erosion** (the wearing away of land by waves and wind) or by **deposition** (the building up of land through deposits of sand and other materials). Because of these processes, there is no 'typical' or 'average' coastal landform: every **arch**, **stack**, **cave** or **headland** will be unique. There are, however, common features for each type of landform. Geographers examine and describe the similarities and differences of these features and use them to explain how they were formed. For example, Sources 3.2 and 3.3 show two Australian coastal landforms. Geographers would describe both of these landforms as headlands, despite the fact that they look quite different.



Source 3.3 A headland at South West Cape, Tasmania



Source 3.2 Headlands at Port Campbell, Victoria



Source 3.4 Some common coastal landforms

Check your learning 3.1

Remember and understand

- 1 How do beaches change?
- 2 What natural forces are working continuously on the coast carving new landforms?

Apply and analyse

- 3 Describe a stack. How do you think stacks are formed?
- 4 Sketch the image in Source 3.2 and label four landforms.

Evaluate and create

- 5 How have people used the headland in the foreground of Source 3.5? Why might this be a hazardous place to live?
- 6 Each of the three photographs in this section shows headlands. Examine each of these photographs.
 - a Based on these photographs, give a definition of a headland.
 - b What features does each share?
 - c In what ways is each unique?
 - d In pairs, discuss some geographical questions you would ask to explore why the headlands are different.
 - e Where would you find some answers to the geographical questions you have discussed?

keyconcept: change

A day at the beach

Like all landscapes, coasts are constantly changing. During a five-hour visit to a beach, about 2500 waves hit the shore. Each wave picked up millions of grains of sand and moved them. Some grains were moved further inland, some along the beach, some out to sea, and some were picked up and put back in the same place. The wind picked up millions of particles of dry sand and blew them onto the dunes. People walked through the dunes, trampling the plants and creating a wind tunnel that sped up erosion. In the course of the day, the sea level rose and fell about 2 metres as the Moon's gravity pulled the oceans towards shore and away from it, creating tides.



Source 3.5 Bondi Beach in Sydney is located between two headlands.

What makes beaches perfect for geographers to study is the rapid rate of change that takes place there. This is mainly because:

- one wave crashes about every 8 to 10 seconds and each of them changes the coast
- sand is easily eroded and deposited
- people use the coast in many ways, constantly changing it.

For more information on the key concept of change, refer to section GT.1 of 'The geographer's toolkit'.

The power of waves

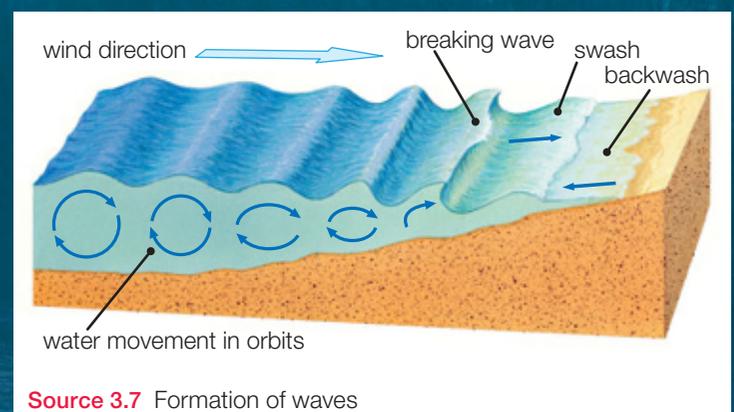
Waves are the main force that shape coastal landscapes. Waves begin at sea when the wind blows across the surface of the water. The water surface rises along with the wind, but then is pulled back down by the power of gravity. This tug-of-war between the drag of the wind and the pull of gravity creates an **orbit** – a circular movement of water (see Source 3.7) beneath the surface. This orbit creates what we see as a wave.

As waves move into the shallower waters near the coast, the bottom of the orbit comes into contact with the sea bed. Friction generated on the sea bed slows the bottom of the wave more quickly than the top. The top (or crest) of the wave continues moving and finally falls forward onto the shore (much as a person can stumble and fall over, head first). The water that falls forward and moves up the shore is called the **swash**. The **backwash** is the water that runs back to the ocean.

The energy in waves can travel thousands of kilometres before it is released on the coast. This energy then changes the coast in three important ways. Firstly, it erodes the coast by breaking down the rocks of cliffs and headlands into small pieces of stone or sand, eventually forming a beach. Secondly, along with tides and currents, the wave energy transports the sand out to sea and along the coast. Thirdly, the waves deposit the sand in new places, forming new beaches, spits and sand bars.

Longshore drift

Although some waves can hit directly onto a shoreline, most waves hit the coast at an angle. This occurs because of the varied shape of the land and the varying direction of the wind that produces the waves. When the waves hit the coast at an angle, the swash picks up the sand and carries it along the beach rather than just dumping it directly forward onto the shore. The next wave that comes along will also move the sand along the beach until eventually, after hundreds of small zigzags, many grains of sand are moved to one end of the beach. They may pile up to form long deposits of material, such as



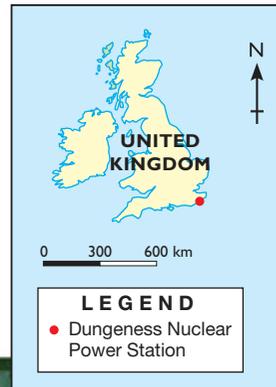
Source 3.6 A surfer harnessing the energy of a breaking wave

Source 3.7 Formation of waves

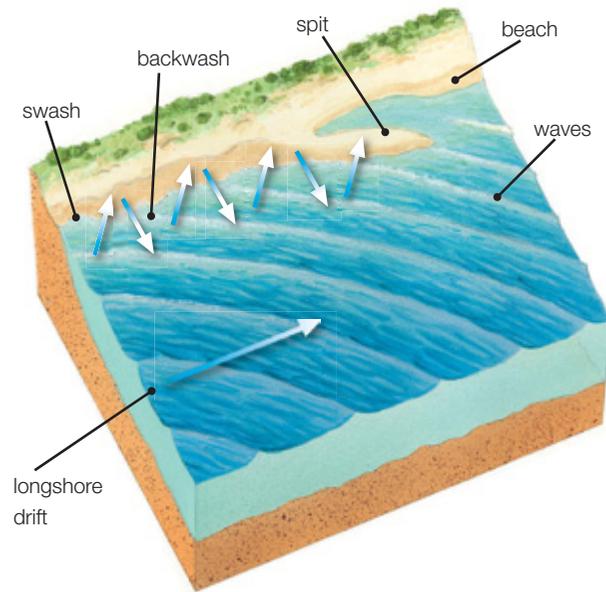
spits and **tombolos** (see Source 3.4), or the wind may change direction, causing new waves to carry sand back in the opposite direction. This movement of sand along a coast is called **longshore drift**. It is a major contributor to the shape of the coastline.

Longshore drift is also responsible for many problems faced by those people who live along the coast. The movement of sand can clog harbours and river mouths. Many coastal communities in Australia spend millions of dollars a year digging up the sand moved by longshore drift and putting it back on the beaches where local residents want it.

One of the most dramatic examples of problems caused by longshore drift can be found on England's south-eastern tip, in a town called Dungeness. Here, a nuclear power station has been built near the coast on an ancient and very large spit made of small stones called shingle. For centuries, this shingle has been shifting back and forth along the southern coast. Currently, huge amounts of the small shingle stones have to be moved to prevent the shingle from eroding. Erosion would threaten the station itself, potentially causing sea water to enter the reactor and bring about a nuclear meltdown. A meltdown would result in radioactive contamination – a disaster with devastating effects that could last thousands and thousands of years.



Source 3.8 Longshore drift is threatening Dungeness Nuclear Power Station



Source 3.9 Longshore drift

Check your learning 3.2

Remember and understand

- 1 What is the difference between swash and backwash?
- 2 How do waves begin?
- 3 Why do waves break?

Apply and analyse

- 4 How do waves change the coast?
- 5 What do you think happens to sand on a beach where the waves strike directly onto the beach rather than on an angle?

Evaluate and create

- 6 Describe the journey of a grain of sand on a beach where the waves strike at an angle.
- 7 Like many beaches around the world, Dungeness is being changed by longshore drift.
 - a What are the local authorities doing about this?
 - b Why is this particularly serious at Dungeness?
 - c Discuss with a partner some other possible solutions. Decide on your best solution and then sketch it so that you can present it to the class.
 - d When you have heard all the possible solutions from your classmates, decide on the one you consider to be the most likely to succeed. Explain why you think this would work.

Erosional landforms

Coastal landforms are created in two main ways. This is due to the fact that when waves hit the shoreline their effects can be varied. They can help to create landforms that allow plants and animals to live and thrive, or they can destroy landforms, killing plants and animals or driving them away.

The types of waves that erode and destroy sections of coast are known as **destructive waves**. Destructive waves are tall and frequent, which means they crash into the shoreline, digging out large chunks of land and eroding the beach. Their swash is weaker than their backwash, causing soil and nutrients to be drawn back into the sea rather than deposited on land.

Destructive waves begin in a large, stormy ocean. The waves travel thousands of kilometres, building up energy that is unleashed onto the rocks and sands of the coast. These waves carve the coastline into amazing shapes in much the same way that a sculptor carves shapes from a piece of marble. This process of wearing away is known as erosion, and the landforms created this way are known as erosional landforms.

A stretch of coastline close to the town of Port Campbell in southern Victoria (Source 3.10) provides a good example of erosional landforms. This part of Australia's coast is constantly being battered by waves from the Southern Ocean. As a result, the limestone cliffs in the area are being slowly chipped away, creating an ever-changing coast.

1 Cliff

Cliffs along coasts are formed by the action of waves on rock. The power of the waves erodes softer rock, leaving the more durable rock behind.

3 Gorge

Some caves can be hundreds of metres long. Waves entering long caves can wear away the roof, causing it to collapse and forming a deep gorge.



Source 3.10 A section of coastline near the town of Port Campbell in Victoria

2 Cave

As waves approach the coast they tend to bend around headlands and islands and attack them from the side in a process known as **refraction**. When waves encounter a weak spot in the cliff (such as a section of soft limestone) they wear away the rock. They create a small opening, which is soon enlarged into a cave. The waves can now enter the cave and erode the sides and top.

4 Arch

As waves erode the back of a cave they may penetrate right through the headland and produce an arch. Waves may pass through the arch, eroding the sides and top. The arch here (inset) has recently eroded and fallen into the sea creating two stacks (main image).

5 Headland

Some sections of the coastline are made up of harder rock than other sections. These can resist the energy of the destructive waves longer than the softer parts and remain as headlands – high, rocky outcrops of land.



6 Bay

The softer parts of a coastline wear away more quickly than headlands and become bays.

7 Stack

As the soft rock of arches is eroded by the destructive waves, the rock above the arches eventually falls into the sea leaving behind stacks – vertical columns – of rock.

Check your learning 3.3

Remember and understand

- 1 Describe what a destructive wave is in your own words.
- 2 Why do some rocks erode more quickly than others?

Apply and analyse

- 3 Study Source 3.10.
 - a How many caves, arches and stacks can you identify?
 - b Describe the waves in this landscape. What evidence is there that they are destructive waves?

Evaluate and create

- 4 Predict what changes might occur in the next few thousand years in the landscape shown in Source 3.10. On a sketch or copy of the photograph, sketch and label the following features of a future landscape:
 - a collapsed stack
 - a new arch
 - a new stack
 - the shape of the new coastline
 - a new gorge.
- 5 This coastline is moving inland at the rate of about 2 centimetres a year. The Great Ocean Road, which you can see in the background, is about 200 metres from the coast at present.
 - a Estimate the date at which it will fall into the sea.
 - b What other features of the human environment in this region will also change by then?

Depositional landforms

Unlike destructive waves, **constructive waves** have characteristics that help to create landforms that allow plants and animals to live and thrive. Constructive waves are long and low which means they begin far out at sea and gently roll onto the shore, allowing for a smooth and gentle landing. In this way, soil and plants are deposited onto the shore. The swash of these waves is slow and strong, which means that materials from the sea can be brought further inland. The backwash, in contrast, is very weak, which means materials are not dragged back into the sea. In this way, a wide, gently sloping beach is formed. Plants can grow and thrive, and the animals that feed on them will settle there.

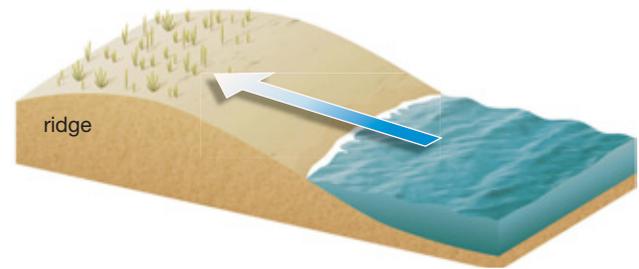
When waves are small and gentle, they do not generate enough energy to erode the land or cause great and sudden destruction. This is generally the case in bays and harbours that are sheltered from strong winds, such as Port Phillip Bay in Melbourne and Sydney Harbour. Sandy soil is moved from the base of cliffs and from the mouths of rivers by the action of the water. It is carried by constructive waves to new sites along the shore and gently deposited there. Whereas erosional landforms are the result of the removal of material from the shoreline, depositional landforms are the result of this addition of material. Constructive waves and the shapes they create are called depositional landforms.

The most common depositional landforms are beaches. A beach is formed when constructive waves carry sand, pebbles and broken coral or shells in their swash and deposit them on the shore (see Source 3.12). These small waves do not have enough energy in their backwash to take the sand back to sea, so it remains as a beach. Storms may bring destructive waves several times a year and wash away parts of the beach, but the slow, gradual process of beach building repairs this damage.

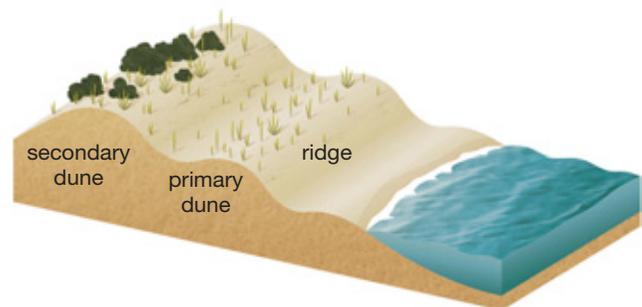
As the tide goes out, the sand dries out and the wind can then pick up individual grains and blow them inland. As the grains move, they may be trapped by an obstruction, such as plants, or they may collect in areas sheltered from the wind. As the sand piles higher it forms **sand dunes** (see Source 3.13). Plants grow on these dunes and hold them together, which allows even larger plants to take root and grow. But if the plants are removed,



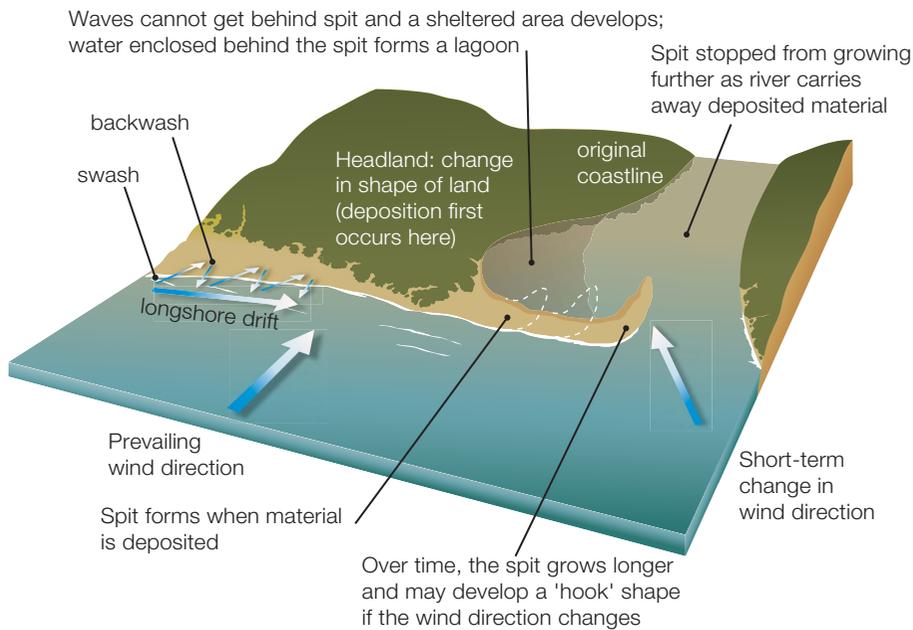
Source 3.11 Whitehaven Beach, Queensland, is an example of a depositional landform.



Source 3.12 Constructive waves carry sand onto the shore where it collects and forms a beach. Wind picks up dry sand and blows it inland.



Source 3.13 Sand is trapped by plants and collects in dunes. Over time larger plants grow over the dunes, holding them together and making them stable.



Source 3.14 How spits form



Source 3.15 A massive blowout dune inches its way across Fraser Island away from the beach.

entire dunes can gradually move further inland, covering roads, car parks, paddocks and plants. These are called **blowout dunes** (see Source 3.15).

As well as moving inland, sand moves along the coast as a result of longshore drift. As sand is deposited along coasts, other landforms can be created by the forces of water and wind.

A **spit** is a long, curved landform that is built up at the mouth of a river, which is where the river widens and ends. A river carries soil and rocks from upstream in its swiftly moving water. This material is dumped at the river mouth, forming a spit. Over time further soil and rocks collect at the river mouth, making the spit larger and more secure. This more stable environment encourages the growth of plants, which, in turn, provide habitats for animals.

Some spits grow so large that a river may be forced to change its course to reach the sea. Over thousands of years, the river mouth may move hundreds of metres along the coast and a stretch of calm water behind the spit, known as a **lagoon**, is formed. These are often home to communities of plants and wading birds, such as herons and egrets.

A **tombolo** is formed when waves curve around an island close to shore and deposit a bar of sand or other sediment on the lee side of the island (the side closest to the mainland). Eventually, enough material builds up on the leeward side that a permanent connection, or tombolo, is made between the island and the mainland (see Source 3.4).

Check your learning 3.4

Remember and understand

- 1 Why do constructive waves tend to add sand to a beach rather than take it away?
- 2 What role does the wind play in the formation of sand dunes?
- 3 What is a lagoon and how does it form?

Apply and analyse

- 4 Why are waves important to the formation of a tombolo?
- 5 Is the dune in the photograph of Fraser Island (Source 3.15) advancing towards the camera or away from it? How can you tell?
- 6 Describe three key steps in the formation of a spit.

Evaluate and create

- 7 Draw a sketch map of Whitehaven Beach (Source 3.11) showing the locations of sand, sea, rivers and forest. (For more information on sketch maps refer to section GT.2 of 'The geographer's toolkit'.) Remember that a map is a view from above, not on an angle as in the photograph. On your sketch map, use arrows to show the movement of sand.

3.1 bigideas: broadsheet

Mandurah, Western Australia

The city of Mandurah, south of Perth in Western Australia, is typical of many Australian coastal communities; it has a growing population, with thousands of people flocking to its beach in summer. However, the beaches at Mandurah have a problem – the sand there just will not stay put! For much of the year, winds approaching the coast from the south-west cause waves to strike the coast at an angle. These waves move sand northwards along the beach in the process known as longshore drift. At other times, winds from the north-west move sand away from Mandurah in a southwards direction.



Source 3.16 The fieldwork site at Silver Sands beach, Mandurah

skilldrill

Measuring longshore drift

The coast is a popular place for geography field trips because it is possible to see and measure many of the changes that are taking place there. There are several ways to measure the forces responsible for longshore drift. You will need some equipment to do this and you will need to record your findings carefully so you can process the data back in the classroom and present your findings.

Step 1 Measuring wind direction. Stand on the beach and feel the wind. Use a magnetic compass oriented to north (see Source 3.17) to determine the direction from which the wind is blowing. You may need to drop a few grains of dry sand to help you establish the wind direction. Try to establish the wind's 'average' direction. Draw a line in the sand showing this direction.



Source 3.17 A magnetic compass oriented to north



Source 3.18 This boy is measuring wind speed with a hand-held anemometer

Step 2 Measuring wind speed. The device for measuring wind speed is called an anemometer. Your school's sports department may have an anemometer, as they are sometimes used to measure wind speed at athletic events. Set up the anemometer and take regular readings of the wind speed every 5 minutes over a 20-minute period. This will allow you to work out the average wind speed.

Step 3 Measuring longshore drift. Measure and mark out a set distance of 10 metres on the beach near the water's edge. Stand at the upwind end of your marked-out area and throw an orange out into the water directly from that point. Record the time taken in seconds for the orange to move 10 metres along the coast. Divide this number by 10 to find out the rate of longshore drift in metres per second. Try this at a few different places along the beach and a few different distances

from the shoreline in order to work out the average speed of longshore drift. Use your magnetic compass to work out the direction of this drift.

Apply the skill

- 1 List the equipment you would need to complete the fieldwork activities described.
- 2 Why is measuring wind direction important in understanding longshore drift?
- 3 Source 3.20 shows a student's notes from a field trip to Silver Sands beach at Mandurah (Source 3.16). Read them carefully and answer the questions that follow.
 - a Calculate the average wind speed by adding together all the recorded speeds and dividing the total by four.
 - b What other evidence was provided that it was windy on the day of the field trip?
 - c Calculate the average rate of longshore drift. Add together the five observations and then divide the total by five.
 - d Why was the sand moving northwards on the day of the field trip?
 - e What other trend is apparent in the measurements of the longshore drift?

Year 8 Fieldwork: Silver Sands beach, Mandurah

Date: 7 September 2012
 Location: Silver Sands beach, Mandurah
 Weather: Fine (no rain) a bit windy
 Waves: Medium (about 1-2 metres high) and choppy
 Wind Direction: South-westerly

Wind speed observation

Time	Wind speed
10.00	22 km/hr
10.15	18 km/hr
10.30	26 km/hr
10.45	14 km/hr

Longshore drift observation

Test no.	Approximate distance from shore line	Time (in seconds) taken to travel 10 metres
1	5 metres	182
2	4 metres	190
3	12 metres	228
4	20 metres	425
5	10 metres	212

Direction of movement: Northwards

Evidence of sand movement:
I noticed that sand has banked up beside a stone wall that has been built into the sea. There was a lot of sand on one side of the wall but hardly any on the other side. When the wind blew strongly, sand was being blown along and across the beach. Some of this was blowing as far as the car park.

Source 3.20 Student fieldwork recorded at the fieldwork site at Silver Sands beach, Mandurah (Source 3.16)



Source 3.19 Mandurah, Western Australia

Extend your understanding

- 1 Is Silver Sands beach being changed mainly by constructive waves or destructive waves? Give two reasons for your answer.
- 2 Look carefully at the oblique aerial photograph in Source 3.19.
 - a In which direction is longshore drift moving sand at Mandurah beaches in this photograph? Give some evidence from the photograph for your answer.
 - b How might longshore drift affect the opening of the river in the centre of the photograph?
 - c What evidence is there of measures taken to try to limit and control longshore drift?

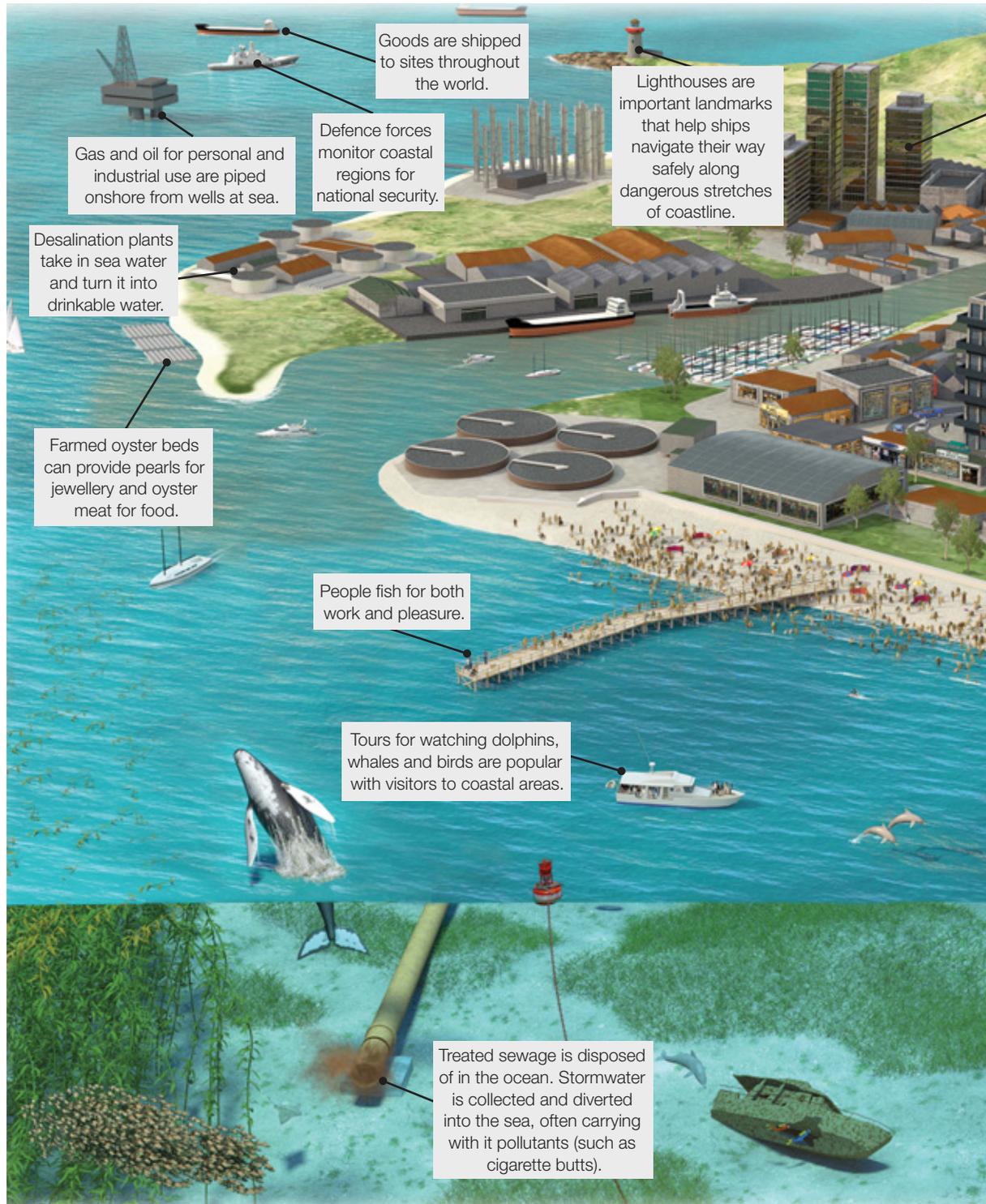
3.2 How are coastal landscapes used and managed?

One landscape, many uses

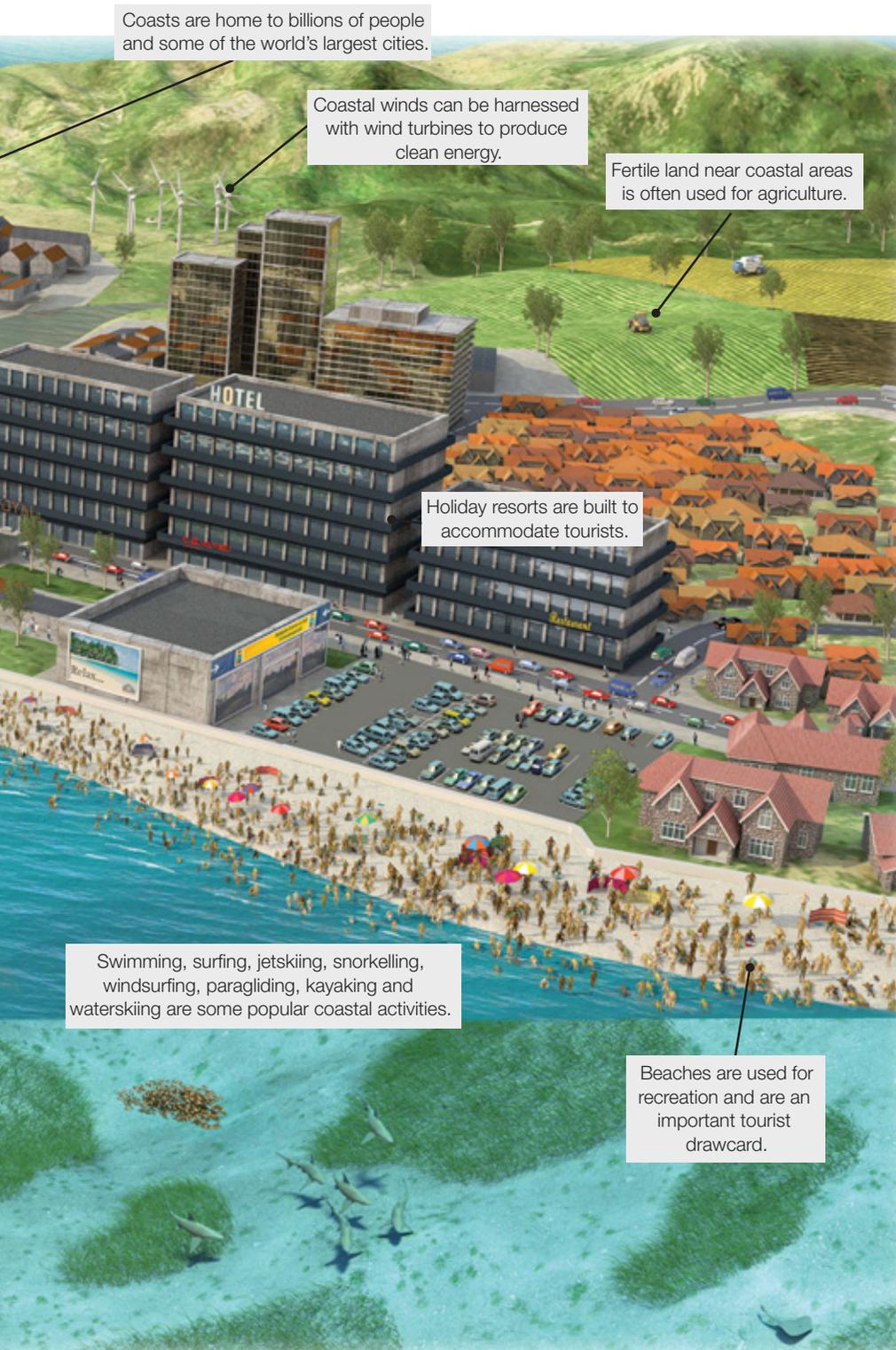
Coastal landscapes are some of the most highly populated areas on Earth. About 3.5 billion people – more than 50 per cent of the world’s population – live on or near a coast. Some geographers estimate that this number will double over the next 15 years.

In Australia, this figure is already much higher – 85 per cent of us live within 50 kilometres of the sea. Many coastal towns and cities are currently experiencing rapid population growth, increasing this figure even more.

Coastal areas are used for much more than places to live. Source 3.21 shows some of these uses and their impacts on the environment.



Source 3.21 How and why people use coastlines



Check your learning 3.5

Remember and understand

- 1 Name two ways in which ships and boats are used in a coastal landscape.
- 2 Which parts of the coastal landscape in Source 3.21 have attracted the most people? What are these people doing.

Apply and analyse

- 3 How do you use the coast? Which of the labels on Source 3.21 describe ways you use the coast?
- 4 Has the artist chosen to show a coast shaped by destructive or constructive waves? How can you tell?
- 5 How does tourism change coastal areas?
- 6 Why do you think so many people live near the coast?

Evaluate and create

- 7 Can you think of any uses of the coast not shown in Source 3.21?
- 8 Which activities shown in Source 3.21 would have no or very little impact on the natural environment? Which three would have the greatest impact?
- 9 Identify one activity shown in Source 3.21 that you believe has the greatest impact on the environment. Work with a partner to discuss some ways in which people could reduce the impact of this activity on the environment.
- 10 Use a street directory (or Google Maps) to examine a coastal city in Australia. Carefully examine the coastline of this city and list all the ways in which the people of the city have changed the coast or used it in some way. What are some common changes or uses and what are some surprising ones?

Managing coastal landscapes

The forces of nature are constantly changing coastal landscapes around the world. The shapes of beaches are changed; spits are formed; harbours fill with sand; and waves erode the coast, causing houses, roads and other structures to collapse into the sea. Cities and towns built in coastal areas are often affected by these natural processes.

The residents of coastal cities and towns around the world have responded by trying to control or manage the natural processes. Their responses differ depending on the types of forces being dealt with. For example, along depositional coastlines responses are designed to combat the presence of too much sand, while along erosional coastlines the responses are designed to combat the wearing away of the land.

Coastal management for depositional coasts

The main issue confronting communities along depositional coasts is sand movement. For example, the sand that makes up Adelaide's beaches is gradually moving northwards under the influence of longshore drift. This is causing the beaches in some areas to become narrower, leading to waves eroding land close to roads and houses. In other areas, sand is being deposited in river mouths, blocking boat access to the sea. In Australia, the Department of Sustainability, Environment, Water, Population and Communities is trying a number of measures to address this problem.



Source 3.22 These groynes near Brighton Beach in Adelaide were built to protect the millions of cubic metres of sand pumped onto this beach in the 1990s.



Source 3.23 Two training walls and a breakwater have helped to trap sand at the mouth of Glenelg Harbour in Adelaide.

Constructing sea walls from large rocks, concrete blocks or sandbags can slow or even stop the movement of sand along the coast. **Groynes** – walls that jut out from a beach into the sea – prevent erosion of a beach by stopping waves from pounding onto the shore, and by directing them away from specific areas of the beach (see Source 3.22). **Training walls** – walls on either side of the mouth of a river – are built to prevent sand from blocking a harbour or river mouth (see Source 3.23).

Another method to prevent the erosion of beaches is to move sand from one place to another. This method, known as beach nourishment (or beach replenishment), may involve moving thousands of truckloads of sand every year to reverse the effects of longshore drift. In Adelaide, millions of cubic metres of sand have been dredged from the sea floor or taken from dunes in other places and trucked onto the eroding beaches.

Coastal management for erosional coasts

In places where destructive waves are eroding the coast, communities have responded by building barriers, parallel to the coast, to prevent waves from reaching the coastline. These barriers are usually made of concrete or piles of rocks or rubble. Walls that are built out in the sea are called **breakwaters**. Walls that are built close to the coast are called **seawalls**. These barriers are designed to direct the water's force at the solid walls made of hard materials rather than the soft and easily moved sands and dunes.

While these walls may help in the short term, they can often create new problems. The energy of the wave may be deflected downwards, for example, eroding the front of the wall, weakening it until it eventually collapses into the sea. The shoreline is then left unprotected.



Source 3.24 Lakes Entrance on Victoria's east coast

Check your learning 3.6

Remember and understand

- 1 What are groynes and why have they been built in Adelaide?
- 2 Have the structures built at Glenelg Harbour (see Source 3.23) been successful in controlling the movement of sand? Give some evidence for your answer.

Apply and analyse

- 3 Examine Source 3.24 carefully.
 - a Is this an erosional or depositional coast? What is your evidence for your answer?
 - b What is the groyne designed to do? Is it working?
 - c What is the training wall designed to do? Is it working?

Evaluate and create

- 4 There is a large build-up of sand in the river channel at site A in

Source 3.24. Over time it may build up further and become a danger to small boats using the river.

- a What does this build-up of sand tell you about the river?
- b What would you do to try to control this sand build-up? You may like to sketch your solution onto a copy of the photograph.

- 5 Draw a sketch map of a coastline that includes a groyne, training walls, seawalls and a breakwater. (For information on drawing sketch maps refer to section GT.2 of 'The geographer's toolkit'.) Show these features in your map legend.

The impacts of gas exploration on coastal landscapes

In many coastal areas, human activities impact on natural processes and environments. An example of this is the development of a natural gas plant on Curtis Island off the coast of Queensland near the town of Gladstone. The plant being built will allow liquefied natural gas (LNG) to be stored and loaded onto ships for transportation. LNG is gas that has been compressed into liquid form to make it easier to transport and store. The gas is extracted from onshore coal seams before being piped to the island. Ships then transport the gas to ports around the world, particularly in Asia.

The facility will allow the company building it and the 520-kilometre pipeline that brings the gas to the port to sell the gas and make a profit. The company argues that building the facility also creates thousands of jobs and boosts the economy of the region.

Gladstone is the largest port in central Queensland with over 1500 large ships using the port facilities every year. Large quantities of coal, petroleum and cement are already moved through the port. When the plant is



Source 3.25 A typical LNG ship is 300 metres long, 45 metres wide and needs a channel at least 12 metres deep.

Source 3.26 An oblique view of the construction site at Laird Point on Curtis Island



completed, each week two to three specially designed ships will carry LNG from Curtis Island to export markets. Other companies are also interested in building LNG plants on the island.

Gladstone port and Curtis Island are located beside the Great Barrier Reef. The reef is the largest in the world and is considered one of the world's great natural wonders. It is also included on the UN World Heritage list. Curtis Island sits within the Great Barrier Reef World Heritage area, so the companies building the plant have had to ensure that they follow strict guidelines about changes to the environment.

Some people remain concerned that the new gas facility will endanger the natural environment, including the reef. In particular, they are worried about the following:

- To allow large LNG ships to reach the gas plant 8 million cubic metres of sand and mud need to be dredged from the channel between Curtis Island and the mainland. This environment is home to marine life, such as turtles and dugongs.
- Dredged material will be dumped near the reef.
- The LNG plant requires a reliable supply of fresh water so a desalination plant is being built as part of the facility. This takes water from the sea, removes the salt and pumps the salt back into the sea.
- The movement of ships through the reef means there is the potential for a shipping accident that may damage the reef.

NATURAL GAS PLANT DEVELOPMENT AREA



Source 3.27

Source: Oxford University Press

Check your learning 3.7

Remember and understand

- 1 What changes are taking place on Curtis Island? Why are these changes taking place?

Apply and analyse

- 2 Construct a table with two columns: 'Arguments for the new LNG plant' and 'Arguments against the new LNG plant'. List the various arguments in the correct columns.
- 3 Imagine that you are a representative of the World Heritage committee that has come to Curtis Island to find out whether the LNG plant is going to affect the Great Barrier Reef. Make a list of the questions you would ask in your investigation. Discuss these with a partner before sharing them with the class.
- 4 Carefully examine the map showing the natural environments in this region (Source 3.27).
 - a Describe the natural environment in which the LNG plant is being developed. In your description include details about vegetation as well as birds and animals.
 - b Dugongs are marine mammals that feed on seagrass on the sea floor. How might dredging affect these animals?

Evaluate and create

- 5 Design and produce a poster either supporting or opposing the expansion of the Curtis Island plant for display in the Gladstone town hall.
- 6 Debate the topic, 'While the development might have some impact on the environment, Australia's prosperity is more important.'

Caring for coastal landscapes

Many human activities are changing coastal landscapes in negative ways. Some of these changes (such as the building of new ports or holiday resorts) are deliberate, but many are accidental. A line of litter (such as fishing nets, plastic bottles and household rubbish) can be seen along the high tide mark of some beaches. The fragile vegetation on sand dunes is sometimes trampled and destroyed by thoughtless beach-goers; without the small bushes and trees that hold the dunes together, the wind blows sand further inland. Beaches are eroding, water quality is declining because of pollution and, in many places, coastal animals and plants are endangered by human activities.

