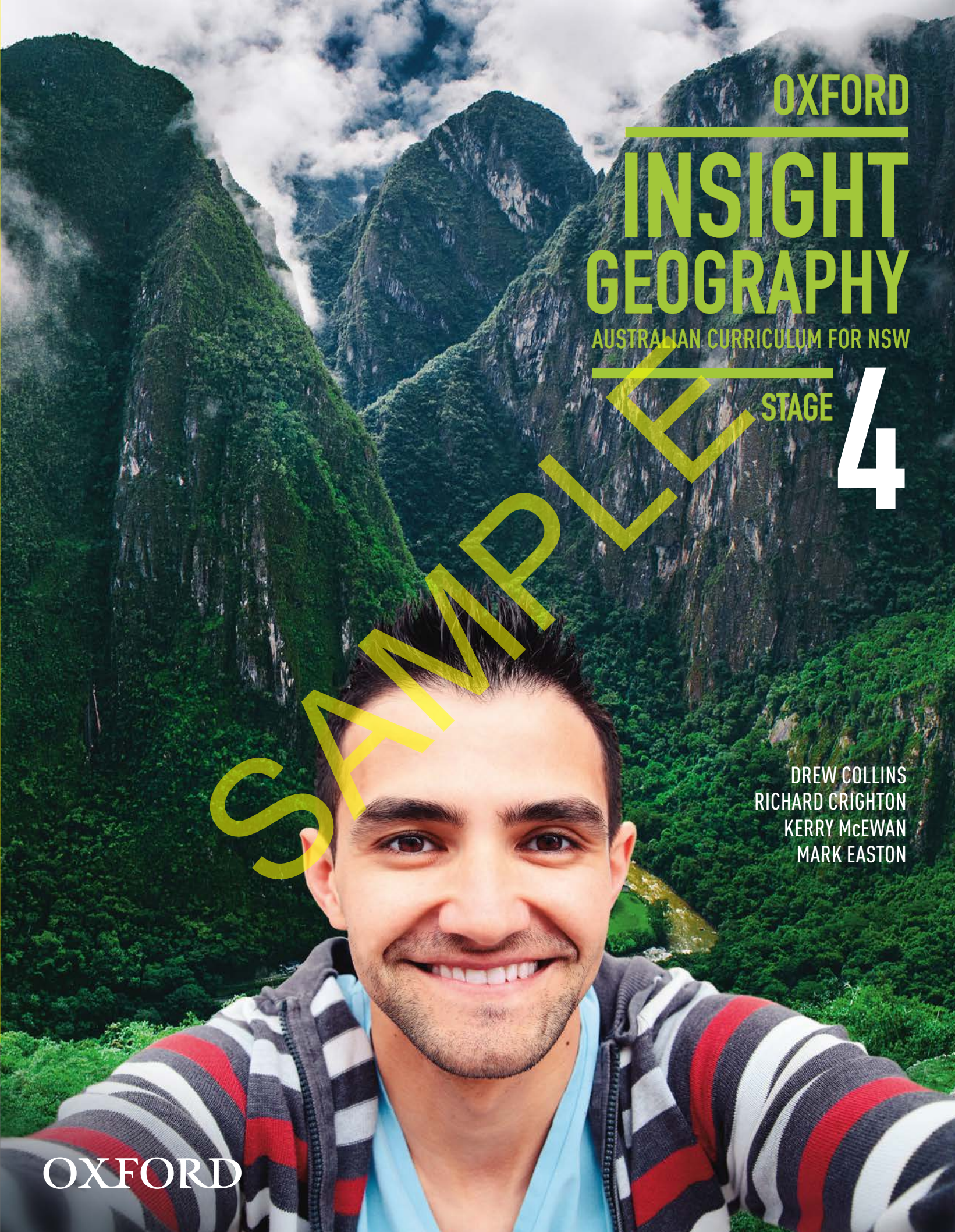

OXFORD INSIGHT GEOGRAPHY

AUSTRALIAN CURRICULUM FOR NSW

STAGE 4

DREW COLLINS
RICHARD CRIGHTON
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MARK EASTON

OXFORD

CONTENTS

USING *OXFORD INSIGHT GEOGRAPHY*

Oxford Insight Geography has been developed and written by a team of experienced NSW Geography teachers to meet the requirements of the NSW syllabus for the Australian Curriculum: Geography. *Insight Geography* comprehensively covers all syllabus content to help students successfully meet all of the required outcomes. *Insight Geography* takes the guesswork out of the new syllabus: chapters are organised around the key inquiry questions from the syllabus while geographical concepts, geographical inquiry skills and geographical tools are integrated meaningfully into every chapter. The features, structure and design of the Student book, Student obook assess and Teacher obook assess will help you:

» optimise student understanding

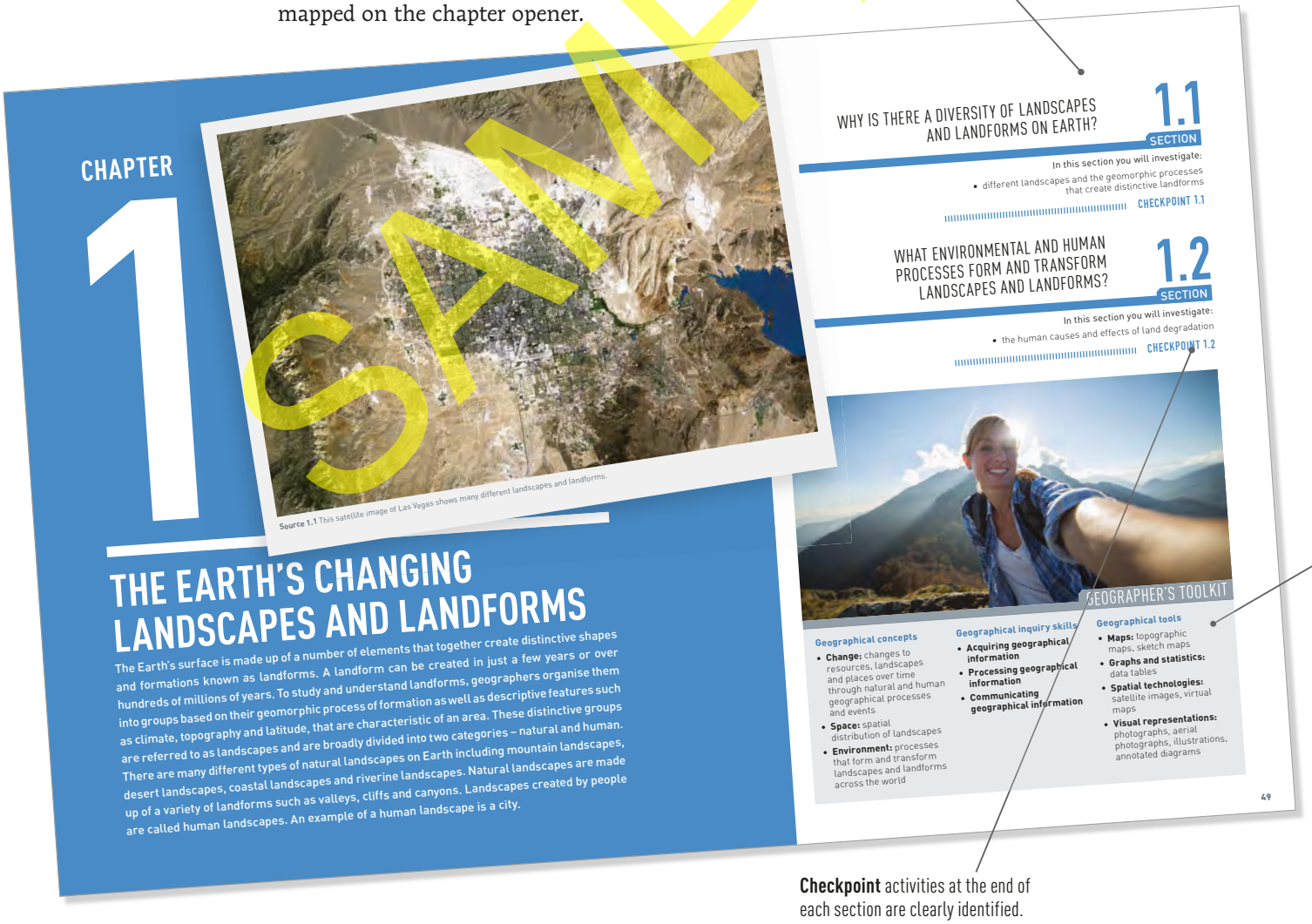
» personalise teaching and learning

» deliver better results.

OPTIMISE STUDENT UNDERSTANDING

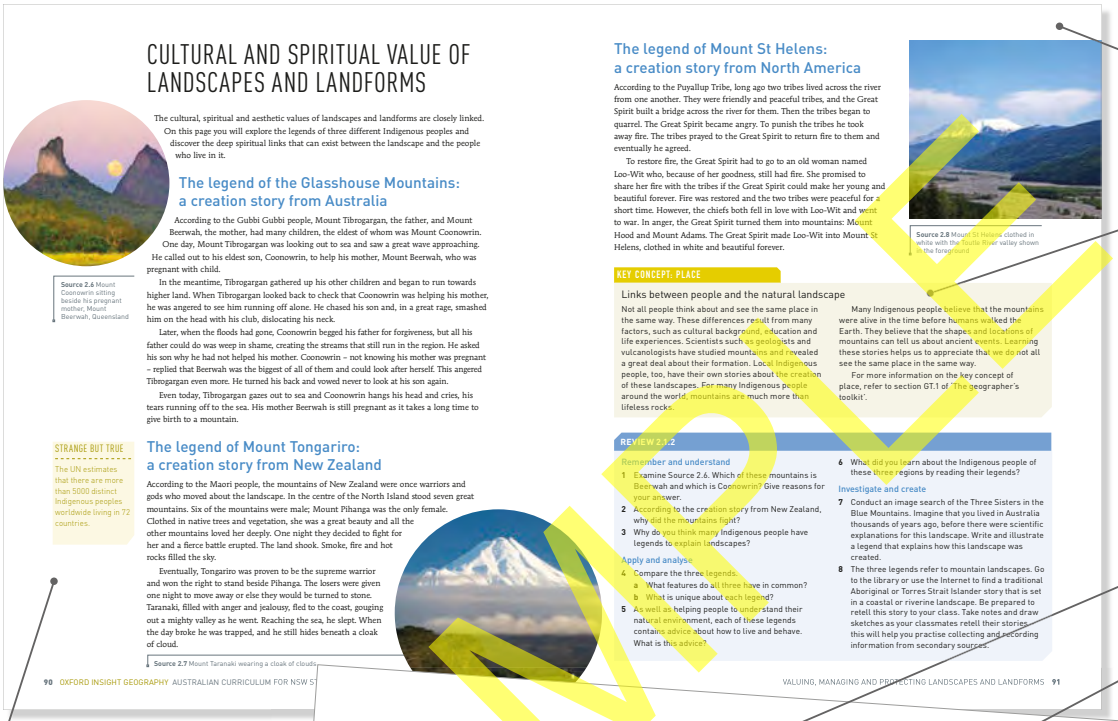
Each chapter of *Oxford Insight Geography* is sequenced according to the NSW Geography syllabus and structured around the key inquiry questions from the syllabus. Content dot points clearly map the learning sequence for students. Concepts, skills and tools are integrated in every chapter and mapped on the chapter opener.

The learning sequence for each chapter is structured around the key inquiry questions and content dot points taken directly from the syllabus.



Checkpoint activities at the end of each section are clearly identified.

Each topic covered in the Student Book is supported by a range of maps, graphs and statistics, visual representations, spatial technologies and fieldwork suggestions designed to engage and challenge a range of students. Key concepts are integrated into every chapter in the key concept boxes. Geographical inquiry skills are used to structure rich tasks and fieldwork suggestions.



CULTURAL AND SPIRITUAL VALUE OF LANDSCAPES AND LANDFORMS

The cultural, spiritual and aesthetic values of landscapes and landforms are closely linked. On this page you will explore the legends of three different Indigenous peoples and discover the deep spiritual links that can exist between the landscape and the people who live in it.