Recognising that these threats exist, many people and organisations are working to preserve and protect our coastlines: from large global programs to individual volunteers who donate their time and energy. One such organisation is Coastcare, whose 60000 volunteer members identify environmental problems in local coastal regions and work to solve those problems. Coastcare volunteers remove invasive weeds, litter and trampled plants from dune areas, and they plant new vegetation to anchor the dunes and keep the sand from blowing away.



Source 3.28 Years 9 and 10 students turn a beach into an open-air laboratory as part of the Teach Wild program

Source 3.29 Coastcare volunteers planting native vegetation on dunes near Darwin



Another organisation, Ocean Care Australia, is part of a global network that helps school and community groups to clean litter from coasts as part of an 'adopt-a-beach' program. Many schools, particularly those in coastal areas, have become involved in initiatives such as this.

Governments and large organisations have recognised the vital role that schools can play in educating young people about coastal issues. The Teach Wild program is just one of these. A partnership between the Australian Government (through CSIRO), Shell and Earthwatch Australia, this program enlists the help of school students to monitor the health of coastal ecosystems. As part of this program, school students collect and map debris (such as bottles, nets and other litter) found along the coast.

Case study: saving the Fairy Tern

Many plants and animals that live in the coastal environment are under threat from human activities. One bird that is considered to be at risk of extinction in Australia, New Zealand and New Caledonia is the Fairy Tern. There are about 5000 Fairy Terns in Australia. About half of these live in Western Australia; the rest are found in a few smaller colonies, primarily in South Australia, Victoria and southern New South Wales. Fairy Terns lay their eggs and raise their chicks in open nests in sand dunes, without cover from grasses and bushes. This makes them especially vulnerable to attack from introduced predators, such as wild foxes and domestic cats and dogs. The other major threat comes from four-wheel-drive vehicles, which disturb nesting pairs and destroy nests by driving straight over them.

Those terns that nest in national parks, however, have a helping hand. The managers of national parks can make and enforce clear rules about visitor behaviour. Restrictions on where people can go, and what they can and cannot do, are designed to protect the environment and to make the area safe for terns. In Coffin Bay National Park in South Australia, for example, Fairy Tern nesting sites have been fenced off and all vehicles are banned from these areas. Dogs are forbidden and fox numbers are kept under control through the use of poison baits. The numbers of birds are monitored by park rangers and by volunteer groups, such as Friends of Parks. These measures have seen the numbers of Fairy Terns in Coffin Bay stabilise. Rangers hope they will soon increase.



Source 3.30 A Fairy Tern nesting on an open beach

Check your learning 3.8

Remember and understand

- 1 What are some of the problems caused by people in coastal environments?
- 2 How are the individuals and groups in Sources 3.28 and 3.29 responding to these problems?
- 3 Why are the Fairy Terns so vulnerable to attack from predators?

Apply and analyse

- 4 While Coastcare is a national organisation, each local group can respond differently to issues at the coast. Explain why it is important that responses differ from place to place.
- 5 What could a Coastcare group at Coffin Bay do to help protect the Fairy Tern?
- 6 What could visitors to the coast do to reduce their impact on the natural environment?

Evaluate and create

- 7 Parts of Coffin Bay National Park are remote and wild places where access is only possible with a high-clearance four-wheel-drive vehicle.
 - a Why do people visit wild places such as Coffin Bay?
 - b What impacts might human activities have on the natural environment?
- 8 Create a leaflet that encourages people in coastal areas to join their local Coastcare group.

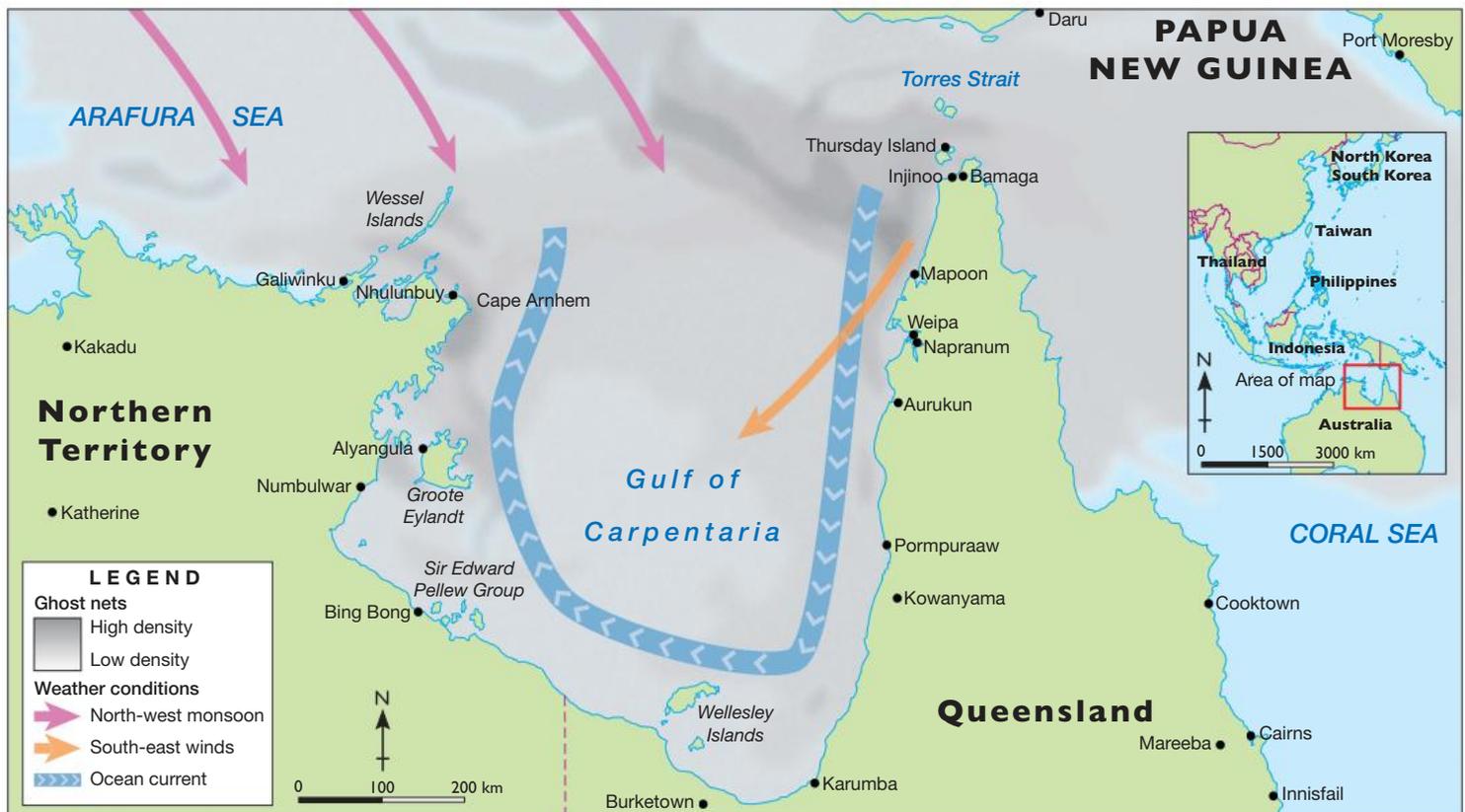
The impacts of fishing on coastal landscapes: Ghost nets

Every year, about 6.4 million tonnes of fishing gear (nets and tackle) is lost in the world's oceans. Most of this is made up of abandoned fishing nets that have drifted free from boats in extreme weather conditions or have been cut free because they became entangled. In many cases it is cheaper and easier for fishermen working in waters to the north of Australia to cut these tangled nets free than to haul them in and untangle them. The nets, still afloat because they are plastic, are carried south on ocean currents and continue to entangle fish and other marine species, such as turtles, dugongs and even crocodiles. They are referred to as **ghost nets** and at any one time there are thousands of them in the ocean.



Source 3.31 Yirralka Laynlapuy rangers remove a ghost net from a beach in Eastern Arnhem Land.

THE GULF OF CARPENTERIA: WEATHER PATTERNS AND DENSITY OF GHOST NETS

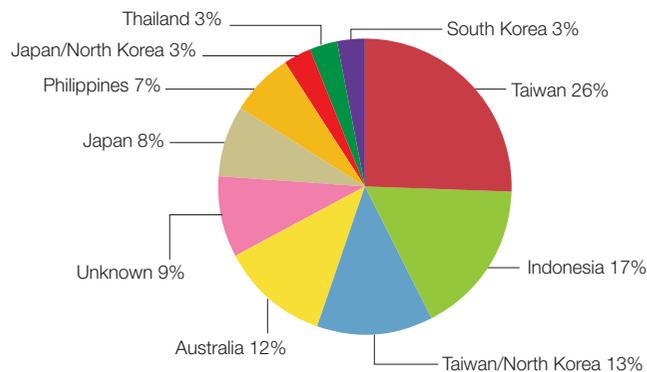


Source 3.32

Source: Oxford University Press

About 100 000 marine mammals are killed by ghost nets every year. This includes endangered animals, such as whales, Australian sea lions and turtles. In northern Australia, ocean currents and winds carry ghost nets into the Gulf of Carpentaria where they can remain for years, trapped by circulating currents (see Source 3.32). Tides and storms wash them onto the shore and then drag them back to sea or bury them in the sand.

In response to this issue, GhostNets Australia, an organisation dedicated to removing ghost nets from the waters and beaches of northern Australia, was formed in 2004. It is an alliance of coastal Indigenous communities from Queensland, Northern Territory and Western Australia. Since GhostNets Australia was formed its rangers have retrieved about 12 000 nets from Australian waters. This represents about 90 kilometres of netting. As well as removing the nets, these rangers also free trapped wildlife, map the location of the nets using GPS systems, and try to identify the origin of the nets using resources supplied by the World Wildlife Fund.



Source 3.33 Origin of nets found at Cape Arnhem, Northern Territory

keyconcept: interconnection

Where do the ghost nets come from?

Although some environments are unique, no environment exists in isolation from others. There are links between places, and by exploring these links we can develop a better understanding of the ways in which networks and systems work. This may help us to solve problems such as marine and coastal pollution. In the case of the ghost nets of the Gulf of Carpentaria, geographers examine the winds and currents of the area to help explain why nets collect in this region. By examining the data collected by the GhostNets Australia rangers and other researchers we can also find out the origin of the nets (see Source 3.33).

For more information on the concept of interconnection, refer to section GT.1 of the 'The geographer's toolkit'.

Check your learning 3.9

Remember and understand

- 1 What are ghost nets?
- 2 Why do ghost nets create problems for the natural environment?
- 3 Describe the work done by the GhostNets Australia rangers.

Apply and analyse

- 4 Examine Source 3.32. How do ocean currents and winds affect the movement of ghost nets. Refer to specific winds and places in your answer.
- 5 Why do you think most GhostNets rangers are Indigenous Australians?

Evaluate and create

- 6 On an outline map of the Asia-Pacific region, locate and label the countries of origin of fishing nets found at Cape Arnhem (see Source 3.33).
 - a Shade in each of these countries using darker shades for countries that have contributed many nets and lighter colours for those with fewer nets. For example, you may use red for countries with more than 15 per cent, orange for those with 5 to 15 per cent, and yellow for those with less than 5 per cent.
 - b Describe the pattern shown on your map.

- c Use arrows to show the paths that may have been taken by these nets to reach Cape Arnhem.
 - d Use BOLTSS to finish your map.
 - e How far have the Japanese nets travelled to reach the Gulf of Carpentaria? Why is this hard to estimate correctly?
 - f Why are rangers and researchers interested in the origins of the nets?
- 7 What do you think should be done to reduce the number of ghost nets in the oceans? Why do you think this is such a difficult problem to solve?

3.2 bigideas: broadsheet

Gold Coast Seaway, Queensland

A good example of coastal management in action can be seen on Queensland's Gold Coast. Northward sand movement over centuries has caused the mouth of the Nerang River to be pushed north along the coast. This created a long spit sheltering a lagoon (known as The Broadwater). Although this is a natural process, it created several problems in the region. The southern tip of South Stradbroke Island was being eroded by the waters emerging from the mouth of the Nerang River, the spit was unstable and large amounts of moving sand in the mouth of the Nerang River made boating hazardous.

The solution was to build training walls at the mouth of the Nerang River to stabilise the sand and to direct the river flow away from the southern end of South Stradbroke Island. This structure became known as the Gold Coast Seaway. To move the drifting sand from one side of the seaway to the other, a 490-metre-long sand-collection jetty was built. Beneath the jetty are 10 pumps that collect the sand and pipe it to South Stradbroke Island. This sand-bypass system, which can move 500 cubic metres of sand an hour, was the only one in the world when it was completed in 1986.

skilldrill

Drawing sketch maps

One of the most useful skills a geographer can master is the drawing of sketch maps. Sketch maps show the main features of the landscape that you are studying, but do not contain the details you would be expected to include on a formal map. While conducting fieldwork you will probably start with a basic outline map of the main features of the location you are studying, such as a coastline. The steps listed here are for a sketch map that you would complete as part of your fieldwork.



Source 3.34 Aerial photograph of the Nerang River entrance, 1984. You can see how the southern tip of South Stradbroke Island has been eroded by the waters flowing out of the river.



Source 3.35 An aerial photograph of the Nerang River entrance, 1985, at the beginning of the construction of the Gold Coast Seaway

Step 1 Look closely at the outline map you have been given to see if you can recognise some of the features around you. Orient your map by turning it around so that it is facing the right way.

Step 2 Decide on the focus of your fieldwork. If you are studying the ways in which people have managed a coastal landscape, for example, you will mark on your map features such as training walls and a sand collection jetty.

Step 3 Label the features that you recognise. Keep your writing neat and level across the page.

Step 4 Look around the area you are studying in your fieldwork and find other examples of ways in which people have managed the coast. Locate and label these on your sketch map. You may find it best to shade large areas, such as the training walls, and to add a legend to show the shading and any other symbols you use.

Step 5 Add carefully labelled arrows to show examples of movement. For example, in the sketch map of the Gold Coast Seaway (Source 3.37), an arrow shows the direction in which sand is moving. Other examples may include the movement of people, cars and water.

Step 6 Add any examples you can find of change over time. A build-up of sand on one side of a groyne, for example, shows that sand is moving along a beach. A collapsed stack or a pile of rocks at the base of a cliff is evidence of erosion.

Step 7 Add a title that includes the date, and a north arrow. (You may need to use a compass.)

Apply the skill

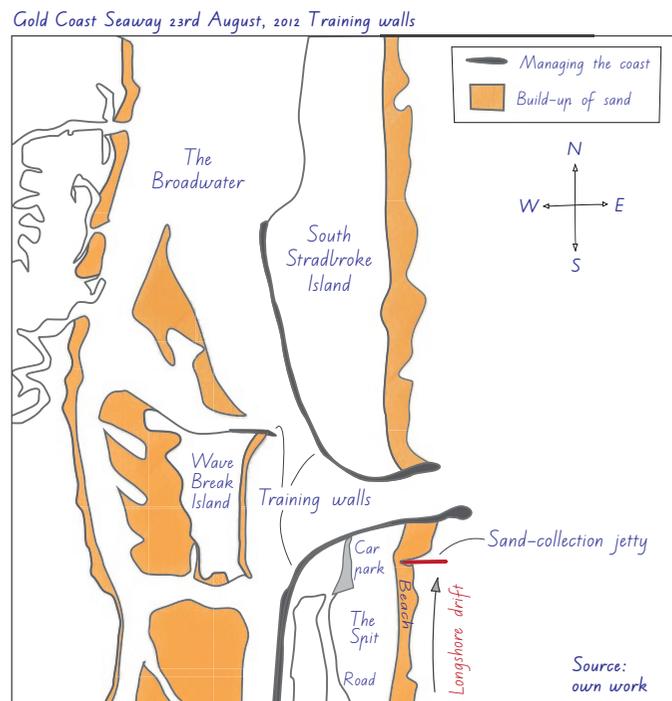
- 1 Create a sketch map of the area shown in Source 3.34. Remember that all maps show a view from directly above. On your sketch map, show how people have managed this coast.

Extend your understanding

- 1 Why were training walls built at the mouth of the Nerang River?
- 2 What effect did the training walls have on the direction of water from the Nerang River?
- 3 Name the coastal process that the training walls are designed to manage.
- 4 How successful have the structures been? Give some evidence from the vertical aerial photograph (Source 3.36) for your answer.
- 5 What evidence is there in the photograph (Source 3.35) that sand is moving down the Nerang River?



Source 3.36 An aerial photograph of the Gold Coast Seaway, 2002. You can see how South Stradbroke Island has built up and become stabilised with natural vegetation.



Source 3.37 A sketch map

3.3 Are coastal landscapes hazardous places?

Coastal erosion

Waves and currents are constantly changing coastal landscapes. In some places, wave action erodes beaches and cliffs, which can create many problems for people who live in coastal communities. Many built features (such as caravan park facilities, roads, houses, walls and playgrounds) on or near an eroding coastline face the constant threat of collapsing into the sea. Most at risk are communities built on sandy coastlines, as these landforms can change very rapidly – with devastating consequences.

Case study: Kingscliff, New South Wales

A community affected by coastal erosion is Kingscliff in northern New South Wales. At times, a wide beach, popular with holiday-makers, extends in front of the town. Structures such as a bowling club and surf life saving club have been built beside the beach. Roads, paths and car parks have also been built along the coast. However, storm waves occasionally batter the beach and scour out huge quantities of sand. The beach can disappear overnight and waves then directly erode the base of the buildings and roads.

The local community has responded to this changing coastal landscape in a number of ways. A **training wall** and **groynes** have been built at the mouth of the river that flows into the sea. This controls flooding and has helped to secure the southern end of the beach. Trees have been planted to help hold the larger dunes in place and a sea wall has been built in front of some of the buildings, including the bowling and surf clubs. Storm waves have, however, at times eroded the base of this wall, and large textile bags filled with sand have had to be piled in front to help protect the wall from wave erosion.



Source 3.38 In 2010, storm waves in Kingscliff caused a road to fall into the sea (foreground) and threatened the local surf life saving club (background).



Source 3.39 Kingscliff beach in July 2012 showing a seawall that has been built to protect homes and businesses along the coast.

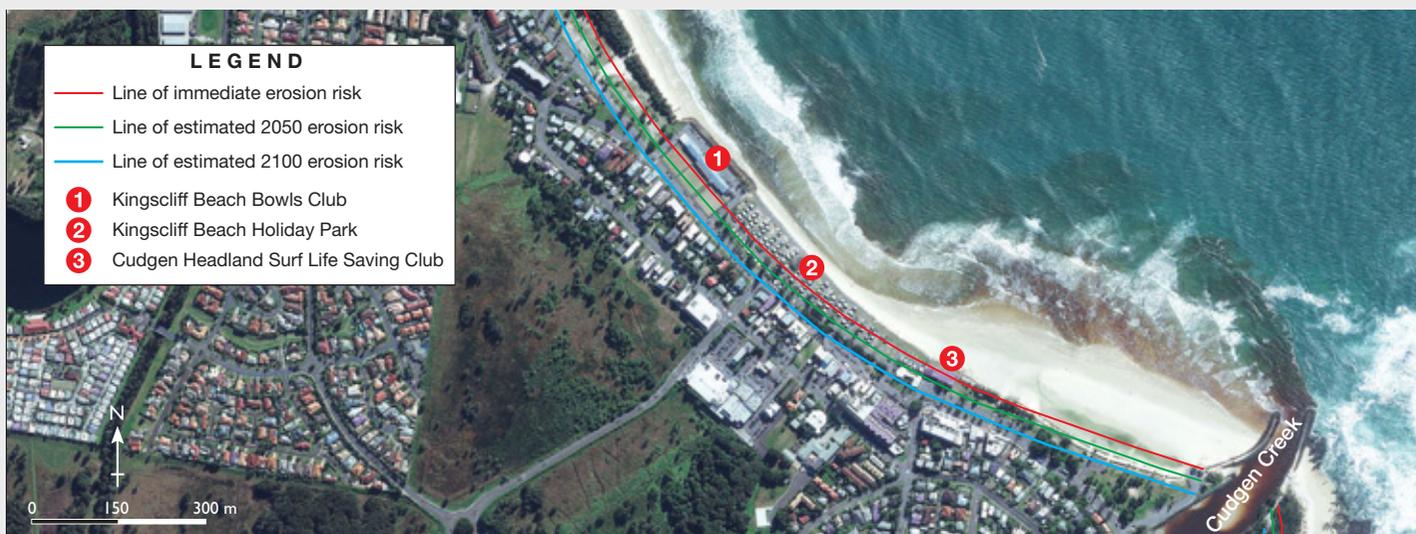
keyconcept: change

Future changes at Kingscliff

A study of the Kingscliff coastline has found that a strip of land 40 metres wide is vulnerable to strong storms and could be eroded to the point where it disappears entirely. This includes much of the caravan park and surf club and the entire bowling club. More alarmingly, the study found that a combination of rising sea levels due to climate change and the natural process of erosion will threaten

much greater areas around Kingscliff in the future. The authors of the study estimated the rate of erosion in this area as about 20 centimetres a year. On the satellite image (Source 3.40), lines have been drawn that show areas at immediate risk in a storm, areas at risk in 40 years and areas at risk in 90 years.

For more information on the key concept of change, refer to section GT.1 of 'The geographer's toolkit'.



Source 3.40 A satellite image of Kingscliff showing areas at risk of coastal erosion

Check your learning 3.10

Remember and understand

- 1 Why are some coastal communities more at risk from coastal erosion than others?
- 2 How has the Kingscliff community responded to coastal erosion?

Apply and analyse

- 3 Examine Sources 3.38 and 3.39 showing Kingscliff beach severely affected by erosion.
 - a List any changes as a result of erosion that you can identify in these sources.
 - b Use your understanding of the way in which sand moves to explain these changes.

- c How might these changes affect local residents and holiday-makers in the region?

Evaluate and create

- 4 Examine Source 3.40 showing predicted changes over the next 90 years.
 - a Describe the area at immediate risk from coastal erosion.
 - b Use the scale to estimate the distance the coastline is predicted to move inland in the next 90 years.
 - c Describe the changes to this area if this prediction is correct.
- 5 Based on the evidence that you can see in these images, has the local community been successful in controlling coastal erosion? Use the evidence in your answer.
- 6 Imagine that you have been asked by the Kingscliff community to help protect their coast from further erosion by storms. They also want their beach to be attractive to tourists. What advice would you give them?

Rip currents

On Australian beaches the biggest threat to people enjoying the sea is being swept away by a **rip current** while swimming, and then drowning.

At least one-half of all beach drowning deaths in Australia involve rip currents (more commonly known in Australia as 'rips'). During the summer, on average, there is a death related to rip currents every two or three days. Rip currents account for more deaths in Australia than bushfires, floods, cyclones, shark attacks and **tsunamis** combined in an average summer. So what is a rip current, and how can you avoid being caught in one?

A rip current is a channel of water (like a river within the sea) that moves swiftly from the beach out towards open water. This kind of current can develop on any shoreline affected by wave action. When waves are small their swash is slow and gentle, but in rougher water waves coming into shore will push water towards the shoreline. This water needs a place to go, and will move sideways along the shore and then shoot back out to sea at the first opportunity. If there is an opening in a sand bar offshore, the water will head quickly in that direction. The resulting 'river within a sea' will usually travel at about half a metre per second, but can

also be several times that speed. Because this quickly moving water appears to be quite smooth on the surface, swimmers frequently mistake these patches of water for safe, calm waters – and that is when they find themselves in great danger.

In some places, such as at Bondi Beach, rip currents are almost constant features. The rip current at Bondi Beach even has a name – the Backpackers' Express – after the many inexperienced foreign backpackers who are caught in it each year. In other places, rip currents can suddenly appear and disappear. They may stay in place for a few hours or for only a few minutes. On one day they may be at one end of the beach and the following day appear at the other end. These temporary rip currents are generally more dangerous, as beachgoers can be caught by surprise.



Source 3.41 The 'Backpackers' Express' rip current at Bondi Beach, Sydney, can make this popular beach a dangerous place to swim.



Source 3.42 A surf life saver pulls a swimmer from a rip current. Surf life savers have patrolled Australian beaches for over 100 years and in that time they have saved more than 600 000 lives.



Source 3.43 A poster released by Surf Life Saving Australia with advice about avoiding and escaping a rip current

Staying safe

The best way to stay safe at the beach is to avoid rip currents in the first place. Before you enter the water, watch the surf for a few minutes. Areas of calm, darker or murky water may indicate that a rip current is present. You should always swim between the flags at beaches that are patrolled by surf life savers. Surf life savers carefully inspect the beach and find a safer swimming area away from rip currents. Red and yellow flags indicate where this section of the beach is located and also show that life savers are on duty, watching swimmers and helping when needed.

Check your learning 3.11

Remember and understand

- 1 What is a rip current?
- 2 What is the best way to avoid being caught in a rip current?

Apply and analyse

- 3 Why do you think people swim where there is a rip current rather than on a sandbank which is relatively safer?
- 4 Why do you think the Bondi Beach rip current is called the Backpackers' Express?
- 5 There are no flags on the beach shown in Source 3.41. What does this tell you about this beach? What does it tell you about the people who are swimming?

Evaluate and create

- 6 Design a sign that could be used to warn swimmers about rip currents. Use a symbol or picture rather than words on your sign to explain the danger.

Tsunamis

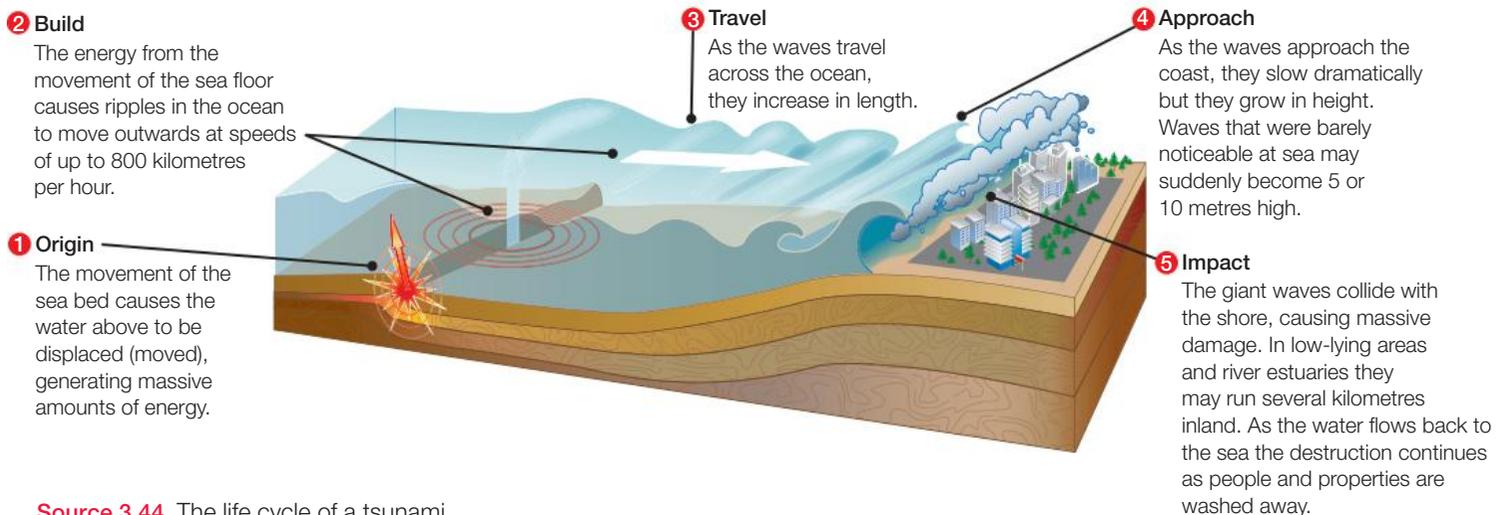
Giant waves called **tsunamis** (a Japanese word meaning 'harbour wave') are perhaps the most terrifying coastal hazard. A tsunami is created when natural events move a huge amount of water in a short period of time. The largest and most common tsunamis are created when the sea floor moves upwards during an earthquake. This causes a series of high, very broad waves to be generated. Other events that can cause tsunamis include underwater volcanic eruptions and landslides. Smaller tsunamis can be created when a large landslide reaches the sea or when large sheets of ice break off glaciers.

2004 Indian Ocean earthquake and tsunami

On Boxing Day 2004, a natural disaster of epic scale and force struck many of the countries surrounding the Indian Ocean. A huge earthquake near the southern coast of the Indonesian island of Sumatra triggered massive, broad waves of water that slammed into nearby coastal towns and cities, such as Banda Aceh in Indonesia. The tsunami then travelled across the Indian Ocean, sending huge amounts of water inland with tremendous force wherever it encountered low-lying coastal areas. Indonesia, Sri Lanka, India and Thailand were most affected, but deaths were recorded as far away as Somalia, Tanzania and even South Africa. By the time the tsunami had run its course, much of coastal Asia lay in ruins.



Source 3.45 Banda Aceh, Indonesia, before and after the tsunami struck – 23 June 2004 (top) and 28 December 2004 (bottom)



Source 3.44 The life cycle of a tsunami

keyconcept: space

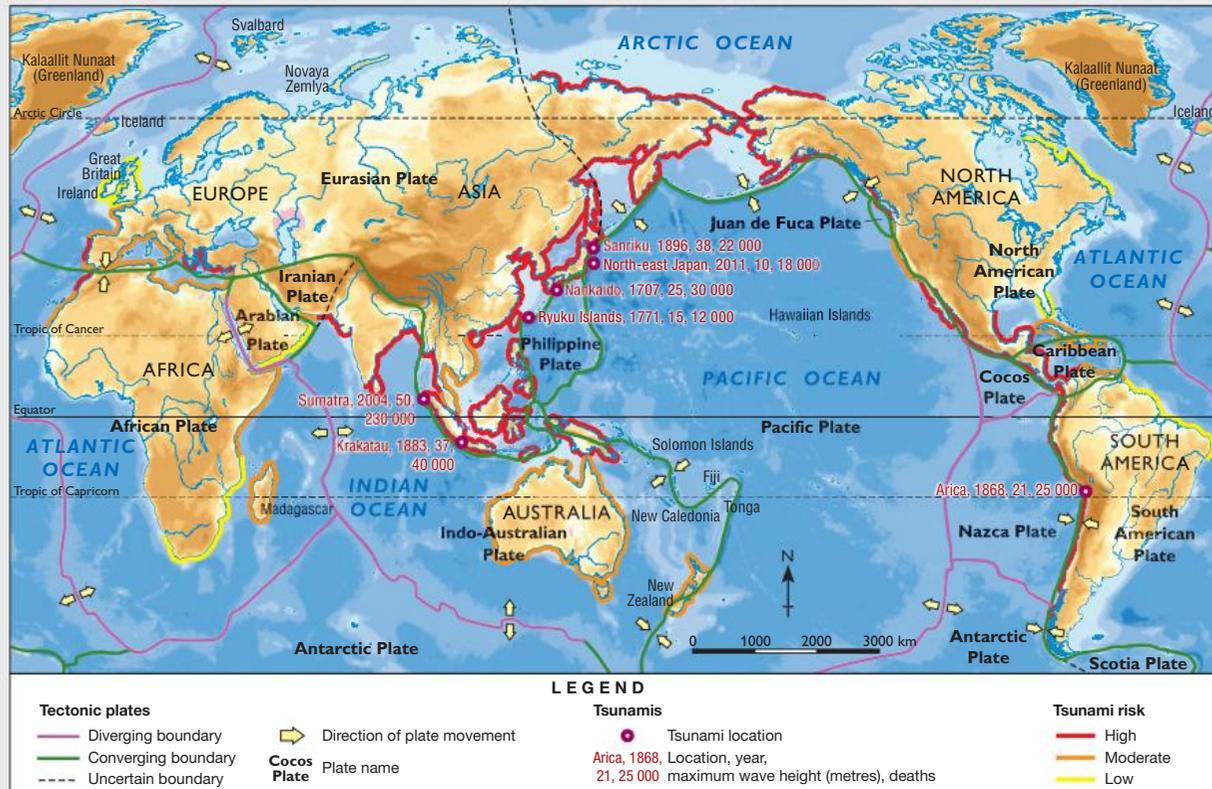
Where do tsunamis occur?

Geographers have noticed that some coastal areas are much more at risk from tsunamis than others. By comparing the distribution of tectonic plate boundaries, earthquakes and tsunamis, they found that coastal areas facing a region

where undersea earthquakes occur are most at risk from tsunamis. Japan is the world's most earthquake-prone country, as its east coast lies within 100 kilometres of a very active plate boundary.

For more information on the key concept of space, refer to section GT.1 of 'The geographer's toolkit'.

WORLD: TSUNAMI THREAT AND OCCURRENCE



Source 3.46

Source: Oxford University Press

Check your learning 3.12

Remember and understand

- 1 What are some of the causes of tsunamis?
- 2 In 2004, which countries were worst hit by the Indian Ocean earthquake and tsunami?
- 3 Describe how a tsunami wave changes as it approaches the coast. How do these changes make it more dangerous?

Apply and analyse

- 4 Study the map (Source 3.46). Describe the distribution of the most tsunami-prone regions of the world.
- 5 Describe the relationship between plate boundaries and the level of tsunami threat as shown on the map. Give the names of specific places and plates in your answer.

- 6 Hawaii lies thousands of kilometres from a plate boundary and yet it is one of the world's most tsunami-prone places. Explain why this is the case.

Evaluate and create

- 7 Sketch the outline of the Banda Aceh coast as shown in the June 2004 satellite image (Source 3.45 (top)). On your sketch label five changes caused by the 2004 tsunami.
- 8 While the 2004 tsunami caused immediate damage to Banda Aceh, some of its effects will be felt for years. In a small group, discuss how tsunamis affect people and places, and classify the effects as either short term or long term.

2011 Japanese earthquake and tsunami

The world's largest **tectonic plate**, the Pacific Plate, is moving slowly westwards towards Japan at the rate of about 80 millimetres a year (see Source 3.46). This movement causes many earthquakes and makes Japan the tsunami capital of the world. Because of the danger, many Japanese towns and cities are protected from tsunamis by high sea walls. There are also many tsunami evacuation centres built on higher ground across Japan. Japanese people, aware of the threat, are educated about ways to prepare for a tsunami event.

On 11 March 2011, all these preparations were put to the test when one of the largest earthquakes ever recorded sent massive tsunami waves racing towards Japan and eastward across the Pacific Ocean. Within an hour, tsunami waves up to 7 metres high reached Japan's east coast and caused immediate devastation.

The waves in some places pushed several kilometres inland. The water cascaded over the tsunami walls and washed away buildings, cars, roads and people. The damage was worst in areas close to the epicentre of the earthquake; in these areas entire towns were destroyed or entirely washed away. The movement of the tsunami waves was strongly influenced by the shape of the land, as the water tended to be funnelled into estuaries and bays. In one location, researchers found fishing equipment that had been carried 30 metres up a cliff face, making these waves among the highest ever recorded in Japan.

In some places, the earthquake caused land to sink (subside) and this allowed

the waves to travel even further inland. Almost 300 000 buildings were completely destroyed and more than 1 million were damaged. Four large shipping ports were destroyed and a further 300 fishing ports were damaged. Damage to power stations and electricity lines left more than 4 million homes without electricity. An estimated 25 million tonnes of debris was created in the earthquake and tsunami, 5 million tonnes of which was washed into the Pacific Ocean. Items such as boats and soccer balls began washing onto the west coast of North America about a year after the disaster.

Eleven nuclear reactors that supplied electricity in Japan were immediately shut down after the initial earthquake, but the safety systems of several of these plants were destroyed in the tsunami that followed.

JAPAN: 2011 EARTHQUAKE AND TSUNAMI



Source 3.47

Source: Oxford University Press





Source 3.48 The 2011 Japanese tsunami destroyed everything in its path as it moved inland (from left to right)

This caused three of the nuclear reactors at the Fukushima Daiichi Power Plant to overheat and go into meltdown, releasing high levels of radiation into the atmosphere. In response to the disaster, all people living within 20 kilometres of the damaged power plant were ordered to evacuate their homes.

The final death toll may never be known but authorities estimate that nearly 16 000 people were killed by the earthquake and tsunami and more than 6000 were seriously injured. More than 12 months after the disaster, more than 3000 people were still listed as missing.

Check your learning 3.13

Remember and understand

- 1 What event triggered the Japanese tsunami in March 2011?
- 2 What were some of the effects of the tsunami on people within an hour of the waves striking the coast? What were some of the effects that would still be felt a year later?

Apply and analyse

- 3 Examine Source 3.47. Describe the location of Japan relative to tectonic plate boundaries. How does this location make the country the 'tsunami capital of the world'?
- 4 The centre of the earthquake was about 70 kilometres from

the coast of Japan. How soon did the tsunami waves reach Japan's east coast? How fast were they travelling? At this speed, how long would they take to reach California, 7800 kilometres away?

Evaluate and create

- 5 In the photograph (Source 3.48), the first tsunami wave can be seen as it moves from left to right. Describe what you think will happen in this place in the 15 minutes after this photograph was taken.
- 6 Japanese children are taught what to do if a tsunami wave is approaching. What do you think they are told to do?

3.3 bigideas: broadsheet

The Twelve Apostles

Victoria's south-western coastline is under constant attack from the water. Large, destructive waves from the Southern Ocean are eroding the soft limestone. Softer rocks are being eroded more quickly, while harder rocks are withstanding the attack a little longer. These harder rocks remain as stacks, arches and headlands, producing one of the world's most spectacular coasts. More than 1 million visitors a year are drawn to the Port Campbell coast, many of whom are secondary-school students who come to see and study coastal erosion in action.

skilldrill

Creating a field sketch

Field sketching is an important skill for all geographers. Field sketching is used to show the different geographic features of a landscape in a simple visual form. Being able to sketch the features of an environment is useful as it can provide the geographer with a visual record of their observations while in the field. Outlines, shading and annotations and labels are all used by the geographer to capture all relevant details of the environment being observed in their sketch.

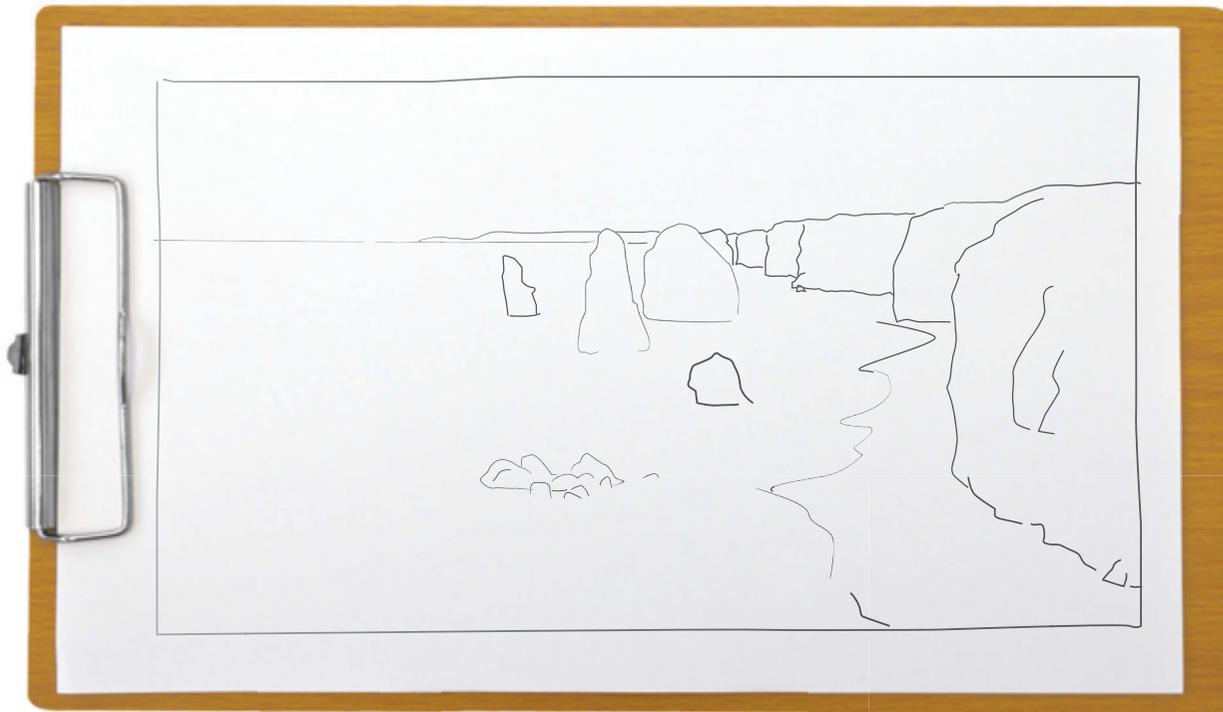
For example, imagine that you are standing on the viewing platform looking at the Twelve Apostles while on a geography field trip. You have been asked to complete a field sketch with a focus on the ways in which this coast is changing. Sources 3.50 to 3.52 demonstrate how to build up a field sketch. Here are the steps to take when completing a field sketch.

Source 3.49 The Twelve Apostles seen from the visitor's viewing platform



Step 1 Establish the boundaries of your landscape and draw a border of the correct shape.

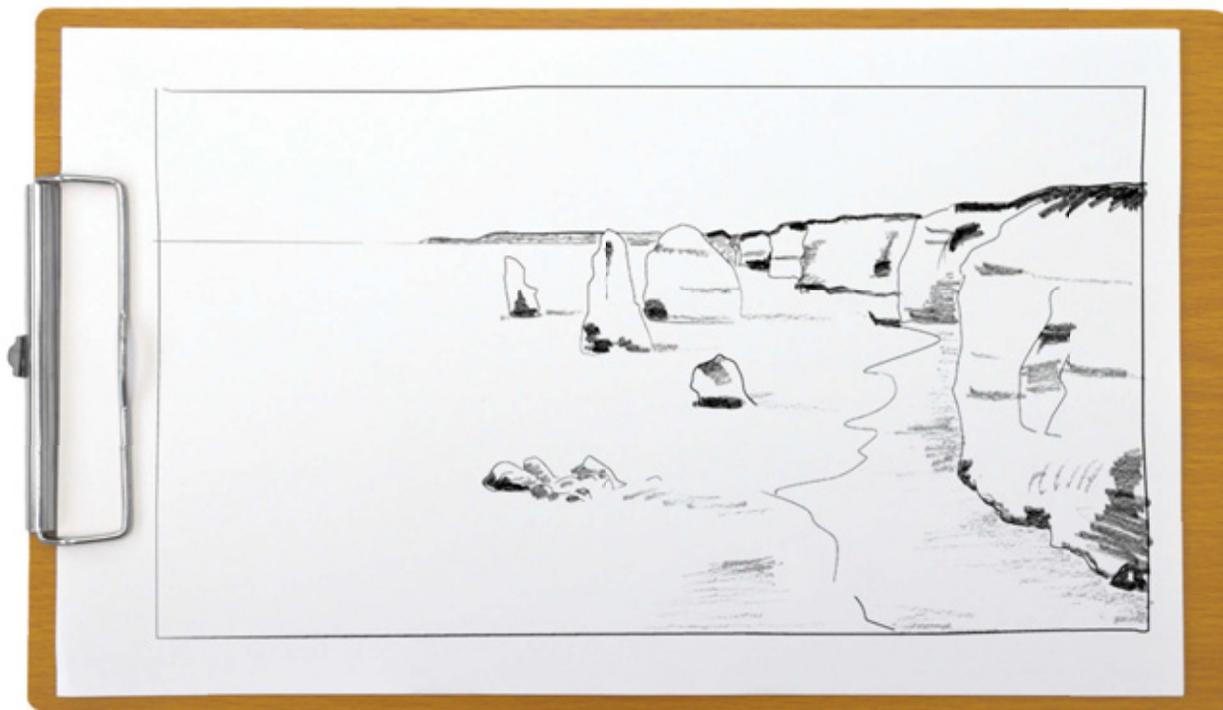
Step 2 With a pencil, lightly sketch the main landscape lines. If there is a horizon in the scene put this about one-third from the top of the frame.



Source 3.50 Stage 1 in completing a field sketch of the Twelve Apostles

Step 3 Keeping in mind the features that you want to focus on, add detail to your sketch.

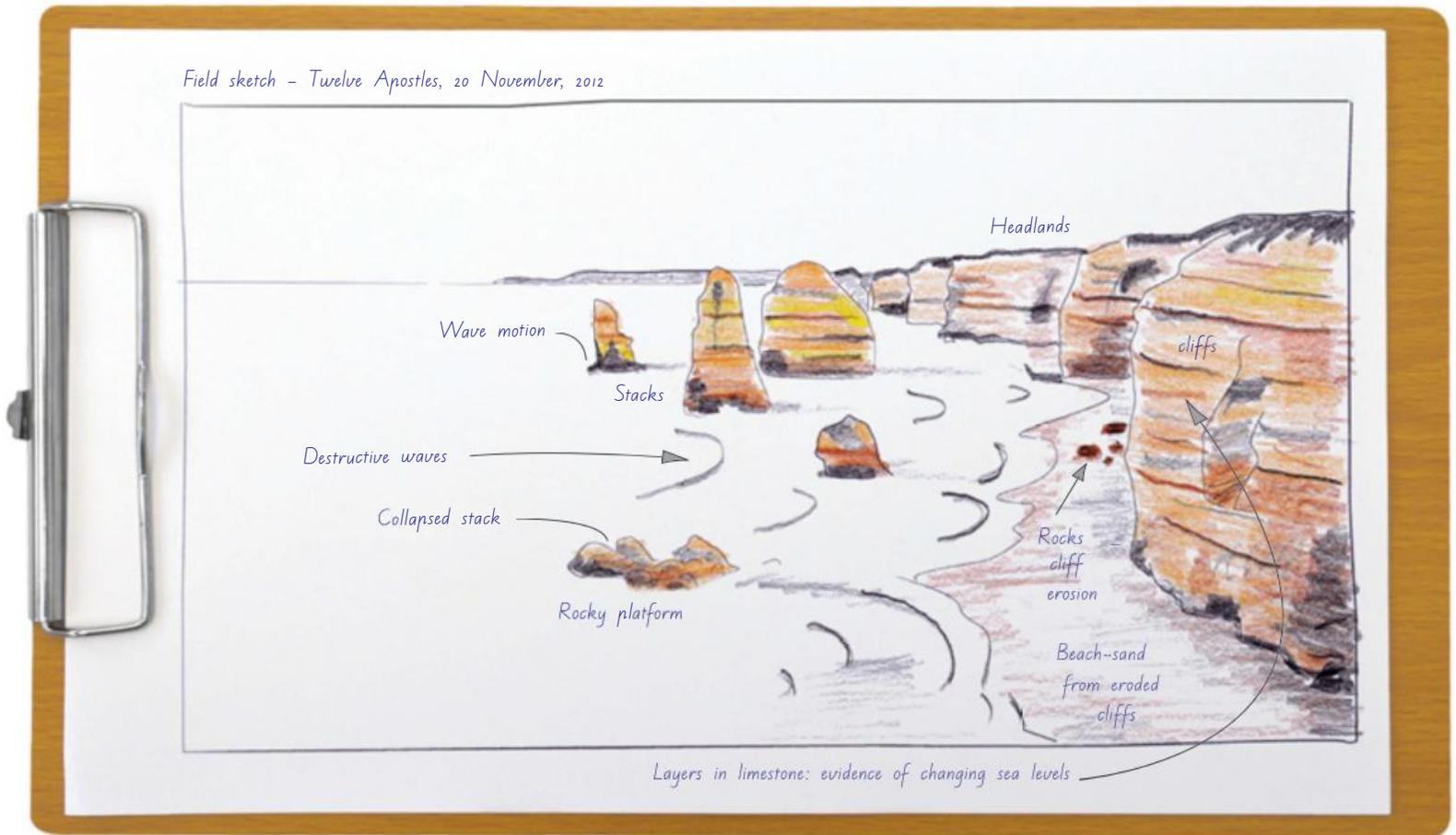
Step 4 Add shading. Shading helps to establish depth in your sketch and also helps to show the shape of objects.



Source 3.51 Stage 2 in completing a field sketch of the Twelve Apostles

Step 5 Add some colour if you wish. Don't try to copy every subtle colour of nature; just give a hint of the right colour. Label those parts of the scene that you consider most important.

Step 6 Label your sketch with the location and date.



Source 3.52 Stage 3 in completing a field sketch of the Twelve Apostles

Apply the skill

1 Complete a field sketch of Bondi Beach using Source 3.41. On your sketch label the following features:

- rocks
- beach
- swimmers
- rip currents.

Use arrows to show the movement of water towards and away from the beach.

Extend your understanding

- 1 What evidence is there in the photograph that this coast is changing over time? Give some reasons for your answer.
- 2 What natural forces are bringing about these changes?
- 3 What hazards exist in this place for visitors?
- 4 How could these hazards be minimised?
- 5 If you were visiting a depositional coast on a field trip what could you sketch to show how the coast is changing?

The image shows two women in the foreground, both wearing blue hijabs and shawls that feature the design of the Malaysian national flag, including a white star and stripes. They are holding hands, suggesting a sense of unity or solidarity. The woman on the left is smiling slightly, while the woman on the right has a more serious expression. In the background, other people wearing similar shawls are visible, though they are out of focus. The overall scene appears to be an outdoor gathering or event.

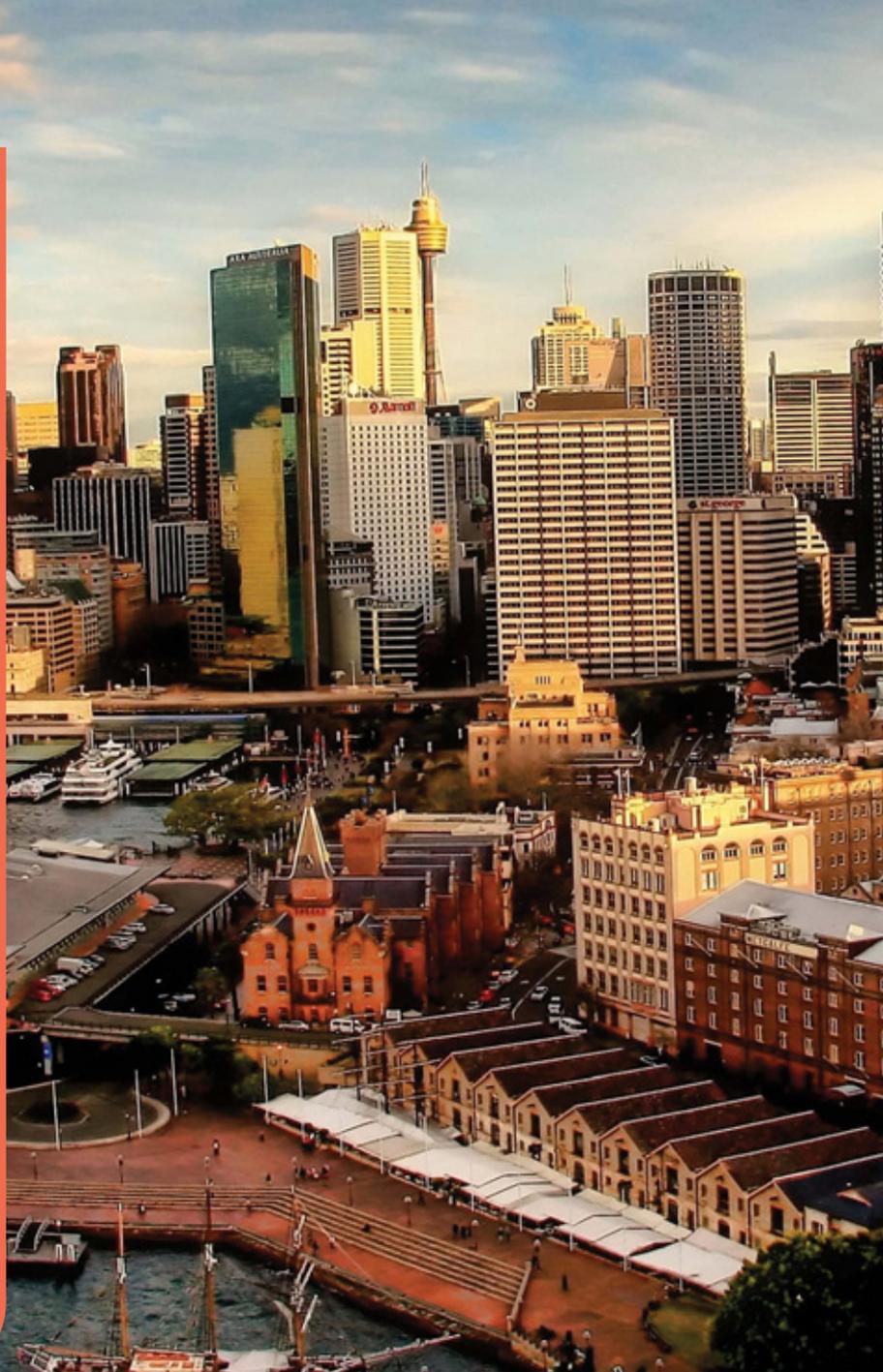
Changing
nations

unit

2

Life in different cities

Australia's original coastal settlements were established near sources of fresh water and deep harbours. Over time these settlements grew into cities, and Australia is now one of the most urbanised countries in the world, with nine out of 10 Australians living in an urban area. Around the world, cities keep getting bigger. Growing cities put pressure on land resources and require investment in **infrastructure** such as housing, roads, schools and other services. **Megacities**, many of which are located in Asia, can become swamped with so many people that even the basic supply of housing, clean water and sanitation is difficult.



4.1

Why do people live in cities?

- 1 Why might the English settlers who arrived in Australia in 1788 have chosen Sydney (Source 4.1) to begin their new colony?
- 2 Some of the world's cities are growing rapidly. What types of things attract people to cities?
- 3 What are some of the disadvantages of living in cities?

4.2

Where do people in different countries live?

- 1 In which areas of Australia do most people live today?
- 2 Why do you think Australians live in these areas and not in other parts of the continent?
- 3 Where do you think most people live in the United States of America?



Source 4.1 A view of Sydney's CBD taken from the Sydney Harbour Bridge. The Rocks (left foreground) is a historic part of Sydney's city centre and a popular tourist attraction today.

4.3

How can we plan for Australia's urban future?

- 1 Look carefully at Source 4.1. How can you tell that Sydney has grown into a large city over a long period of time?
- 2 What problems do you think city planners might have to deal with?

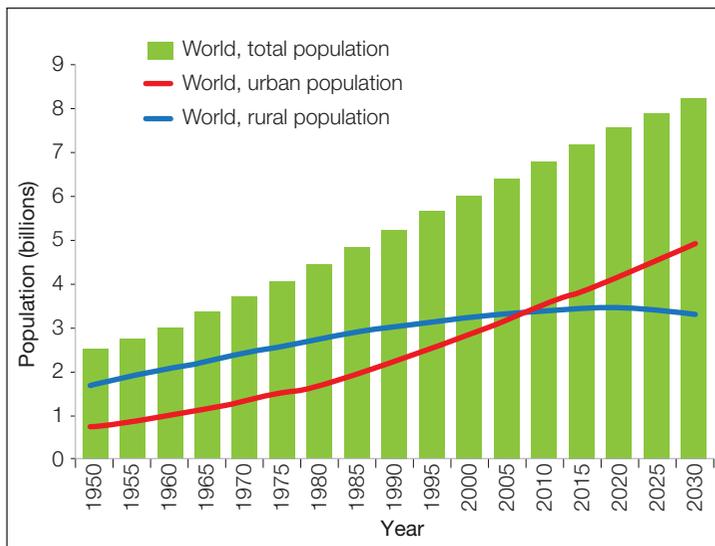
4.1 Why do people live in cities?

The urban explosion

On an ordinary day in 2007, something extraordinary happened. For the first time in human history, the number of people living in urban areas (cities) was greater than the number of people living in rural areas. Since that day, the world's cities have continued to grow at a faster rate than rural areas. **Urbanisation** – the increase in the proportion of people living in urban areas – is one of the most significant changes in human population trends ever recorded.

For thousands of years of human history, cities have been the exception rather than the rule. In fact, billions of people have lived and died without ever seeing – let alone living in – a large city.

This all changed about 200 years ago with the arrival of the industrial age. New, improved farming methods and farm machinery meant that fewer people were needed to produce larger amounts of food. In the cities, new inventions, such as the steam engine and the knitting mill, created new jobs for many people. Less work in rural areas caused people to flood into cities looking for work and new opportunities. This trend quickly changed the economies of many countries, and cities became centres of industry and commerce.



Source 4.2 The urban and rural population of the world, 1950–2030



Source 4.3 1950 – New York was the world's largest city, with a population of just over 12 million people.



Source 4.4 1990 – Tokyo's population reached 25 million, making it easily the world's largest city.



Source 4.5 2030 – Based on current trends, New Delhi is expected to be the world's largest city by 2030 with a population of over 40 million.

Cities around the world have grown rapidly in the last 70 years. By around 1950, the world's population was 2.5 billion and there were seven cities with more than 5 million inhabitants. The largest of these cities was New York, with a population of around 12 million. Today, there are more than 7 billion people on Earth and just over half of them live in cities. While many of these cities have populations under 1 million, there has

been an explosion in the number and size of the world's very large cities. These cities, with a population greater than 10 million, have become known as **megacities**. As of 2012, there are 27 megacities around the world. Eleven of these have populations greater than 20 million. Geographers refer to the rapid growth of the world's cities in the last 20 years as an urban explosion.

skilldrill

Generating questions for a geographical inquiry

Geographers look carefully at the world around them and ask questions about what they see. The questions they ask often come from natural curiosity and may start a major investigation. When developing questions of your own for a geographical inquiry, follow these steps:

Step 1 Think about a topic or problem you would like to investigate. Conduct some research online or in the field in order to identify an exciting area to explore.

Step 2 Think about the types of patterns or exceptions that are linked to the topic you are investigating. Write a series of open-ended questions that help you to explore them. Open-ended questions can have more than one correct answer and cannot simply be answered with 'yes' or 'no', such as 'Why are cities sometimes abandoned?'

For example, when investigating the image of the ancient ruins of the city of Uruk in Iraq (Source 4.6), a geographer would ask why this city was built in such a barren, dry place. This would then lead them onto other questions such as:

- Was this place wetter in the past?
- How did the people who lived here grow their food?
- Where did their water come from?

Apply the skill

- 1 Look carefully at Source 4.6 showing the ruins of part of one of the world's oldest cities.
 - a What looks out of place in this image?
 - b Generate an open-ended question that may help you investigate why this feature appears in this place.
 - c Generate another open-ended question about the people who once lived in this place.
- 2 Can you think of some more questions to ask about the city of Uruk, based on Source 4.6?



Source 4.6 Excavations in Iraq have revealed the ruins of the ancient city of Uruk.

Check your learning 4.1

Remember and understand

- 1 Do most people in the world today live in cities or in the countryside?
- 2 What is a megacity? Name three megacities.
- 3 Why has most of the world's population growth occurred in cities rather than in rural areas?
- 4 Study Source 4.2. Describe the growth of the world's population since 1950. Give two reasons for the trends you have described.

Apply and analyse

- 5 Why do you think many people in poorer countries move from rural areas to urban areas?

Evaluate and create

- 6 Compare the photos of New York, Tokyo and New Delhi (Sources 4.3, 4.4 and 4.5). What are some features common to all three cities? In what ways have large cities changed between 1950 and today?

How cities are organised

For many people, cities can appear to be confusing and disorganised places – not for geographers, though. Geographers identify patterns in the way areas and features of cities are organised. These patterns bring a sense of order to these complex places. Like a jigsaw puzzle, cities are made up of individual pieces that, together, make up a distinctive **landscape** (see Source 4.7).



Central business district (CBD)

The central business district (CBD) is generally the oldest and most accessible part of any city. Because lots of people and businesses compete to have offices there, land prices are higher than other parts of cities. Because of this, developers build tall buildings to maximise the available land and provide office and living space for more people.



Residential areas

The largest area of any city is used for housing and to provide facilities, such as hospitals and schools, for the people who live there. Australian cities are renowned for their sprawling residential areas.

MELBOURNE: LAND USE, 2006



Source 4.7

Source: Oxford University Press



Commercial areas

Commercial areas are usually located on major roads. Large shopping centres are now a feature of many suburbs in Australian cities. With 530 shops, Chadstone Shopping Centre is the largest such centre in Australia.



Industrial areas

Factories, mills and warehouses are important parts of most cities. Industrial areas are often located near important transport links (such as ports, freeways and rail lines) but as far away as possible from residential areas.



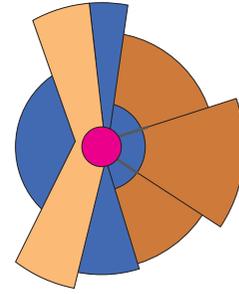
Parkland and nature areas

Parkland and nature areas are important as they offer people living in cities sporting and recreation opportunities. They are also essential for ensuring that native plant and animal populations remain healthy.

Models of city land use

Although every city is unique, they all share certain characteristics. For example, tall buildings tend to be located near the centre of every city, because land there is expensive. Land is usually cheaper near the edges of every city, so that is where people tend to live. By mapping the main land uses in a range of cities it is possible to identify similar patterns.

Some geographers have tried to explain these patterns by developing models that illustrate these patterns. One of these is the sector model. It shows how a city is divided into sectors (similar to slices of a cake) that are used for different purposes.



LEGEND

- Central business district
- Residential area
- Commercial area
- Industrial area

Source 4.8 The sector model is one of many used to understand and explain land use in cities.

Check your learning 4.2

Remember and understand

- 1 Why are there often tall buildings near the city centre?
- 2 Look closely at the oblique aerial photograph of Chadstone Shopping Centre (Source 4.7). Which features suggest that most customers arrive by car?

Apply and analyse

- 3 Look carefully at Sources 4.7 and 4.8.
 - a In what ways does land use in Melbourne resemble the pattern of land use shown in the sector model?
 - b In what ways is it different?
- 4 Study Source 4.7. How has Port Phillip Bay influenced the way land is used in Melbourne?
- 5 Why are industrial areas usually located near major transport links?

Evaluate and create

- 6 Work in small groups to copy and complete the following table. In the left-hand column identify land use patterns in Source 4.7. In the right-hand column record possible reasons for this pattern. An example has been done for you. Try to identify two more.

Land use pattern in Melbourne	Possible reasons for this land use pattern
Tall buildings found in the CBD of the city	This is the most accessible part of the city; land is expensive there.

- 7 Why are models used to describe and explain things such as land use?

The advantages of cities

Australia's high level of urbanisation can have advantages not only to the people who live in cities, but also to the nation as a whole. These advantages can roughly be divided into two categories – economic and social.

Economic advantages

Among the economic advantages offered by cities are access to work, industry, trade and, of course, income. Because cities are home to so many people, they are an obvious location for businesses and large companies to base their offices. Cities also provide companies with huge numbers of customers in a relatively small space, making it easier for them to sell their goods and services there. In addition, cities offer the best access to transport links, such as major highways, ports, railway lines and airports. These services (known as **infrastructure**) are vital for factories and businesses to manufacture and trade efficiently.

Probably the most obvious economic advantage offered by cities is the wide range of jobs available to those who live there. These range from jobs that involve little training and education through to highly skilled jobs requiring years of university study and training. Three-quarters of all jobs in Australia are based in our major cities and the income generated in those cities accounts for around 80 per cent of the total economy.

Source 4.9 Cities, such as Brisbane (shown here), are obvious locations for both small and large companies to base their offices because they offer access to a large number of potential customers.



Source 4.10 Cities, such as Perth (shown here), provide a range of travel and transport options for the people who live there.



Source 4.11 Cities, such as Sydney (shown here), offer a wide range of world-class hospitals and health care options for the residents there.



Throughout history, cities have been the birthplace of new ideas and inventions that have changed the world. Some of these (such as skyscrapers, subways, elevators and sewerage systems) were invented in response to the challenges of city living. Other great inventions (including telephones, computers, cameras, the iPod and the Internet) all began in cities. Many of history's greatest thinkers, including William Shakespeare and Albert Einstein, lived in cities. Cities continue to be places of innovation and change as they allow individuals and organisations to share ideas and resources effectively.

Social advantages

There are a range of social advantages of city life, including access to schools, hospitals and other services, and activities such as entertainment, sporting and cultural events.

Cities generally offer more social advantages than rural areas because there is a higher concentration of people in a smaller area. It is usually easier and cheaper to supply services to people who live closer together than to those who live far apart. As a result, city-dwellers have access to an enormous range of goods and services. Cities provide their residents with essential services, including water, electricity, supermarkets, public transport, health care, communication services (such as Internet access and Wi-Fi), schools and universities. In addition to these services, cities offer access to a range of non-essential products and services, including specialty boutiques, movie theatres, art galleries, casinos, aquariums, and major sporting and entertainment events.

One of the main ways in which the populations of Australian cities grow is through the arrival of people from overseas. For many newly arrived immigrants, the first experience of Australia will be a new home in a large city. Cities are obvious choices for new arrivals because they offer the best opportunities for employment, good access to government and support services (such as translators and community workers), and the best possibility of making links with people from their own cultural and language backgrounds. Immigration results in cultural diversity, which can often be seen in the range of shops, social and cultural organisations, restaurants and religious buildings (such as churches, mosques and temples). Over time, these new arrivals contribute to Australian cities and customs in many subtle ways. These changes help to make our cities dynamic and vibrant places.



Source 4.12 Constable Amitoj Singh, a member of the Sikh religion, is an example of how cultural and religious diversity can be seen across Australian cities. He is the first member of the Victoria Police to wear an official police-issue turban.

Check your learning 4.3

Remember and understand

- 1 Why do city-dwellers usually have access to a wide range of goods and services?
- 2 Why are cities often places of innovation and invention?

Apply and analyse

- 3 People in cities usually live longer than people in rural areas, particularly in poorer countries. Why do you think this is the case?
- 4 Examine Sources 4.9 to 4.11. What advantages of city living are shown in each of these images?
- 5 Why do you think young people in country towns often move to a city after they finish their high school education?

Evaluate and create

- 6 List a number of advantages of life in cities and then rank them from most to least important. How did you decide on your ranking? Did any of your classmates have a list similar to yours? Why/why not?
- 7 Australian inventions include the black box flight recorder, Google Maps, spray-on skin, the bionic ear, Wi-Fi and plastic bank notes. Select one of these (or another Australian invention) and research its inventor and the place where the invention was developed.

The disadvantages of cities

Although there are many advantages to city life, there are also a number of disadvantages. Cities house a large number of people in a relatively small space, and this can create a number of unwanted problems and disadvantages. These disadvantages can roughly be divided into two categories – environmental and social.

Environmental disadvantages

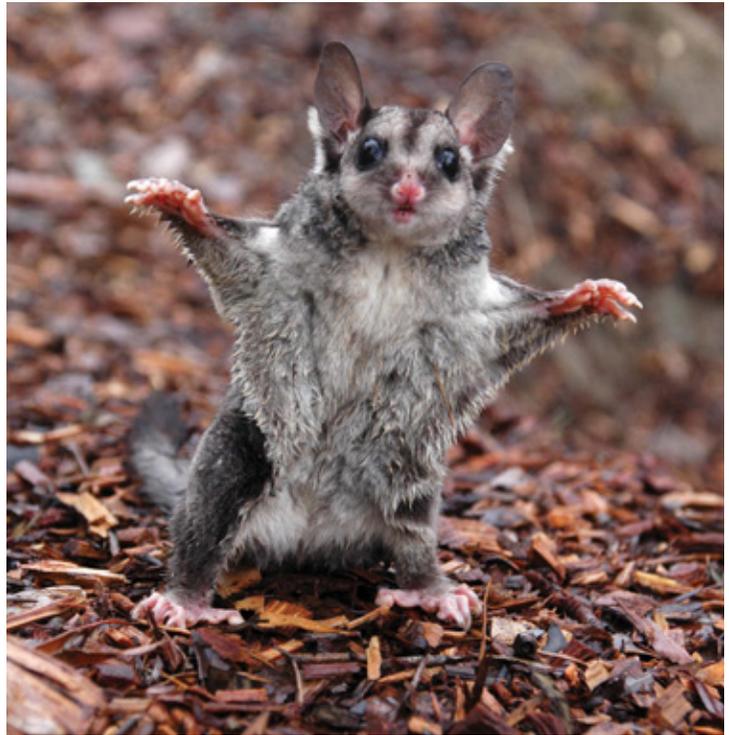
Cities change the natural environment in many ways. The people, factories, cars and industries based in cities often pollute the air, water and soil. The goods and services needed by the residents of cities include food, water, electricity, petrol and gas, and these often have to be transported long distances, creating even more pollution. As Australian cities grow in size they place an enormous amount of stress on the natural environment around them.

The locations we have chosen for our cities are often home to native plants and animals. As our cities and suburbs grow, forests and grasslands are cleared, lakes and wetlands are drained, and rivers are diverted or dammed. Soft earth is replaced with hard surfaces, such as concrete and roads. This often has disastrous consequences for native animal and bird populations. A recent study found that more than half of Australia's rare or threatened plants, mammals, birds, reptiles and fish live in or near our cities.

Social disadvantages

The social disadvantages faced by city-dwellers can vary widely from suburb to suburb, so one person's experience may be very different from another's. Overcrowding and rising house prices might be a disadvantage for those living in the inner city, while lack of schools and hospitals might be a disadvantage for those living in new housing estates on the edge of the city.

As the populations of Australian cities grow, land on the edges of cities is often converted from farmland and green spaces into residential areas. This urban sprawl comes at a cost to both the environment and to people.



Source 4.13 The squirrel glider, native to eastern Australia, is endangered by the loss of its habitat due to the sprawling city suburbs along the east coast.



Source 4.14 New suburbs on the city fringes of Perth expanding into areas of native bushland



Source 4.15 Traffic congestion is now a common problem in all major cities in Australia.

Regardless of where the residents of a city live, many will experience some form of disadvantage that impacts on their quality of life. Most of these disadvantages are linked to competition for services and resources. Because cities are home to large numbers of people concentrated in relatively small areas, these services and resources can be stretched beyond their limits. Some of the problems most commonly experienced by people living in cities include:

- traffic congestion – the result of too many people trying to use the roads at the same time
- rises in the cost of housing, food and utilities – the result of greater numbers of people competing for resources than can be supplied
- waiting times for schools, public transport and medical care – the result of more people trying to access these services than they were originally designed to accommodate
- rates of crime – the result of a complex combination of factors including unemployment, cultural and economic background, age and gender.

Check your learning 4.4

Remember and understand

- 1 Why is traffic congestion a common problem in many Australian cities?
- 2 How are squirrel gliders (Source 4.13) being impacted by urban sprawl in eastern Australia?

Apply and analyse

- 3 Describe the changes taking place in Source 4.14. How will these changes impact on the people who already live in this place? How will they impact on the natural environment?

Evaluate and create

- 4 With a partner, choose a large city in a developing country, such as Lagos (in Nigeria) or Mumbai (in India), and conduct a brief Internet search into the disadvantages of city life for people living there.
 - a How might the problems experienced by people living in your chosen city be different from those experienced by city-dwellers in developed countries such as Australia and the United States?
 - b Make a list of the disadvantages experienced by people living in your chosen city and another list of disadvantages experienced by people living in a large city close to you.
 - c Which problems are the same and which are different?
- 5 What strategies do you think could be put into place to protect endangered species whose natural habitat is near a city, such as the squirrel glider in Source 4.13?

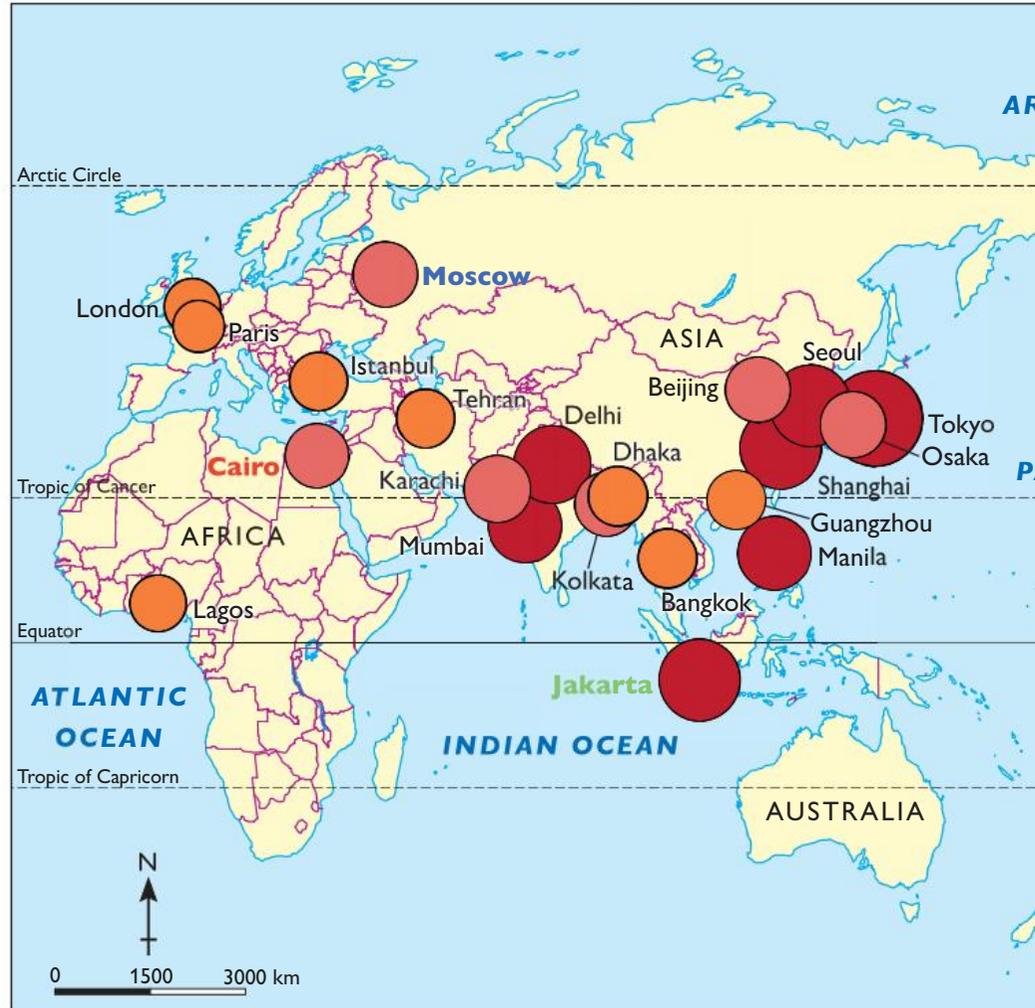
The rise of the megacity

Today, more people around the world are living in cities than ever before. A century ago, only about 15 in every 100 people lived in cities. Today, that number is more than 50 in every 100 people. This increase has resulted in the creation and growth of many cities worldwide, and an explosion in the number of very large cities, known as **megacities**. Megacities are urban areas with populations of more than 10 million people.

In addition to the increase in the number of megacities over the last century, there has been a change in where these cities are found. No longer do the megacities of Europe and North America dominate – instead, the megacities of Asia, South America and Africa are becoming the world's largest.

Four of the world's megacities are explored briefly below. Although they are located in different parts of the world and have many unique characteristics, they also face many of the same challenges and have more in common than you might first think.

WORLD: MEGACITIES



Source 4.16

Cairo: Africa's first megacity

Cairo is the largest city in Africa and the Middle East. Its location on the Nile River has provided the city's residents with fresh water, fertile soil to grow food and a method of transportation for thousands of years. Modern Cairo is a bustling city of more than 15 million people. This rapid rate of expansion has led to a number of social and environmental challenges. For example, Cairo has some of the world's worst traffic congestion and air pollution.



Moscow: the biggest city in the biggest country

Russia is the world's largest country and its capital, Moscow, one of the world's megacities. Moscow was established on the banks of the Moscow River almost 1000 years ago. Today, Moscow often tops the list of the world's most expensive cities because of the high cost of housing there. Traffic congestion and air pollution from cars are significant problems in Moscow, as they are in many large cities.



Check your learning 4.5

Remember and understand

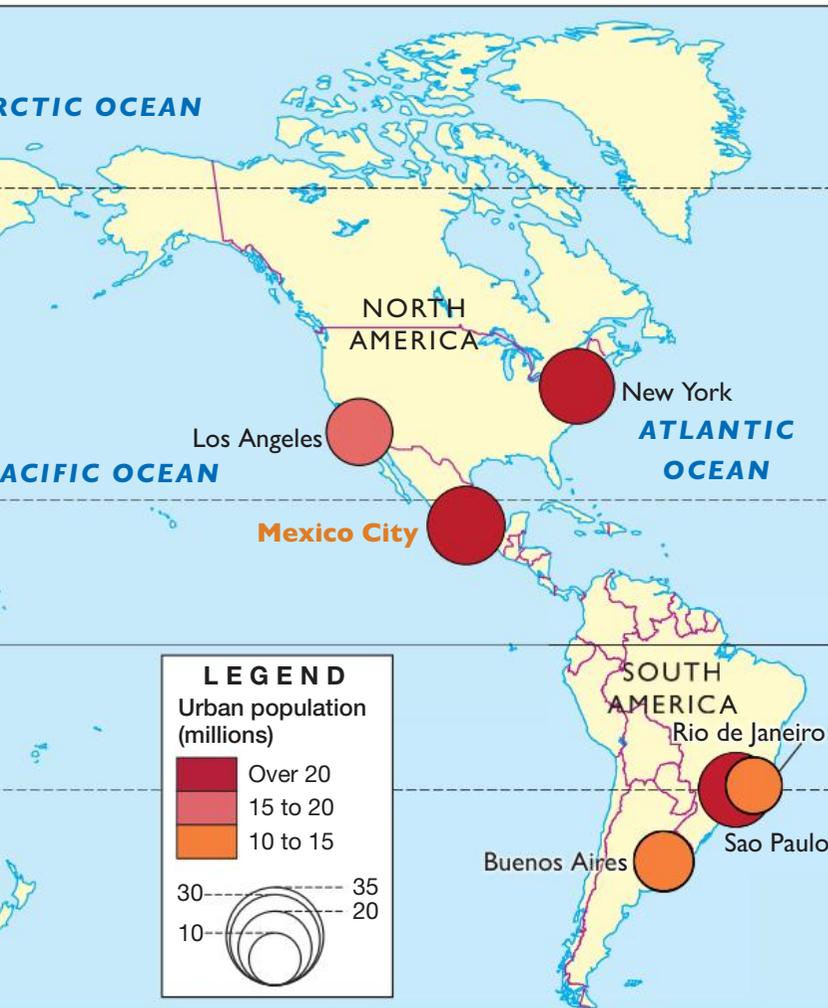
- 1 How many megacities are there in the world? How many of these megacities could you have named before reading the information given here?
- 2 Which continent is home to the most megacities?
- 3 Do you think the number of megacities will increase or decrease over the next 20 years? Give some possible reasons for your answer.
- 4 What are some of the problems faced by people living in megacities? Which of these problems will become worse as each of these cities grows in size?