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.

Source 2.6 Mount Coonowrin sitting beside his pregnant mother, Mount Beerwah, Queensland

STRANGE BUT TRUE

The UN estimates that there are more than 5000 distinct Indigenous peoples worldwide living in 72 countries.

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

According to the Maori 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.

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 2.7 Mount Taranaki wearing a cloak of clouds

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

According to the Puyallup Tribe, 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 2.8 Mount St Helens clothed in white with the Toutle River valley shown in the foreground

KEY CONCEPT: 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 vulcanologists have studied mountains and revealed a great deal about their formation. Local Indigenous people, too, have their own stories about 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 more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.

REVIEW 2.1-2

Remember and understand

1 Examine Source 2.6. 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 mountains 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?

Investigate and create

7 Conduct an image search of the Three Sisters in the Blue Mountains. 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.
8 The three legends refer to mountain landscapes. Go to the library or use the Internet to find a traditional Aboriginal or Torres Strait Islander story that is set in a coastal or riverine landscape. Be prepared to retell this story to your class. Take notes and draw sketches as your classmates retell their stories – this will help you practise collecting and recording information from secondary sources.

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VALUING, MANAGING AND PROTECTING LANDSCAPES AND LANDFORMS 91

CASE STUDY

MOVING TO NOOSANGATTA

The warmer climate and stunning natural features of the south-east Queensland coastline mean this region has many high-rating liveability factors. The region, in fact, has attracted many Australians, particularly older people from New South Wales and Victoria, to make the move north. Just 50 years ago, the Gold Coast and Sunshine Coast were small holiday towns. Today, the area has seen such extensive growth and development that the towns and cities along this section of coastline may join together to form a continuous urban area known as a megalopolis. Some geographers predict that Noosa in the north and Coolangatta in the south will one day also join to form one vast urban area that some people have already nicknamed 'Noosangatta'.

The high population growth in south-east Queensland over the last few decades has led to an increasing demand for housing. As the suburban areas have spread, there has been a loss of 7500 hectares (75 square kilometres) of bushland and farms each year. The stunning natural features and easygoing lifestyle that attracted people to move to the area in the first place are coming under threat. A victim of its own success, the area is in danger of becoming less liveable.

Source 4.16 An oblique aerial photograph of coastal development between Noosa and Brisbane

REVIEW 4.1-4

Remember and understand

1 Why are many older Australians moving north to settle in south-east Queensland?
2 Explain what is meant by the expression 'a victim of its own success'.

Apply and analyse

3 Describe the importance of natural features such as rivers, mountains and coasts in affecting the location and shape of cities. Use evidence from the map (Source 4.17) for your description.
4 Is it likely that the city of Toowoomba will join the Noosangatta megalopolis? Give reasons for your answer.

Investigate and create

5 Explore the region shown in Source 4.17 on Google Earth. Use the 'Historical Imagery' tool to find examples of places that have undergone great changes in the last 10 years.

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SKILL DRILL

Reading a complex map

A map is a plan of an area of the Earth's surface drawn directly from above. Complex maps, such as the one shown in Source 4.17, can appear a little confusing at first because they show a wide range of features. As with all maps, however, it is important that you read the legend, title, source and scale carefully, so that you can learn more about the region being shown.

Follow these steps to help you read and understand a complex map:

Step 1 Read the title carefully. Make sure that you understand what the map shows and the region that is shown in the map. If you are unsure of the location of the region, locate it in your atlas to see where it sits in relation to other regions or countries.

Step 2 Check the source of the map so that you can assess the reliability of the information. Maps drawn by government departments and professional publishers are generally more reliable than those drawn by individuals and businesses.

Step 3 Look carefully at the symbols and colours used in the legend and find an example of each of these on the map. Look for relationships between these symbols such as roads and urban areas.

SOUTH-EAST QUEENSLAND: ECOLOGICAL AND URBAN AREAS

Source 4.17

Source: South-East Queensland Regional Plan 2009–2031, Queensland Department of Infrastructure and Planning

Apply the skill

1 What is the source of the map shown in Source 4.17?
2 Is this a reliable source of information?
3 Use the line scale to estimate the straight line distance from:
- Brisbane to Robina
- Brisbane to Noosa
- Brisbane to Toowoomba.

For a guide on estimating distance, refer to section GT.3 of 'The geographer's toolkit' (Skill drill: Using line scale to measure distances).

4 Describe the distribution of existing and future urban areas. Use the names of towns and cities as well as compass directions and geographic features such as the coast and rivers in your description.
5 Describe the distribution of protected areas and the land and wetlands areas of high ecological significance.
6 Which areas of high ecological significance are likely to be impacted most by the continued growth of urban areas in this region?

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SAMPLE

Chapter content is organised into discrete two- or four-page units to support teaching and learning.

Key concept boxes encourage students to think geographically.

Case studies expose students to a range of sources.

Skill drills support an explicit focus on geographical skills.

Strange but true boxes present a range of weird and wonderful geographical facts designed to entertain and provoke discussion.

Geographical concepts, **Geographical inquiry skills** and **Geographical tools** are integrated meaningfully into every chapter and highlighted here on every chapter opener.

Every two- or four-page unit concludes with a **Review** question box with differentiated **Remember and understand**, **Apply and analyse** and **Investigate and create** tasks to provide a range of activities for different abilities and learning styles.

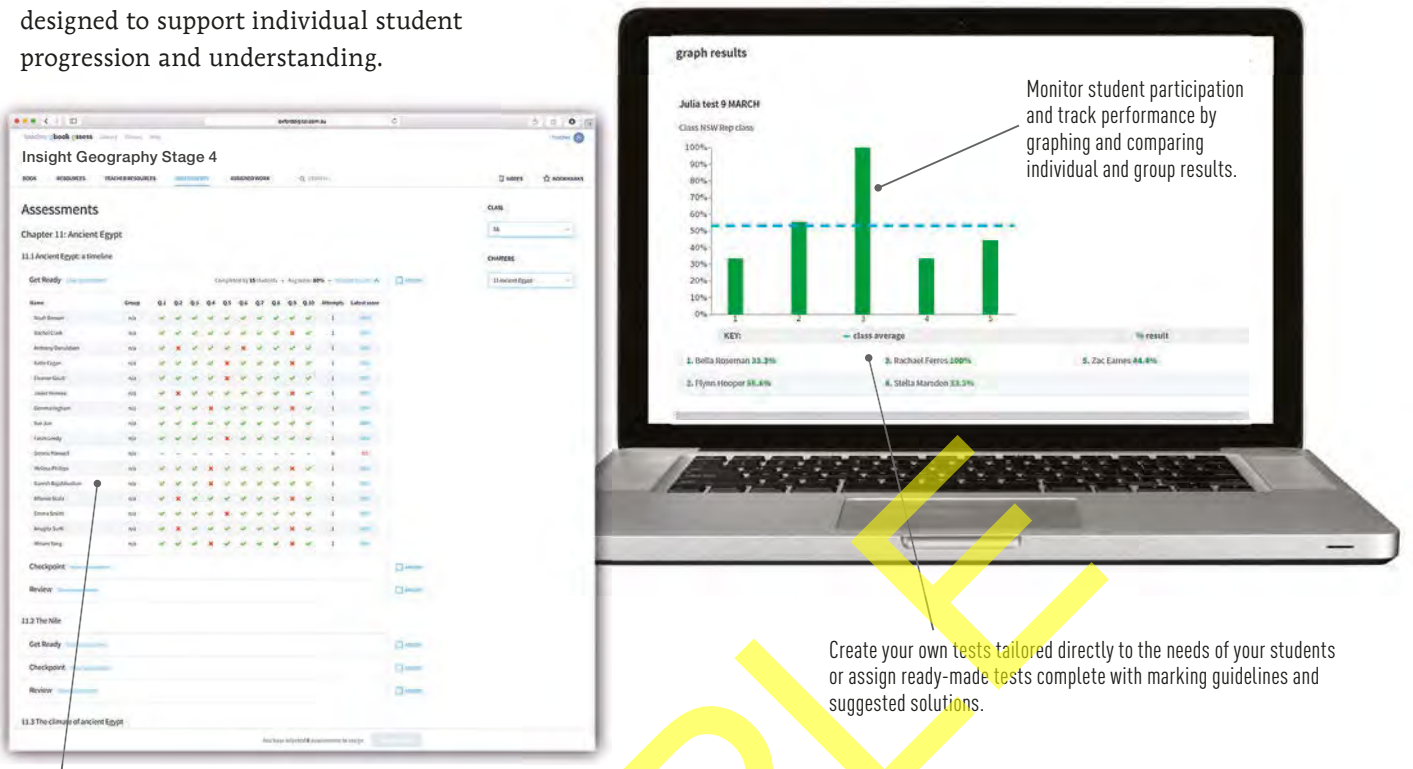
PERSONALISE TEACHING AND LEARNING

The new syllabus demands contemporary online learning for all students in NSW. *Oxford Insight Geography* delivers new opportunities for teachers and students to personalise teaching and learning through obook assess:

» obook provides an electronic version of the Student Book with note-taking, highlighting and bookmarking. The obook includes videos, interactive learning modules, weblinks and worksheets, and can be accessed both online and offline. Access your entire cloud-based obook library anywhere on any device with one simple login.

Teachers can set students homework, tests and tasks mapped directly to the NSW Geography syllabus outcomes.

» assess provides 24/7 online assessment designed to support individual student progression and understanding.



Monitor student participation and track performance by graphing and comparing individual and group results.

Create your own tests tailored directly to the needs of your students or assign ready-made tests complete with marking guidelines and suggested solutions.

Select from hundreds of auto-marking assessment tasks at various difficulty levels – foundation, standard and advanced.

DELIVER BETTER RESULTS

Oxford Insight Geography helps to deliver better results for you and your students by ensuring that student progress on all syllabus outcomes and content can be carefully monitored throughout every chapter. Features contained at the end of every section of every chapter allow you to easily identify gaps in student understanding and target further development in these areas.

Checkpoint questions appear at the end of every section. They are linked to content dot points in the NSW Geography syllabus and are designed to help you identify areas of weakness in student understanding. They can be used flexibly – completed orally in class (to support formative assessment) or set as written tests (to support summative assessment).

Rich tasks appear at the end of every section. They are open-ended, inquiry-based tasks designed to engage students to develop their geographical inquiry skills.

Each **Checkpoint** is supported by three separate student worksheets available electronically (via the Teacher ebook assess). These worksheets are graded to **support**, **consolidate** or **extend** students, or differentiate abilities and personalise learning in your class. Like Checkpoint questions, student worksheets are linked to content dot points from the syllabus with the goal of providing tailored support to ensure better results.

CHAPTER

1

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

THE EARTH'S CHANGING LANDSCAPES AND LANDFORMS

The Earth's surface is made up of a number of elements that together create distinctive shapes and formations known as landforms. A landform can be created in just a few years or over hundreds of millions of years. To study and understand landforms, geographers organise them into groups based on their geomorphic process of formation as well as descriptive features such as climate, topography and latitude, that are characteristic of an area. These distinctive groups are referred to as landscapes and are broadly divided into two categories – natural and human. There are many different types of natural landscapes on Earth including mountain landscapes, desert landscapes, coastal landscapes and riverine landscapes. Natural landscapes are made up of a variety of landforms such as valleys, cliffs and canyons. Landscapes created by people are called human landscapes. An example of a human landscape is a city.

WHY IS THERE A DIVERSITY OF LANDSCAPES AND LANDFORMS ON EARTH?

1.1 SECTION

In this section you will investigate:

- different landscapes and the geomorphic processes that create distinctive landforms

CHECKPOINT 1.1

WHAT ENVIRONMENTAL AND HUMAN PROCESSES FORM AND TRANSFORM LANDSCAPES AND LANDFORMS?