Apply and analyse

- 5 Examine the location and distribution of the world's megacities. In what ways are many of their locations similar? What cities do not share all of these similar location features?
- 6 The images of these megacities show that tall buildings are common in many city centres. Why do you think this is the case? Why are there usually very few tall buildings on the edges of cities?

Evaluate and create

- 7 Select one of the megacities shown on the map (Source 4.16) that is not described in detail. Conduct some Internet research on this city. Find out about its location, history and any issues faced by the people who live there. Write a short paragraph about this city, similar to those shown here.



Source: Oxford University Press

Jakarta: Australia's neighbour goes mega

Current estimates put the population of Jakarta at about 25.3 million people. Up to half the population lives in slums, called kampongs, where temporary homes are built on land considered unsuitable for housing. One of the city's biggest problems is the fresh water supply. Most residents use bores (deep wells) to obtain their fresh water. In North Jakarta so much water has been drawn from the ground that the land has begun to subside (sink) in places, leading to a greater risk of flooding.



Mexico City: the biggest megacity in the Americas

Mexico City's location is unusual when compared to most other megacities around the world. It is situated on a dry lake bed high in the mountains, rather than close to the coast and rivers. Like Cairo, Mexico City suffers from severe air pollution. This is made worse by the surrounding mountains, which help to trap polluted air. There is also great pressure on the groundwater resources in the region. In some cases, bores (deep wells) have caused land to collapse under buildings and roads.



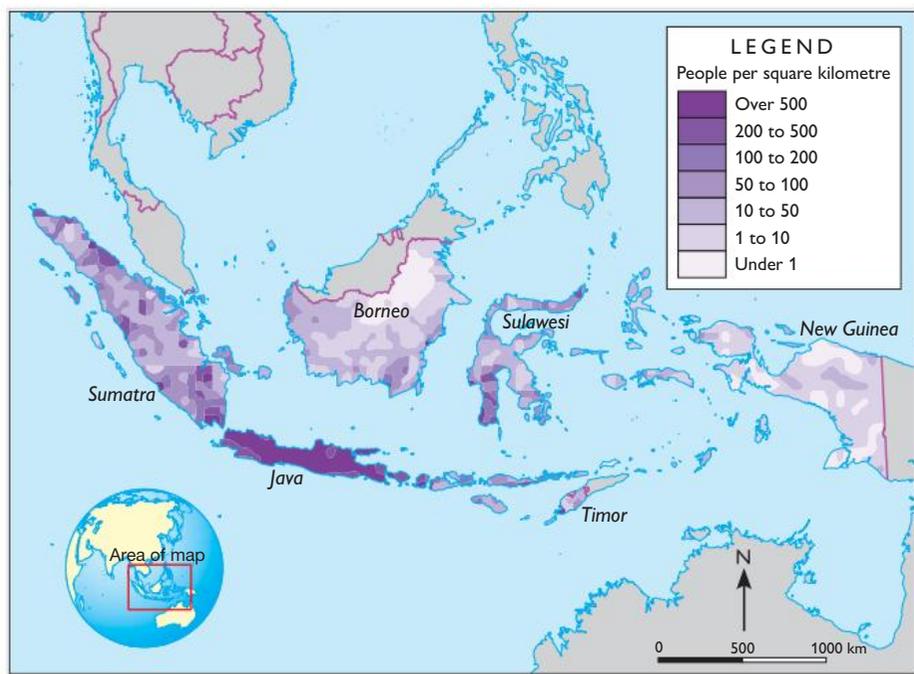
Urbanisation in Indonesia

Asia is home to some of the world's largest and fastest-growing cities. Of the 50 cities around the world with a population of over 5 million, half of them are located in Asia. Many of these cities are growing so quickly that they are unable to meet the demands of new residents, large numbers of whom are escaping rural poverty and looking for opportunities to improve their lives.

Urban growth in Indonesia

In 1950, Jakarta was the only Indonesian city with a population in excess of one million and only 15 per cent of Indonesia's population lived in urban areas. By 2010, a total of 10 cities had grown to have one million people.

INDONESIA: POPULATION DENSITY



Source 4.17

Source: Oxford University Press

Between 2000 and 2010 Indonesia's population increased from 204 to 238 million. The proportion of the population living in urban centres also increased significantly during this period, from 42 per cent to 50 per cent. About 68 per cent of Indonesia's urban population live in cities on the island of Java which has 20 cities with a population of 100 000 plus and seven cities with populations of over one million.

The migration of people from rural areas to large cities is a major factor in Indonesia's urban growth. Often, people living in rural areas lack employment and education opportunities so the younger people

move to cities for work, entertainment, education and health services. They leave behind an ageing rural workforce. Of the 140 million farmers in Indonesia, 80 per cent are aged 45 and above.

Jakarta: Indonesia's megacity

Jakarta, the capital city of Indonesia, is located on the island of Java. In late 2011, the population of the official metropolitan area of Jakarta was recorded at 10.1 million, qualifying it as a megacity. In reality, however, the population of greater Jakarta (that is, the suburbs surrounding the metropolitan area) brings the total population closer to 19 million. Jakarta is a very old city, having been settled as a trading settlement over 1500 years ago. Jakarta is located on the north-western coast of Java. A range of volcanoes and hilly slopes south of the city feed a series of rivers that have built up a fertile floodplain leading to the Java Sea. The combination of the flat, low-lying plain and the tropical climate means that flooding is a frequent problem for the residents of Jakarta.

Like many other cities across Asia, Jakarta is a place of contrasts. Slums sit alongside skyscrapers, modern homes and luxury hotels. Half of the population of Jakarta live in these slums. The homes there are often built from temporary materials on land considered unsuitable for regular housing. In the slums, running water, electricity and sanitation are difficult to obtain.

One of the biggest problems in Jakarta is the fresh water supply. The current piped system is largely ineffective, so most residents use **bores** to obtain their fresh



Source 4.19 Satellite images of Jakarta taken in 1976, 1989 and 2004. Urban areas appear as blue-green and vegetation appears as orange-red.

water. In North Jakarta so much water has been drawn from the ground that the land has begun to sink in places, leading to a greater risk of flooding. A limited sewerage system due to the lack of running water makes the threat of disease a constant concern.



Source 4.18 A slum located in the metropolitan area of Jakarta, Indonesia

Check your learning 4.6

Remember and understand

- 1 What percentage of Indonesians live in urban areas? How did this change between 2000 and 2010?
- 2 In Indonesia, why are young people moving from rural areas to the cities?

Apply and analyse

- 3 How does Source 4.18 show the contrasting living conditions in Indonesia?
- 4 What health issues do you think the children in Source 4.18 might face?
- 5 How have residents in Java helped solve their fresh water problem? What additional problem has this caused?

Evaluate and create

- 6 Trace an outline of the city boundary of Jakarta in 1976 shown in Source 4.19. Mark the coastline and shade in areas of vegetation. Mark in any rivers or lakes that you can see. Now add an overlay sheet showing the city boundary in 2004. Describe the spatial change over time as shown on your overlay map.

4.1 bigideas: broadsheet

Sydney – our biggest city

In 1901, both Sydney and Melbourne were home to about half a million people. Within a few years, though, Sydney had outgrown Melbourne, and by the year 2000 Sydney was the only Australian city with a population over 4 million people. One in five Australians now live in Sydney and it continues to grow by over 35 000 people a year.

By studying the rate at which Sydney grows and by analysing the ways in which the population there is changing, geographers can learn a lot about the causes and effects of urbanisation in Australia.

skilldrill

Interpreting choropleth maps

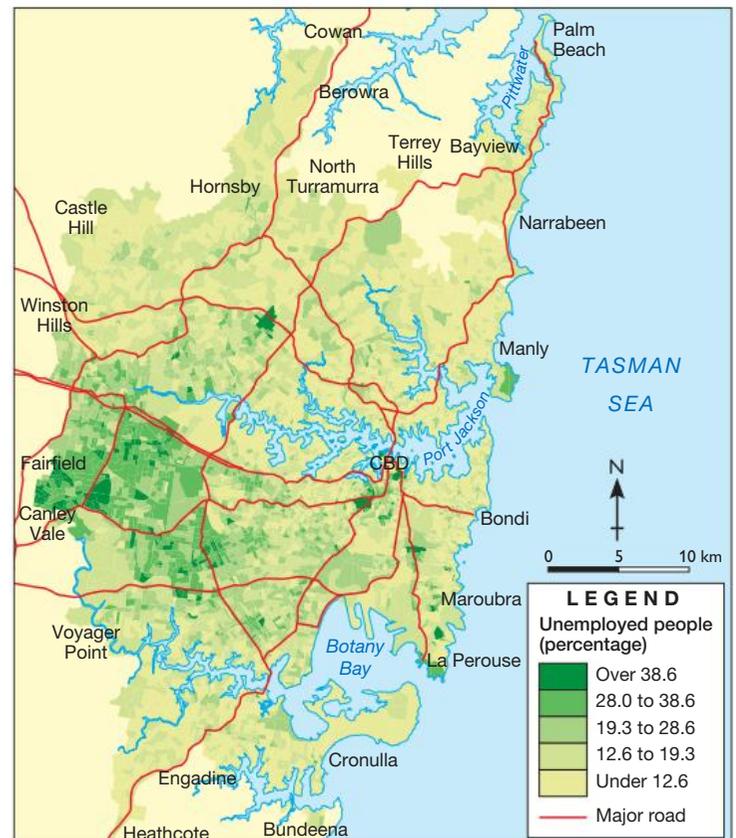
Sources 4.20, 4.21 and 4.23 are known as choropleth maps. These maps give a quick impression of spatial patterns by using dark and light shades of the same or similar colours. Darker shades usually show ‘the most’ and lighter shades show ‘the least’. To interpret a choropleth map, follow these steps:

- Step 1** Read the title carefully so you understand what is being shown on the map.
- Step 2** Look carefully at the legend so that you understand what the various shades and colours represent.
- Step 3** Look for large areas of similar shades and for other patterns (such as lighter colours near the edges of the city and darker colours near the centre of the city in Sources 4.20, 4.21 and 4.23).
- Step 4** Look for any exceptions to the general pattern.

Apply the skill

- 1 Study Source 4.23. Why do you think the areas with the highest percentage public transport users make linear patterns (i.e. form lines)?
- 2 Study Source 4.20.
 - a Use direction (north, south, east or west) to describe the area of Sydney where the highest percentage of unemployed people live.
 - b What might be some of the advantages of living in this region for people who are unemployed?
 - c What might be some of the disadvantages of living in this region for people who are unemployed?
- 3 Study Source 4.21.
 - a Which regions have the lowest percentage of people born overseas?
 - b Which regions have the highest percentage of people born overseas?
 - c What special services might the government offer in areas with larger numbers of immigrants?
 - d In what ways can ethnicity change an area?

SYDNEY: UNEMPLOYED PEOPLE, 2006



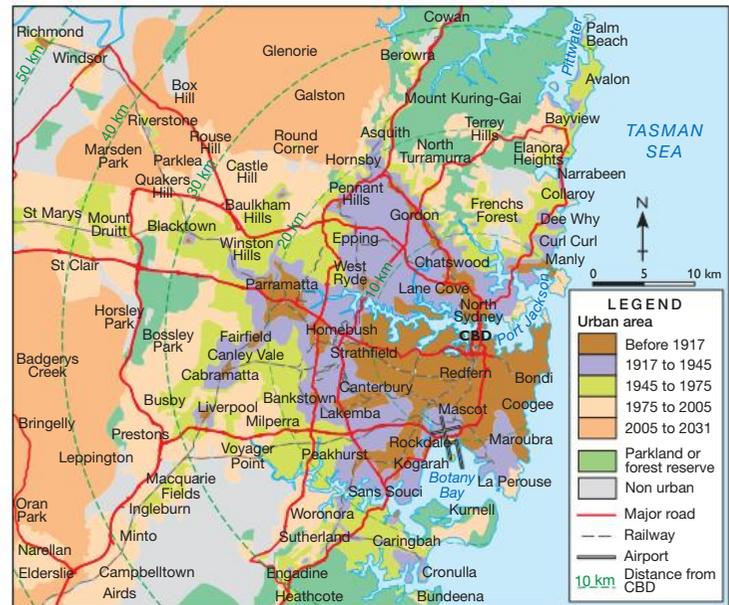
Source 4.20

Source: Oxford University Press

Extend your understanding

- 1 What resources do you think early settlers looked for when selecting a place to live in Australia?
 - a How do you think this compared to the resources required by the Aboriginal people of Australia?
- 2 Study Source 4.22.
 - a The city of Sydney was established on the southern shore of Port Jackson. How far south did Sydney grow by 1917?
 - b In 1932 the Sydney Harbour Bridge was opened, linking the south to the north of Sydney over Port Jackson. How did this help the population to spread to Sydney's north shore?
 - c Use direction and distance to explain the most recent pattern of growth in Sydney.

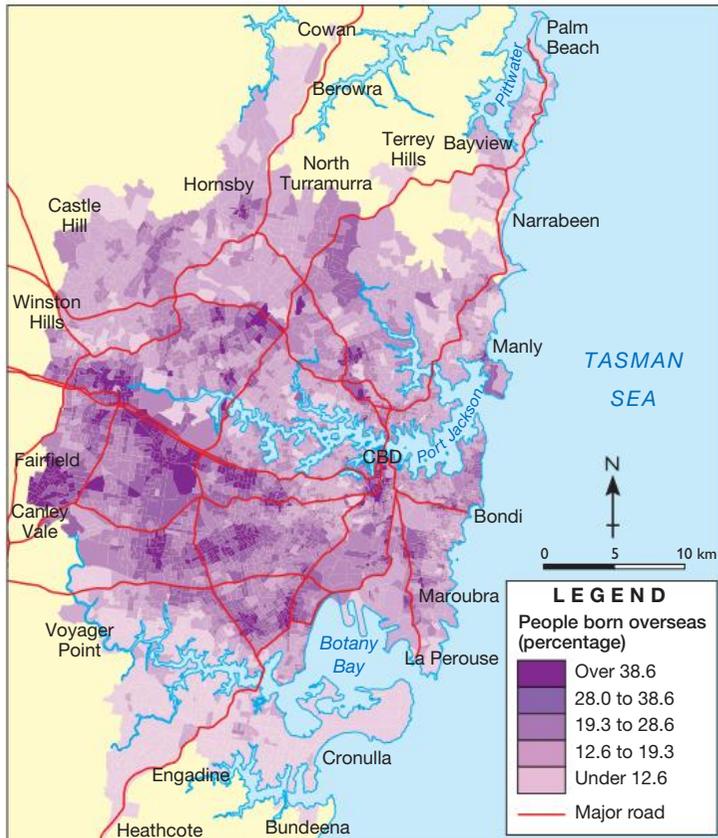
SYDNEY: URBAN GROWTH



Source 4.22

Source: Oxford University Press

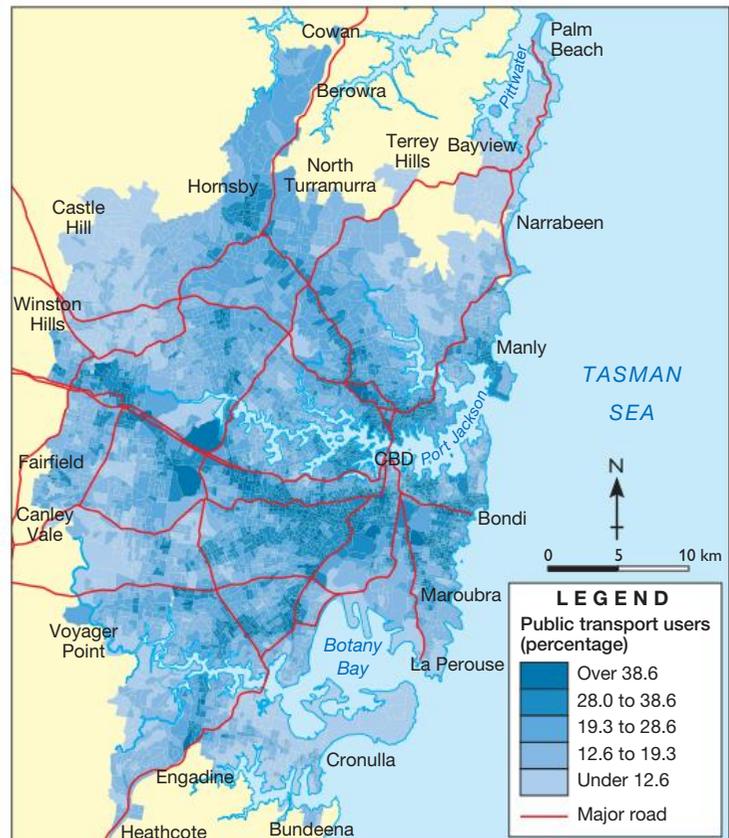
SYDNEY: PEOPLE BORN OVERSEAS, 2006



Source 4.21

Source: Oxford University Press

SYDNEY: PUBLIC TRANSPORT USERS, 2006



Source 4.23

Source: Oxford University Press

4.2 Where do people in different countries live?

Where Australians live

Australia's population is more unevenly spread than virtually any other country on Earth. Of the 23 million people who live in Australia, more than 12 million live in just five cities. All these cities are state capitals and all are located on the coast. Nearly 90 per cent of all Australians live in a town or city, and 85 per cent of us live within 50 kilometres of the coast.

Where do Australians live?

The best way to show the places where Australians live is to map the distribution of the population and study the **population density**. This not only shows the locations where people live but also the number of people who live in each square kilometre. Regions where there are lots of people per square kilometre are said to have a high population density. For example, Sydney's 10 most populated suburbs all have more than 10000 people living in each square kilometre. Regions where there are very few people per square kilometre are said to have a low population density.

Australian cities

Cities in Australia are located close to the natural and/or built features that humans need most. These features include fresh water and fertile soil as well as transport links, such as harbours, railways and roads.

Most of Australia's earliest towns were settled on bays, harbours and at river mouths on the coast. These towns were able to trade and communicate with each other. Rivers not only provided clean drinking water but also water for growing food, cleaning, manufacturing and transport. Many of these early towns have grown into our largest cities – Sydney, Melbourne, Brisbane, Adelaide and Perth.

As farming spread and important minerals such as gold were discovered, inland cities such as Bendigo, Bathurst, Castlemaine, Ararat, Kalgoorlie and Rockhampton began to develop. Industrial towns such as Newcastle grew near transport hubs where goods could be sent to markets in Australia and overseas.



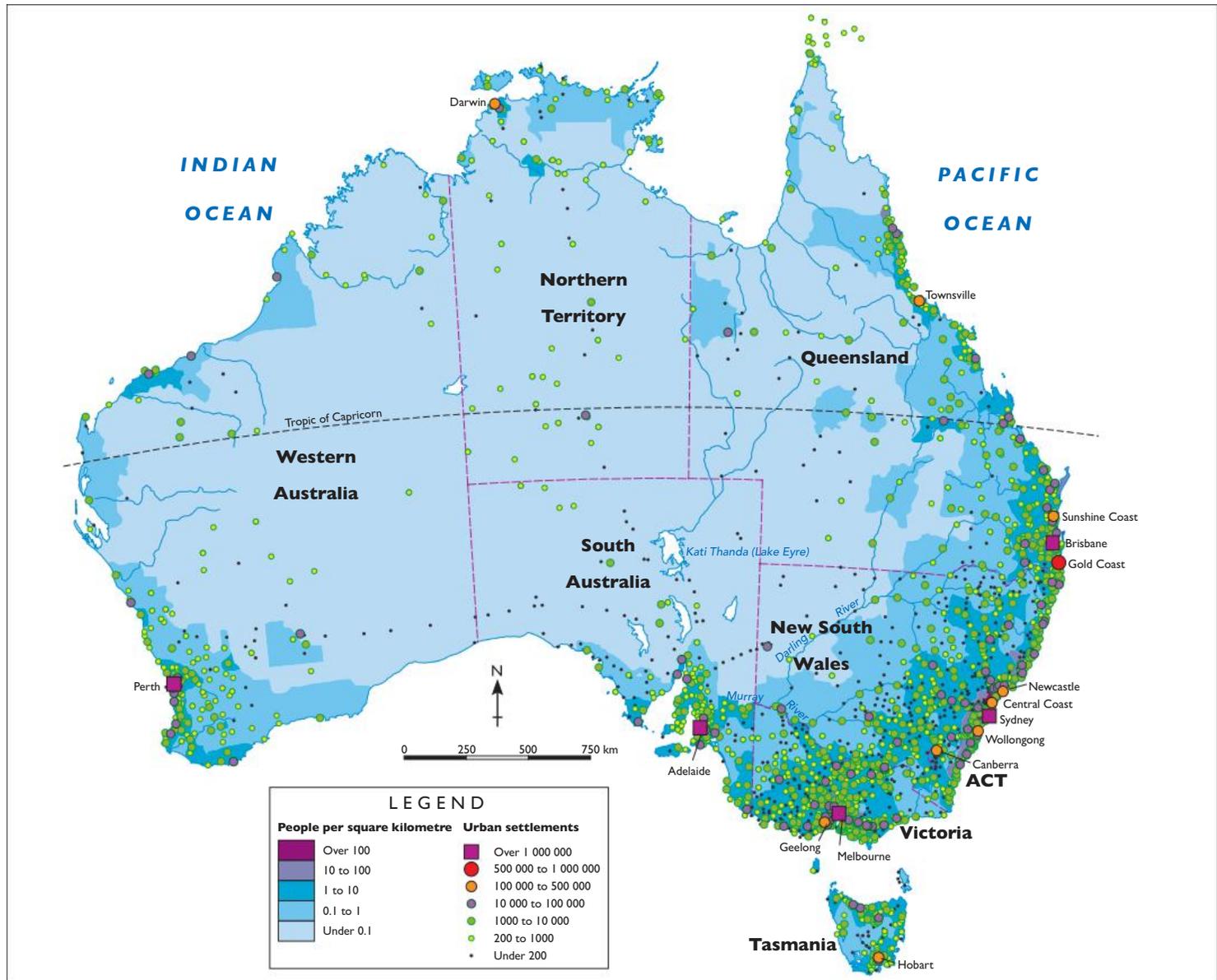
Source 4.24 Australia has one of the lowest population densities of any country on Earth. Ninety-seven per cent of Western Australia has a population density of less than 0.1 people per square kilometre.



Source 4.25 South Australia's Barossa Valley has a medium population density as it includes a mix of towns and farming regions.



Source 4.26 The Sydney suburb of Elizabeth Bay is the most densely populated place in Australia with just over 20000 people per square kilometre.



Source 4.27

Source: Oxford Atlas

Check your learning 4.7

Remember and understand

- 1 Why are most cities located near a source of fresh water?
- 2 Which parts of Australia are densely populated?
- 3 Which parts of Australia are sparsely populated?
- 4 How many Australian cities have more than 1 million people? In what ways are their locations all the same? Why do you think this is the case?

Apply and analyse

- 5 Study Source 4.24. Why do you think so few people live in parts of Western Australia?
- 6 Compare Elizabeth Bay (Source 4.26) with the Barossa Valley (Source 4.25).
 - a In what ways are they similar and in what ways are they different?
 - b In which of these two places would you prefer to live and why?
- 7 Study Source 4.27 and describe the distribution of Australia's population using the PQE method. (See section GT.2 of 'The geographer's toolkit'.)

Why Australians live where they do

There are many reasons why people live where they do. In Australia, some of the most important factors relate to the natural environment. Much of the continent has low rainfall and poor soil fertility, making it very difficult for people to live and grow crops there. As a result, Australians tend to live in the parts of the country that receive the most rainfall.

The role of landscapes and climate

Australia's physical environments and different climate zones play a major role in where Australians choose to live. Places that receive the highest and most reliable rainfall are often the most populated. These regions are found in the south-east of the country, to the east of a mountain range known as the Great Dividing Range. This mountain range stretches from Cape York Peninsula in the north of Queensland to the Grampians in western Victoria. The Great Dividing Range has a great impact on the climate along the east coast of Australia, which in turn influences where people choose to settle (see Source 4.29). It also influences the kinds of vegetation that grows there and the kinds of animals that live there.

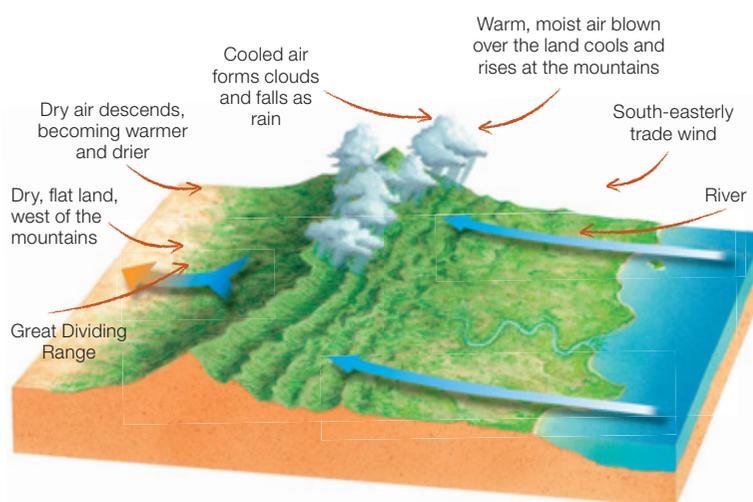
Winds from the south-east push warm, moist air over the land. This air is forced to rise over the Great Dividing Range. As the air rises, it cools. Cool air cannot hold as much moisture as warm air, so the moisture condenses into water droplets that fall as rain on the eastern side of the Great Dividing Range (see Source 4.28). The rain fills hundreds of rivers that run eastward to the coast. These rivers supply fresh water for drinking, food production, hydroelectricity, industry and transport. Most Australians live in coastal towns and cities near the mouths of these rivers. On the western side of the range, most of the land is dry and flat. The once moist air that passes over the range is now dry. As the air descends to the west of the Great Dividing Range it becomes warmer but remains dry, so little rain falls there. As a result, very few people live there.

The pull of the city

As in other countries around the world, in Australia the economic pull of the large cities is attracting more people to them. Between 2001 and 2011, the population of

Australia increased by 2.9 million. The cities of Sydney and Melbourne became home to 40 per cent of these people (around 1.16 million).

The key attractions of living in a large Australian city are the opportunities for jobs and education. Australia's major cities generate 80 per cent of the country's wealth and employ 75 per cent of our workforce. By 2010, 75 per cent of all Australians lived in cities with populations greater than 100 000.



Source 4.28 The influence of the Great Dividing Range on Australia's climate

Check your learning 4.8

Remember and understand

- 1 Why do so few people live in inland Australia?
- 2 What is an important economic factor that helps to explain why people live where they do?
- 3 How does the Great Dividing Range influence where people in Australia live?
- 4 List three ways in which water has influenced where people in Australia live.

Apply and analyse

- 5 Study Source 4.29. Which features of the natural environment do you think were important when deciding on the locations of Hobart, Gympie and Kalgoorlie?
- 6 Which factors discussed here apply to where you live?

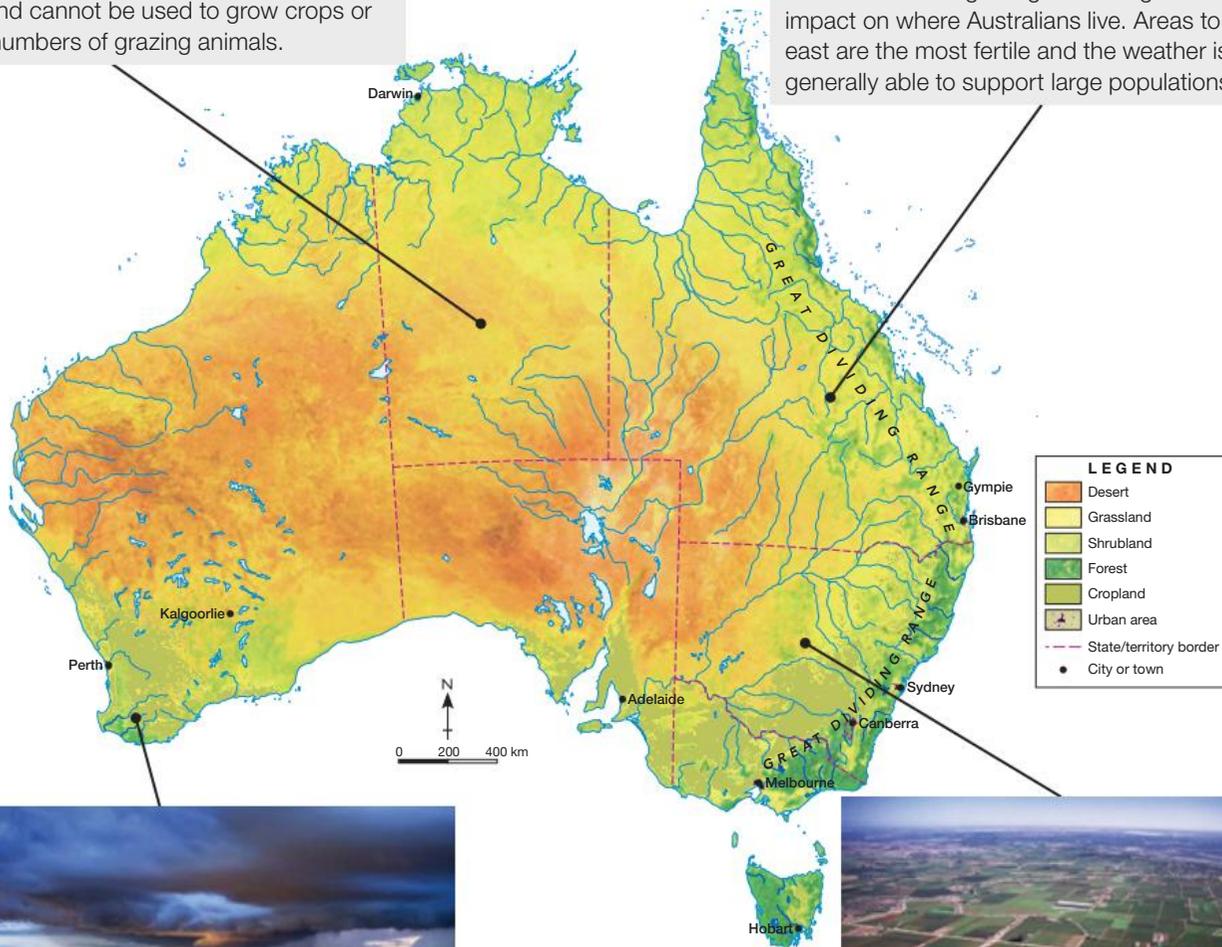
AUSTRALIA: ENVIRONMENTS



Much of inland Australia is desert and too dry to support large populations. The soil is generally very poor and cannot be used to grow crops or farm large numbers of grazing animals.



The Great Dividing Range has a significant impact on where Australians live. Areas to its east are the most fertile and the weather is generally able to support large populations.



The south-west of Western Australia receives regular rainfall from passing storms and cold fronts. The region also has a temperate climate and fertile soil, making it an excellent food and wine producing area.



Two major rivers along with fertile soil attracted farmers to the region now known as the Murray–Darling Basin. It has since become Australia's most important agricultural region. One-third of Australia's food supply comes from here.

Where Americans live

America is similar to Australia in that the majority of people there live in **urban** areas. In fact, in the north-east of the United States a number of major cities (including New York, Washington and Boston), along with a number of smaller cities, have grown so large in recent years that they have begun to merge into one continuous urban area. The area is now often referred to by the name BosNYWash. Home to about 55 million people, it is classed as a **megalopolis**.

American cities

There are usually three distinct parts to every US city:

- the city centre (often referred to as 'downtown')
- the **suburbs**
- the **exurbs**.

At the centre of most cities in the United States is an area of tall skyscrapers and high-density residential apartment buildings. Downtown is often the place where the city was first settled and now contains the head offices of large companies and large residential apartment buildings. Land in the city centre is often very expensive, so buildings are tall rather than wide.

Beyond the city centre lies a large area of medium-density residential housing known as the suburbs. In many US cities, the suburbs grew rapidly from the 1950s onwards as people moved out of apartment buildings downtown and built free-standing houses on the city's edges. The suburbs are home to well over half of those who live in US cities.

Separated from the suburbs, but connected to them by a network of roads and rail lines, lies an area known as the exurbs. They are separated from the city by farmland and open spaces, and the people who live there usually commute into the city for work. For this reason, the exurbs are sometimes also called 'dormitory suburbs'. Over time, as the suburbs and exurbs grow in size they may join together, increasing the size of the city. Geographers refer to this expansion as **urban sprawl**. The United States is home to some of the world's most sprawling cities. A key driver of urban sprawl is car ownership. Cars allow those people who live in the suburbs or exurbs to commute to work in the city centre much more safely and easily than they could in the past.



Source 4.30 The area known as BosNYWash is often referred to as a megalopolis. It can be seen clearly on the north-east coast of the United States in this satellite image taken at night.



Source 4.31 This exurb being developed on the outskirts of Salt Lake City in Utah is an example of urban sprawl.



Source 4.32

Source: Oxford University Press

By Australian standards, the sheer number of people living in cities in the United States is staggering. In fact, the total number of residents living in only 10 of the largest US cities is around 75 million (see Source 4.33). This number is more than three times the total population of Australia.

Source 4.33 Ten largest US cities

Rank	City	Population
1	New York	19 015 900
2	Los Angeles	12 944 801
3	Chicago	9 504 753
4	Dallas	6 526 548
5	Houston	6 086 538
6	Philadelphia	5 992 414
7	Miami	5 670 125
8	Atlanta	5 359 205
9	Boston	4 591 112
10	San Francisco	4 391 037

Check your learning 4.9

Remember and understand

- 1 What is the difference between a suburb and an exurb?
- 2 Why do you think the continuous urban area in the north-east of the United States is sometimes referred to as BosNYWash?
- 3 What do geographers call areas such as BosNYWash?

Apply and analyse

- 4 Look closely at the map showing population density in the United States (Source 4.32). Make a list of three patterns that you notice on the map. Share your observations with a classmate and then with your class.

- 5 Compare Source 4.32 with a map showing population density in Australia (Source 4.27). Make a list of the similarities and the differences between the population densities of these two countries.
- 6 US cities often have three main parts. What are these parts? Do large Australian cities also have these parts?

Evaluate and create

- 7 Do you think cities in the United States and Australia share similar characteristics? Provide reasons for your answer.
- 8 Which geographical key concepts would you use to help explain the development of the exurb in Source 4.31?

Why Americans live where they do

As you have learned, the American population of 314 million people is not distributed evenly. Some parts of the country are dominated by enormous, crowded cities and large towns that are home to tens of millions of people, while other parts of the country are vast areas of wilderness where virtually no-one lives. This is because people tend to live in places that supply their basic needs – food, water and shelter. In the United States, the most densely populated places tend to share the same features:

- a temperate climate (one that is not too cold or too hot)
- reliable rainfall and rivers to supply fresh water
- fertile soils for growing crops
- relatively flat, as opposed to mountainous, landscapes
- closeness to the coast.

The role of landscapes and climate

As Source 4.34 shows, much of the western United States is mountainous. A vast plain with a few low mountain ranges stretches from the foothills of the Rocky Mountains almost all the way to the east coast. For this reason the east of the country, especially the areas along the coast, is the most densely populated.

The United States is a vast country – the world's fourth largest. It extends almost from the tropics in the south to the Arctic Circle in the north. This gives the United States a wide range of climates. The climate in the south of the country tends to be much warmer than in the north. In winter, snow can blanket northern cities such as New York and Chicago. In summer, it can be extremely hot and humid in southern cities such as Atlanta and Austin.



Source 4.34 A satellite image of the USA highlighting the key topographical features

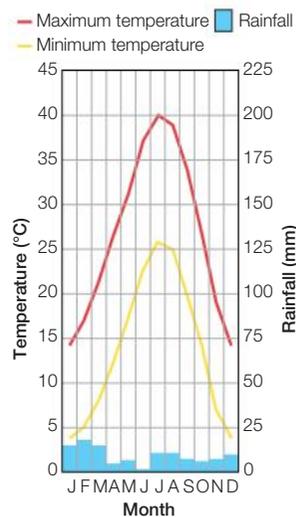
UNITED STATES: RAINFALL



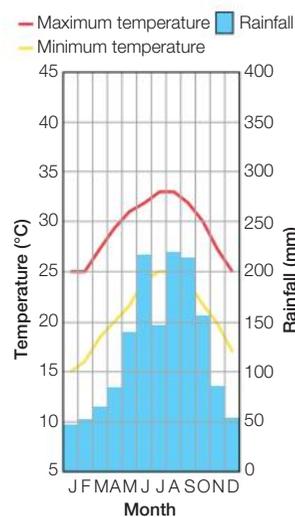
Source 4.35

Source: Oxford University Press

Temperatures tend to vary as you travel from the south up to the north, while the amounts of rainfall tend to vary from the east to the west. Mountainous areas, such as the Rocky Mountains in the west and the Appalachian Mountains in the east, have a big effect on rainfall across the country. They bring large amounts of rain to some places and create **rain shadows** (dry areas) in other places.



Source 4.36 A climate graph for Las Vegas in the state of Nevada, United States



Source 4.37 A climate graph for Miami in the state of Florida, United States

Check your learning 4.10

Remember and understand

- 1 Why are the populations of most countries clustered together rather than spread out evenly?
- 2 Why are most large cities located on or near rivers?

Apply and analyse

- 3 Compare the climate data for Las Vegas and Miami (Sources 4.36 and 4.37). Identify and describe the similarities and differences between them.
- 4 Why do you think the climates of Miami and Las Vegas are so different?

Evaluate and create

- 5 Imagine that you are travelling by road from New York on the east coast to San Francisco on the west coast.
 - a Use Source 4.34 to describe the landforms and landscapes that you might see on your journey.
 - b Use Source 4.35 to describe how the rainfall might vary as you travel west.

Life in New York – a US megacity

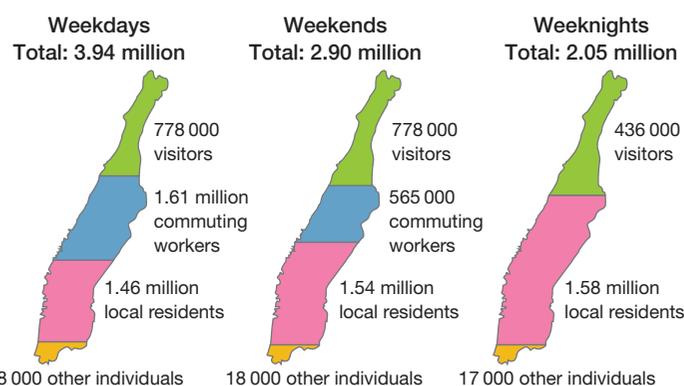
New York is the largest city in the United States and is also among the largest cities in the world. New York was the world's first **megacity** (a city of more than 10 million people). For much of the 20th century it was also the largest city in the world.

New York is made up of five areas known as boroughs. These boroughs are Manhattan, the Bronx, Queens, Brooklyn and Staten Island. In the outer neighbourhoods of Staten Island and Queens many people live in single-storey homes similar to those found in the suburbs of most Australian cities. In the inner neighbourhoods of the other three boroughs almost everyone lives in apartments. Manhattan, in particular, is one of the most densely populated places on Earth. It has a population of more than 1.5 million people in an area of less than 60 square kilometres. This is a **population density** of about 27 000 people per square kilometre. The overall population density of all five boroughs of New York,

however, is around 10 500 people per square kilometre. When you compare this with Sydney – which has a population density of 2000 people per square kilometre – you get an idea of just how many people there are in New York. They literally live on top of one another!

Apartment buildings dominate the skyline in New York. Each floor of an apartment building is commonly divided into four to six apartments. A typical New York apartment is about 21 square metres in area, but this

Source 4.38 This oblique aerial photograph shows part of Manhattan Island in New York. In the foreground are apartment buildings in an area known as Central Park West, in the middle ground is Central Park and in the background is the Upper East Side.



Source 4.39 A comparison of the population density of the island of Manhattan in New York by day (left), by night (right), and weekends (centre)





Source 4.40 Is this the smallest apartment in New York? Felice Cohan pays US\$800 per month to live in this tiny 8 square metre apartment on the Upper West Side of Manhattan. The living space is so small that she can open the front door while sitting on the toilet!

varies widely depending on the apartment blocks and location. About half of New Yorkers own their own apartment and the other half rent. There is often a convenience store at ground level in the building and a subway station nearby. For many New Yorkers, the corner coffee shop is an important meeting place because their apartments are too small for entertaining (see Source 4.40).

A huge number of people flood the island of Manhattan from the surrounding boroughs each day for work and then return home to the outer suburbs each evening. This more than doubles the population of Manhattan each day (see Source 4.39) and is only possible because of a complex and efficient system of tunnels, bridges, rail lines, ferries, bicycle lanes and pedestrian walkways that link the island to the surrounding boroughs and cities. Of the 1.6 million people who travel into Manhattan every day, about half arrive by train. This makes the New York subway the busiest underground train system in North America and the seventh busiest in the world.

Rank	City	Passenger rides per year
1	Tokyo, Japan	3.16 billion
2	Seoul, Korea	2.43 billion
3	Moscow, Russia	2.39 billion
4	Beijing, China	2.18 billion
5	Shanghai, China	2.01 billion
6	Guangzhou, China	1.65 billion
7	New York, US	1.64 billion
8	Paris, France	1.51 billion
9	Hong Kong, China	1.48 billion
10	Mexico City, Mexico	1.41 billion

Source 4.41 The top 10 busiest metropolitan train systems in the world measured by passenger rides per year. Australia's busiest train system (in Melbourne) has a total of 200 million passenger rides per year (Note: 1 billion = 1000 million).

Check your learning 4.11

Remember and understand

- 1 Describe a typical New York apartment building and apartment.
- 2 Where are the world's busiest train systems? Why are they in these places?

Apply and analyse

- 3 Compare the population density of New York by day and night (Source 4.39). Why do these two figures vary?
- 4 Compare the population density of New York with Australia's largest city, Sydney. How different are these figures and what impact do you think this difference has on the lives of people living there?

Evaluate and create

- 5 Use the information provided to describe a day in the life of a typical New York resident.
- 6 Compare the way of life of a typical New Yorker with the life of a typical person where you live. Use a Venn diagram to show features that are unique to each community and features that are shared.

4.2 bigideas: broadsheet

The growth of Las Vegas

Cities grow for many different reasons. Some cities grow because they are located on major roads, railway lines or coastal ports. Some cities grow because large numbers of people come in search of work and new opportunities. Other cities grow because they are near reserves of important minerals, metals and natural resources.

Las Vegas in the US state of Nevada is an unusual city for a number of reasons. It is located in a desert region with little rainfall, yet despite this it is one of the fastest-growing cities in the United States. This is due almost entirely to its role as a centre for gambling and entertainment. The state of Nevada has more casinos than any other state in the USA; around 361 in total. The city of Las Vegas alone is currently home to more than 120 casinos and about 200 000 slot machines.

Las Vegas attracts millions of visitors a year. This tourism creates jobs for skilled and unskilled workers who flood into the city. This, in turn, creates jobs for builders, road engineers and many other residents.

Source 4.42 Population of Las Vegas, 1910–2010

Year	Population
1910	3 321
1920	4 859
1930	8 532
1940	16 414
1950	48 289
1960	127 016
1970	273 288
1980	463 087
1990	741 459
2000	1 375 765
2010	1 951 269

Source 4.43 The US states with the most casinos and the number of casinos in each of these states

State	Number of casinos
Nevada	361
California	184
Florida	150
Montana	146
Washington	125
Oklahoma	115

skilldrill

Creating column and line graphs

Graphs are used in geography to display data and make it easier to understand. Raw data often appears as a confusing table of numbers, so turning data into graphs makes it easier to recognise and analyse trends and patterns. Some commonly used graphs in geography are:

- column graphs – used to compare data (for example, to compare the sizes of several cities)
- line graphs – used to show trends over time (for example, the growth of a city's population).

To draw a graph you should follow these steps:

- Step 1** Decide whether a column graph or line graph will best suit your purpose.
- Step 2** Examine the data carefully to decide on the axes and the scale you should use so that all the data fits. It is important that the scale on each axis is an even scale; for example, 1 centimetre equals 1 million people.
- Step 3** Construct your axes and your scale using a ruler.
- Step 4** Plot the data carefully. Use a straight, horizontal line for a column graph. Use a small, neat dot for a line graph.
- Step 5** On a column graph, draw a series of columns that extend to the horizontal axis. Lightly shade each column with a coloured pencil. On a line graph join the dots with a smooth, freehand line.
- Step 6** Label each axis with a description of the data and give your completed graph a title.

Apply the skill

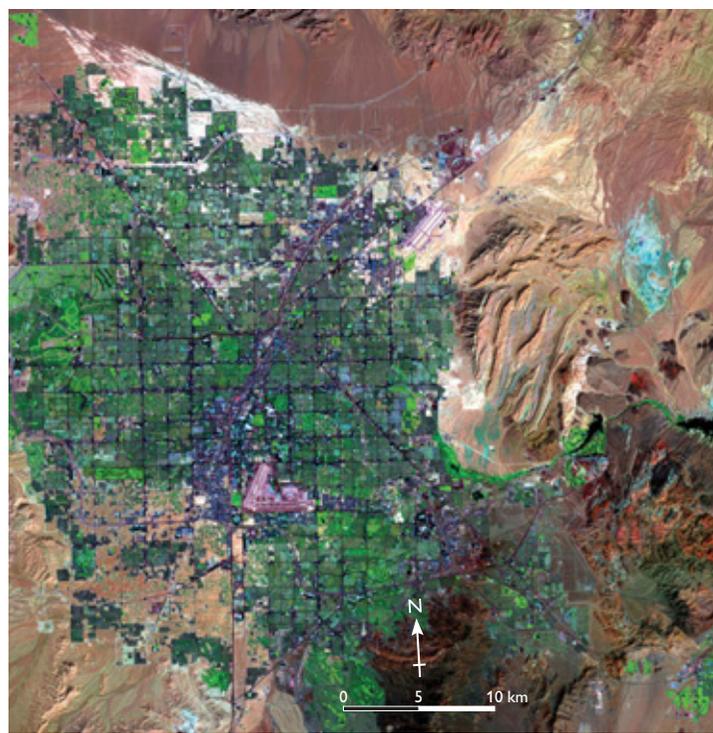
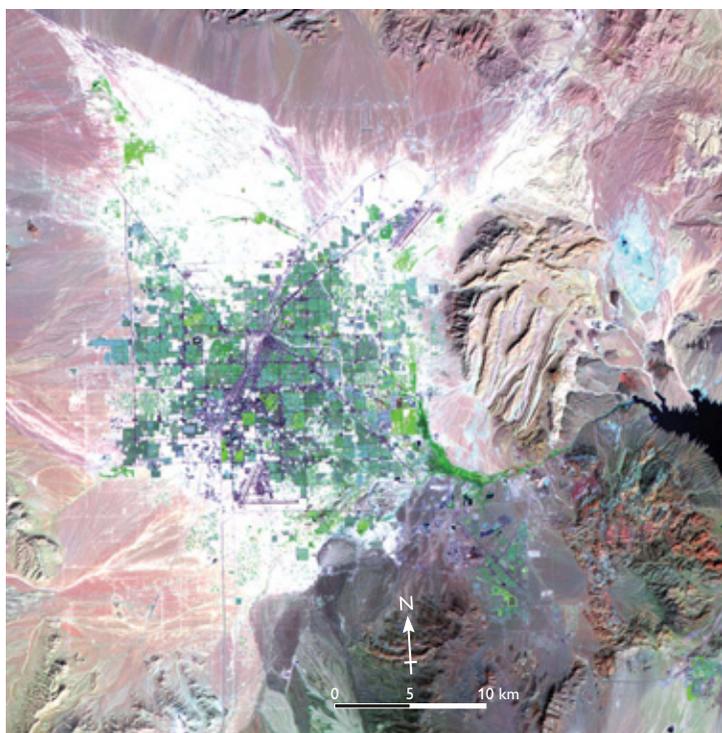
- 1 Using the data provided in Sources 4.42 and 4.43, create two different types of graphs:
 - a a line graph showing the growth of the population of Las Vegas from 1910 to 2010 (see Source 4.42)
 - b a column graph showing the numbers of casinos in selected states (see Source 4.43).

Extend your understanding

- 1 Study Source 4.42.
 - a Describe the changes in the population of Las Vegas between 1910 and 2010.
 - b Why did the population change over this time?
- 2 Examine the satellite images of Las Vegas taken in 1984 and 2011 (Source 4.44). In these images, urban areas appear green and the surrounding desert is brown. How has the centre of the city changed over time? How have the edges of the city changed?
- 3 Examine Source 4.45. Use the steps described in Broadsheet 3.3 to construct a field sketch of this scene. On your sketch label five ways in which this suburb has changed the natural environment.



Source 4.45 A new suburb pushes out into the desert on the edge of Las Vegas



Source 4.44 Satellite images of Las Vegas, 1984 (left) and 2011 (right)

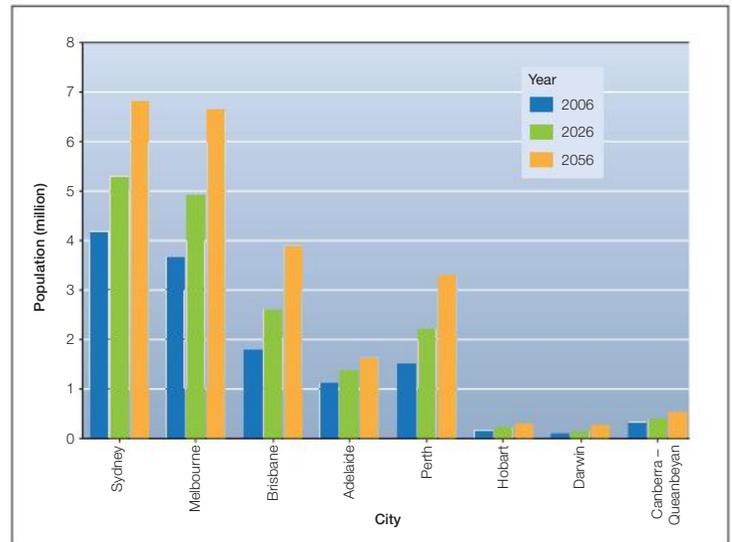
4.3 How can we plan for Australia's urban future?

Managing the growth of our cities

Around Australia today, about 75 per cent of the total population live in just 18 cities (see Source 4.47). Because this number is so large, it is vital that the growth of these cities be carefully planned and managed – both now and into the future. In 2013, the population of Australia reached 23 million, but by 2056 it is estimated that the population will reach 36 million. It is also estimated that around 72 per cent of this growth will take place in our major cities (see Source 4.46).

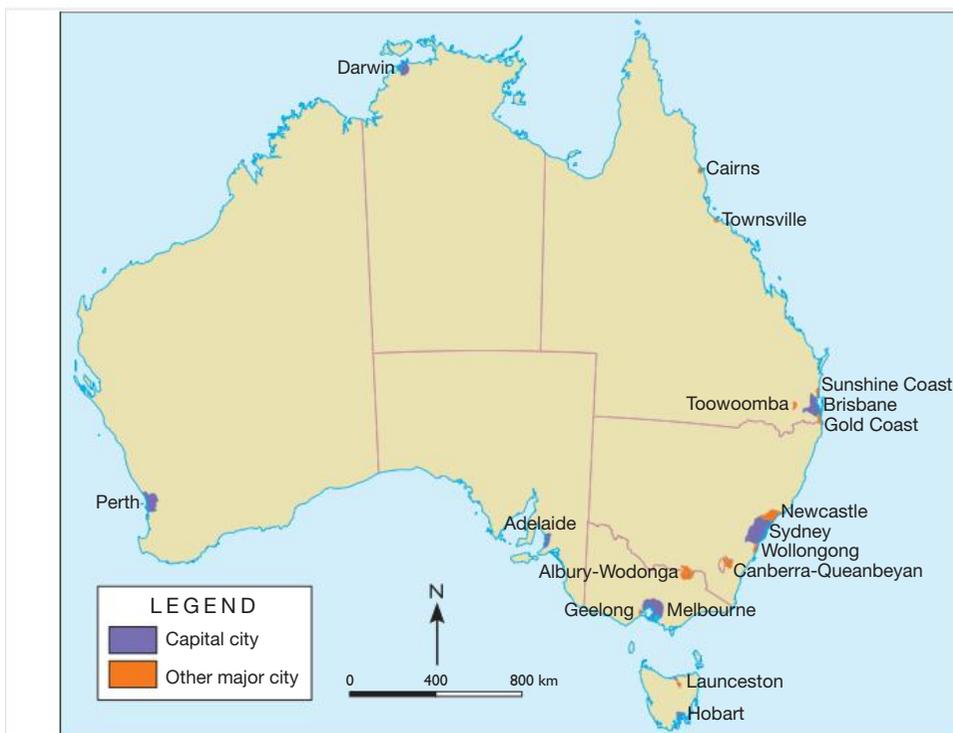
Planning for future cities

Growing urban populations place many pressures on governments and councils who need to plan and build new houses and **infrastructure**, such as schools, hospitals, roads, sewerage systems, power and gas lines, phone and Internet cables, public transport links and shopping



Source 4.46 Population projections for Australia's capital cities to the year 2056

AUSTRALIA: MAJOR CITIES WITH POPULATIONS OVER 100 000



Source 4.47

Source: Oxford University Press

centres. By 2050, it has been estimated that Australia will need a further:

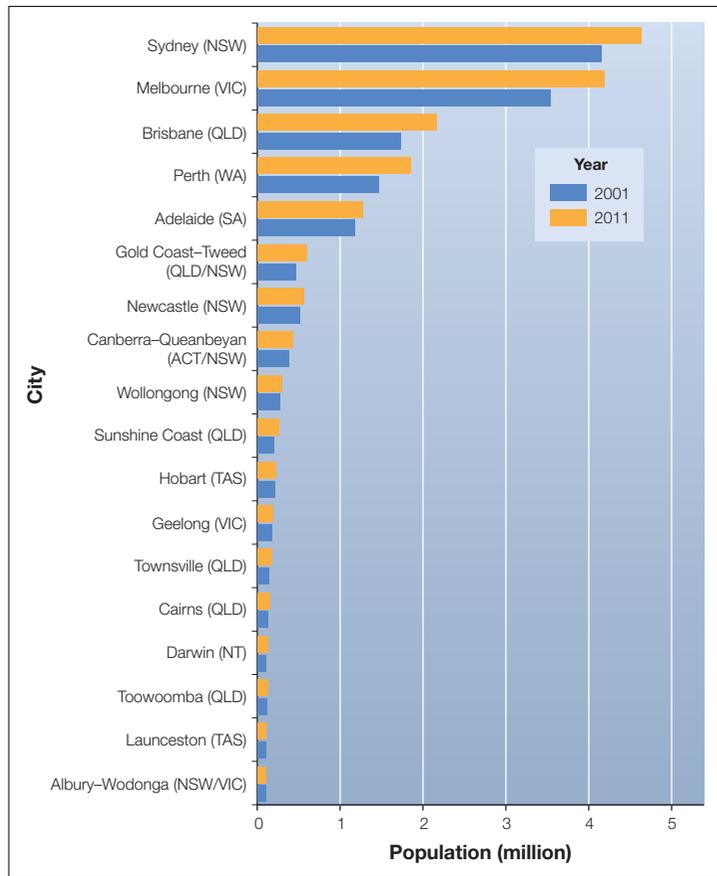
- 6.9 million homes (an 82 per cent increase)
- 173 348 kilometres of new roads (a 51 per cent increase)
- 3254 new schools, 1370 new supermarkets and 1370 new cinema screens.

These services take time to build and are extremely expensive, so they need to be budgeted for in advance. There are also serious environmental issues to consider. The construction of new homes and suburbs can damage or pollute the natural environment and have a negative effect on plant and animal populations.

When planning and managing the future growth of Australia's cities, governments and local councils often rely on the following three strategies:

1 Suburbanisation

Making more land on the outskirts (fringes) of cities available for new suburbs to be built.



Source 4.48 Population growth in Australia's largest cities 2001–2011

Source 4.49 One of Melbourne's newest suburbs, Docklands is an example of urban renewal. The old docks have been redeveloped with apartments, business and restaurants.

2 Urban renewal

Redeveloping existing areas of unused land or buildings within cities to provide housing for new communities.

3 Decentralisation

Encouraging the growth of regional and suburban areas by moving jobs and businesses there, rather than keeping these things concentrated in the central business districts of major cities.

These strategies will be explored in more detail in the remainder of this section.

Check your learning 4.12

Remember and understand

- 1 How many more people are estimated to be living in Australia by 2050?

Apply and analyse

- 2 Look carefully at Source 4.48.
 - a Which city added the most people between 2001 and 2011?
 - b As a percentage, Perth had the greatest population growth between 2001 and 2011. Approximately how many new residents were added to Perth's population?
- 3 Look carefully at Source 4.46.
 - a Which city is estimated to add the most people between 2006 and 2056?
 - b What services and infrastructure will this city need to meet the needs of its growing population?
- 4 Name the three management strategies used by governments to plan for future growth in cities. Can you give an example of each of these strategies in a major city near you?



Suburbanisation

Suburbanisation is the process of growing cities outwards by building new housing estates away from the central business district. New suburbs are often built on what was once farmland or bushland on the rural–urban fringe. Services are then attracted to these new suburbs to meet the needs of the growing population. Schools, shopping centres, medical centres and sporting facilities are built and the area becomes **urbanised**. Industries can also be attracted by the cheaper land and rents of the outer suburbs.

Case study: Suburbanisation in Melbourne

Melbourne added more new residents than any other Australian city in the decade between 2001 and 2011. Many of the 650 000 new residents moved to new housing estates on the fringes, contributing to the expansion of Melbourne’s urban boundaries. Melbourne is one of the world’s largest cities by area – stretching 100 kilometres from east to west – and it is still getting larger.

More land on the city’s western, northern and south-eastern fringes is now set to undergo suburbanisation. These growth corridors will provide homes for up to 100 000 new residents. The largest development of 10 500 new homes for 29 500 new residents is in Lockersburg which is part of the north growth corridor (see Source

4.51). This area will include a train station, a main road, three primary schools, a secondary school, four new sports reserves and a town centre.

Advantages

A major advantage of suburbanisation is that housing estates are relatively quick and inexpensive to establish on already cleared farmland on the fringes of many Australian cities. The housing estates built there also provide an affordable option for new residents and can be designed to meet the needs of modern populations. New housing can also be built to be more energy efficient and sustainable than older housing in established suburbs.

Disadvantages

Disadvantages of suburbanisation are that new infrastructure to service housing developments can be very expensive to supply and local services can be slow to arrive, leaving new residents isolated. Residents in new outer suburbs end up relying on the use of motor vehicles because of infrequent or unreliable public transport. This leads to further congestion of major roads to the CBD. For example, by 2031 it is expected that Melbourne roads will have to cope with an additional 3 million car trips every day.

Source 4.50 Melbourne added 650 000 new residents between 2001 and 2011, many ending up in new suburbs on the city’s fringes.



MELBOURNE: GROWTH CORRIDORS 2013



Source 4.51 Source: Growth Areas Authority

Case study: The Southern Brown Bandicoot

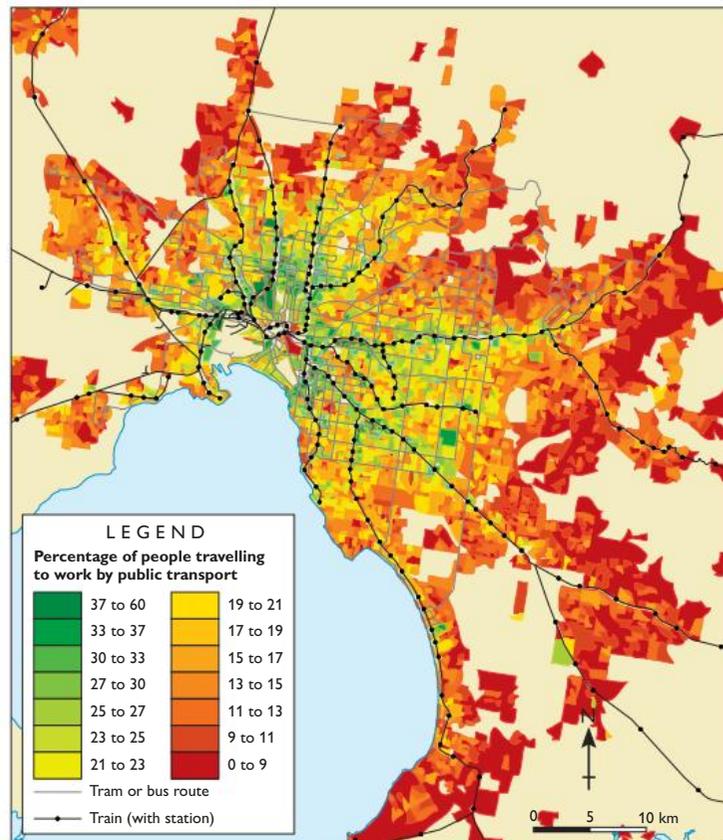
Urban sprawl also eats into productive farmland and nature areas on the edges of cities, impacting on native wildlife. The Southern Brown Bandicoot is an endangered native animal which lives in the area of Melbourne’s south-east growth corridor. They are under increasing pressure from the clearance of their native habitat and attacks by foxes, dogs and cats.



Source 4.53 The Southern Brown Bandicoot is under threat from Melbourne’s suburbanisation.

To help the Southern Brown Bandicoot survive, habitat corridors linking their fragmented habitats together are a feature of the new development plans in the region. These open spaces will also provide recreation spaces for the new residents.

MELBOURNE: PUBLIC TRANSPORT USE, 2006



Source 4.52 Source: Australian Bureau of Statistics

Check your learning 4.13

Remember and understand

- 1 What is suburbanisation?
- 2 What infrastructure and services are being built in the new suburb of Lockerbie, north of Melbourne?
- 3 What problems has Melbourne’s suburbanisation caused for the Southern Brown Bandicoot?
- 4 What plans are in place to help protect this endangered species?

Apply and analyse

- 5 Look carefully at Source 4.51.
 - a Which two growth corridors link existing urban areas with Melbourne’s metropolitan area?
 - b What disadvantages of suburbanisation does Source 4.50 clearly illustrate? Name two examples.
- 6 Examine Source 4.52.
 - a What pattern of public transport use in outer suburbs is created?
 - b What problems might this cause for people in Melbourne?

Urban renewal

Urban renewal is the process of taking existing areas no longer in use within a city's boundaries and redeveloping them. Often the areas selected are places that have become rundown or disused over time (referred to as urban decay). For example, old warehouses and docks that are no longer used because the city's port has closed down or been moved are often redeveloped to provide new houses for residents and offices for businesses. Green spaces can also be created for entertainment and leisure.

Urban renewal allows townhouses and apartment blocks to be built in existing urban areas so that more people can be housed within established suburbs rather than needing to build new ones.

Advantages

Urban renewal can help a city cope with population growth without the need for urban sprawl. By building in established suburbs, developers can make use of the existing infrastructure such as transport routes, energy supply and telecommunications. New residents are able to share in the advantages of inner-city living.

Disadvantages

Historic areas can have special significance for a city but the preservation and refurbishment of old buildings can be expensive. Developers also need to ensure that any new building blends in with existing buildings which can also put limits on the use of the site. A sharp increase in population numbers in a small area can put pressure on established services, and even decrease the liveability of the area for existing residents.



Source 4.54 Pyrmont-Ultimo in 1980



Source 4.55 Pyrmont-Ultimo in 2012

For example, public transport may not be able to meet the increased demand, leading to overcrowding on the routes servicing the areas being redeveloped.

Case study: Pyrmont-Ultimo, Sydney

Since 1992, the peninsula of Pyrmont in Sydney has been part of a large urban renewal project that is expected to see the residential population grow to 20 000 and the number of jobs in the area grow to 26 000 by 2021 (see Source 4.55).

Pyrmont was once the location of shipyards, wool stores, mills, iron foundries and a coal power station. By the 1950s, the heavy industries had shut down and moved away from the area. In the 1970s, shipyards moved to Port Botany and the facilities at Pyrmont became obsolete. The area fell into a state of urban decay. Warehouses were empty, wharves were demolished and the train service ceased. By 1981, the local population had fallen to just 1590 people.

Today, the Pyrmont-Ultimo area has undergone a process of urban renewal. It is now home to a young, wealthy, professional community. More than 13 000 residents now live in medium-density housing there. Train services have restarted and over 30 per cent of households do not own cars. Retail shops, cafés and restaurants have opened and the peninsula now has more than eight hectares of new parks.

Once known for its old industrial buildings and smokestacks, the peninsula is now home to e-commerce and electronic media companies such as Network 10, ABC and Foxtel, and radio stations Nova and 2SM.

Check your learning 4.14

Remember and understand

- 1 Give an example of urban decay from your own local area or somewhere you know.
- 2 What is urban renewal?

Apply and analyse

- 3 Look carefully at the oblique aerial views of Pyrmont-Ultimo in Sources 4.54 and 4.55.
 - a Which parts of the area have remained the same?
 - b List three changes that have taken place from 1992 to 2012.
- 4 What do you think are the advantages and disadvantages of the medium-density housing shown in Source 4.56?
- 5 People aged 20–29 make up 55 per cent of the population in Pyrmont-Ultimo. Why do you think people in this age group are attracted to the area?
- 6 What percentage of residents in Pyrmont-Ultimo don't own cars? Why do you think this is the case? How does this help urban planners in inner Sydney?

Source 4.56 Pyrmont wharf area with its medium-density housing



Decentralisation

Decentralisation is the process of encouraging population growth and job creation in areas outside the central business districts of major cities. Decentralisation is a strategy that governments use to take the pressure off larger capital cities by providing job opportunities in other areas such as:

- smaller towns and cities in regional areas
- newer suburbs on the outskirts of cities.

Decentralisation to regional cities

One way to decentralise growing capital cities is to encourage people to move to smaller regional cities and towns nearby. Industries and companies are given financial benefits to encourage them to move their operations from capital cities to regional centres. Government departments are also established in regional centres. For example, in 2013, the regional city of Geelong in Victoria was chosen as the headquarters for DisabilityCare Australia – the organisation that will administer the disability insurance scheme. Geelong was chosen over larger cities such as Sydney or Melbourne to encourage the creation of jobs and other opportunities there.



Decentralisation to suburbs

Another way to decentralise capital cities is to spread the location of multiple business activity centres across the city so that business is not all centralised in the CBD. These smaller business activity centres become hubs for employment and are established in a range of suburbs with good public transport. This form of decentralisation is designed to spread the load so that all workers do not have to travel to the CBD every day but instead can find employment in more accessible locations in the suburbs. In Melbourne, the centres of Box Hill, Dandenong, Footscray, Frankston, Werribee and Ringwood have all been identified as suitable to become major business centres in addition to the CBD.

MELBOURNE: POTENTIAL BUSINESS ACTIVITY CENTRES



Source 4.58

Source: Oxford University Press

Source 4.57 Geelong has benefited from regional decentralisation plans.

Natural decentralisation

Sometimes population movement trends can operate as a form of decentralisation naturally, without government involvement. From 1970 to 2000, for example, many older people moved from Sydney and Melbourne to coastal areas on Queensland's Gold and Sunshine coasts. This was a form of decentralisation driven by retirees attracted by a warm climate and cheaper housing. As housing prices in these regions have increased, however, the numbers of people migrating north has declined.

Advantages

Decentralisation of the population can help relieve some of the problems of large cities such as the cost of housing, traffic congestion and damage to the natural environment.

Disadvantages

It can often be difficult and expensive to get companies and workers to move to regional centres in the numbers necessary to make incentive and development programs a success.

Case study: Canberra, a decentralised city

Canberra is Australia's largest decentralised city and today has a population of 367 000 people. The inner-city area was originally designed by the American architect Walter Burley Griffin. Within the central area of the city near Lake Burley Griffin, major roads follow a geometric hub-and-spoke pattern rather than a grid. The outer areas of the city, built later, are laid out in a Y shape.

Source 4.59 The district of Canberra Central is one of the oldest parts of the city and is divided into divisions (suburbs) such as Barton, City and Dickson.

Canberra is organised into a series of seven residential districts:

- Canberra Central – settled from the 1920s onwards has 25 suburbs
- Woden Valley – first settled in 1964 has 12 suburbs
- Belconnen – first settled in 1966 has 25 suburbs (and 1 not yet developed)
- Weston Creek – settled in 1969 has 8 suburbs
- Tuggeranong – settled in 1974 has 18 suburbs
- Gungahlin – settled in the early 1990s has 18 suburbs (and 6 not yet developed)
- Molonglo Valley – developed in 2010 has 13 suburbs planned.

Each district contains a mixture of a town centre, group centres, local suburbs and industrial areas. The town centre is the focus for business and social activities. The layout of these districts around a series of central shopping and town centres linked by freeways is designed to make them self-sufficient and prevent the mass-commuting of workers into the CBD every day, as is the case in all of Australia's other major cities.

Check your learning 4.15

Remember and understand

- 1 What is decentralisation?
- 2 How do governments try to encourage people to move to regional towns?
- 3 What were the reasons for retirees moving to the Gold and Sunshine coasts between 1970 and 2000?

Apply and analyse

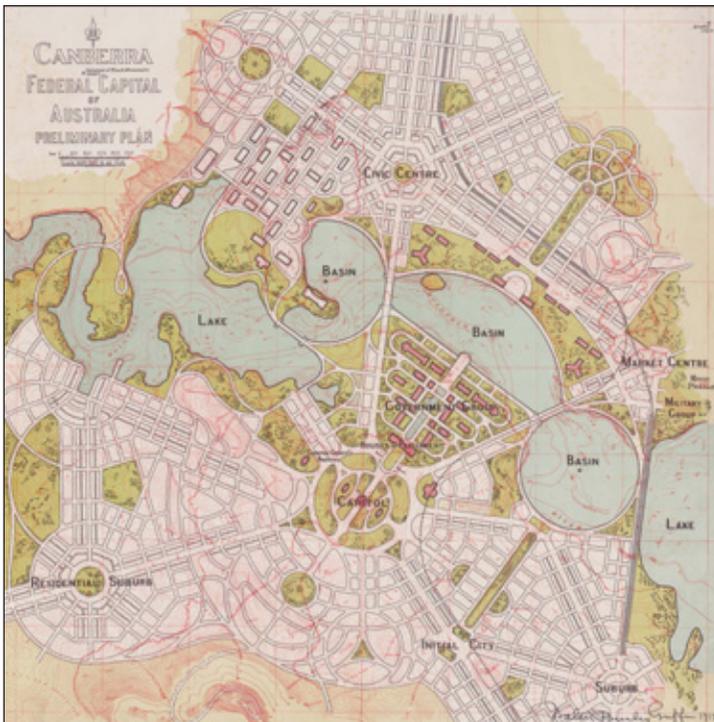
- 4 Look at Source 4.58.
 - a What are the advantages of having several business activity centres rather than just one CBD?
 - b Do you think a vibrant and bustling CBD is important for a city to have? Why/why not?



4.3 bigideas: broadsheet

Canberra – a planned city

Urban planning happens on many different scales. An example of urban planning on a massive scale is Australia's capital, Canberra. In 1911, the Australian Government announced a competition to design the city. Entries were submitted by architects from around the world. The winning design came from a Chicago architect, Walter Burley Griffin. His design involved a series of shapes that would line up with important features of the natural environment, such as the surrounding hilltops. Griffin's plan also included a central lake. This lake now bears his name – Lake Burley Griffin.



Source 4.60 Walter Burley Griffin's original plan for Canberra, drawn in 1911

skilldrill

Comparing vertical aerial images

A range of sources used by geographers – such as maps, plans and photographs – are drawn or captured from directly above. In a **vertical aerial photograph**, the camera is positioned directly above the landscape (often from a satellite or aeroplane). Vertical aerial images can be a useful tool for examining a small area of the Earth's surface in detail. This vertical view (often called **plan view**) allows geographers to see the extent of any features and patterns they make on the Earth's surface. Most importantly, comparing these sources helps geographers identify any changes that have taken place over time. This type of analysis allows us to compare the original plans for cities and suburbs against photographs taken after they have been established. These types of comparisons are useful for geographers in a number of ways. When comparing vertical aerial images, follow these steps:

- Step 1** Examine the scale and the legend of both sources. Ideally, these will be the same. If they are not, you will need to be careful when making comparisons that the area on one image corresponds exactly to the same area on the other image.
- Step 2** Look for geographical features such as the outline of lakes, the location of streets and landmarks such as railway stations. This allows you to compare other features in this landscape.
- Step 3** Locate features that appear on both images that are similar. Take note of these.
- Step 4** Locate features that appear on both images that are different. Take note of these.
- Step 5** Prepare a list or table of these similarities and differences and try to explain the different reasons for them. You may need to conduct more research at this point in order to do this.

Apply the skill

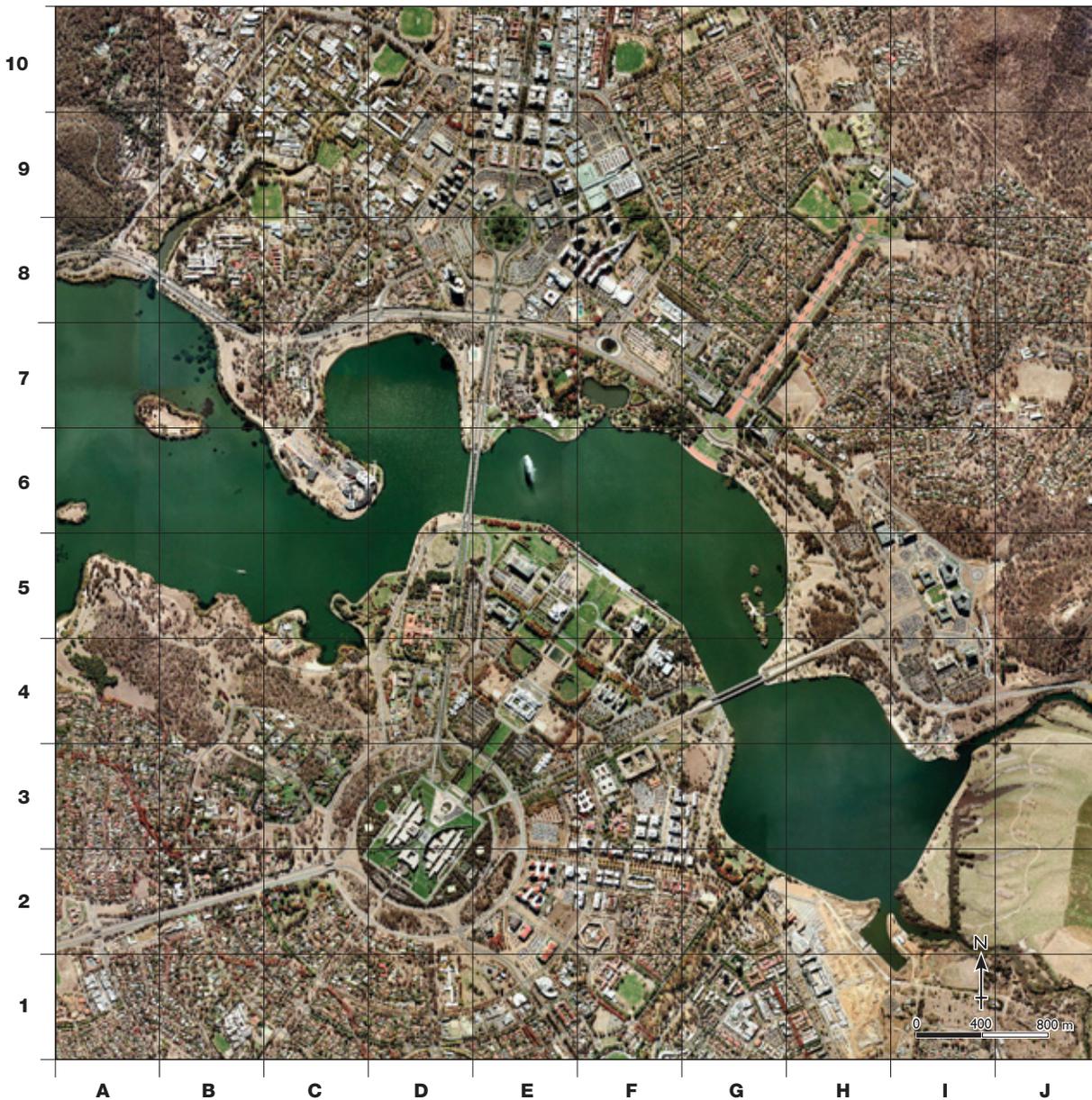
- 1 Look closely at Griffin's plan for Canberra (Source 4.60).
 - a What are some of the distinctive features of his plan?
 - b The judges particularly liked the way in which this plan took into account natural features, such as the surrounding hills and the native bush. What evidence can you find of this on the original plan?

- 2 Look closely at the vertical aerial photograph of modern Canberra (Source 4.61).
- What features indicate that this is a planned city?
 - What is located at I5? Is this the land use that Griffin called for at this place?
 - Can you find three examples of where Griffin's plan has not been followed? For example, there is a missing bridge north-west of Capital Hill.
- 3 How well have modern-day town planners in Canberra followed Griffin's original town plan? Give some evidence from the plan and photograph in your response.
- 4 What evidence is there in the aerial photograph that Canberra's population is increasing?