1.2 SECTION

In this section you will investigate:

- the human causes and effects of land degradation

CHECKPOINT 1.2

GEOGRAPHER'S TOOLKIT

Geographical concepts

- **Change:** changes to resources, landscapes and places over time through natural and human geographical processes and events
- **Space:** spatial distribution of landscapes
- **Environment:** processes that form and transform landscapes and landforms across the world

Geographical inquiry skills

- **Acquiring geographical information**
- **Processing geographical information**
- **Communicating geographical information**

Geographical tools

- **Maps:** topographic maps, sketch maps
- **Graphs and statistics:** data tables
- **Spatial technologies:** satellite images, virtual maps
- **Visual representations:** photographs, aerial photographs, illustrations, annotated diagrams

1.1 THE EARTH'S LANDSCAPES

WHY IS THERE A DIVERSITY OF LANDSCAPES AND LANDFORMS ON EARTH?

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 are 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 or built landscapes. Some different types of landscapes are described on the following pages.

WORLD: EXAMPLES OF DIFFERENT LANDSCAPES

Source 1.2

Source: Oxford University Press

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.

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

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.

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

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

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

4 Desert landscapes

An arid desert is defined as an area of land that receives no more than 250 millimetres of rain per year, whereas a semi-arid desert receives between 250 and 500 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 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 Jenolan Caves in New South Wales are an example of a karst landscape.

STRANGE BUT TRUE

Australia has some of the oldest geological features in the world, with the oldest known rocks dating from more than 3000 million years ago, and rare zircon crystals dating back 4400 million years located in much younger rocks. The zircons evolved very soon after the planet was formed. These ancient features compare with the oldest known rock on Earth in north-western Canada. Scientists say that rock was formed 4031 million years ago.

6 Human landscapes

Unlike the types of naturally occurring landscapes described above, human landscapes are created by humans. These 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, rivers and mountains.

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

REVIEW 1.1.1

Remember and understand

1 Describe the meaning of the geographical term 'landscape'.

2 Which types of landscapes are found around the tropics of Capricorn and Cancer?

3 Why do you think human landscapes are included in the definition of the word 'landscape'?

Apply and analyse

4 Look carefully at Sources 1.2 to 1.8. Create and complete the following table by listing the different types of unique landscapes shown in Source 1.2. The first one has been done for you.

Unique landscape	Characteristics including landform(s) you would expect to find in this landscape	Dominant geomorphic force
Mountain landscapes, e.g. the Himalayas, Asia	High elevation, steep slopes, snow-capped jagged peaks, no visible vegetation on peaks	Tectonic plates forcing land to fold upwards

5 You will need a blank outline map of Australia, which can be downloaded from your obook, and an atlas to complete this question.

- **a** Annotate the map of Australia to show an example of each type of landscape.
- **b** Compare the physical map of Australia to a physical map of China. Identify one difference and one similarity.

6 Write a description of the location of desert landscapes. Give possible reasons to explain why they are there.

Investigate and create

7 Investigate one landscape that interests you. It may be a well-known landscape or one in your local area. In your investigation, include its location, what makes the landscape unique and provide information of how it is used. Why is this landscape different from the areas around it? Present your information creatively.

THE EARTH'S LANDFORMS

You have already discovered that the Earth has a great range of natural landscapes, including mountain, desert, coastal and riverine. Within these landscapes, distinctive landform features can be found. A **landform** is a specific shape or physical feature of the Earth's surface which has been produced by a **natural process**. Natural processes are also called **geomorphic processes**. Examples of landforms include valleys, cliffs, beaches, sand dunes and plateaus. Geomorphic processes can include **erosion, deposition**, **weathering** and **tectonic activity.**

Source 1.9 Some common landforms found in different natural landscapes

COASTAL LANDSCAPES

Atoll
Ring-shaped coral reef or a string of closely spaced small coral islands encircling a shallow lagoon

Archipelago
Group or chain of islands

Bay
Broad, curved indentation in the coastline

Beach
Deposited rock particles – such as sand, gravel or pebbles – along the coastline

Cliff
Steep rock face formed by the action of the waves

Coral reef
Underwater ridge formed by the growth and deposit of coral

Headland
Narrow, high land jutting out from a coastal cliff into the sea

Island
Area of land surrounded by water

Isthmus
Narrow strip of land or sand that connects an island to the mainland

Spit
Narrow strip of sand protruding into the sea

Stack
Tall pillar of rock formed by wave action eroding a cliff

MOUNTAIN LANDSCAPES

Cirque
Bowl-shaped hollow at the head of a valley or on a mountainside formed by glacial erosion

Glacier
Large frozen river of ice that slowly moves down a valley in response to gravity

Mountain
Steep-sided, lone peak rising over 600 metres above the surrounding land

Mountain range
Chain of connected mountains

Ridge
Long, narrow elevation of land

Volcano
Opening in the Earth's crust where molten rock, ash and gas can escape

RIVERINE LANDSCAPES

Delta
Fan-shaped, low-lying area of deposits at the mouth of a river

Drainage basin
Area providing water to a river system

Estuary
River mouth broadening into the sea

Floodplain
Flat area over which water spreads in times of flood

Gorge
Deep, narrow, steep-sided valley

Lake
Large body of water surrounded by land

Meander
Bend in a river

Oxbow lake
Crescent-shaped lake on a river floodplain

River
Natural waterway that takes water downhill by gravity to the sea

Tributary
Small river that joins a larger river

V-shaped valley
Narrow, steep-sided valley carved out by the upper reaches of a river

Waterfall
River water spill over resistant rock

Watershed
High point from which water flows into a drainage basin

DESERT LANDSCAPES

Butte
Flat-topped hill

Desert dune
Wind-blown particle formation

Hamada
Area covered in boulders and large stones

Inselberg
Isolated, steep-sided hill of resistant rock on a plain

Mesa
Flat-topped, steep-sided plateau

Oasis
Desert area with a water supply provided by groundwater

Wadi
Dry watercourse in a narrow valley that divides a plateau

REVIEW 1.1.2

Remember and understand

1 Describe the meaning of the geographical term 'landform'.

2 Identify four geomorphic processes.

Apply and analyse

3 Identify an Australian example of at least five of the landforms described in Source 1.9.

Investigate and create

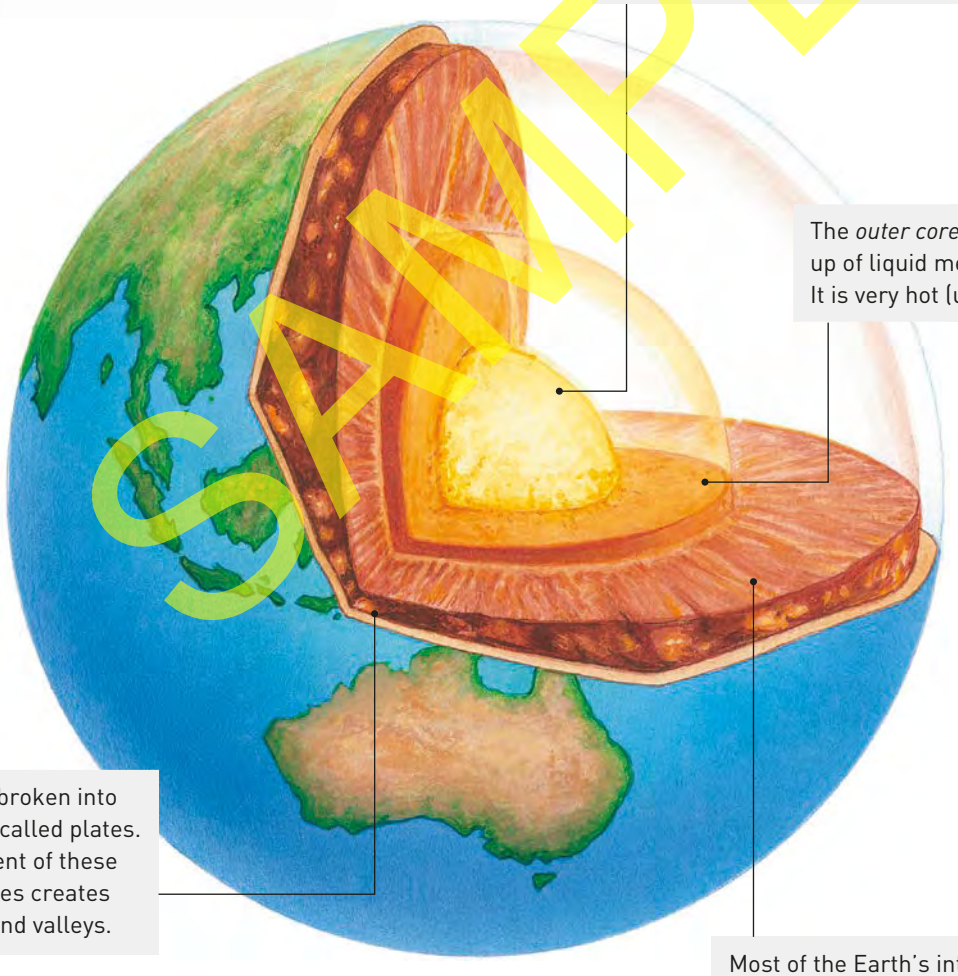
4 Create a travel brochure for the NSW tourism government agency promoting one of the landforms shown in Source 1.9. Investigate the landform and provide a description including information about how it was formed. You should include persuasive text that aims to encourage tourists to visit your chosen landform.

TECTONIC ACTIVITY

Natural and human landscapes are formed and transformed by many different processes, including geomorphic, hydrological, atmospheric, biotic and human processes. You are about to explore four of the geomorphic processes that form and transform the Earth: tectonic activity, erosion, deposition and weathering. To understand these processes, you first 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 1.10).

Source 1.10 The Earth's layers



Tectonic plates

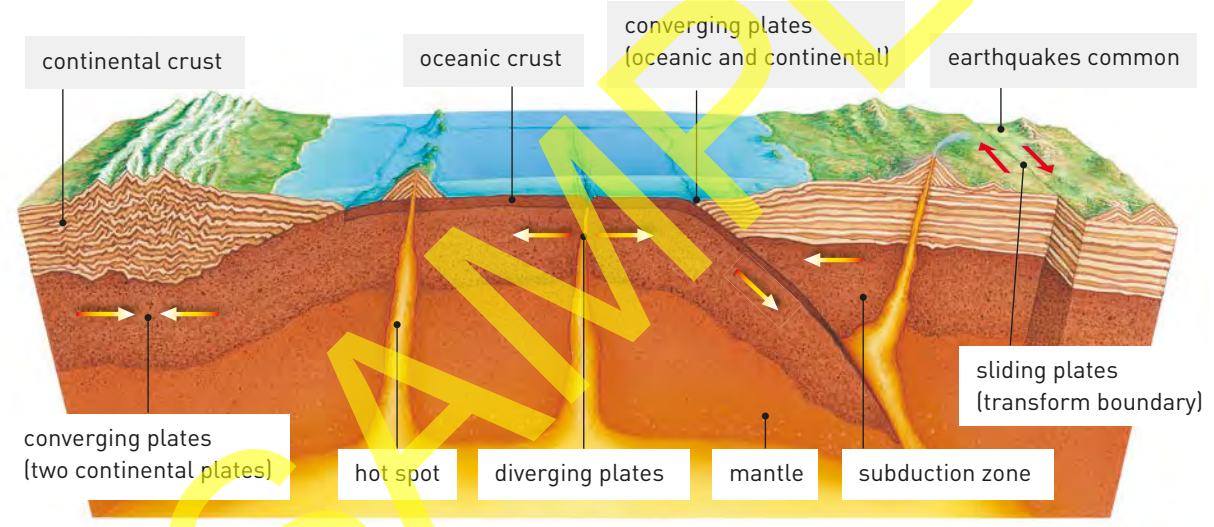
The outer layer of the Earth's surface (known as the crust) is broken into large pieces called tectonic plates. These plates are around 100 kilometres thick and fit together like enormous pieces of a jigsaw puzzle. Currents in the red-hot molten material (**magma**) under these tectonic plates cause them to move about (see Source 1.11).

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.

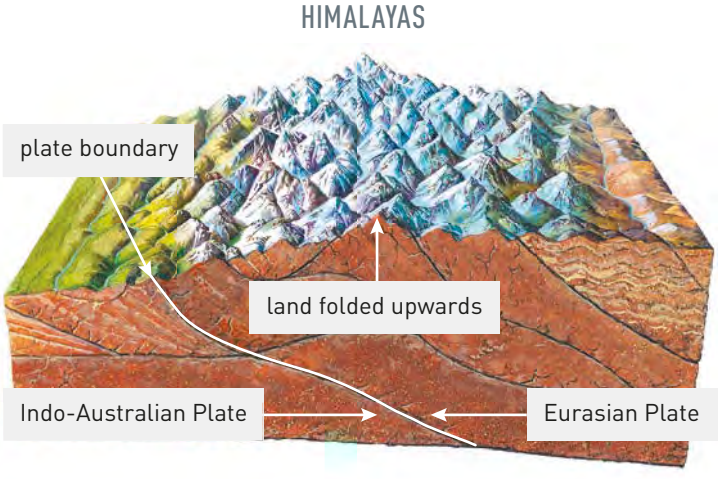
In other places, tectonic plates are being pulled apart from one another (**diverging**). This process creates rifts in the Earth's surface that allow hot magma to ooze to the surface and create new land. The world's longest mountain range, the mid-Atlantic Ridge, is an undersea mountain range formed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

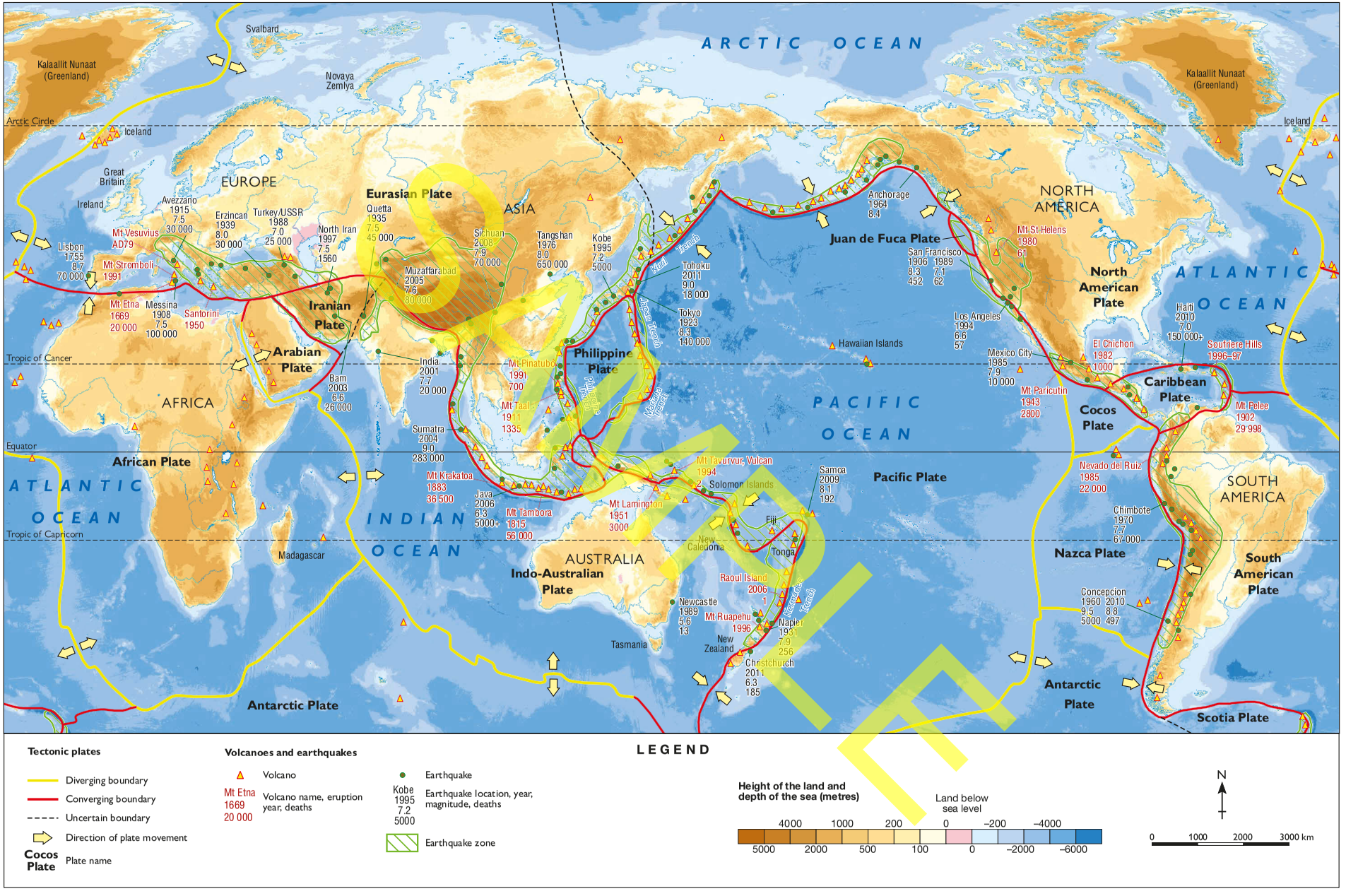
Source 1.11 Tectonic plate movement



Source 1.12 The collision of tectonic plates (left) caused the formation of the Himalayas (right) between 50 and 70 million years ago when India collided with Asia.



WORLD: TECTONIC PLATES



Source 1.13 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: Oxford University Press

Source 1.14 In South America, four plates are colliding with each other (converging), creating the Andes.

Source 1.15 In Africa, three plates are moving apart (diverging), creating the Great Rift Valley.

Source 1.16 In North America, two plates are sliding past each other (transform boundary), creating the San Andreas Fault.

REVIEW 1.1.3

Remember and understand

1 What are the four layers of the Earth?
2 What is the name given to the huge pieces of the Earth's crust?
3 How do the Earth's tectonic plates move?
4 What is the name given to the plate boundary where the plates are being pushed together?

Apply and analyse

5 Refer to Source 1.13.
   - **a** Describe the plate boundary you would expect to find in the middle of the Atlantic Ocean.
   - **b** Explain the difference between that plate boundary and the one to the north and east of Australia.
   - **c** On which plate is Australia located?
   - **d** In which direction is this plate moving?

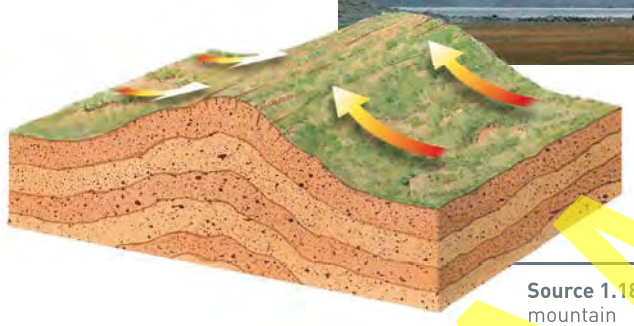
Investigate and create

6 Identify any possible links you notice between the three types of plate boundaries (converging, diverging and transform) and:
   - **a** landforms such as mountain ranges
   - **b** volcanoes
   - **c** phenomena such as earthquakes.

HOW MOUNTAINS ARE FORMED

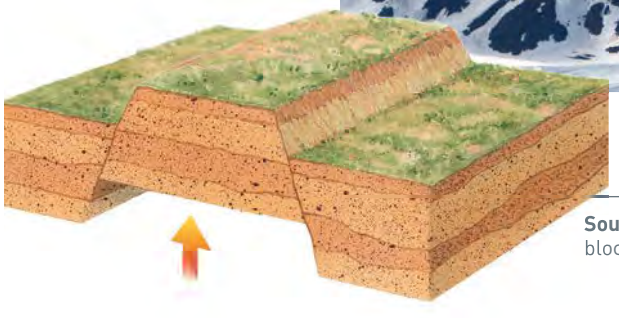
Mountains are formed where the surface of the Earth has been pushed upwards. Tremendous forces inside the Earth can crumple the surface into long mountain chains, such as the Andes or Himalayas, or punch right through the surface to create volcanoes, such as Kilauea on the island of Hawaii and Mount Kilimanjaro in Tanzania.

Source 1.17 These mountains on the edge of the Zanskar Valley in Ladakh, India, are clearly distinguishable as fold mountains.



Source 1.18 Creation of a fold mountain

Source 1.19 Block mountains in the Arctic region of Norway



Source 1.20 Creation of a block mountain

Types of mountains

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

- fold mountains
- block mountains
- volcanic mountains.

Fold mountains

Fold mountains are created by upward pressure where two tectonic plates collide. As the plates converge, layers of rock buckle and are 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.

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.

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.

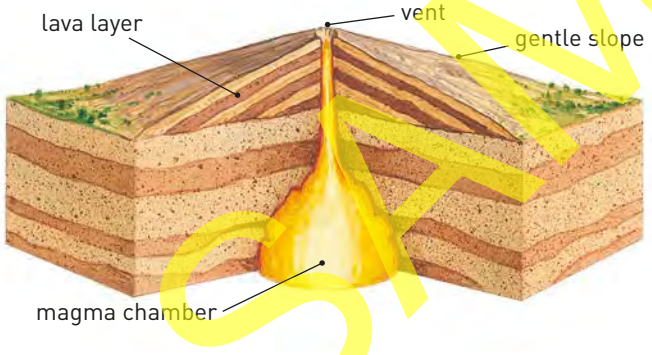
Source 1.21 Rangitoto Island in Auckland, New Zealand, is an example of a shield volcano.

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 1.23). Rangitoto Island is an example of a shield volcano (see Source 1.21).

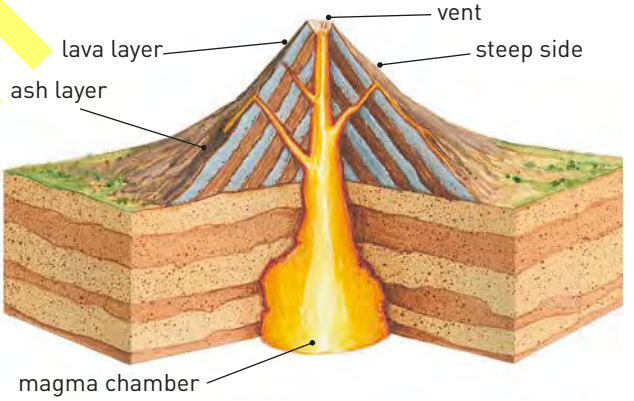
The more familiar steep-sided **volcanic cones** (see Source 1.24), such as Mount Fuji in Japan, are formed when lava and ash do not travel far from the crater. These materials are then left as a new layer on the sides of the cone, building it higher.

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.

Source 1.22 Mount Fuji in Japan is an example of a volcanic cone.



Source 1.23 A cutaway diagram of a shield volcano



Source 1.24 A cutaway diagram of a volcanic cone

REVIEW 1.1.4

Remember and understand

1 Describe the process of folding.

2 How does a volcanic eruption change the shape of the land?

Apply and analyse

3 What are the similarities between folding and faulting? What are the important differences?

4 Sketch and label a diagram of the block mountains in Norway (Source 1.19) to show how they are formed.

5 Explain why some volcanoes are steep-sided cones and some are not.

6 Why is every volcano in the world a different shape?

Investigate and create

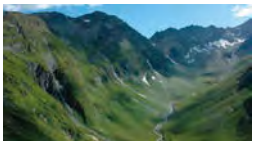
7 Use a search engine to identify a mountain and research it to create a fact file to share. Provide the following details: name, location, age, elevation, mountain range, how it was formed and an interesting fact. Also include a photograph or a drawing of the mountain.

WEATHERING, EROSION AND DEPOSITION

While tectonic activity causes the Earth's surface to be uneven (think of mountains and volcanoes), **gradational forces** work to smooth out the landscape. The landforms and features created by tectonic processes come under attack when they are exposed to atmospheric processes and gravity. Gradational forces wear down the high places and fill in the low places.

The different types of gradational forces are weathering, erosion and deposition. The agents include wind, water, ice, sunlight and chemical decomposition.