Extend your understanding

- What types of issues can changing land use and development create for people living in cities?
- What evidence of changing land use can you identify in H1 and H2?
- Use an atlas or Google Maps to locate the following features shown in Source 4.61:
 - National Gallery of Australia
 - Captain Cook Memorial Jet
 - Parliament House.

Provide a grid reference for each of these features.



Source 4.61 Vertical aerial photograph of modern Canberra

Migration

People have always been on the move. Geographers refer to this movement of people as migration. There are many different reasons why we move – for work, for family, for love, or for the chance of a better life. There are also different ways in which we move – we move around the block, to the next town, to a different state, or even to the other side of the world. Movements within the same country are known as internal migration, while movements between different countries are known as international migration. Some people choose to move – known as voluntary migration – while others are forced to move – known as forced migration. In Australia, most people are voluntary migrants. Within a five-year period, about one-third of Australians will change their home address at least once. Worldwide however, the numbers of forced migrants (people fleeing violence, poverty, famine or war) is on the rise.



5.1

Why do people move?

- 1 Where are the people shown in Source 5.1 moving to and why?
- 2 What do you think it means to be a migrant worker?
- 3 What is Chunyun?

5.2

What are the impacts of migration?

- 1 What effect do you think the migration of people from rural China to the cities has had on the communities they have left behind?
- 2 Are there any similarities between what is happening in rural communities in China and Australia?



Source 5.1 Every year around 700 million people across China travel home to take part in the Chinese New Year celebrations. The period of time in which they travel (known as Chunyun) has been described as the largest annual human migration in the world. Many of the people shown here are migrant workers from rural China who are returning home for the holidays.

5.3

How has international migration changed Australia?

- 1 In what ways is Australia a multicultural country?
- 2 As a class, make a list of features of different communities in Australia that demonstrate we live in a multicultural society. Highlight examples from your community.

5.1 Why do people move?

Voluntary migration in Australia

People who are free to choose when and where they move are referred to as **voluntary migrants**. Most people who move to and within Australia are voluntary migrants.

Australia has a very mobile population. Statistics show that more than 40 per cent of us move home once every five years. Around 15 per cent of us move at least three times in that same period. Source 5.3 shows the main reasons why people move home in Australia, while Source 5.2 demonstrates these trends using an example of an individual and the types of decisions they might make during their lifetime.

As you can see, migration in Australia is usually a very personal decision and is based on a number of important factors. These may be linked to a person's personal tastes, family life, income or health. In Australia, for example, there has been a movement of people towards the edges of large cities and towards smaller towns on the coast. The first of these moves is largely due to the cheaper land available on the city fringe and the second due to people looking for a change in lifestyle. This movement of people to regional coastal towns is referred to as a 'sea change'.



When my sister was born, my parents bought a big house for us in the Melbourne suburb of Glen Waverley. I was three years old when we moved in.



I lived at home with my mother, father and sister until I was in my early 20s because I was studying at university and couldn't afford to move out. Our house didn't feel so big anymore!



When I was 29, I got married. My wife and I bought our first house in the suburb of Brunswick and moved in together. It had two bedrooms.



By the time I was 38, we had three children. Our family moved interstate to Brisbane because I was offered a job promotion. We bought a large house with five bedrooms in the suburb of Oxley.

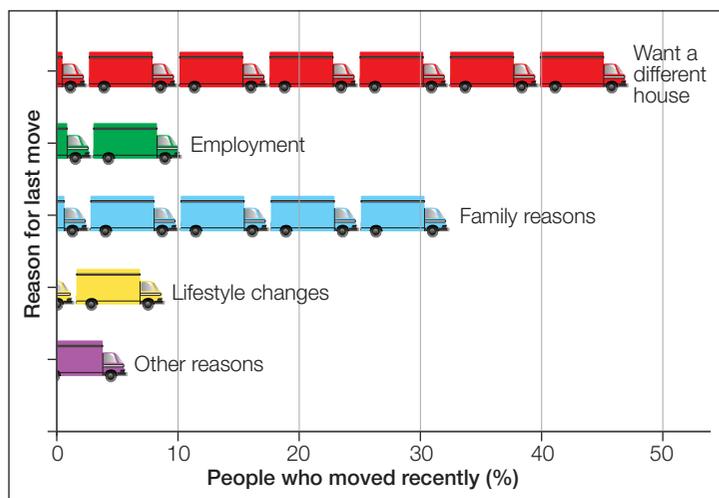


By the time my wife and I were in our 50s, all our children had moved out and were starting families of their own. The house seemed too big for just the two of us, so we sold it and bought a two-bedroom apartment in a suburb closer to my office in the city.



When my wife and I retired in our mid-60s, we bought a small apartment in a development on the Sunshine Coast so we could be closer to our grandchildren and enjoy a more relaxed lifestyle.

Source 5.2 People move for different reasons at different stages of their life.



Source 5.3 The main reasons people move home within Australia. (Proportions may add up to more than 100 per cent as respondents could provide more than one reason for their last move.)



Source 5.4 New homes being built on the edge of Torquay in Victoria to accommodate more sea changers

The effect of sea changes on coastal communities

The popularity of sea changes in Australia, particularly along the south-eastern coast, is presenting many challenges for coastal councils. Population growth in coastal communities has meant an increasing demand for infrastructure and services. Careful planning is needed if these communities are to retain the lifestyle attractions that attracted the increasing numbers of people there in the first place. As well as this, climate change – the impact of extreme weather conditions and increasing coastal erosion – is also causing problems for councils.

Coastal councils are predicting that permanent populations will continue to expand. A large percentage of non-resident property owners are aged between 45 and 64 and many eventually plan to move permanently to their coastal property. Those planning to make the move in the next two to five years is around 67 per cent.

As populations in coastal areas grow, sleepy coastal towns are expanding into regional centres that require new hospitals, sewerage systems, water resources, roads and other services. In the past, it generally took between 50 and 100 years for a small coastal town to grow into a larger regional centre. Today, the same level of growth is often taking place over five to 10 years. Councils are still working out how to deal with this growth. As well as dealing with the increased needs for infrastructure and housing, coastal communities need to retain their character and historic value if they are to remain attractive to sea changers and tourists in the future.

Check your learning 5.1

Remember and understand

- 1 What is the main reason that people in Australia move home?
- 2 What is a sea change?
- 3 How does a person's stage in life influence whether or not they will move?
- 4 What are the main challenges facing coastal communities because of the popularity of sea changes?

Apply and analyse

- 5 When a town's population grows, it can have a major impact on the natural environment. Brainstorm this idea with a partner and make a list of the potential impacts. Share your brainstorm with your classmates.
- 6 Using Source 5.3, categorise the reason for each move made by the person in Source 5.2.

Evaluate and create

- 7 Conduct a survey on the reasons why people move. Each person in the class should find three (unrelated) people who have moved in the last five years. Ask each person 'what was the main reason you moved?' Compare your class findings with the types of reasons given in Source 5.3. What were the differences and the similarities?
- 8 Is your class typical of the Australian population? What percentage of your classmates has moved home in the last five years?

Moving to cities

The world's population is growing rapidly, with the fastest growth occurring in cities. All across the world, people from rural areas are moving to cities in search of work and better opportunities. Geographers refer to this trend as urban drift.

Rural people are drawn to cities by the promise of better jobs, more money, and greater access to hospitals, schools and child-care facilities. There is also likely to be better access to services (such as electricity, clean water and sanitation) in most larger cities. Access to a range of entertainment options, such as cinemas and nightclubs, also attracts people. For all these reasons and many others, people tend to be attracted to urban areas.

Cities across the developing world in places such as Africa, Asia and South America are the fastest growing in the world today. The city of Lagos in Nigeria, for example, is one of the world's fastest growing cities, increasing by about 1 million people every three years. Lagos is expected to become Africa's largest city by 2015. Much of this growth comes from the movement of people from the countryside to the city. New migrants hope for a job, a house and a future, but the reality is often much worse – life in an urban slum.

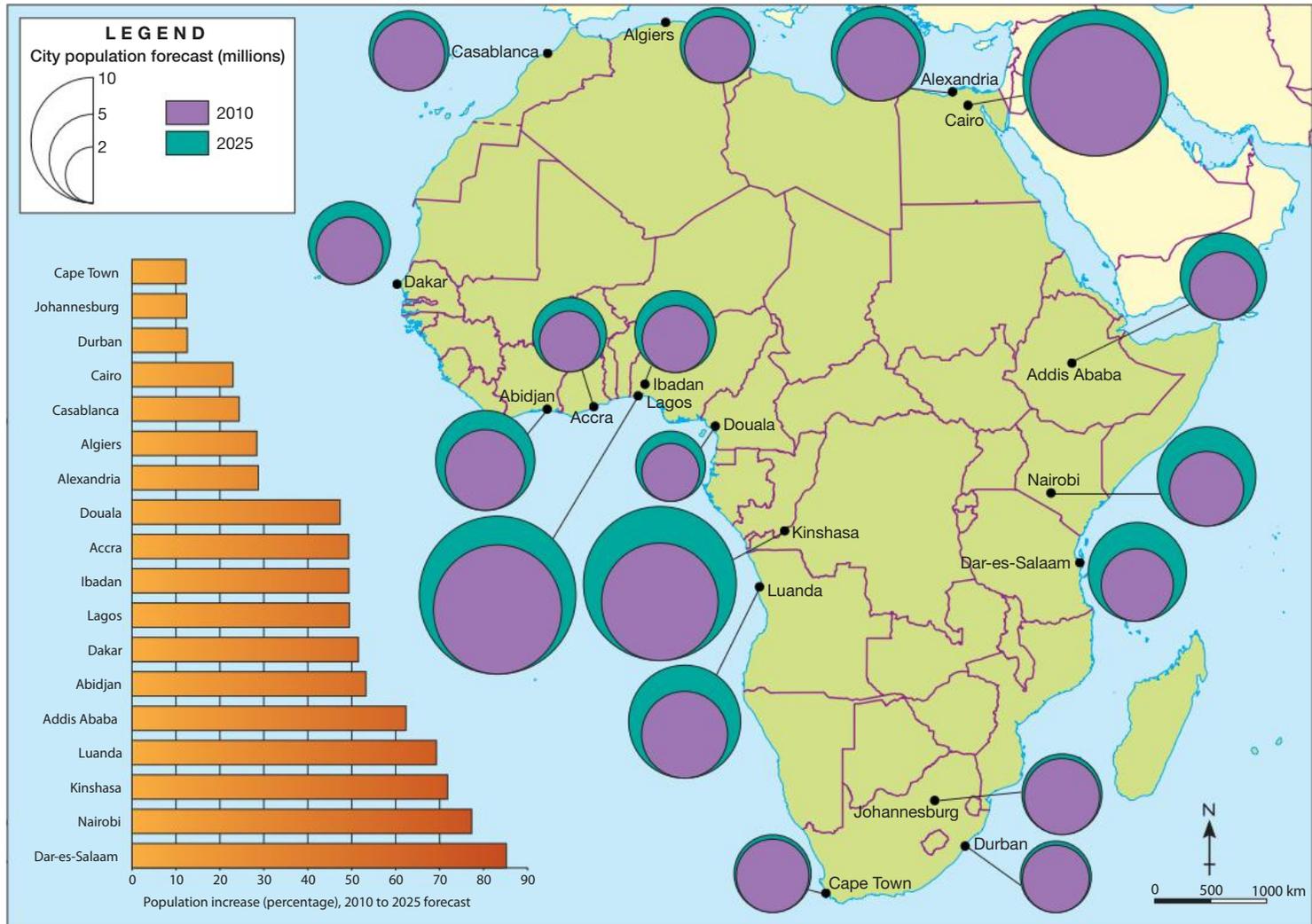


Source 5.5 The population of a place grows if births and arrivals outnumber deaths and departures. This is happening in many large cities.

Source 5.6 A row of yellow buses picks up passengers in Oshida market in Lagos, Nigeria



GROWTH OF AFRICAN CITIES



Source 5.7

Source: Oxford University Press

Check your learning 5.2

Remember and understand

- 1 What is urban drift?
- 2 There are four ways in which populations can change, as shown in Source 5.5. Which of these helps explain why the population of Lagos has grown so rapidly?

Apply and analyse

- 3 Look carefully at Source 5.7.
 - a Estimate the size of the population of Lagos in 2010 and 2025.
 - b How much might the population of Lagos grow between 2010 and 2025?

- c Which city on the west coast of Africa is expected to grow even faster?
- d The biggest percentage growth is expected to occur in two cities on the east coast of Africa. Name these cities.

Evaluate and create

- 4 Sketch the scene shown in Source 5.6. Use the guide to preparing fieldwork sketches at the end of section 3.3 to help you. On your sketch, label the following features: unpaved roads, open drains filled with rubbish, market stalls, evidence of electricity, public transport network and evidence of low rates of car ownership.

Urban slums

As people pour into the world's cities they bring about great change. Many cities around the world are struggling to cope with this urban explosion. Providing new arrivals with the basic services they need (such as water, food, housing and sanitation) is becoming difficult in many cities. As a result, many people moving to cities in the developing world find themselves living in **slums**. Every slum is different, but they share some basic features: poor housing standards and very little assistance from city authorities for the people who live there.

Virtually every city in the developing world has at least one slum. Some have grown to become cities in their own right as people continue to flood into the city. Most of the world's slum dwellers live in Africa and Asia but the world's largest, at about 4 million people, is in Mexico City. It is impossible to know exactly how many people live in slums but the United Nations estimates that the figure is more than 1 billion people; that is one-seventh of all humanity! Even more alarmingly, this number is expected to double to 2 billion over the next twenty years.

Case study: Life in Dharavi slum, Mumbai, India

One such slum is located in India's largest city, Mumbai. It is known as Dharavi and was the setting for the Oscar-winning 2008 film *Slumdog Millionaire*. For hundreds of years, Dharavi was home to fishermen who fished in the mangrove swamps and rivers surrounding the village. As the population of the nearby city of Mumbai grew, the city expanded outwards. By 1900 it had completely surrounded Dharavi. The swamps on which Dharavi had been built dried out and were filled in. With nowhere to fish, the traditional economy of the area collapsed, but a new economy was about to begin. The newly reclaimed swampland provided space for migrant communities arriving from the countryside. The former fishing village was soon transformed into a bustling suburb, which became home to people such as leather tanners, potters and garment workers.

Attracted by the bright lights of Mumbai with its Bollywood film industry, cinemas, trains, buses, schools and jobs, thousands of rural migrants continue to pour into the city every day. Most of them arrive with no money and few possessions. They take up residence wherever they can, building crude homes from whatever materials they can salvage; no open space in the city is considered off limits.

Source 5.8 Dharavi slum in Mumbai, India





Source 5.9 This boy is employed to sort through rubbish and separate materials for recycling.

While many new arrivals find space on the edges of Mumbai, some make their way to Dharavi, near the city centre. More people arrive daily. This tiny area of about 2 square kilometres has one of the world's highest population densities – 500 000 per square kilometre. This gives each person about 2 square metres of living space. The size of the total population is difficult to gauge but is thought to be more than 1 million. Most live in cramped, dirty conditions with only one toilet for every 1440 people. Canals and streams are heavily polluted with human waste. Water pipes are installed illegally by tapping into the city water mains that run past the slum. Electricity is connected in the same way.

Toxic black smoke spews from the oil drums that are used as furnaces all day. These furnaces power some of the heavy industries inside Dharavi, such as large-scale recycling, leather tanneries, metalwork and machinery manufacturing.

There is virtually no health care available inside Dharavi. Diseases from drinking contaminated water are particularly common.

Despite all these problems, there is a less gloomy side to Dharavi. Rather than a slum full of despair, many people consider it to be a slum of hope. While it is one of the world's largest slums, it is also one of the world's most prosperous. There are estimated to be about 15 000 single-room factories in the slum, most of them recycling items from the waste produced by Mumbai's 19 million people.

As Mumbai has increased in size and population, this tiny slum with 1 million residents has become some of the most valuable real estate in the city. Property developers, keen to take advantage of its good location close to the city, are pressuring the government to redevelop the area as housing for India's growing middle class. The current plan is to demolish Dharavi and build new high-rise apartments for the slum dwellers.

However, this plan is viewed with suspicion by many Dharavi residents. They prefer their do-it-yourself suburb to the proposed 'concrete jungle' of high-rise apartments. With India's population increasing by around 17 million a year, the pressures on India's planners and its people, including the slum dwellers of Dharavi, will intensify in the future.

Check your learning 5.3

Remember and understand

- 1 What is a slum?
- 2 Why has the number of people living in slums increased in recent years?
- 3 How has the suburb of Dharavi changed over time?
- 4 Why do some people refer to Dharavi as a 'slum of hope'?

Evaluate and create

- 5 Imagine that you were able to spend one day at Dharavi. Describe the sights, sounds, smells and tastes that you think you would experience.
- 6 Some people feel that slums such as Dharavi should be bulldozed and the residents forced to move into high-rise apartments. How do you feel about this? What points would you use to try to convince a person with the opposite point of view? Join a class discussion about the future of slums, such as Dharavi.

Moving for work

Moving for work is an important reason why people migrate to another region. In poorer countries one family member may move to another town, city or country in order to find a better job. Much of the money the person earns is sent back home in order to help support his or her family. This money is known as **remittances**.

More than US\$400 billion a year is moved between countries as remittances; the vast majority of it is from workers in **developed countries** to their families back home in poorer countries. The 7.7 million Filipinos living overseas, for example, send more than US\$8.5 billion back home every year.

Source 5.10 Dubai, capital city of the United Arab Emirates, is in the middle of a construction boom. Overseas workers, particularly from India and Pakistan, are providing most of the labour. The world's tallest building, the Burj Khalifa, was opened in 2010. It is 818 metres tall and cost US\$4.1 billion to construct. About 700 000 migrant workers worked on the project. The Burj Khalifa can be seen from nearly 100 kilometres away.

Case study: the Persian Gulf

Some of the oil-rich countries in the Persian Gulf (such as Oman, Bahrain and the United Arab Emirates) require large workforces in their industries and households. Millions of workers from countries such as India, Pakistan and Nepal make the journey to the Gulf to take advantage of wages many times higher than they would be able to earn in their home countries. The population of the United Arab Emirates, for example, is about 5.6 million people, 4.7 million of whom are migrant workers. The workers add to the prosperity of the Gulf countries by providing a source of labour. They also add to the prosperity of their home countries as they return wealthier and more skilled than when they left.

Some migrant workers are not treated well by their employers. In the United Arab Emirates, for example, many construction workers are not paid wages. They work extended hours without overtime compensation, and they work in unsafe environments, leading to death or illness. They also experience squalid living conditions in labour camps, and have their passports and travel documents withheld.



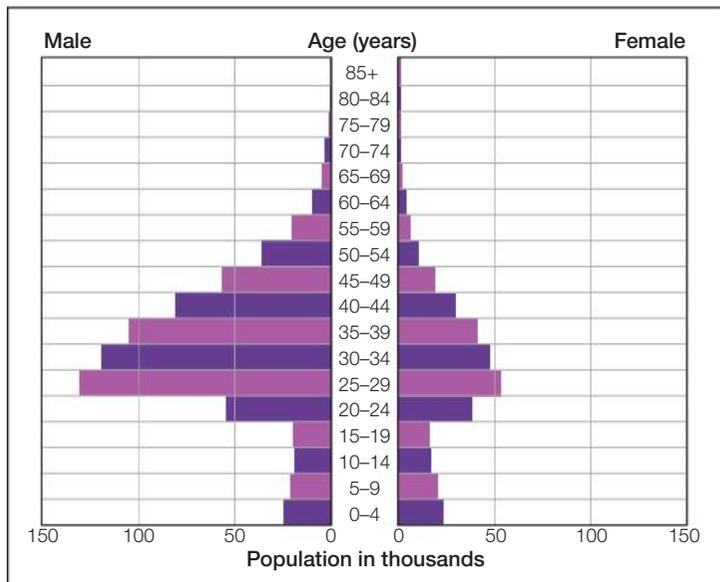


PERSIAN GULF COUNTRIES: POPULATION BORN IN ANOTHER COUNTRY



Source 5.11 Workers on the Burj Khalifa Tower were housed in work camps in the desert. Their pay of about US\$1 per hour was mostly sent to their families back home.

Source 5.13 Source: Oxford University Press



Source 5.12 Population pyramid of foreign-born Kuwaitis, 2007

keyconcept: scale

Studying a region

Population movements can be studied at a range of scales from the local to the global. Here you have learnt about movements in the Persian Gulf. In geography, a region can mean both an area between the local and national scale (such as regional Queensland), or between the national and global scale, such as the Persian Gulf region. Because this includes more than one country but not the whole world it is referred to as a region. Other regions include the Middle East, Asia and the countries of the Sahara Desert. For more information on the key concept of scale, refer to section GT.1 of 'The geographer's toolkit'.

Check your learning 5.4

Remember and understand

- 1 What are remittances?
- 2 Explain how remittances benefit the individual who sends them, the family to which they are sent and the country to which they are sent.
- 3 Use Source 5.11 to help describe how workers on the Burj Khalifa project lived and worked.

Apply and analyse

- 4 Examine Source 5.13.
 - a Which countries of the Persian Gulf have the highest percentage of foreign-born workers?

- b What percentage of Saudi Arabia's labour force was born overseas?
- 5 Carefully study the population pyramid (Source 5.12).
 - a Are most foreign workers in Kuwait male or female?
 - b What age are most foreign-born workers in Kuwait?

Evaluate and create

- 6 Imagine you are a foreign worker in the Persian Gulf. Write a short letter back to your family to accompany your remittance payment.

Moving for safety

While most people who move are free to do so there are also many forced migrants. The United Nations estimates that more than 40 million people around the world have been forced from their homes. Most of these people remain within their home country and are referred to as **internally displaced persons (IDPs)**. Millions of others are forced to cross international borders to escape persecution or to find another home after a natural disaster. These people are referred to as **refugees**. About half the world's refugees have fled from Iraq and Afghanistan and are seeking refuge in countries such as Pakistan, Iran and Syria. Pakistan alone hosts 1.7 million refugees.

Case study: Ahmad Akbar, an Afghan refugee

Fierce fighting for control of Afghanistan over decades has resulted in millions of refugees and IDPs. This is the story of one of them.

Ahmad Akbar, the eldest son of Ali, lives in Sarcasma, a small village in Afghanistan. Many people in Sarcasma fought against the Taliban and, in revenge, Taliban forces attacked the village. They rounded up 116 women and children and executed 60 of them in the local bazaar. 'I knew then', said Ahmad's father, 'I had to get my eldest son out of Afghanistan; it was my duty to save him.' In fear of Ahmad's life, Ali sold his truck to pay a people smuggler US\$14 000 to get Ahmad and two other young men to safety in Australia. Ahmad's long journey had begun – see ① in Source 5.16.

The three men hid in the back of a truck and were driven over the mountains into Pakistan ②. From there they were flown to Jakarta in Indonesia ③ and then travelled to Kupang on the island of Timor ④. The town is well known as a staging post for refugee boats heading to Australia. Ahmad and 438 other refugees were crowded onto a 20-metre-long fishing boat by people smugglers for a 200-kilometre journey from Kupang to Australia.

The grossly overloaded boat broke down and began to leak. Fearing for their lives, the refugees were rescued by the Norwegian freighter the Tampa, whose captain was responding to a distress call ⑤. Australian authorities

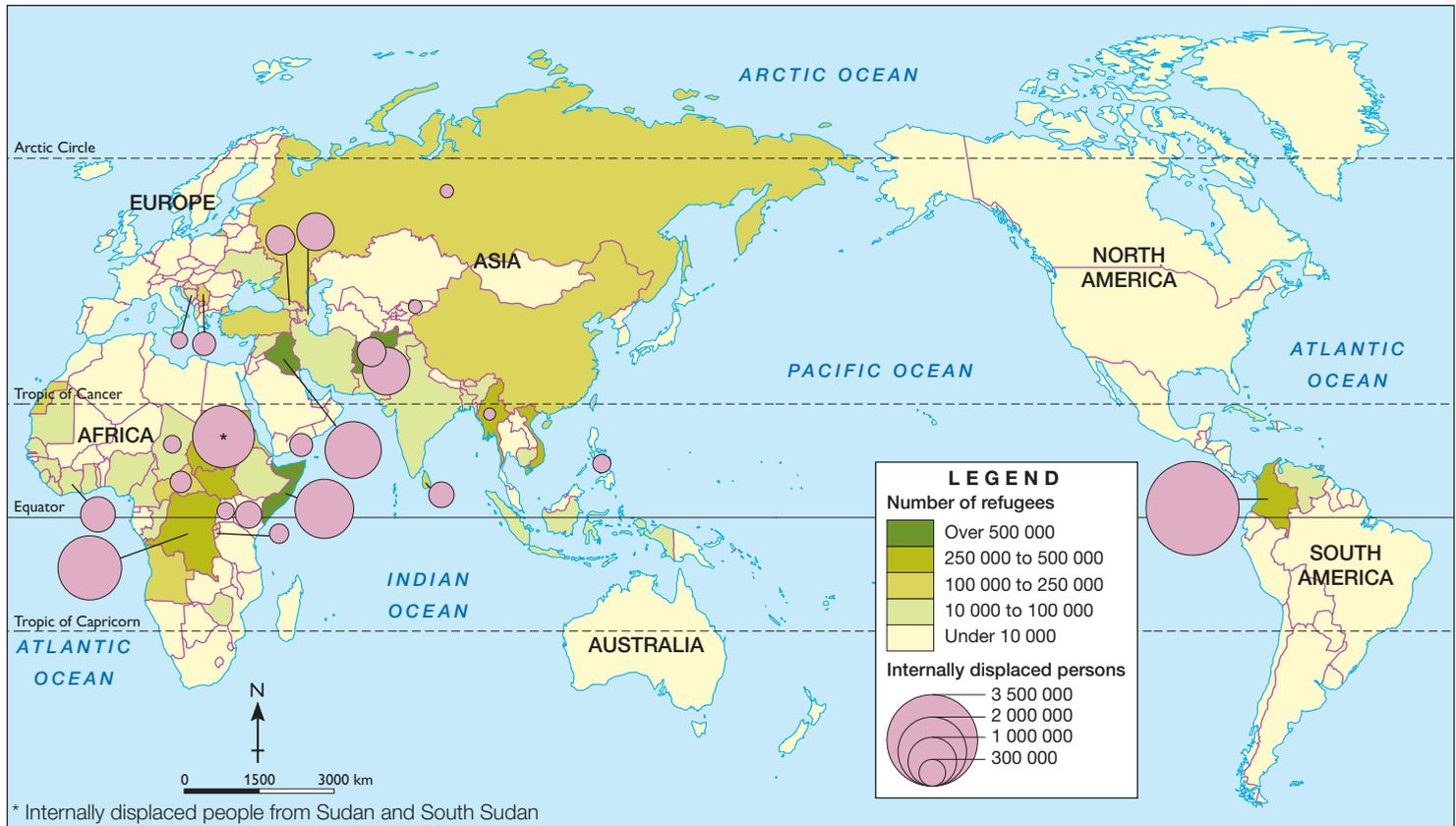
refused requests by the ship's captain to bring the refugees to Australia, maintaining that the rescued refugees were the responsibility of Indonesia. So instead of being taken to Australia, Ahmad and the other refugees were moved onto an Australian navy ship, the HMAS Manoora, at Christmas Island. They were then taken to the small Pacific island of Nauru ⑥ where Australian authorities had built two detention camps to house refugees while their applications to settle in Australia were processed.

Ahmad was held on Nauru for two years while authorities assessed his claim that he was a genuine refugee. 'I told the interpreter how the Taliban had killed women and children and that my father had organised my escape to Pakistan and then to Indonesia', Ahmad said. 'I pointed out my village on a map. But I was not believed.' His application was turned down and he was returned to Afghanistan ⑦. Ahmad claims that his application was prejudiced as his interpreter was of a different ethnic group from his.

He believes that he was treated unfairly by the Australian authorities, who did not accept his claim that he was a genuine refugee. In an interview he stated, 'I thought Australians had a love of humanity, but they smashed my dreams.' Back in his village in Afghanistan, Ahmad Akbar sees little hope for the future.

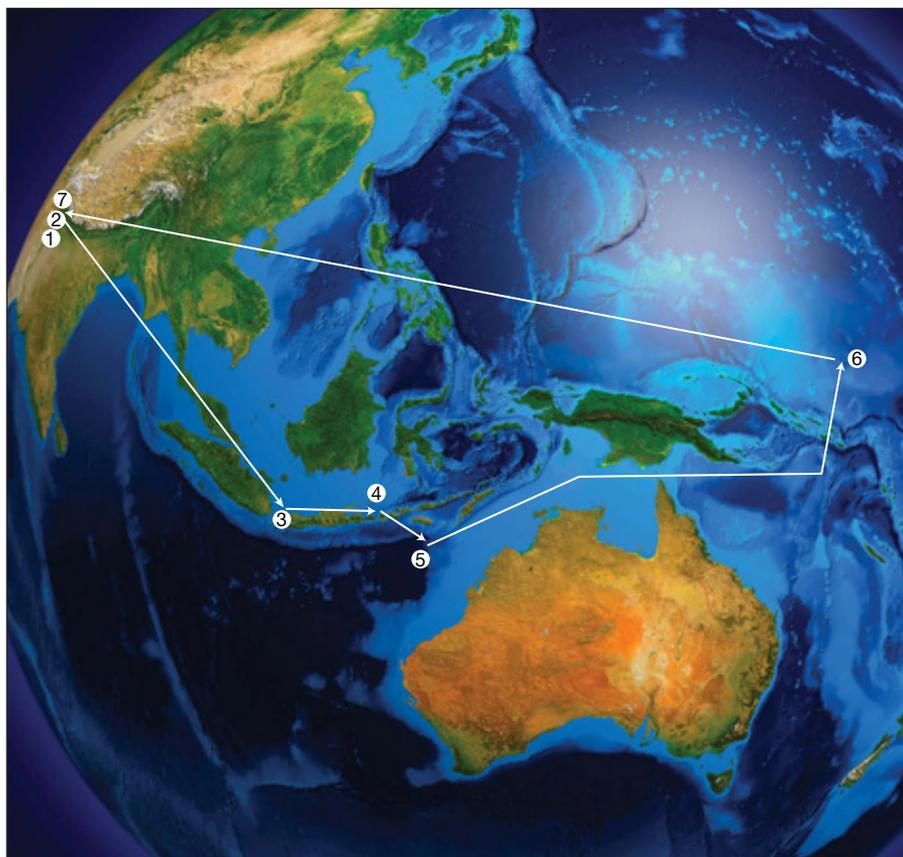
Source 5.14 The Tampa alongside the distressed fishing boat





Source 5.15

Source: Oxford University Press



Source 5.16 The route taken by Afghan refugee Ahmad Akbar

Check your learning 5.5

Remember and understand

- 1 What is a refugee?
- 2 What is the difference between a refugee and an internally displaced person?
- 3 Why did Ahmad leave Afghanistan?
- 4 How does he feel about the way he was treated?
- 5 Why do some countries produce many refugees?
- 6 Why do you think Ahmad tried to get to Australia rather than staying in Indonesia or Pakistan?

Apply and analyse

- 7 Using Source 5.15 and the world map inside the back cover of this book, list the countries with the greatest number of refugees and IDPs.

5.1 bigideas: broadsheet

Rapid change for the Aeta

The Aeta are a group of Indigenous people living in the Philippines. Traditionally hunter-gatherers, they survived on a diet of fruits, honey, animals and fish collected from their mountain forest home. Today, these forests are being cleared for farms, logging and mines. One important region of Aeta settlement was the island of Luzon, where they lived for thousands of years in small villages on the lush slopes of Mount Pinatubo. In June 1991, Mount Pinatubo, an active volcano, exploded in one of the worst eruptions in history, devastating the Aeta population there. More than 200 000 Aeta lost their homes. After the eruption, many were forced into resettlement camps or urban areas where they face an uphill battle to preserve their traditions. Most are illiterate and have no sense of money or land ownership. The average life expectancy of Aeta men and women is now just 16.5 years.

skilldrill

Analysing geographical photographs

Photographs are one of the many tools that geographers use to study different environments and places. There are three main types of photographs used commonly by geographers in the field:

- ground-level photographs
- oblique photographs
- vertical photographs.

1 Ground-level photographs

Ground-level photographs are taken on ground level, as the name suggests. They record exactly what a person would see if they were standing in front of the scene. Ground level photographs enable the viewer to clearly see the detail in the environment and appreciate the scale of objects in it. Features in the foreground of ground-level photographs generally look bigger and features in the background generally look smaller. Ground-level photographs are useful for geographers because they show a lot of detail. They are also less expensive and easier to produce than other types of photographs.

2 Oblique photographs

Oblique photographs are taken on an angle from a high point. They can be taken looking down from a cliff or mountain, or from an aircraft or hot-air balloon (known as aerial oblique). Oblique photographs are useful for geographers because they show a larger area than ground-level photographs. Oblique photographs are not used for making maps because the scale in the foreground is different to the background, making accurate measurements difficult.

3 Vertical photographs

Vertical photographs are taken from directly above (this is also referred to as plan view). They can either be taken from an aircraft or a satellite orbiting the Earth. Vertical photographs are particularly useful to geographers and cartographers because they show the largest areas of any type of photography.



Source 5.17 A ground-level photograph showing the volcanic ash and mudslides (lahars) that destroyed settlements and forced the Aeta from their homes. They were unable to continue their lifestyle in the devastated environment.

They can be used to make maps because the scale is constant. When taken from low altitudes they can be used to analyse smaller areas; when taken from high altitudes they can be used to analyse extremely large areas.

When analysing a photograph, you need to infer (use factual knowledge to decide) what might be happening and the possible reasons for it. A good way to do this is to think of the photograph as the answer to a question like 'How has the lifestyle of the Aeta changed?' With this question in mind, look for important features that can help provide an answer. Additional questions you should ask when analysing geographical photographs include:

- What is happening in the photograph?
- What are the reasons for this?
- What do the features tell us about the people or landforms being shown?
- What is the most important or dominant feature shown in the photograph and why?
- Do you think this feature may have changed over time? Why or why not?
- How do the features shown relate to one another?

Apply the skill

- 1 Look carefully at the ground-level photograph shown in Source 5.17.
 - a What does this photograph tell you about the effects that the eruption had on the Aeta?



Source 5.18 An oblique aerial photograph showing an Aeta village destroyed by pyroclastic flows from the Mount Pinatubo eruption

- b What can you learn from the photograph about the conditions in which the Aeta live?
- 2 Look carefully at the oblique aerial photograph shown in Source 5.18.
 - a What does the photograph tell you about the scale of the damage to the home of the Aeta?
 - b Does this photograph help to explain the reasons why the Aeta were forced into resettlement camps?
 - 3 Look carefully at the vertical satellite photograph shown in Source 5.19.
 - a Why is it possible to draw a map from a satellite image but not from a ground-level photograph?
 - b What does the photograph tell you about the extent of the damage to the natural environment in which the Aeta live?

Extend your understanding

- 1 What challenges to their way of life were the Aeta people facing before the eruption of Mount Pinatubo?
- 2 How did the eruption speed up the change for the Aeta living on the slopes of Mount Pinatubo?
- 3 What issues do you think the Aeta people faced when they were moved to resettlement camps?



Source 5.19 A vertical satellite photograph showing the aftermath of the Mount Pinatubo eruption. Torrential rain mixed with ash from the eruption caused mudslides (lahars). The lahars appear as rivers of mud flowing down the slopes of Mount Pinatubo.

5.2 What are the impacts of migration?

Explaining population movements

The world's population is on the move. We move around the block, to the next town, the next state or across the world. About one in every 33 people worldwide is an international migrant, living in a country other than the one in which they were born. In Australia, the figure is more like one in every four.

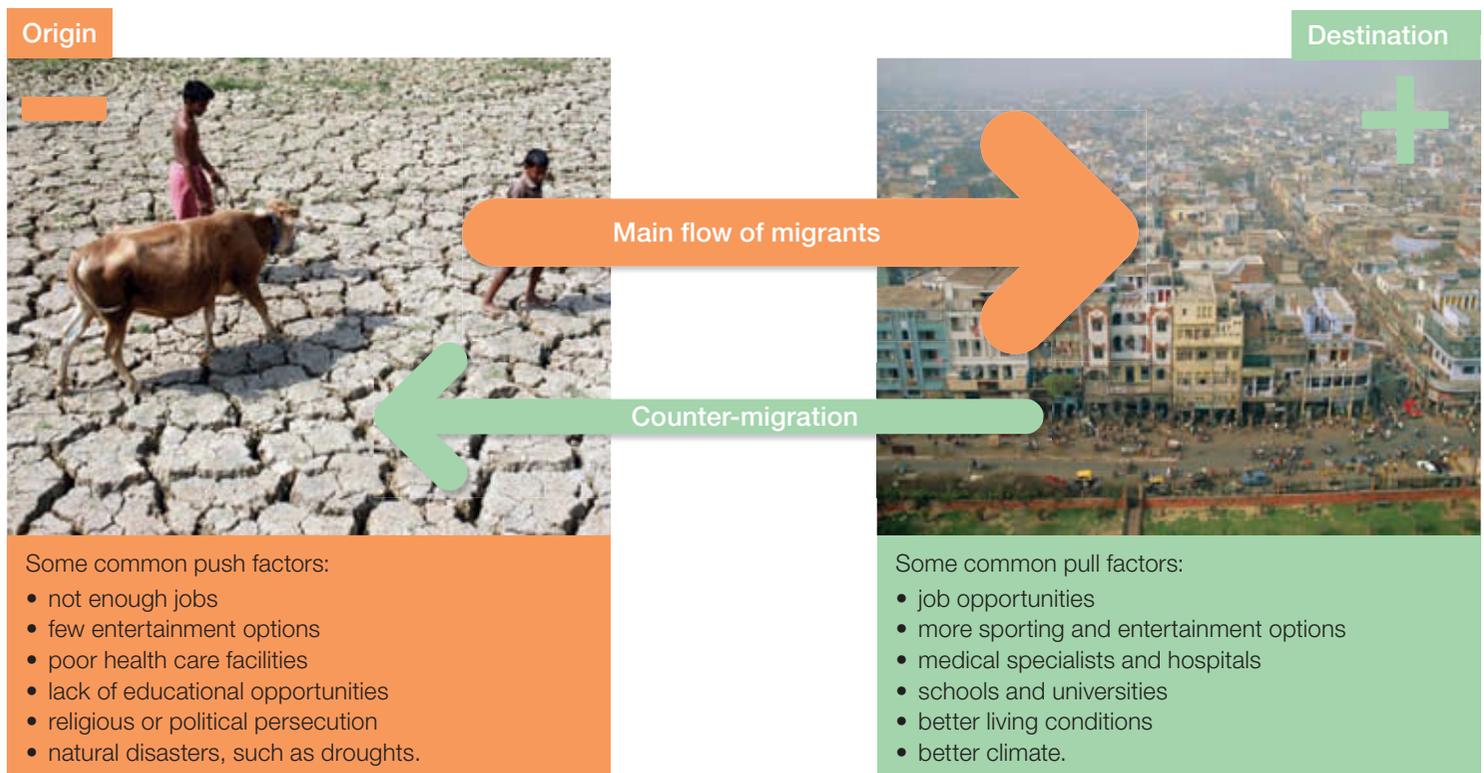
One of the largest movements currently underway around the world is the internal migration of people from rural areas to cities. When seeking to explain the reasons behind such population movements geographers often use models that simplify reality and show general trends.