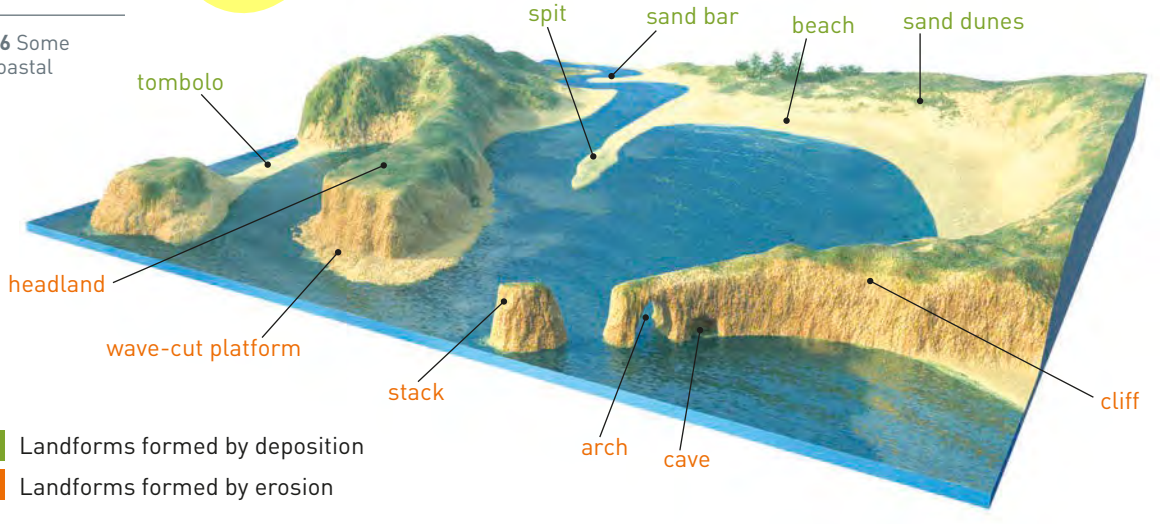
Source 1.25 Gradational forces

Gradational force		Process	Landforms
Weathering		This is the breakdown or decay, but not the removal, of rocks and minerals at or near the surface.	Weathered landforms can include unique rock features such as fins, alcoves, arches (pictured) and hoodoos.
Erosion		The land surface is worn down by running water, ice, wave action or wind. The debris is then transported either by the running water, ice, waves or wind.	Erosional landforms can include river valleys created by running water, cirques and U-shaped valleys created by glaciers (pictured), mesas and buttes created by wind, and stacks and bays created by wave action.
Deposition		This occurs once the weathered and eroded material has been transported by running water, ice, waves or wind, and is said to be 'laid down'.	Depositional landforms can include deltas formed by running water; terminal moraine left by glacial retreat; sand dunes created by wind; and beaches, spits and tombolos created by wave action.

Erosion and deposition in coastal landscapes

Constant movement of water and wind carve coastal landscapes into an amazing variety of landforms. 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

Source 1.26 Some common coastal landforms



'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.

KEY CONCEPT: CHANGE

A day at the beach

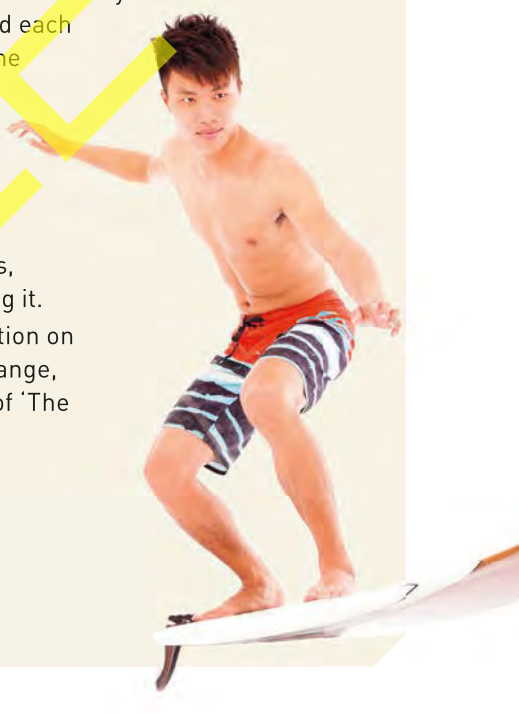
Like all landscapes, coasts are constantly changing. During a five-hour visit to a beach, about 2500 waves hit the shore. Each wave picked up millions of grains of sand and moved them. Some grains were moved further inland, some along the beach, some out to sea, and some were picked up and put back in 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 1.27 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'.



REVIEW 1.1.5

Remember and understand

1 Describe how gradational forces differ from tectonic activity.
2 List and describe the three major gradational forces.
3 How do beaches change?

Apply and analyse

4 By referring to the image of common coastal landforms, describe how you think an arch is formed.
5 Sketch the image in Source 1.27 and label five landforms.

Investigate and create

6 Choose one landform from the list below and carry out some research on its formation. Include where you would expect to find the landform, whether or not it is formed by erosion or deposition, and the processes that have been involved in its formation. Give an example of the landform and provide an image of it.
   - desert landforms: inselberg, butte, mesa
   - coastal landforms: spit, tombolo, beach, cliff
   - mountain landforms: cirque, V-shaped valley
   - riverine landforms: delta, floodplain, gorge
7 Design an experiment in which you could demonstrate erosion and deposition by wind, water or ice.

EROSIONAL LANDFORMS

Source 1.28 A section of coastline near the town of Port Campbell in Victoria

Coastal landforms are created in two main ways. This is because 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 1.28) 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.

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.

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.

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.

REVIEW 1.1.6

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 1.28.

- **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?

Investigate and create

4 Predict what changes might occur in the next few thousand years in the landscape shown in Source 1.28. 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?

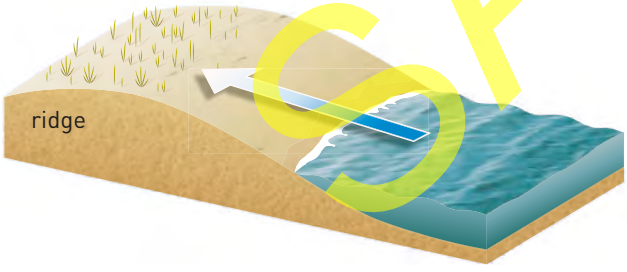
DEPOSITIONAL LANDFORMS

Source 1.29 Whitehaven Beach, Queensland, is an example of a depositional landform.

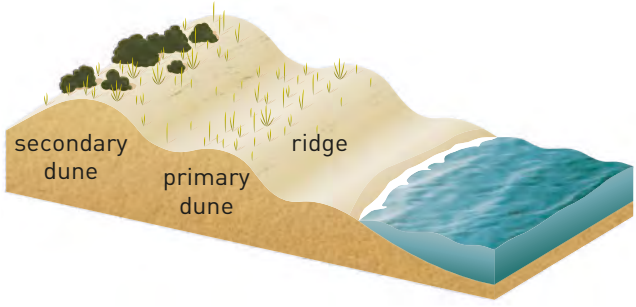
Unlike destructive waves, **constructive waves** help to create landforms that allow plants and animals to live and thrive. Constructive waves are long and low. They begin far out at sea and gently roll onto the shore, allowing for a smooth and gentle landing. In this way, soil and plants are deposited 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 1.30). 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.



Source 1.30 Constructive waves carry sand onto the shore where it collects and forms a beach. Wind picks up dry sand and blows it inland.



Source 1.31 Sand is trapped by plants and collects in dunes. Over time larger plants grow over the dunes, holding them together and making them stable.

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 1.31). 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, entire dunes can gradually move further inland, covering roads, car parks, paddocks and plants. These are called **blowout dunes** (see Source 1.32).

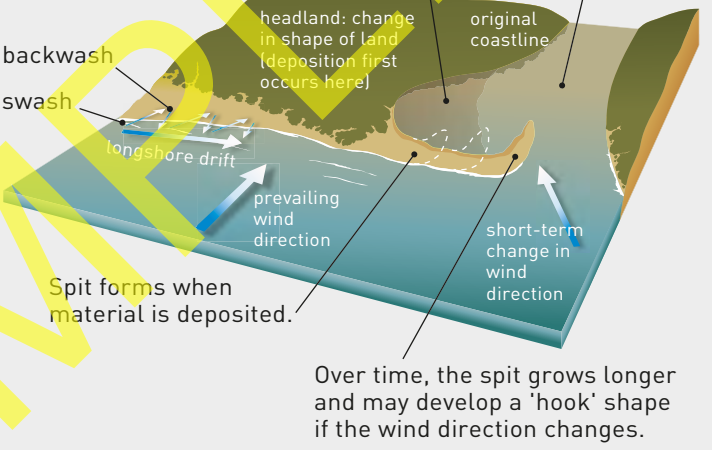
Source 1.32 A massive blowout dune inches its way across Fraser Island away from the beach.

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 1.26).



Source 1.33 How spits form

REVIEW 1.1.7

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 1.32) 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 1.29) showing the locations of sand, sea, rivers and forest. 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.

USING MOUNTAIN LANDSCAPES

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 tribesperson 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.

Source 1.34 The mountain landscape provides many resources.

REVIEW 1.1.8

Remember and understand

1 Which use of mountain landscapes shown in Source 1.34 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 mountains not shown in Source 1.34?

Apply and analyse

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

Investigate and create

7 Select two uses of mountains that can coexist without affecting each other. Explain why there is no conflict between 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 ideas with the rest of the class and be prepared to add to your list of potential impacts.

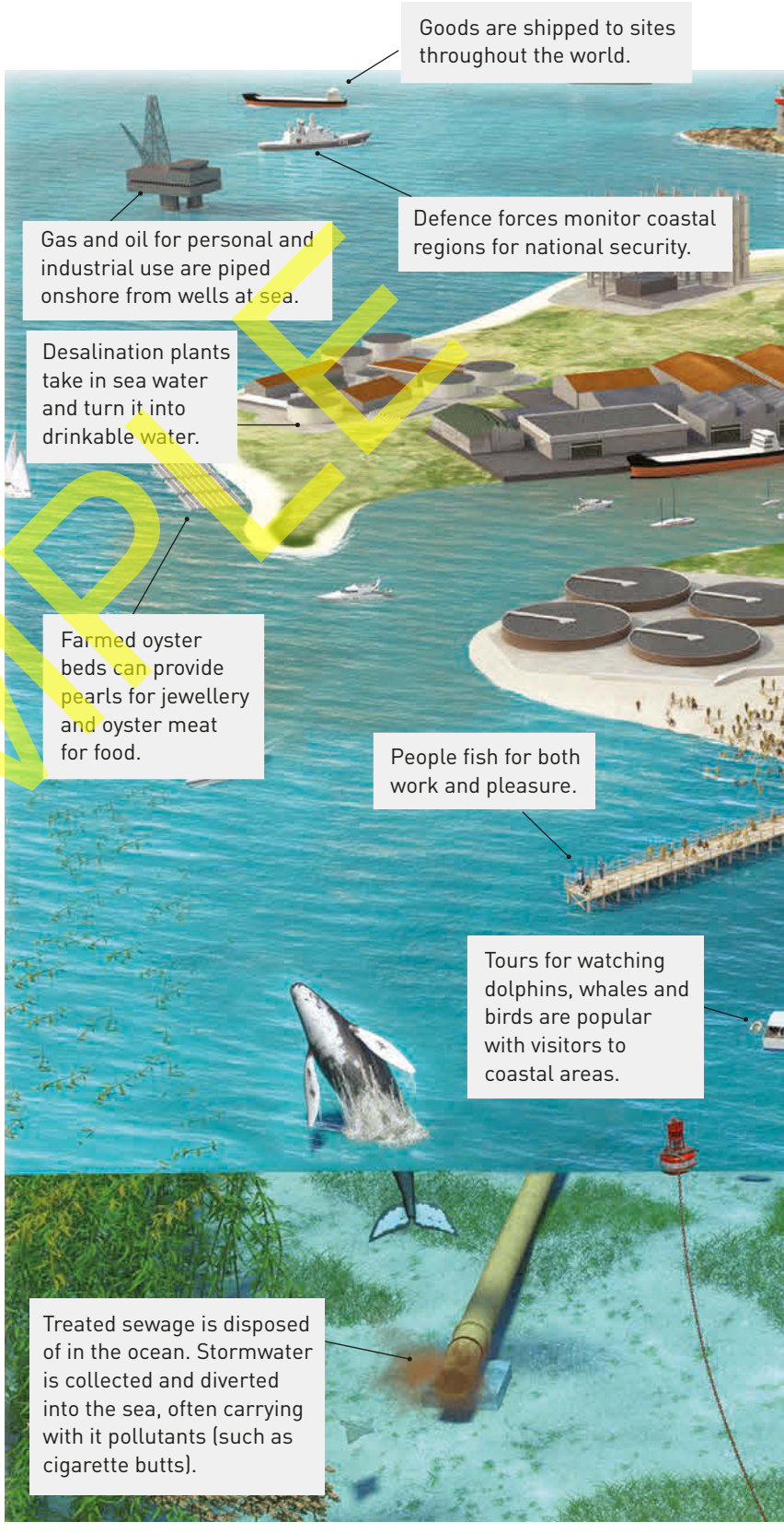
USING COASTAL LANDSCAPES

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 1.35 shows some of these uses and their impacts on the environment.

Source 1.35 How and why people use coastlines



REVIEW 1.1.9

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 1.35 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 1.35 describe ways you use the coast?

4 How does tourism change coastal areas?

5 Why do you think so many people live near the coast?

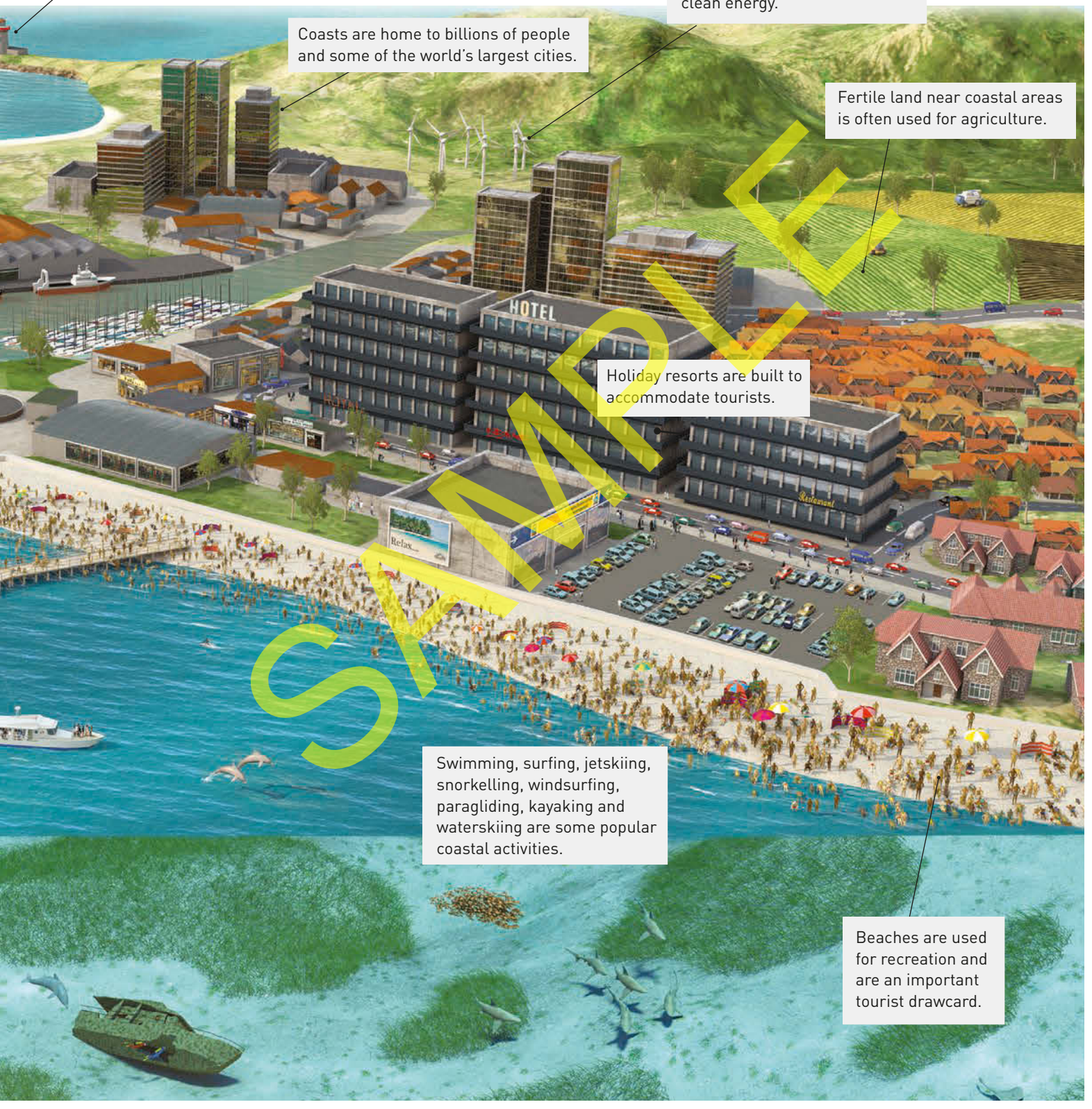
Investigate and create

6 Can you think of any uses of the coast not shown in Source 1.35?

7 Which activities shown in Source 1.35 would have no or very little impact on the natural environment? Which three would have the greatest impact?

8 Identify one activity shown in Source 1.35 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.

9 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?


Lighthouses are important landmarks that help ships navigate their way safely along dangerous stretches of coastline.
Coastal winds can be harnessed with wind turbines to produce clean energy.
Coasts are home to billions of people and some of the world's largest cities.
Fertile land near coastal areas is often used for agriculture.
HOTEL
Holiday resorts are built to accommodate tourists.
Swimming, surfing, jetskiing, snorkelling, windsurfing, paragliding, kayaking and waterskiing are some popular coastal activities.
Beaches are used for recreation and are an important tourist drawcard.

1.1

CHECKPOINT

WHY IS THERE A DIVERSITY OF LANDSCAPES AND LANDFORMS ON EARTH?

- **Investigate different landscapes and the geomorphic processes that create distinctive landforms**

1 Describe how the mountain landscape of the Andes in South America was formed in terms of plate tectonics. [5 marks]

2 Explain why Japan has active volcanoes and experiences earthquakes on a daily basis. [5 marks]

3 Explain the difference between weathering and erosion. [4 marks]

4 Explain how throughout a river's course, from its headwaters to its delta, there will be a range of erosional and depositional landforms. Name and describe the landforms that occur along a river's course. [6 marks]

TOTAL MARKS [/ 20]

RICH TASK

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 more than 3000 kilometres long and tall enough to hold back the world's largest ice sheet.

Acquiring geographical information

1 Use Source 1.36, Source 1.37, Skill drill: using a map legend and other information from Section 1.1 to complete an investigation into the landscapes and the geomorphic processes that create distinctive landforms in Antarctica.

a Use the map of Antarctica (Source 1.37) to describe the distribution of mountains on that continent.

b How do you think the Transantarctic Mountains were formed? Give reasons for your answer.

c 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.

Source 1.36 The Transantarctic Mountains in Antarctica

SKILL DRILL

Using a map legend

In order to show the features on maps clearly, various symbols and colours are used. To help us unlock the information on the map these symbols are explained in a legend (or key). There are three main types of map symbols:

- *point symbols* – show features in one particular place (such as a railway station or a scientific base)
- *line symbols* – show features that connect places on the map (such as roads and rivers)
- *area symbols* – use colours or patterns to represent large areas (such as lakes and ice sheets).

Apply the skill

1 Study Source 1.37.

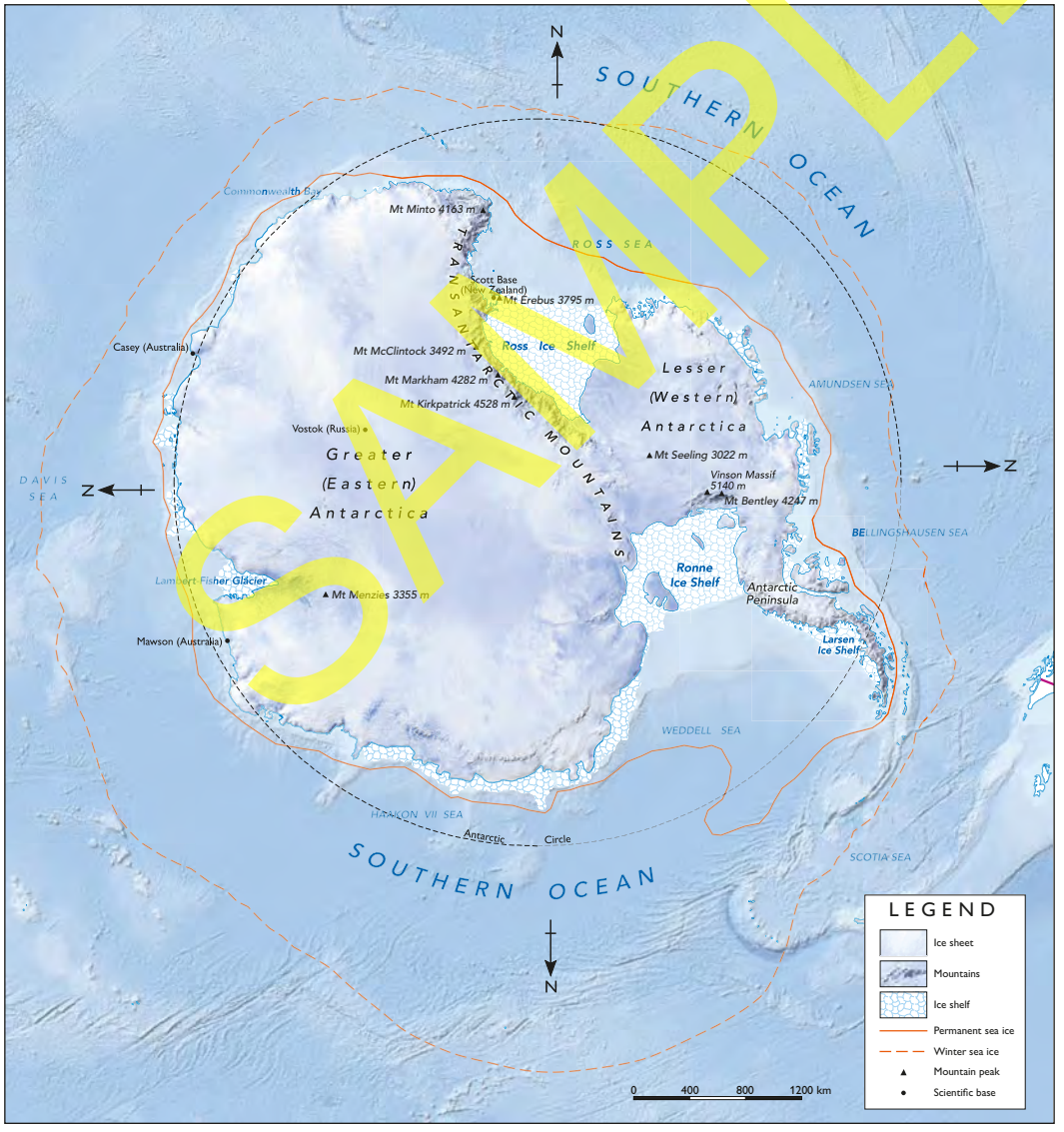
a What symbol has been used for mountain peaks on this map?

b Give an example of an area symbol used on this map.

c How many scientific bases are on this map?

d What do you notice about the location of the ice shelves on this map?

ANTARCTICA



Source 1.37

Source: Oxford University Press

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Change
- » Inquiry skill: Acquiring geographical information
- » Tools: Maps, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

CHECKPOINT

1.2 LANDSCAPES ARE ALWAYS CHANGING

WHAT ENVIRONMENTAL AND HUMAN PROCESSES FORM AND TRANSFORM LANDSCAPES AND LANDFORMS?