Push and pull factors

One such model is known as Lee's migration model, developed by US geographer Everett Lee. Lee stated that

there are both positive and negative factors of the place each migrant comes from (the origin) and the place each migrant is going to (the destination). The negative factors Lee called **push factors** as they tend to push people away from a certain place. The positive factors he called **pull factors** as they tend to pull people towards a certain place.

Every migrant believes that the place he or she is going to is better than the place he or she is leaving. However, not everyone who believes that better opportunities exist elsewhere will move; they may see certain obstacles to moving, such as family ties and moving costs. Furthermore, some migrants find that the new place does not give them everything they hoped for and so they return to where they came from. This is called counter-migration.



Source 5.20 Lee's migration model

Population movements in Somalia

The concept of interconnection is used by geographers to show how everything on the Earth, living and non-living, is connected in some way. When population movements happen on a large scale, as they have in Somalia for example, they can impact on communities around the world. In Australia, virtually all population movements are voluntary, but in other countries people are forced to move. If people are forced to move to another country they are referred to as **refugees** but if they are forced to move within their own country they are referred to as '**internally displaced persons**' or IDPs. There are more than 26 million IDPs in the world.

About 1.5 million of these are in Somalia, Africa. An ongoing drought has forced many poor farmers to leave their land and move to camps near the capital Mogadishu, where they hope to find food and water. They join the hundreds of thousands of Somalis who are fleeing violence and fighting in the city and in other areas of the country. Many of them live in temporary settlements on the sides of the road leading to Mogadishu. The largest IDP settlement, Afgooye, is home to at least half a million people.

As many living in the IDP settlement have little hope of returning to their homes in Somalia, their hopes turn to moving to a new country that holds the promise of a better life. Large numbers of Somalis have been accepted as refugees in countries around the world, including Australia. This has brought new communities to Australia, adding to Australia's cultural mix. In this way, the war and drought in Somalia has resulted in a change in Australia's cultural make-up.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



Source 5.21 An internally displaced man in Somalia passes a group of military vehicles on his way to Afgooye

Check your learning 5.6

Remember and understand

- 1 What are the differences between push factors and pull factors?
- 2 Using Source 5.20, list some of the main reasons why people move to the city.
- 3 What advantages does the city have for people looking for work?
- 4 Why doesn't everyone move?

- 5 What is a refugee?
- 6 What is the main difference between a refugee and an internally displaced person?

Apply and analyse

- 7 Why is the population of the Afgooye camp in Somalia growing?
- 8 What are the push and pull factors responsible for the growth of Afgooye?

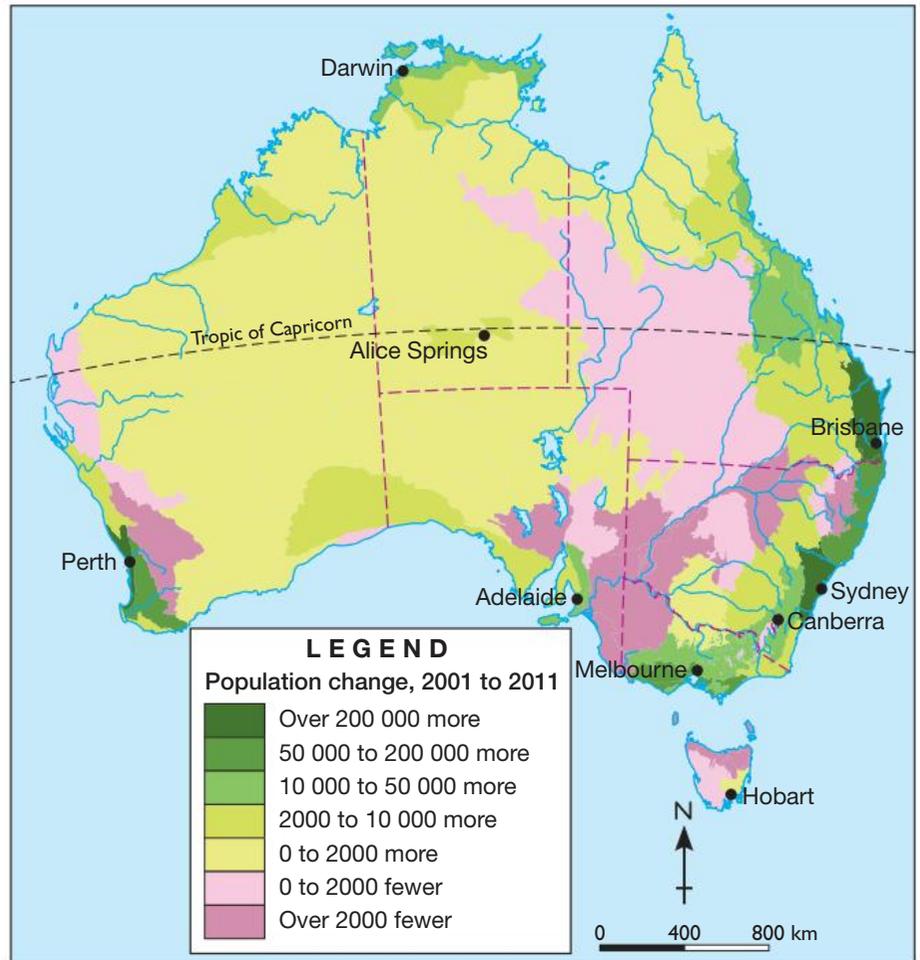
Population movements in Australia

Australians are some of the world's most mobile people. Forty per cent of us move house at least once every five years. People move for a wide variety of reasons, and if enough people move this leads to large-scale changes in the population at local, regional and national scales. For example, young people who live in country towns often must move to one of Australia's capital cities to attend university. This changes the population size and number of young people in both places. Similarly, older people may move from unpleasant climates to milder climates in order to better enjoy their retirement. This means the population of both places will change. Source 5.22 shows the ways in which Australia's population shifted in the 10 years between 2001 and 2011.

The map clearly shows that Australia's four largest cities and the areas surrounding them are growing more rapidly than the rest of Australia. Other significant trends include the following:

- Western Australia has overtaken Queensland as the fastest growing state. This is partially due to workers migrating because of job opportunities in the Western Australian mining industry.
- The inner-city areas of our largest cities are some of the fastest growing areas in the country. Inner-city Perth, for example, is growing at more than 12 per cent per year.
- The large cities are getting larger both in terms of their population and their size. Some of the fastest growing places in Australia are on the edges of the cities where more land is available for housing estates. The population of Wyndham in outer Melbourne, for example, is increasing by almost 30 people a day.

AUSTRALIA: POPULATION CHANGE, 2001–11



Source 5.22

Source: Oxford Atlas



Source 5.23 As with many rural towns in Australia, the population of Trundle in New South Wales is declining. To attract new residents, some empty farm houses are available for rent for only \$1 a week.

Our fastest growing suburbs

One of the key population movements in Australia is the movement of people, particularly young families, to the outer suburbs of our major cities. Some of Perth's outer suburbs, for example, are growing at five times the

national average. The fastest growing suburb in Perth is Wanneroo on the city's northern coastal fringe. More than 6200 people are moving to the suburb every year and new housing estates are being built to house them.



Source 5.24 The outer suburbs of Perth are some of the fastest growing urban areas in Australia.

Check your learning 5.7

Remember and understand

- 1 Why are the populations of some rural areas in Australia declining? How is Trundle (Source 5.23) trying to reverse this trend?
- 2 Using Source 5.22, list three places in Australia where the population is increasing. Next to these place names, explain why they are increasing.

Apply and analyse

- 3 Australia's population changes due to factors at a range of scales: global, national and personal. Give an example of a change at each of these scales.
- 4 Study Source 5.22. Describe the changes in the

distribution of Australia's population between 2001 and 2011. Why did the population change in this way?

Evaluate and create

- 5 Look closely at Source 5.24 showing a new housing development in Wanneroo.
 - a How has the natural environment been changed?
 - b Why do you think young families often build houses on the edges of cities, rather than near the centre?
 - c Name some of the advantages of living in this place.
- 6 How do you think Australia's population will change in the next 30 years? Brainstorm these changes and then, with a partner, discuss the impacts of your predicted changes on people and places.

Case study: the growth of Australian mining towns

One of the most significant population movements in Australia today is the movement of people to areas rich in mineral deposits (such as iron ore and coal) to work in and around the mines. This movement is due to a resources boom – a massive increase in demand for Australian mineral resources, particularly from Asian countries such as China and India. Many small towns located near mineral deposits are growing rapidly in size, population and prosperity as a result. This is creating opportunities for some people in these towns and problems for others.

The town of Moranbah, Queensland

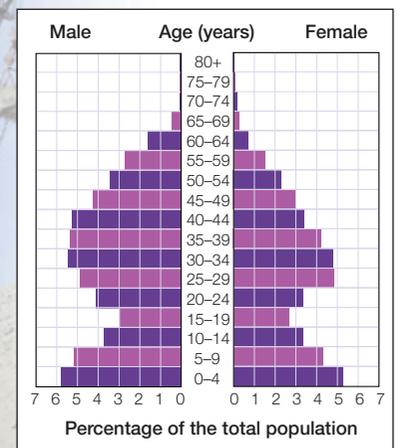
Lying beneath much of Queensland is one of the world's richest coal deposits – the Bowen Basin (see Source 5.27). Located in the Basin is the town of Moranbah. As people move to the Bowen Basin to take advantage of jobs in the mining industry, many buy or rent a house in Moranbah, making it their home. Others continue to live in more distant places, such as Brisbane and Sydney. They fly into Moranbah for work and then fly home when their shift is finished. Some may stay in the area for three weeks and then fly home for two weeks; others may work in

the mines from Monday to Friday and then fly home for the weekend. This type of lifestyle is referred to as 'fly in, fly out' (FIFO), which allows miners to take advantage of available jobs in remote areas without disrupting their families' living arrangements.

The changes in Moranbah, such as FIFO workers and the overall growth in population, present several key issues for governments and the residents of the town. For example:

- The price of houses and the costs of rent have increased dramatically in response to the demand for places to live. When a new mine started near the town, the rental price of some houses jumped by \$1000 per week. Some rentals are now as high as \$3000 per week and a new house may cost up to \$1 million.
- New infrastructure, such as schools and roads, needs to be developed for the incoming miners and their families without reducing the liveability of the town.
- Efforts need to be made to avoid a clash of industrial land uses, such as coal-handling facilities, with other land uses, such as schools, parks and houses.
- Plans must be made for the long term when demand for coal may fall and people leave the town.
- Steps need to be taken to reduce the environmental and health impacts of mining on the local environment.

Source 5.25 Many of the workers at the Peak Downs coal mine live in Moranbah.



Source 5.26 Population pyramid for Moranbah



Source 5.27 Residents of Moranbah protested in 2011, concerned that ‘fly in, fly out’ (FIFO) miners were increasing house prices but contributing little to their town.

CENTRAL WEST QUEENSLAND: BOWEN BASIN AND LOCATION OF OPERATING COAL MINES



Source 5.28

Source: Oxford University Press

Check your learning 5.8

Remember and understand

- 1 Why is the population of Moranbah growing and changing?
- 2 Why does this population growth result in higher house prices?

Apply and analyse

- 3 Examine Source 5.26.
 - a Which age groups make up the majority of the population?
 - b Are there more males or females in these groups?
 - c Given that Moranbah is a typical Australian mining town, what does this population pyramid tell you about the populations of mining towns generally?
- 4 Examine Source 5.28.
 - a Use the scale provided to estimate the distance from the Peak Downs coal mine to Moranbah.
 - b How many operating mines are there within 100 kilometres of Moranbah?
 - c What facilities for transporting coal to Asia have been built in this region?

Evaluate and create

- 5 Work in a group to brainstorm the positive and negative impacts of the population growth in Moranbah. In your brainstorm you may like to use headings, such as ‘changes to the environment’, ‘changes to housing’ and ‘changes to people’s way of life’.
- 6 What would happen if the demand for Australia’s coal suddenly fell and the mines near Moranbah closed? How would this impact on the town and its people?

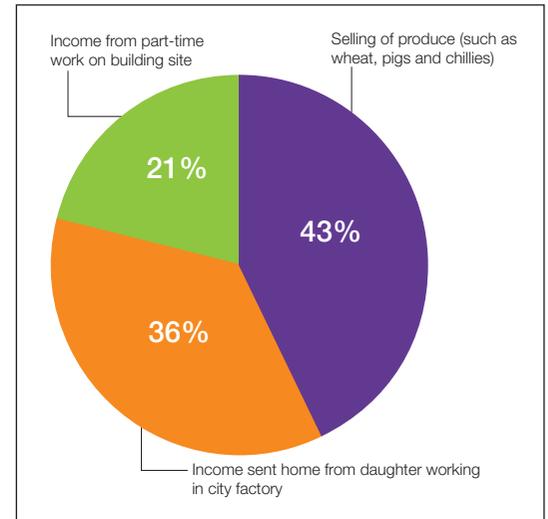
Population movements in China

For thousands of years, most Chinese people have lived in small rural villages. Their life was dominated by the daily routine of farming – planting, weeding and harvesting crops, and caring for animals such as pigs and cows. Over the last few decades, however, this situation has begun to change as more and more people move to one of China’s booming cities to find work and a better life.

Although China is still home to more than half a billion farmers, it is also home to some of the world’s largest and fastest growing cities. The movement of people from rural areas to cities in China is one of the greatest migrations in human history. Lured by the remarkable boom in China’s economy over the last decade, millions of Chinese peasants are leaving their farms and heading for cities along the east coast. This has led to many inequalities between rural and urban areas, with the average income in rural areas being about one-third of that in cities.

From rural life ...

Xianglan Li lives in a small village in Guangxi Province in southern China. Her day begins at dawn, when she wakes to sweep the concrete floor of the small home she shares with her husband and son. After breakfast she feeds her chickens and pigs, and collects waste from the pig sty to carry to the fields for fertiliser. Using the water from the buckets she has placed beside the house to collect rainwater, she throws some on the road to keep down the dust. Like most rural villagers in China, the family has no car.



Source 5.30 Like many families in rural China, Xianglan’s family relies on money sent home from a relative working in the city.

Source 5.29 Small villages dot the landscape of Guangxi Province in southern China.



Xianglan's husband works part time as a labourer on a building site in a nearby town. Xianglan joins other villagers walking to their fields a few kilometres from the village. The roads are slowly filling with small tractors and bikes, as well as farmers carrying their produce on long poles. There is a buzz of excitement as tomorrow is market day.

Xianglan spends her morning weeding the wheat and picking chillies for the market. In the afternoon she collects firewood from the nearby forest. Carrying the wood and chillies, she walks through the village to her home. Some farmers are spreading out their wheat crop in the village square to dry it, ready to separate the grain from the stalks. The stalks will become feed for the pigs and fuel for the cooking fire.

Although her home has no running water and no inside toilet, it does have a new colour television that her daughter, Xiu, has sent from Shenzhen. There is only electricity for a few hours in the evening, so after dinner Xianglan and her husband sit on their bed and watch a new soap opera. They go to sleep as the sun sets.

... to urban life

Xianglan's daughter, Xiu, lives in Shenzhen, a major city with a population of 10 million people near Hong Kong, hundreds of kilometres from her family's village. Shenzhen is a full day's train ride away. Three years ago, Xiu left her family home to move to the city to find work. She now works in a factory where she assembles mobile phones. Xiu lives in a dormitory owned by the company and shares a room with seven other workers, most of whom are also from Guangxi Province. There is a cafeteria in the dormitory building and the bathrooms have hot and cold running water. There is reliable electricity, which the workers use to watch television in their spare time, wash their clothes and charge their mobile phones. Virtually everyone has a mobile phone; some have two or three.

Xiu works 10 hours a day in the factory. She is pleased to have a job so she can help support her parents and brother, but she finds the work boring and repetitive. She knows that if she quits she will be quickly replaced, but she sometimes thinks about moving back to Guangxi. She catches the train home once a year to celebrate Chinese New Year with her family. Next year, she intends to take home a mobile phone for her father.



Source 5.31 Xiu works in an electronics factory in Shenzhen assembling mobile phones for export.

Check your learning 5.9

Remember and understand

- 1 Why are young Chinese men and women moving to large cities?
- 2 What does Xiu do for a job? Where do you think she was trained for this job?

Apply and analyse

- 3 How has the movement of young Chinese men and women from farms to cities changed both places?
- 4 Why can a worker in the city earn three times as much as a farm worker?

Evaluate and create

- 5 In what ways do you consider Xianglan's life to be better than her daughter's? In what ways do you consider it to be worse? Discuss your answers in a small group. Were there some areas that you all agreed on?
- 6 Imagine that Xiu quit her job and returned home. Explain the impact this would have on the following:
 - a the family's income
 - b the family's food expenditure
 - c the factory in Shenzhen.
- 7 If Xiu's father visited her in Shenzhen, what do you think he would find most surprising about his daughter's way of life? Give some reasons for your answer.

Case study: the growth of China's megacities

In 2012, there were two megacities in China – Shanghai and Beijing. By 2025, six new Chinese megacities with populations of 10 million people are expected to emerge. By this time, 1 billion Chinese people will be living in cities. This is a remarkable change in a country where only 20 per cent of people lived in urban areas in 1990.

The beginning of this change can be traced back to the late 1970s and 1980s. At that time, the Chinese Government began to introduce policies and laws that encouraged economic growth. The goal was to turn China from a country of farmers into a country of business people and factory workers. Businesses and factories soon started to pop up in most Chinese cities, and people began to move from the countryside to take advantage of new job opportunities. Global demand for Chinese goods meant the numbers of factories and factory workers quickly increased. Overseas companies struggled to compete with Chinese manufacturers on price. Many started moving their factories to China to take advantage of China's expertise and lower labour costs. The drivers of this growth and change were China's big cities. In fact, cities in China are expected to produce 90 per cent of the country's total wealth by 2025.

CHINA: POPULATION OF LARGEST CITIES, 2005 AND 2025



Source 5.32

Source: Oxford University Press

keyconcept: place

Dreams of returning home

One of the fastest growing cities in China is Shenzhen in Guangdong Province. In 1980, Shenzhen was a small fishing village with a population of about 10 000. Today, it is home to almost 10 million people. A recent study estimated that about 80 per cent of Shenzhen's population are migrants to the city from rural areas across China.

One of these migrants is Zhao. He moved from his home in rural Hunan Province in 1998 after friends convinced him that he could make more money as a taxi driver in the city than as a farmer.

As a migrant, Zhao is not entitled to have a licence that allows him to own land in Shenzhen. This licence (known as *Hukou*) recognises people as official residents of the city, and without it Zhao feels unwelcome in Shenzhen. Zhao intends to move back to Hunan when his son finishes high school because it has become very difficult to earn enough money as a taxi driver. This is mainly due to traffic congestion and rising petrol prices. In Hunan he intends to return to farming his 0.5 hectare plot of land and to care for his parents, who are becoming too old to farm the land.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.



Source 5.33 Competition among taxi drivers in Shenzhen is fierce



Source 5.34 A snapshot of China's cities by 2025 based on current trends

Check your learning 5.10

Remember and understand

- 1 Why are China's cities growing so rapidly?
- 2 Why are people moving to China's cities?

Apply and analyse

- 3 As a country, how does China benefit from people moving to cities?
- 4 How many megacities (over 10 million people) were there in China in 2000? How many are there expected to be in 2025? Why is this number expected to change?
- 5 In which regions of China are the cities expected to grow most rapidly? Discuss some of the reasons for this

pattern with a partner. Can you find one aspect of the natural environment responsible for this pattern and one aspect of the human environment?

Evaluate and create

- 6 Read about the growth of Australia's cities under 'Population movements in Australia' earlier in this chapter. Compare the reasons for this growth with the reasons for the growth of China's megacities. What are the similarities and the differences?

Australia's mining boom

Australia is home to some of the world's largest and most productive mines. A major supplier of many metals and minerals used around the world, Australia has large reserves of lead, brown coal, nickel, silver, uranium, zinc and zircon. This mineral wealth tends to be located in remote areas of the country. Large mines are currently located in the north-west of Western Australia and central Queensland.

Case study: the mining boom's impact on the movement of Australia's Indigenous population

Until recently, few Indigenous Australians worked for the mining companies. Over the past decade or so this has changed dramatically. Not only are mining companies offering work opportunities for local Aboriginal communities, but they are also recruiting Indigenous workers from other parts of the country on 'fly in, fly out' (FIFO) and 'drive in, drive out' (DIDO) working arrangements.



Source 5.35 The mining sector is providing employment for Aboriginal people in many ways. These trainees, from Kempsey in New South Wales, are training to become 'fly in, fly out' (FIFO) workers in the Pilbara region of Western Australia. This work provides a valuable source of income for the town of Kempsey.

Employing local workers

Mining companies now recognise that recruiting local Indigenous Australian workers benefits both the local communities and the mining companies. Unlike 'fly in, fly out' (FIFO) workers, local Indigenous workers have a spiritual connection to the country in which the mines are located. This makes them much less likely to leave their jobs and move elsewhere. Employing local workers also means that there is little additional strain placed on the housing market as these workers already have homes in the area. Finally, the wages of these Indigenous workers stay in the local area rather than being taken to large cities by FIFO workers. Local children see the miners as role models and the mines as pathways for their own futures. School attendance rates in mining areas tend to be higher than in other remote places.

Employing FIFO workers

The mining boom has also offered employment opportunities for Indigenous Australians living long distances from mining areas. Many fly long distances from their homes (in towns such as Kempsey, New South Wales) to earn a good living as FIFO workers in mines across Western Australia and bring back money to their communities.

Well over 50 000 Indigenous Australians now work in mining. At some mines and mining facilities, such as ports, almost half the workforce is Indigenous. Rio Tinto, one of the world's largest mining companies, is the largest non-government employer of Indigenous people in Australia, with almost 2000 Aboriginal workers. Another mining giant, BHP Billiton, has recruited 720

Indigenous trainees at its Pilbara operations in the last few years. Around one in 10 employees of the Fortescue Metals Group is Aboriginal, and the company has set up special training courses in Port Hedland and Roeburne in the Pilbara region.

Sharing the wealth?

Despite the positives, many Indigenous Australians feel the mining boom has brought little economic benefit and has increased the gap between themselves and non-Indigenous Australians. A recent study showed that there is little difference between the well-being (such as health and life expectancy) of Indigenous people living near mines and those living in other regions of Australia. The mining boom has also driven up housing and food prices in numerous remote communities. Many Indigenous Australians also feel that mining companies show little respect for the special connection they have with the land.

[They] all ripping our country up and we getting nothing back from it, just chicken feed ... Everything, all the mining company, what are they giving back to the people? We are missing out on the luxury that is coming from our land, and other people are enjoying it.

Interview with Aboriginal man, Pilbara region



Source 5.36 Ancient rock carvings on the Burrup Peninsula in Western Australia are now under threat from mining in the area.

Threats to Country

There is also some concern that mining is threatening important sites, many of which are sacred to local Aboriginal communities. On the Burrup Peninsula, in the Dampier Archipelago of Western Australia, for example, there is one of the world's largest collections

Source 5.37 Comparison of Indigenous and non-Indigenous people in the Pilbara

Measure	Indigenous Australian	Non-Indigenous Australian
Average weekly income	\$297	\$1984
Adults who have completed Year 12	19%	47%
Without an Internet connection	55%	11%
Workforce employed in mining (2006)	19%	45%
Employed adults (2006)	47%	86%

of rock carvings (see Source 5.36). Some of these rock carvings date back 9000 years. This is one of the world's most important archaeological sites, as the rock carvings contain the record of an ancient way of life.

The construction of a proposed chemical processing plant on the region's natural gas reserves may result in the destruction of some of the rock art to make way for roads and buildings. Some researchers also believe that air pollution from the plant may erode the art. The art is now listed as a 'Monument in Danger' by the World Monuments Fund.

Check your learning 5.11

Remember and understand

- 1 What are FIFO workers?
- 2 Why do many mining companies now employ Indigenous Australian workers?

Apply and analyse

- 3 Use an atlas to locate the towns of Kempsey in New South Wales and Port Hedland in Western Australia. Estimate the distance between these two places.
- 4 In what ways are the trainees in Source 5.35 similar to other FIFO workers and in what ways are they different?
- 5 Use the data in Source 5.37 to compare the well-being of Indigenous and non-Indigenous people in the Pilbara region.

Evaluate and create

- 6 Do you think that the rock carvings on the Burrup Peninsula should be protected? Give reasons for your answer.
- 7 Do the advantages of mining for Indigenous communities outweigh the disadvantages? Discuss this as a class before reaching a conclusion.

China's manufacturing boom

The manufacturing boom has resulted in a massive movement of Chinese people from rural areas to booming factory cities. It is estimated that 140 million people have left their rural homes, and that 45 million will leave within the next five years.

Case study: the manufacturing boom's impact on the movement of China's rural population

The growth in China's economy has brought many benefits to the Chinese people but this growth would not have been possible without the mobility of its population. The Chinese Government estimates that the country has a 'floating population' of 215 million people (16 per cent of the total population) who are registered as living in a rural area but who live and work in a city. These migrants receive no benefits and are usually not counted as part of the city's population, yet they are improving the economy of their country. In doing so, they are also improving their own standard of living and that of the communities they have left behind when they send money back to their families.

A comparison of living conditions in China between 1995 and 2012 shows some of the ways in which China has changed (Source 5.40). Statistics such as these are often used to show trends as they take into account the whole population and not just a few people.

Perhaps the most amazing statistic is the percentage of the population living below the poverty line or earning less than US\$1.25 a day. In 1981, 85 per cent of the Chinese people were living in poverty. Most of these people were living in rural areas and were only able to grow enough food to feed themselves and their families. By 2005, this figure had fallen to 16 per cent of the population. This means that between 1981 and 2005 over 600 million Chinese moved out of poverty. No other place on Earth has made the same progress at this speed or scale. For many of these people, the way out of poverty involved a move to the booming cities and a job in a factory.

A downside of this economic growth is an increase in the gap between the rural poor and urban rich, with city dwellers earning three times as much as those in rural areas. There has also been a considerable cost to the environment, especially in areas where coal-fired power stations provide the electricity for factories and towns.



Source 5.38 Every year the railway station in the Chinese city of Guangzhou becomes one of the busiest places in the world as migrants from the countryside return home for the Chinese New Year holiday.

CHINA: MOVEMENT OF PEOPLE



Source 5.39

Source: Oxford University Press

Source 5.40 Selected indicators of the standard of living in China, 1995 and 2012

Indicator	1995	2012
Male/female life expectancy	67/69 years	72/76 years
Infant mortality rate	52/1000 births	16/1000 births
Literacy rate	73%	92.2%
Total exports	US\$ 58 919 million	US\$ 1.89 trillion
Electricity consumption	680 400 million kilowatt hours	3.4 trillion kilowatt hours
Carbon dioxide emissions	2 388 613 thousand tonnes	7 706 490 thousand tonnes (2009)
Proportion of population living in cities	33%	47%

Source 5.41 One of the impacts of China's manufacturing boom is air pollution in many cities.

Check your learning 5.12

Remember and understand

- 1 How many Chinese people moved out of poverty between 1981 and 2005?
- 2 Which indicator in the table do you think best shows the improvement in Chinese living conditions? Give some reasons for your answer.

Apply and analyse

- 3 Why has the movement of people been an important part of the improvement in Chinese living conditions?
- 4 What are some of the negative outcomes of people moving from rural China to the cities?
- 5 Look closely at Source 5.39. Where are the wealthiest regions in China? Compare this map to Source 5.32, showing the location of China's largest cities. What similarities do you notice between the location of cities and the wealth of a region?
- 6 Which of these statements best describes the pattern of movement shown in Source 5.39? Justify your choice.
 - Most people move from wealthy areas to poorer areas.
 - Most people move from poorer areas to wealthy areas.
 - There is no clear pattern.

Evaluate and create

- 7 Source 5.41 shows an environmental impact of rapid economic growth. With the class, brainstorm other negative impacts on people and places.

5.2 big ideas: broadsheet

Population movements in India

In terms of area Australia is the sixth biggest country in the world, with a population of around 23 million. The seventh largest country in the world is India, with a population closer to 1.2 billion. This is more than 50 times greater than Australia's population.

Whichever way you look at it, India's population is immense. India is the second most populous country on Earth after China. By 2030, India is expected to overtake China as the most populous country.



While many people think of crowded megacities when they think of India, most Indians live in small rural villages. In fact, more than half the population lives in small communities of fewer than 5000 people.

skilldrill

Interpreting graphs

Graphs provide geographers with the ability to more easily identify trends and patterns in data they have gathered. Graphs can be used to compare places and events, to show change over time, to show the relative importance of different things, and to show important aspects of a place. When interpreting graphs follow these steps:

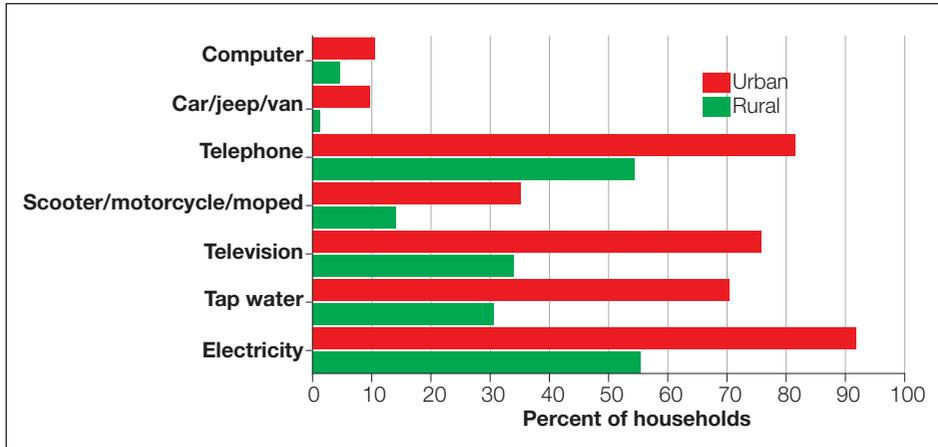
- Step 1** Always read the title carefully so that you know exactly what the graph is showing.
- Step 2** Look carefully at each axis on bar and column graphs so that you understand the scale that has been used.
- Step 3** Look for general trends, such as the overall growth of a city, rather than exceptions to trends.

For more information on a range of different graphs, refer to section GT.2 of 'The geographer's toolkit'.

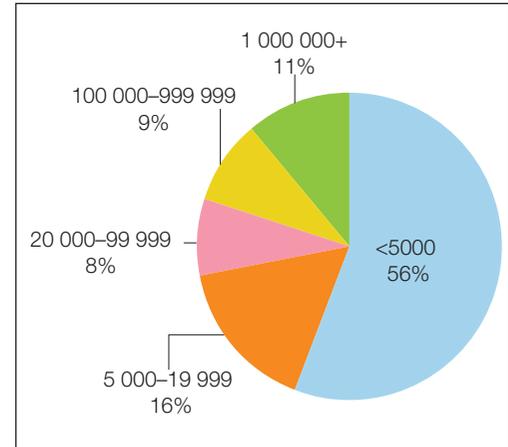
Apply the skill

- 1** Study Sources 5.43 to 5.46 and complete the following tasks, giving reasons for your answers.
 - a** Which of these graphs best shows why many Indians choose to move to urban areas?
 - b** Are conditions better in rural areas or urban areas?
 - c** Which of these graphs best shows the impact of movement to the cities?
 - d** Which of these graphs best shows how India's population is changing over time?
 - e** Which of these graphs best shows where most people in India live?
 - f** The definition of a city varies between countries. One common measure is a place with more than 20000 inhabitants. By this definition, what percentage of Indians live in cities?

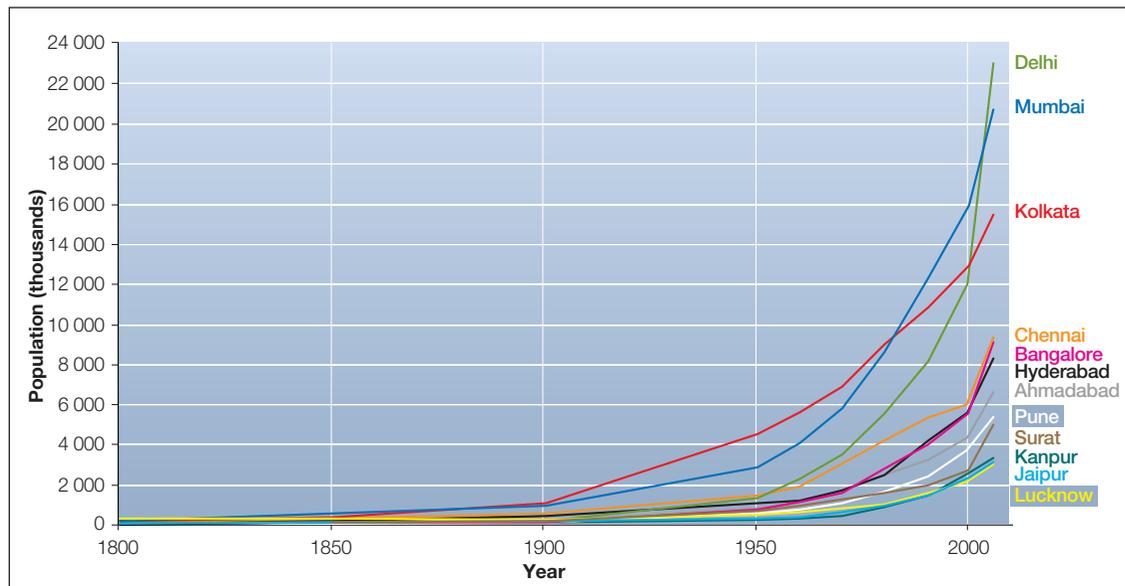
Source 5.42 Most Indians live in small, rural villages.



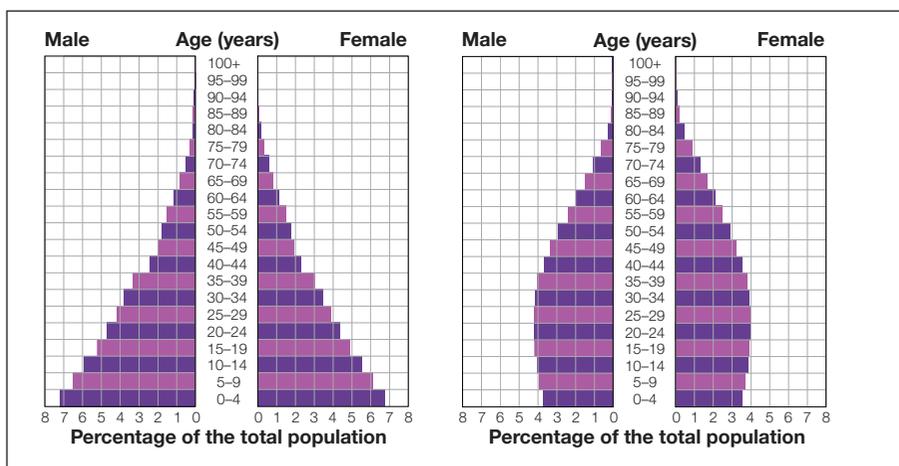
Source 5.43 Household services and amenities of urban and rural Indians



Source 5.44 India's population ranked by the size of the community in which they live



Source 5.45 Growth of India's cities, 1800–2012



Source 5.46 Population pyramids for India, 1990 (left) and 2030 (right)

Extend your understanding

- 1 On an A3 piece of paper, construct a sketch of Lee's migration model as it applies to the cities of India. Use Source 5.20 as a guide to setting this out. Use the information from Source 5.43 to decide on the push and pull factors that attract migrants to India's cities.

5.3 How has international migration changed Australia?

International migration to Australia

Modern Australia has been created and shaped by national and international population movements. From the arrival of the First Fleet in 1788 – loaded with almost 1500 convicts, sailors and soldiers – Australia has been populated by waves of immigrants. First, penal colonies at Sydney, Port Arthur and Fremantle were established. Then large numbers of migrants from Great Britain and Ireland came to establish towns and farms. By the 1860s more than three-quarters of the population were of Anglo-Celtic origin and this figure remains at about 70 per cent to this day. From the middle of the 19th century, immigrants arrived from across Asia and the Pacific Islands, and continued to flow from Europe. They were attracted by various factors, such as gold, work and the promise of a new life.

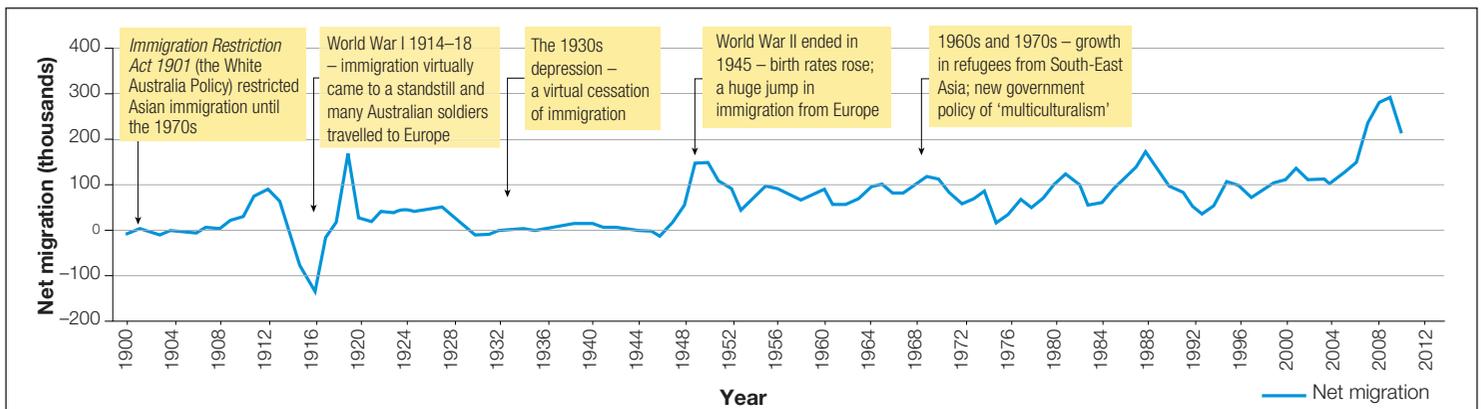
During the 1900s, immigrants from Britain continued to dominate. An immigration policy that discriminated against all non-white migrants (known as the White Australia Policy) was enacted in the first days of the new nation in 1901 and remained until the 1970s.



Source 5.48 The discovery of gold in the 1850s brought many immigrants to Australia.



Source 5.49 Australian citizens by country of birth, 2011. In 2011, more than one-quarter of Australians (around 27 per cent) were born overseas.



Source 5.47 Net migration (total arrivals less total departures) to Australia during the period 1900–2010

The end of World War II in 1945 saw waves of migrants come to Australia from southern European countries, such as Italy and Greece. As immigration policies were freed up, these waves were followed by others from the Middle East, Asia and South America. Australian society is therefore very different from that in long-established countries in Europe and Asia. Just like the United States, Canada, New Zealand and Argentina, this country is largely a nation of immigrants.