The Earth is dynamic. It is constantly moving and changing, transforming landscapes and landforms. The characteristics of most places are influenced by a combination of environmental processes, such as flooding and earthquakes, and human processes, such as mining and construction of cities. Some of these changes are very slow and take place over millions of years, for example, the formation of the Grand Canyon in the US state of Arizona. Other changes take place very quickly, as did the formation of a new island in the South Pacific, just four months after the eruption of an underwater volcano in Tonga.

Source 1.38 The Grand Canyon in Arizona, United States, is thought to have taken more than 17 million years to form as we see it today.

Source 1.39 In 2015, a new island formed in the South Pacific, 45 kilometres north-west of Tonga's capital, Nuku'alofa, four months after the eruption of an underwater volcano.

STRANGE BUT TRUE

The world's population is approximately 7.4 billion people. In 1999, it was six billion. The United Nations estimates that by 2050 the world's population will be more than 9.7 billion.

Humans change landscapes

Without doubt the most constant force of change is us. Humans have been changing landscapes to obtain food and other essential elements for thousands of years. We clear forests and change the shape of the land to graze animals and grow crops. We move mountains and divert rivers to build cities and towns. We even create new land from the sea in coastal areas. In fact, humans have transformed landscapes so much that today very few truly natural landscapes remain. As the world population increases, so too does our demand for resources from the land.

Source 1.40 The rice terraces of Luzon Island in the Philippines were built by the native Ifugao people.

Source 1.41 Palm Jumeirah is an artificial island on the coast of Dubai, United Arab Emirates, constructed from dredged sand and rock breakwaters.

Land degradation

Source 1.42 The Ranger Uranium Mine in the Northern Territory provides a clear example of the way in which places are changed and managed by humans. Here, uranium (used to fuel nuclear power plants) is mined and sold to countries across Asia, Europe and North America. Although the mine is technically separate from Kakadu, it is surrounded by the park on all sides.

Land degradation affects 33 per cent of the Earth's land surface. It reduces the quality of the land and its capacity to produce food. Human activities are the main cause of land degradation. Overgrazing, crop growing without resting the fields, deforestation and land clearing, collection of wood for fuel, and industrialisation including mining are all examples of human activities that cause land degradation. According to the United Nations Food and Agriculture Organization (FAO), the world on average has just 60 more years of growing crops if we do not modify our current practices. To keep up with the global food demand, the FAO estimates 6 million hectares of new farmland will be needed each year. Instead, 12 million hectares a year are lost through land degradation.

Through the ages, people have extracted minerals from rocks (ores) to use for different purposes. The discovery of ores, and people's ability to extract the metals within them, has been crucial for technological development. Today our modern technology and lifestyles depend on the use of a large range of minerals; for example, glass is made from silicates and feldspar and steel is made from iron ore. All these minerals come from the rock in the Earth's crust. If the rock containing the mineral is close to the Earth's surface, it can be dug up by open-cut mining (see Source 1.42). Mining and the processes used to extract minerals from the ore damage our environment. Even where mining occurs underground, crushed rock is dumped in piles around the mine after the valuable minerals have been extracted from it.

REVIEW 1.2.1

Remember and understand

1 Explain why land degradation is an important issue.
2 Is land degradation inevitable?
3 List some of the human activities responsible for land degradation.

Apply and analyse

4 Look carefully at Source 1.42. Create and complete the following table by considering:
   a the environmental impacts of the mining activities
   b how the impacts could be minimised.

Mining activity	Potential environmental impacts	Minimisation of impacts
Using local roads		
Clearing Kakadu bushland		
Using large, heavy machinery		
Removing topsoil		
Dumping crushed rock (mine waste)		
Using explosives to remove material		

5 How can humans accelerate the process of erosion?
6 Identify a natural landscape that has not been changed by humans. Explain why this is possible.

Investigate and create

7 Of the 35 countries most dependent on mining, all but Australia and South Korea are developing countries. Account for two advantages and two disadvantages of this dependence on mining to a developing country.

CAUSES OF LANDSCAPE DEGRADATION

STRANGE BUT TRUE

Did you know that it takes around 100 years to generate 1 millimetre of soil, and that half of all the topsoil on the planet has already been lost over the last 150 years? It has simply been washed or blown away.

All around the world natural landscapes are being transformed by humans. Natural vegetation is cleared and replaced with single plant species, crops and pastures for grazing. Trees are cut down for fuel, paper and building material. Soil is damaged by overfarming and other poor agricultural practices, affecting its ability to support plants and animals. Water diverted from rivers and underground sources to grow crops and raise animals may become polluted through the use of fertilisers and pesticides. All these changes can cause degradation of the natural landscape. Industrialisation increases the stress on the land further by building, mining, energy production and pollution. It is estimated that more than half of the world's **arable** land is moderately or severely degraded. **Soil erosion**, **desertification** and **salinity** are three common forms of land degradation brought about by land clearing and farming.

overgrazing (35 per cent)

deforestation (30 per cent)

Source 1.43 Causes of land degradation

THE FIVE MAIN CAUSES OF LAND DEGRADATION AND THEIR ESTIMATED CONTRIBUTIONS

crop growing (28 per cent)

collection of firewood for fuel (6 per cent)

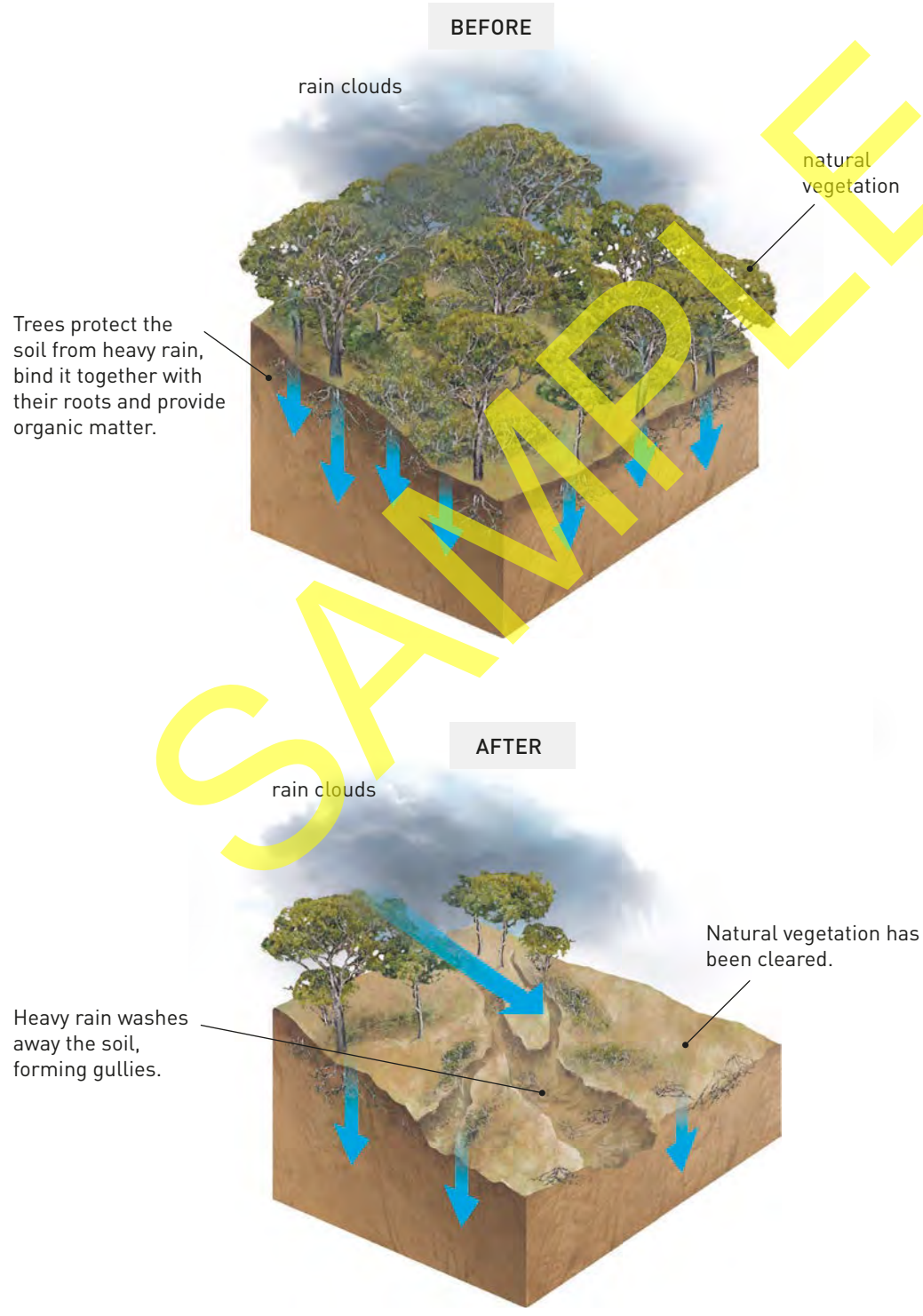
industrialisation (1 per cent)

Soil erosion, desertification and salinity

Soil erosion

Soil erosion is the removal of topsoil faster than the soil-forming processes can replace it. Natural vegetation protects the soil. When land is cleared for farming it loses topsoil easily, often resulting in a lowering of soil nutrients and productivity. Each year, 5 to 7 million hectares of farmland are lost to soil erosion worldwide.

Source 1.44 Soil erosion



Desertification

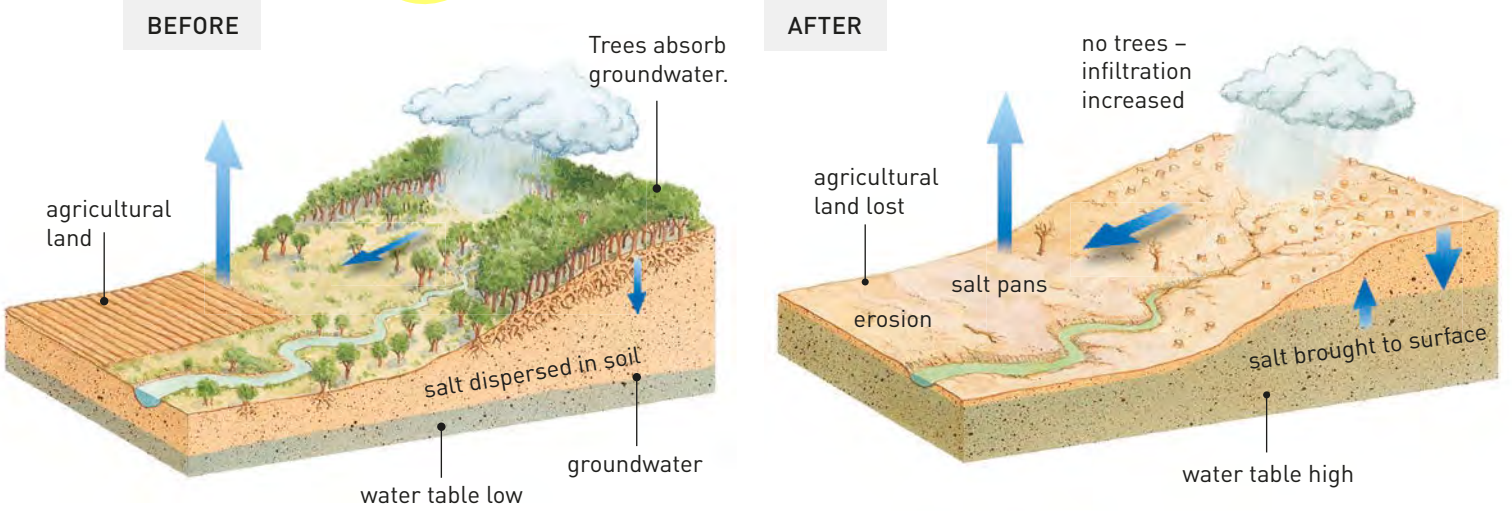
Desertification is the transformation of fertile land into dry, desert-like areas. Human activities such as deforestation, overgrazing and poorly managed agriculture can cause desertification. Unprotected, dry soil surfaces blow away with the wind or are washed away by rain, leaving infertile lower soil layers that are unproductive.