Multicultural Australia

Today, Australia is considered by many to be a multicultural country. This description acknowledges that the people of Australia come from a wide range of ethnic and cultural backgrounds. In 'The People of Australia: Australia's Multicultural Policy', released in 2011, the Australian Government states that 'multiculturalism is in Australia's national interest and speaks to fairness and inclusion. It enhances respect and support for cultural, religious and linguistic diversity.' On 21 March each year, many Australian schools and communities celebrate Australia's cultural diversity by holding Harmony Day events.

keyconcept: place

The birth of multicultural Australia

Some places in Australia have a special significance in the history of certain migrant populations. Such places give these populations a particular connection to the environment and a sense of belonging and identity. This is an important part of the key concept of place.

One such connection is the contribution made by many migrants to the Snowy Mountain Hydroelectric Scheme in New South Wales. Begun in 1949, the scheme diverted water from the Snowy River through 160 kilometres of tunnels to create a series of dams and hydroelectric power stations. This was the largest engineering project ever undertaken in Australia at the time.

Over 100 000 people worked on the scheme between 1949 and 1974. About two-thirds of these workers were immigrants from over 40 countries, including Austria, Finland, Jordan, Russia, the United States, Ireland, Scotland, Wales, England, Germany, Norway, Sweden, Cyprus, Czechoslovakia, Hungary, Poland, Switzerland, Turkey, Estonia, France, Portugal, Italy, Greece, Romania and the Ukraine.

Check your learning 5.13

Remember and understand

- 1 What is multiculturalism?
- 2 Examine Source 5.48 showing miners on the gold fields during the gold rush. How did this event change the environment and the population of Australia?
- 3 The Snowy Mountains Hydroelectric Scheme is thought by many to be the birthplace of multiculturalism in Australia. What do you think this means?

Apply and analyse

- 4 On a blank outline map of the world, locate and label the countries from which migrants came to Australia to work on the Snowy Mountains Scheme. Describe the pattern on your map using the PQE method. (Refer to the section on the PQE method in GT.2 of 'The geographer's toolkit' for instructions.)

Evaluate and create

- 5 Conduct some research into the impacts of international migration on the original Indigenous Australians. What effect did it have?



Source 5.50 Migrants at work on the Snowy Mountains Scheme in 1954

Work was difficult to find in Europe after World War II, so many migrants were attracted by the work and higher wages on offer in Australia. Many of the migrant workers aimed to earn enough money to bring their wives and families to Australia. This is just one example of how Australia began to change from a country mainly populated by English migrants and their descendants to the multicultural society it is today.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.

The changing face of Australia

Australia is a multicultural nation – that is, a nation of many cultures. Australia’s cultural diversity is due mainly to our history. Our population is made up of our Indigenous peoples, the descendants of our British colonial past, and immigrants from the world’s many countries and cultures. Modern Australia is largely a land of immigrants and their children. In 2011, 26 per cent of Australia’s population was born overseas, and a further 20 per cent had at least one overseas-born parent. Today in Australia there are people from more than 200 countries.



Australia’s first female Prime Minister, Julia Gillard, was born in Wales and migrated to Australia as a child.



AFL footballer Nick Riewoldt is of German ancestry.



Comedian Anh Do arrived in Australia as a refugee from Vietnam.



Singer Jessica Mauboy is an Indigenous Australian.

Source 5.51 The faces of cultural diversity in Australia

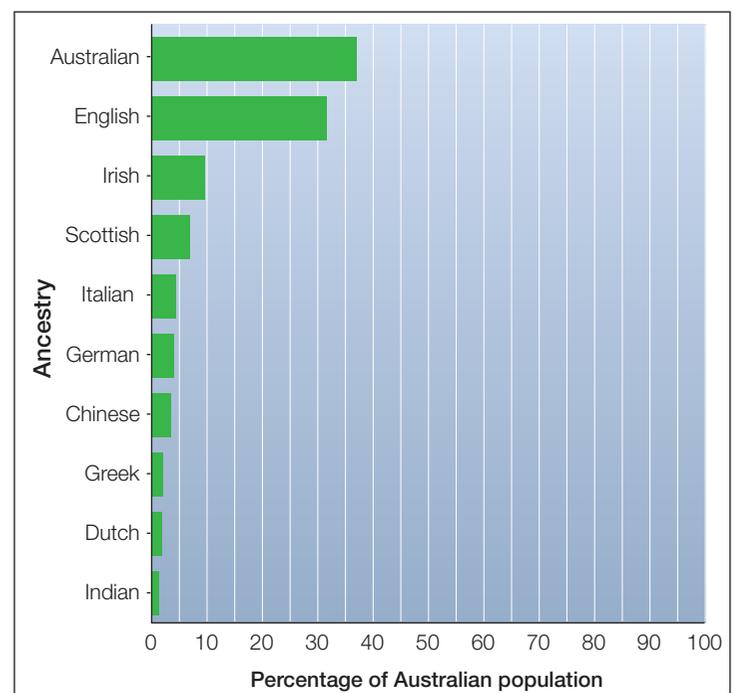
The ancestry of Australians

The Australian **census**, which is taken every five years, asks every Australian to identify their ancestry. They may identify up to two ancestries in their answer. Source 5.10 shows the top 10 ancestries recorded in the 2006 census.

Some geographers also use the term **ethnicity** to refer to a person’s heritage. Ethnicity combines elements of language, place of origin and culture.

Language diversity

The number of languages spoken in a particular country is a good indicator of cultural diversity. English is the dominant language in Australia. Fewer than 1 in 100 Australians cannot speak English. Despite this, more than 200 other languages are spoken in Australian homes every day. The most common include Italian, Greek, Cantonese, Arabic and Mandarin. At the time of European settlement in 1788, it is estimated that more than 250 distinct Indigenous languages were spoken in Australia. Today, this number has fallen to fewer than 150. Of these, fewer than 20 are considered to be strong languages, spoken by all generations.



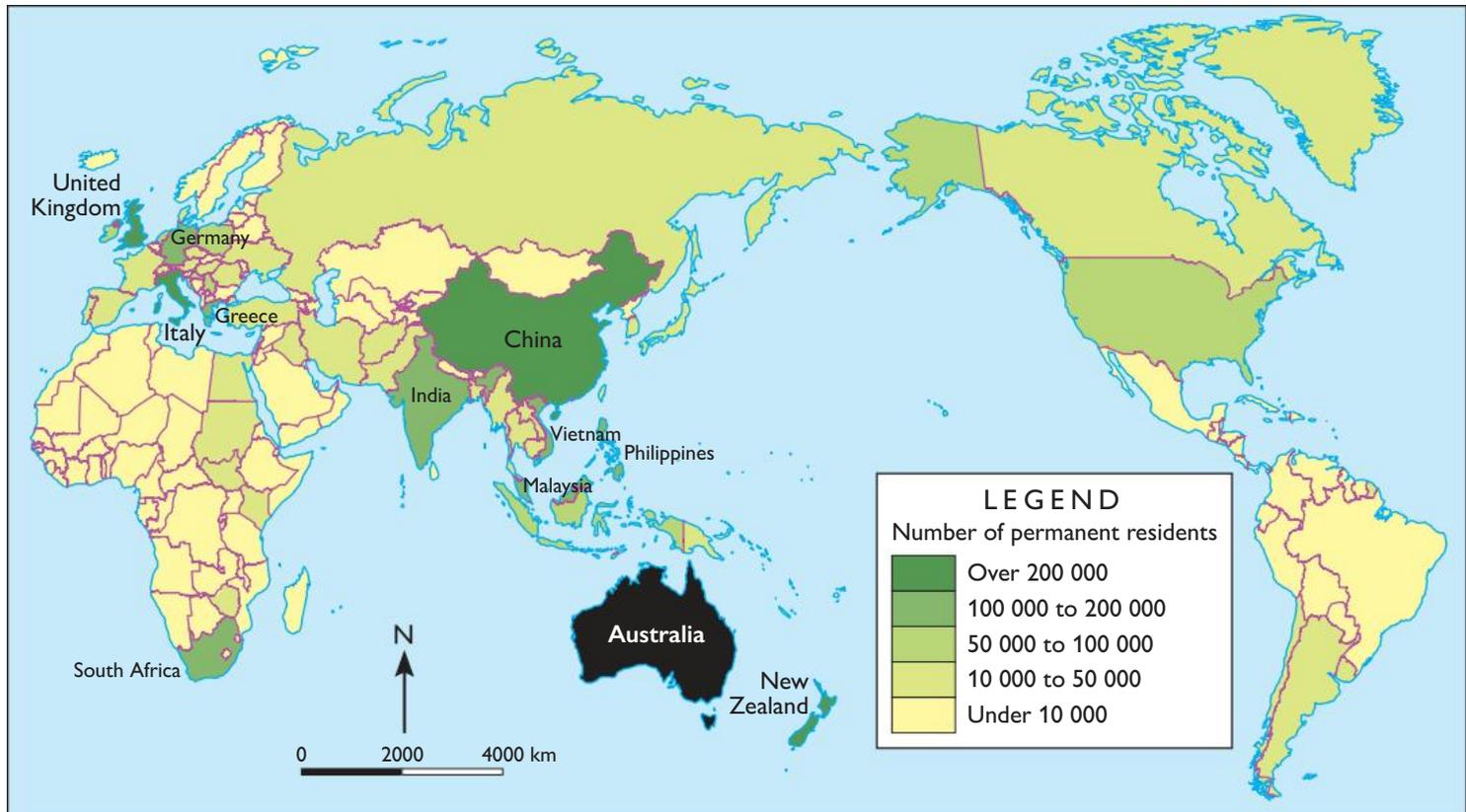
Source 5.52 Most common ancestries in Australia, 2006

Patterns of international migration

Patterns of migration to Australia have been shaped by events and policies in Australia and in other parts of the world. For example, at the end of World War II, Australia took in large numbers of migrants from Europe who had been forced from their homes by the war. The proportion

of the overseas-born population from Europe was 52 per cent in 2001, but this reduced to 40 per cent in 2011 as the number of migrants from Asia and New Zealand increased.

AUSTRALIA: RESIDENTS IN 2006 BY COUNTRY OF BIRTH



Source 5.53

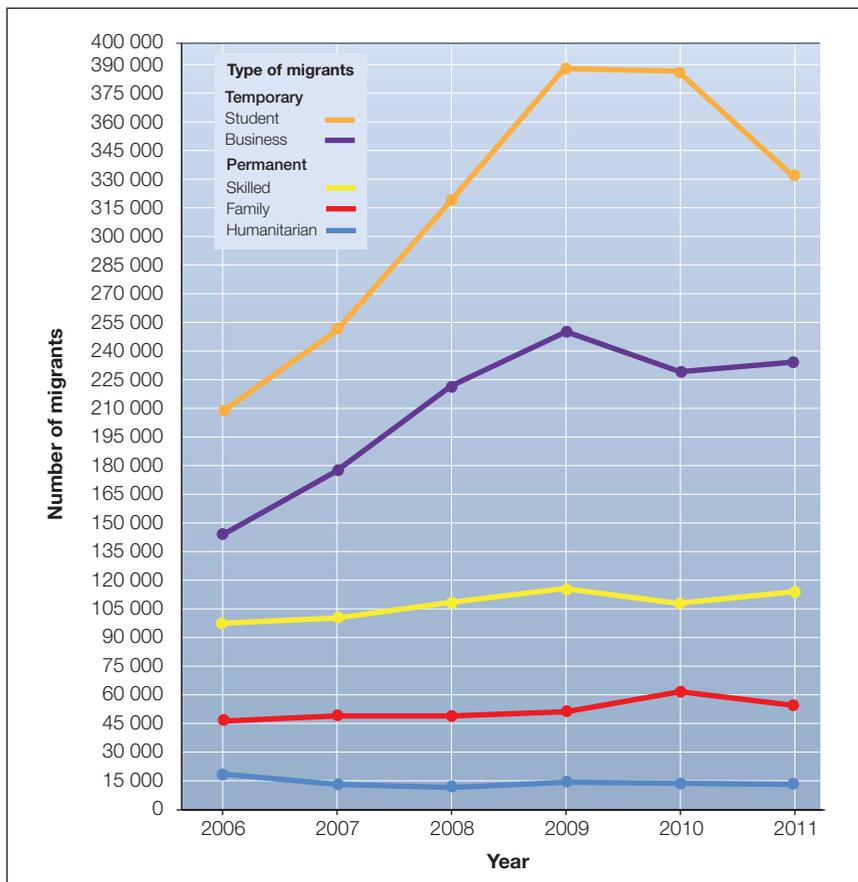
Source: Oxford University Press

Australian Government migration policy

Australian governments rely on overseas immigrants to achieve economic goals. In times of strong economic growth there is a higher demand for migrants to work and live in Australia. This migration intake may fall when the economy is weak and unemployment climbs. The Federal Government is responsible for levels of migration. It sets out categories for migration and sets targets for each group to reflect the economic and political climate in Australia and the world. Australia also provides education services to large numbers of overseas students.

The categories of migrants are:

- 1 Permanent migrants
 - Skilled labour – to fill specific shortages in the workforce
 - Family migration – to help families to reunite
 - Humanitarian – to assist people in need, such as refugees
- 2 Temporary migrants
 - Student – individuals coming to Australia to study for a fixed period
 - Business – workers migrating for a short period or on a working holiday
 - Visitor – a short-term visitor for business, family visit or tourism.



Source 5.54 Migration patterns in Australia

Economic benefits of international migration

As well as social benefits, population movements have the potential to provide many economic benefits. This is most apparent in the contributions that migrants make to the economy of the places they move to. Migrants often fill gaps in the labour market by providing essential skills. The Department of Immigration publishes a list of skilled occupations with shortages of applicants in Australia. Potential immigrants with these skills can then apply for citizenship to the country. Jobs in medicine, construction and education are currently high on this list. Some other sectors of the economy, such as agriculture and hospitality, also rely heavily on migrant labour.

The seasonal nature of fruit and vegetable growing, for example, means that growers need a large workforce for a short period of time. Groups of pickers move between different regions of Australia depending on the crop and time of year. Some of these groups are made up of migrants from similar backgrounds, such as Pacific Islanders or Vietnamese, while overseas backpackers are also an important source of this labour. Whether its tomatoes in Bowen between May and October, mangoes in Cairns between November and December, or apples and pears in Shepparton between February and May, there are tens of thousands of workers following the harvest and contributing their skills and money to the local economy.

Family reunions

Many families can become disconnected through the migration process. This is particularly the case for refugees. Ten-year-old Neema Mukasa was finally reunited with her father at Melbourne airport in 2006 after being separated for six years. In 2000, at the age of four, she was separated from her family, including her twin sister, while fleeing a civil war in the Democratic Republic of Congo. Neema's mother was killed in the violence and her father applied to bring his five remaining children to Australia. They were accepted as refugees under the Australian Government's Humanitarian Program and settled in Shepparton in country Victoria. During an interview with the local school principal, Mr Mukasa told the story of his lost daughter.

The principal contacted the Red Cross and through their tracing service they were able to locate Neema who was living in Nairobi with her uncle. He had desperately tried to find the little girl's

Source 5.55 This worker from Mauritius is harvesting peaches near Swan Hill in Victoria



missing family and had walked through five countries trying to catch up with them. This remarkable journey took them through a series of refugee camps over four years until they eventually reached Nairobi. After contact had been made between Africa and Australia, the family applied to the Department of Immigration for Neema to be able to come to Shepparton and she was reunited with her family.

Although this is just one example of an immigration story, it gives an idea of the types of responses to population movements at various levels. The Shepparton community responds at the local level by providing education and a safe place to live and work for new immigrants. The Department of Immigration operates at the national scale by assessing the refugee claims of thousands of applicants, and the Red Cross operates at the international level in response to disasters and humanitarian crises.



Source 5.56 Neema with her family and the Shepparton principal who helped them become reunited



Check your learning 5.14

Remember and understand

- 1 What does the term 'multicultural' mean?
- 2 What percentage of Australians in 2011 were either born overseas or had a parent born overseas?
- 3 Study Source 5.53. What were the source countries of most Australians born overseas in 2011?
- 4 Why do the numbers of migrants coming to Australia change over time?
- 5 List the different categories of migrants and provide one example for each.

Apply and Analyse

- 6 See if your class is typical of the Australian population by asking each student to identify their ancestry. They may name one or two ancestries. Compare your results to those described in the 2006 census (Source 5.52).
- 7 Study the graph in Source 5.54.
 - a Which category provides most migrants to Australia?
 - b When did most skilled migrants enter Australia? Why might the numbers have increased at this time?
 - c How does the number of humanitarian migrants compare to the other groups? What factors do you think might increase or decrease this category of migrant?

Evaluate and create

- 8 What does the ancestry of modern Australians (Source 5.52) tell you about our past? How do you think this will change over the next 50 years?

Migrant communities in Australian cities

Many people immigrating to Australia choose to start their new lives in areas of a city where people with a similar cultural background have also settled. Over time, these suburbs can develop particular characteristics that reflect the cultures of the people who live there. For example, the Melbourne suburb of Sunshine is home to a large Maltese population, while the Sydney suburb of Marrickville is home to a large Greek population.

New arrivals tend to settle in the same areas for a variety of reasons. The houses there may be affordable, they may have family or friends close by, or there may be a number of community groups and support services nearby. These services might include emergency accommodation, translation services, adult language and education centres, employment agencies and accommodation services (such as Centrelink and Department of Housing). These areas may also provide important social institutions (such as places of worship), and meeting places and shops selling familiar items (such as food, utensils and clothing).

For people from non-English-speaking backgrounds, an important factor that pulls them to live in certain suburbs is the presence of professionals (such as doctors, lawyers and accountants), shopkeepers and other people who speak their language. This can be vital in order to carry out their day-to-day lives.

Case study: the Chinese community in Hurstville, Sydney

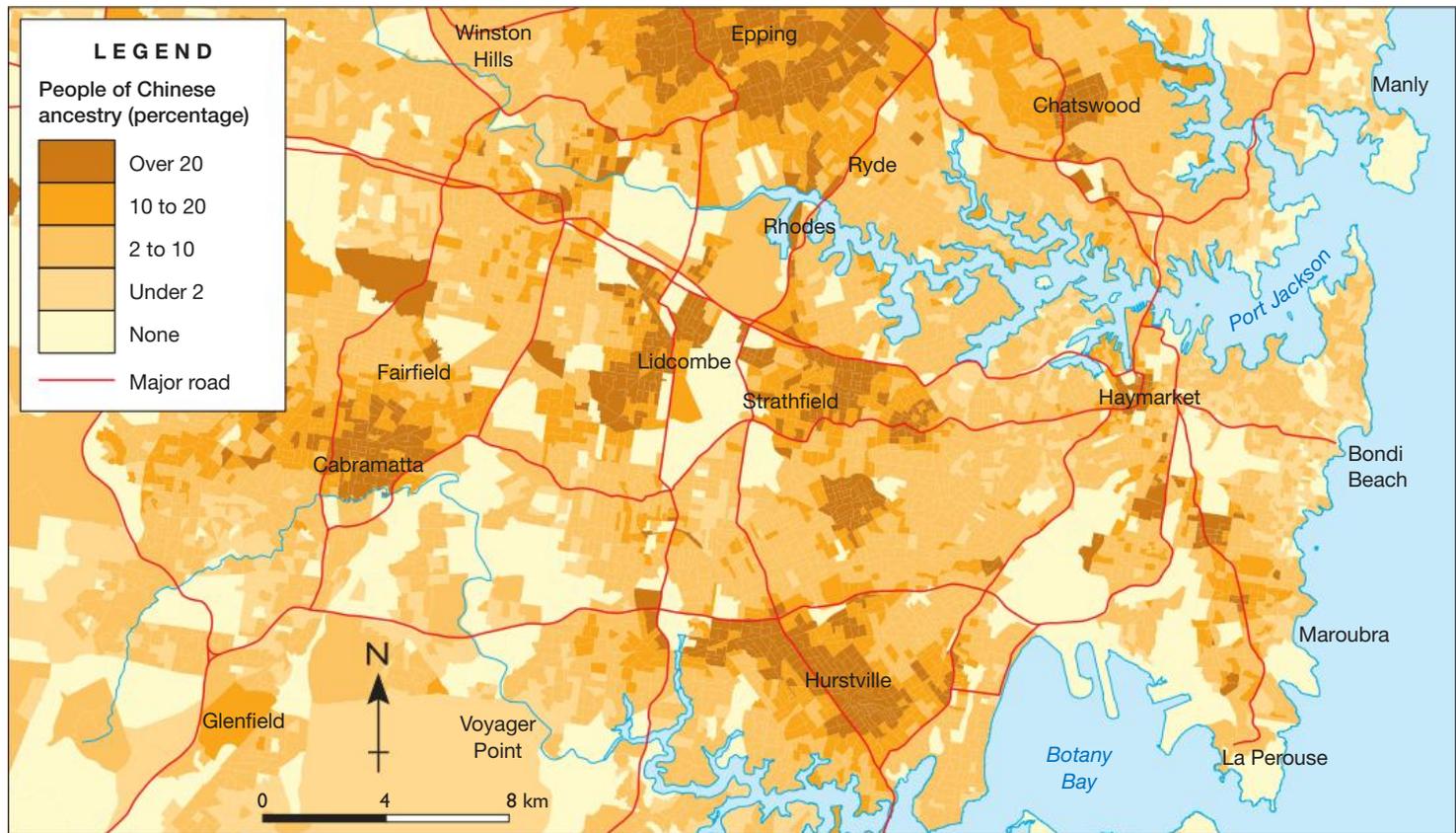
The suburb of Hurstville in Sydney's south is an example of an area with what geographers call a high ethnic concentration. From a total population of around 26 000 residents in 2011, 68 per cent were born overseas and eight out of 10 speak more than one language. Since European settlement of Australia, Hurstville has seen several waves of immigration. First, it was mainly home to people of British and Irish heritage; then came a wave of southern European migrants, largely from Greece and Italy; followed by people from Bosnia, Macedonia and the former Yugoslavia. Since the 1990s it has mainly become home to people arriving from Hong Kong and mainland China.

Chinese immigration to Australia dates back to the 1820s, but grew rapidly in response to the gold rushes of the 1850s and 1860s. During the 20th century a series of government policies (including the White Australia Policy) restricted the number of immigrants from Asian countries to Australia, but since these policies were abandoned in the 1970s there has been a steady increase in the numbers of Chinese people settling in Australia. Today, China is second only to New Zealand in terms of migrant numbers to Australia.



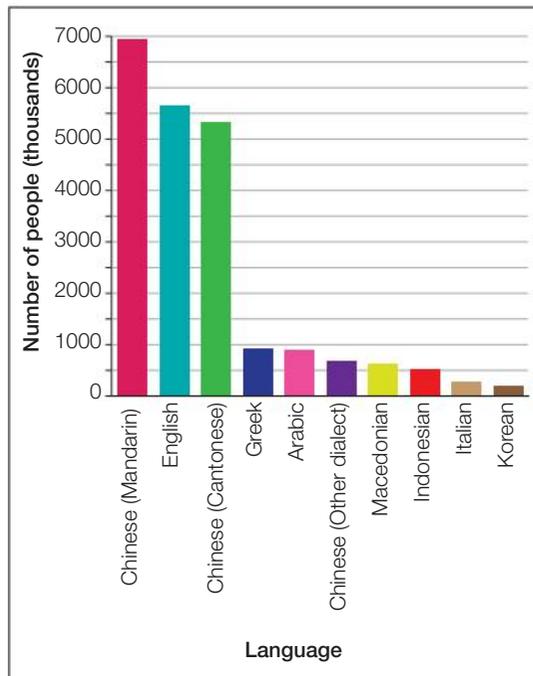
Source 5.57 Chinese businesses in the Sydney suburb of Hurstville

SYDNEY: CONCENTRATION OF RESIDENTS FROM CHINESE BACKGROUNDS, 2011



Source 5.58

Source: Oxford University Press



Source 5.59 Top 10 languages spoken at home by Hurstville residents

Check your learning 5.15

Remember and understand

- 1 Why do people from the same language and cultural backgrounds tend to settle in the same areas of a city?
- 2 Studies show that English-speaking migrants arriving in Australia tend not to settle in groups as much as non-English-speaking migrants. Why do you think this is the case?

Apply and analyse

- 3 Use the PQE method to describe the distribution of residents from Chinese backgrounds shown in Source 5.58. If necessary, refer to section GT.2 of 'The geographer's toolkit' for instructions on using the PQE method.

- 4 How can the arrival of large numbers of people from similar cultural and language backgrounds change the areas in which they settle?

Evaluate and create

- 5 Access the community profile for your community using the census data available on the Australian Bureau of Statistics website (www.abs.gov.au).
 - a Use the country of birth data to construct a bar graph of the top 10 languages spoken at home.
 - b Compare your completed bar graph with the graph for Hurstville shown in Source 5.59. What similarities and differences can you identify?

5.3 bigideas: broadsheet

International migration and Indigenous Australians

By 1900, the number of Indigenous Australians was less than a quarter of what it had been when Europeans first arrived in 1788. As the new immigrants built their penal colonies, towns and farms, Australia's Indigenous peoples were badly affected. Food became scarce as land was cleared, and access to water and sacred sites became difficult or impossible. Western diseases wiped out entire tribes, as the Aborigines had no natural immunity to them.



Source 5.60 This plaque commemorates the 28 unarmed Aborigines massacred in retaliation for cattle theft at Myall Creek in NSW in 1838

The population of the Darung people around Botany Bay, for example, fell by 90 per cent in three years following the arrival of European settlers. In some places there was open conflict between the Indigenous tribes and the white settlers, but armed with rifles, the new arrivals nearly always won. As the Indigenous populations were forced from their traditional lands, many were placed in missions and reserves.

Today, Aboriginal and Torres Strait Islander people have one of the lowest life expectancies in the world. They are under-represented in government, education and employment and over-represented in prisons when compared with the wider Australian population.

skilldrill

Reading complex maps

Complex maps contain more than one set of information to understand.

Step 1 Look carefully at the legend. Complex maps can have more than one part to a legend. These parts will be represented on the map in different ways. For example in Source 5.61 areas of colour are used to show the different types of Indigenous land across Australia. Different coloured symbols are used to show a range of significant sites.

Step 2 Train your eyes to look for one set of information at a time. For example, look at the solid blocks of colour on the map and work out what they tell you.

Step 3 Move to a different set of information and work out what that represents.

Step 4 Look for concentrations of the same symbol in areas to see if patterns exist.

Apply the skill

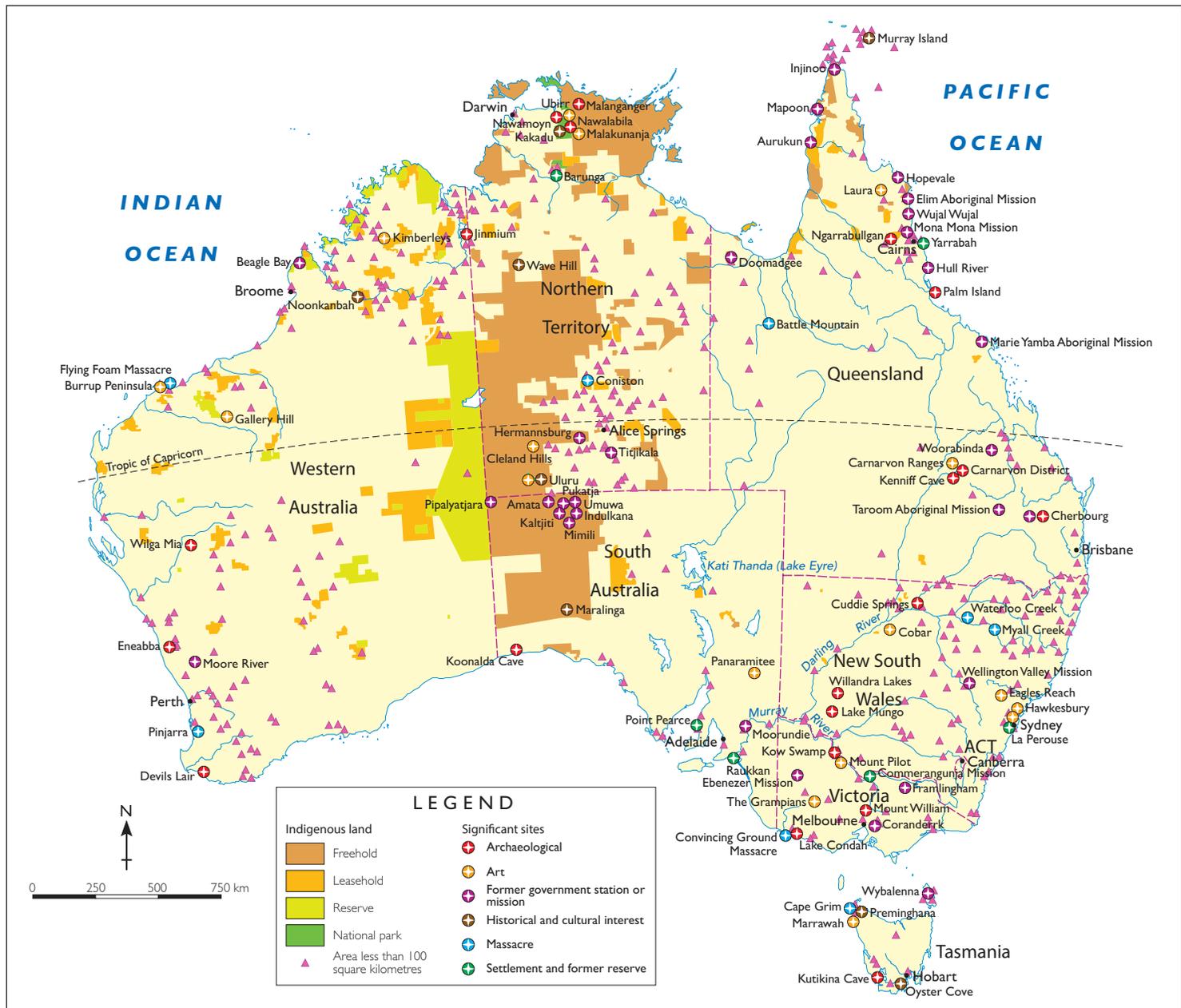
Study Source 5.61.

- 1 Describe where the largest areas of Indigenous-owned land (freehold) are located.
- 2 Which state has no Indigenous owned or leased land over 100 square kilometres?
- 3 The significant sites are harder to pick out on this crowded map, but the colours help them stand out. Describe the location of the Myall Creek massacre site. List the other massacre sites in Australia and state their locations.
- 4 Many art sites are only for Australia's Indigenous people. Where in South Australia is a significant Indigenous art site.

Extend your understanding

- 1 Give three examples of how international migration to Australia impacted on Australia's Indigenous population.
- 2 Do some research on another Indigenous group, such as the Maori in New Zealand or the First Nations people of North America.
 - a How was this group affected by early international migration?
 - b How did this group respond to early international migration?
 - c Find out their life expectancy, employment and imprisonment rates compared with the rest of their country's population. How do these compare with those of Aboriginal and Torres Straits Islander people?

AUSTRALIA: INDIGENOUS LANDS AND SIGNIFICANT SITES



Source 5.61

Source: Oxford Atlas

glossary

A

- annotated visual display (AVD)** a way of presenting the final results of a research project, incorporating images, graphs, notes and explanations in a poster-style format
- arch** a natural feature, usually formed from rock, that forms a bridge-like arc as a result of erosion

B

- backwash** the backwards movement of sea water down a beach after a wave has broken
- bar graph** a graph that shows information as a series of horizontal bars
- blowout dune** a horse-shoe shaped disturbance in a sand dune system
- BOLTSS** a mnemonic (memory device) for remembering the essentials of a map: border, orientation, legend, title, scale and source
- breakwater** a wall that is built out into the sea to help prevent erosion

C

- cardinal points** the four main directions: north, south, east and west
- cave** a hollow space along the coast produced by the action of the waves
- census** a 'head count' or audit of the number of people living in a particular place at a particular time; information collected during a census can often include age, occupation, income, etc.

change a key concept in geography: the dynamic nature of all processes on Earth, whether slow or fast, small or large

choropleth map a map that shows particular data or characteristics, such as population density, by using different shades of the same colour (e.g. light green to dark green) or different colours to show variation

climate graph a combination column and line graph that shows the rainfall and temperature of a given place; also known as a climograph

column graph a graph showing information as a series of vertical columns

compass bearings a precise way of giving compass directions, such as 135° south-east

compound column graph a column graph that has subdivided columns for further comparison of groups

constructive wave a gentle wave that deposits material and builds up beaches

contour lines lines drawn on a map that connect points at the same height to show the height and steepness of land

CSIRO Commonwealth Scientific and Industrial Research Organisation; Australia's national science agency

D

decentralisation the process of encouraging population growth and job creation in suburbs and smaller regional towns or cities rather than in central areas of major cities

deposition the laying down of solid material which has been eroded and transported from another part of the Earth's crust

destructive wave a strong wave that wears away coasts and removes material

direction a way of orienting a map, usually shown by the use of compass points, such as north

dot distribution map a map using dots or other shapes to show the location of a particular feature

E

eastings the gridlines that run vertically on a topographical map

ecosystem a term used to describe the way in which the living organisms (such as plants and animals) in a particular area interact with the non-living organisms in that area (such as water, rocks and climate)

environment a key concept in geography: a specific place on Earth

and all the things, both animate and inanimate, that are there

erosion the wearing away of the Earth's surface by wind, water or ice

ethnicity the background, nationality or culture of a person or group of people

exurb an area beyond an urban centre and its suburbs, usually separated by areas of farmland

F

fieldwork geographical study that takes place outside the classroom at the site of inquiry

flow map a map that shows movement (such as people or goods) from one place to another

forced migration the forced movement of people from one place to another because of war, famine or violence

G

ghost net an abandoned fishing net that floats free in the ocean and is a danger to wildlife

GIS Geographic Information System; a software application designed to capture, store, manipulate, analyse, manage and present all kinds of geographical information

globalisation the growth in the amount of interconnectedness in trade and communication between countries

groyne a man-made barrier that juts out from a beach into the water, made to prevent erosion of the beach from the power of destructive waves and longshore drift

H

headland a steep cliff jutting out into the sea

hot spot a point not on a plate boundary where there is tectonic activity

I

infrastructure the facilities and services necessary for any community, city or country to function (e.g. buildings, electricity, roads, airports and water supply)

interconnection a key concept in geography: the relationship between all things, both animate and inanimate, and all processes, both natural and human

internal migration the movement of people within a region or country

internally displaced person (IDP) a person who has been forced to relocate within his or her own country

international migration the movement of people between countries

L

lagoon a shallow stretch of water which is partly or completely separated from the sea by a narrow strip of land

landform a natural geographical feature or shape that appears on the Earth's surface (e.g. dune, hill, valley, beach and cave)

landscape a section of the Earth's surface made up of a variety of geographical features (known as landforms) that define and characterise it; landscapes can be natural (e.g. coastal landscapes and mountain landscapes) or built (e.g. neighbourhoods and cities)

latitude imaginary lines running east–west around the Earth's surface, parallel to the Equator, used to work out location and direction

lava the molten material that flows from a volcano

line graph a graph that displays data as a line

longitude imaginary lines running north–south around the Earth's surface, from the North Pole to the South Pole, used to work out location and direction

longshore drift the process which moves sediment in a zigzag pattern along a beach by wash and backwash of waves approaching the shore at an angle

M

magma the hot liquid (molten) rock beneath the surface of the Earth

magnetic north the physical place on Earth, near the North Pole, to which a magnetised needle points

mantle the soft layer of hot rock between the crust and the core of the Earth

map a simplified plan of an area shown from directly above the area

megacity a city with a population of more than 10 million people

megalopolis a collection of large cities that are close together and are connected by a network of roads and train lines, effectively forming one continuous urban centre

N

northings the gridlines that run horizontally on a topographical map

O

orbit (waves) the circular movement of water beneath the surface, creating waves

overlay map a map on some type of transparent paper or layer that is placed over a base map, used to show the relationship between features or events on the Earth's surface

P

physical map a map that shows the locations and names of physical features of the Earth, such as mountains and rivers

pie graph a graph that displays data in the form of a pie divided into slices

place a key concept in geography: a part of the Earth's surface that is identified and given meaning by people

political map a map that shows the locations and names of built features of the Earth, such as cities, roads, dams and railways

population density a measurement of the number of individuals per unit area (e.g. 1500 people per square kilometre)

population pyramid a graph that displays the percentage of males and females in a region by age-group

primary data data for a geographical inquiry that was collected in the field by a geographer conducting the inquiry (e.g. survey data, hand-drawn maps or photographs)

pyroclastic flow a fast-moving and dangerous mixture of hot gas and rock that is ejected from a volcano

Q

qualitative data any information that can be recorded in words; for example, Uluru is very large

quantitative data any information that can be recorded as numbers; for example, Uluru is 3.6 kilometres long

R

rain shadow an area of low rainfall on the lee (inland) side of a mountain range

refugee a person who moves to another country because of a natural disaster or to avoid persecution

rip current a strong, narrow flow of surface water, away from the shore, that returns water brought ashore by waves

rural a term used to describe an area located outside cities and towns, such as farming or agricultural areas

S

sand dune a hill or mound of sand formed by wind deposition on the landward side of a beach

scale a key concept in geography: the level at which a geographical inquiry takes place – personal, local, regional, national or global

scale (mapping) a line that indicates the distances on a map as represented in the real world

secondary data data used for a geographical inquiry that was not collected by the geographer conducting the inquiry (e.g. textbooks, atlases and government websites)

sea wall a wall built close to or along a shoreline to prevent erosion or damage by destructive waves

shield volcano a volcano characterised by gentle eruptions that emit runny lava over a wide area

space a key concept in geography: the way things are arranged on the Earth's surface

spit a curved build-up of eroded material that forms at the mouth of a river

subduction the process whereby a denser oceanic plate meets and is pushed down below a lighter continental plate

suburb an area beyond a city centre, with medium-density housing

suburbanisation the process of growing cities outwards by building new housing estates and businesses away from the central business district

sustainability a key concept in geography: the ongoing capacity of Earth to maintain all life

swash the movement of water up the face of a beach after it has broken

T

tectonic plate one of the immense, slowly moving pieces that make up the Earth's surface (or crust) that carry the continents and oceans

thematic map a map that shows details about a particular topic, such as land use or the distribution of resources

tombolo a deposit of sand linking an island to the mainland (or to another island), formed by longshore drift

topographic map a map that shows the shape of the land, its relief and landforms

training wall a wall built to force water into a specific channel, usually built at a river's entrance into a large body of water

tsunami a giant ocean wave caused by an underwater earthquake

U

urban a term used to describe a built-up area such as a city or town

urban renewal the process of taking areas of land in a city that are no longer being used and redeveloping them

urban sprawl the growth of a city onto productive farming land on the city fringes

urbanisation the process of social and economic change that takes place as increasing numbers of people move from rural areas (e.g. farms) to urban areas (e.g. cities)

V

voluntary migration the movement of people from one place to another of their own free will

vulcanologist a scientist who specialises in the study of volcanoes

W

weather map a map that shows conditions in the Earth's atmosphere, such as air pressure, wind speed, wind direction, and warm and cold fronts

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