Source 1.45 Desertification

Salinity

Salinity refers to a high level of salt in the soil, which kills plants. Salt in the underground water is forced to rise when we remove trees with deep root systems that keep the water table low in the ground. This is known as dryland salinity. When extra water from irrigation enters the ground it also forces the water table to rise. This is known as irrigated salinity.

Source 1.46 Salinity



REVIEW 1.2.2

Remember and understand

1 Why is soil important?
2 Where does the soil that is eroded away end up? Describe how it got there.
3 What is desertification? Identify the three main human activities that can cause desertification.
4 What is salinity? Distinguish between dryland salinity and irrigated salinity.

Apply and analyse

5 Construct a pie chart to illustrate the causes of degradation.
6 Consider the processes that contribute to land degradation in farming, listed in the table below. Copy the table into your notebook and complete it by matching the following effects to the causes identified in the table. Remember: a cause is a reason or situation that leads to an outcome or result.
   - Waterlogged soils
   - Acidic and less productive soil
   - Loss of fertile topsoil
   - Smothering of native vegetation
   - Raised water table, bringing salts to the surface
   - Loss of productivity
   - Dried, cracked and hard soil surface
   - Barren and unproductive land
   - Very hard surface that water cannot infiltrate
   - Irreversible damage – abandoned land

Process	Cause	Effect
Acidification	Overuse of fertilisers	
Compaction	Driving over soil in heavy machinery Herds of hoofed animals	
Drought/Desertification	Global warming Lack of rainfall Overcultivation	
Erosion	Clearing of all vegetation, especially trees	
Nutrient depletion	Repeated cropping Overstocking on pasture	
Salinity	Excessive irrigation	
Weed invasion	Introduced species	

Investigate and create

7 You are a journalist trying to create greater awareness of the perils of land degradation. Consider the following statements and explain their meaning in your own words. Then propose another newspaper headline worthy of informing the reader of the importance of soils and the risks of land degradation.
   a 'We're treating soil like dirt. It's a fatal mistake, as our lives depend on it.'
   b 'Soil erosion threatens to leave the world hungry.'
   c 'From dust bowl to bread basket'

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 (see Source 1.47).

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.

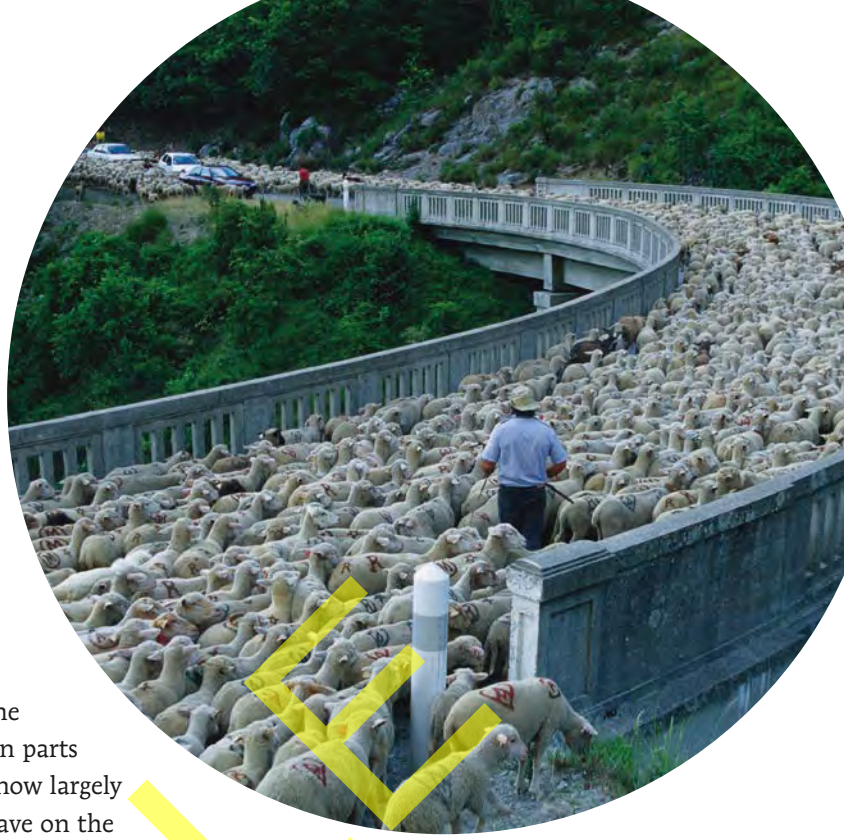
Some terraces, including those shown in Source 1.47, are thousands of years old and farmers often spend many hours a day maintaining them. The crop most often grown in these terraces is rice, which is the staple food of half the world's population.

Source 1.47 These rice terraces on luzon Island in the Philippines are a Word Heritage Site and 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 1.48 and 1.49), 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 1.48 A shepherd takes his flock of sheep into the French Alps for summer.

Source 1.49 Climate data for the town of Mende in the French Alps

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

REVIEW 1.2.3

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 1.47, 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 1.47 suitable for farming.

Investigate 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?

HUMAN IMPACTS 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.

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 1.51). 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

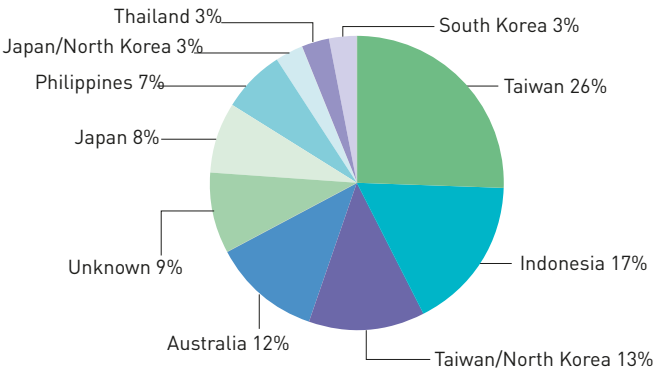
Source 1.50 Yirralka Laynlapuy rangers remove a ghost net from a beach in East Arnhem Land.

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

Source 1.51

Source: Oxford University Press

alliance of coastal Indigenous communities from Queensland, the Northern Territory and Western Australia. Since GhostNets Australia was formed, its rangers have retrieved more than 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 global positioning systems (GPS), and try to identify the origin of the nets using resources supplied by the World Wildlife Fund.



Source 1.52 Origins of nets found at Cape Arnhem, Northern Territory

KEY CONCEPT: 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 origins of the nets (see Source 1.52).

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

REVIEW 1.2.4

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 1.51. 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?

Investigate 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 1.52).
   a Colour 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?

1.2 WHAT ENVIRONMENTAL AND HUMAN PROCESSES FORM AND TRANSFORM LANDSCAPES AND LANDFORMS?

CHECKPOINT

- **Investigate the human causes and effects of landscape degradation**

1 Identify a landscape (for example, a coastal landscape or a mountain landscape) and explain one way that people use it:
   - **a** that improves it
   - **b** that degrades it
   - **c** that doesn't change it at all. [15 marks]

2 Describe the five main causes of land degradation. [5 marks]

3 Explain the consequences of desertification for world food production. [10 marks]

TOTAL MARKS [/30]

RICH TASK

Land degradation and food production

Land degradation is a major global issue. Its importance is critical because of its impact on both world food security and the quality of living environments. High population density is not necessarily the cause of land degradation; it is how people treat the land that will determine the extent of the degradation. People can be the main force in reversing a decrease in land quality. The challenge is for them to be healthy, skilled and motivated to care for the land, because dependence on subsistence agriculture, extreme poverty and illiteracy can be significant causes of land degradation.

Source 1.53 Soil degradation caused by poor farming practices has turned this once productive farm in Kenya into unusable land.

Processing geographical information

1 What benefit would there be in leaving the trees along the ridge?

2 Why does the likelihood of erosion increase when the land is ploughed?

3 What are the arguments for and against clearing the steeply sloping land?

4 Explain how terracing of the slopes can reduce soil erosion.

5 How can water erode sloping land?

6 Does it make a difference which direction the land has been ploughed?

7 Which area could be stocked with the most cattle?

8 How can overstocking an area cause erosion?

9 How could crop rotation reduce soil erosion?

Communicating geographical information

10 You have been employed as a consultant to provide advice to the farm owner. Propose an action plan of 10 points in order of importance.

11 Crop rotation is a practice designed to minimise pests and diseases, reduce chemical use, aid in building and maintaining healthy soil, and manage nutrient requirements – all of which aim to maximise production quantity and quality.
   - **a** Conduct research on crop rotation for a backyard vegetable garden. As you investigate, choose a variety of plants to demonstrate the principles of crop rotation (maximise yield, access available nutrients, avoid disease).
   - **b** Based on your findings, design a garden and make an annotated sketch of it.
   - **c** Perennial plants do not need to be rotated. Why is this so?
   - **d** What else can you do to improve the soil of your vegetable patch?

SKILL DRILL

Reading thematic maps

Thematic maps are used to represent a particular theme or topic; for example, the distribution of instances of desertification, deforestation or land degradation.

Step 1 Look carefully at the legend. Thematic maps use colours or symbols to represent different aspects of the topic on the map. For example in Source 1.54, areas of colour are used to show the different levels of vulnerability to desertification.

Step 2 Train your eyes to move from the legend to the map while you interpret the information. For example, look at the solid blocks of colour in Source 1.54 and work out what they tell you.

Step 3 Move to a different piece of information (in the case of Source 1.54, a different block of colour) and work out what that represents.

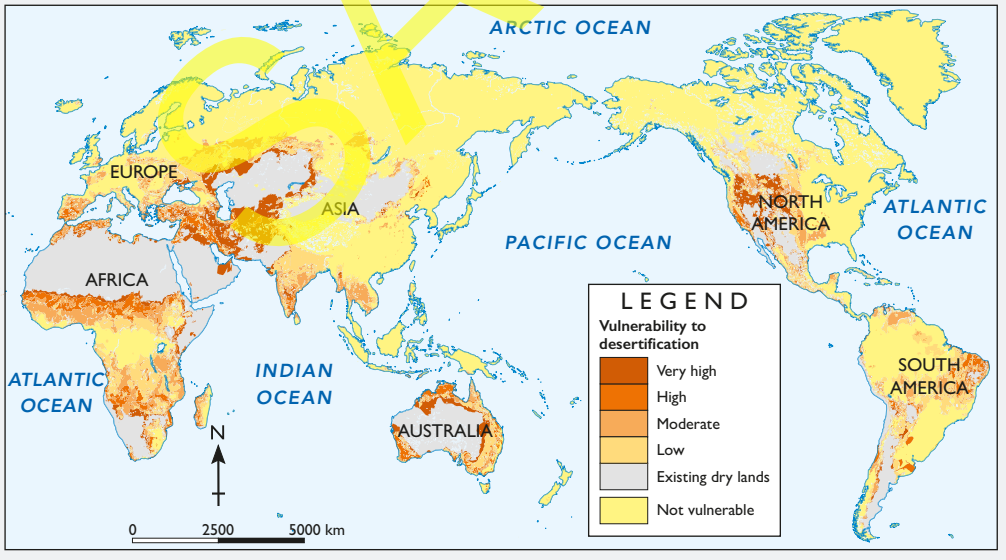
Step 4 Look for concentrations of the same symbol or colour in areas to see if patterns exist.

Apply the skill

Study Source 1.54.

1 What colour represents very low vulnerability to desertification?
2 What colour represents very high vulnerability to desertification?
3 What colour appears to dominate throughout Africa?
4 Which areas appear to have the lowest vulnerability?
5 Select one area that has low or very low vulnerability. Why do you think that is?
6 Select one area that has high or very high vulnerability. Why do you think that is?
7 Rank the continents in order of their vulnerability to desertification. The continent with the highest vulnerability will be number one.
8 What region has the highest concentration of areas that are not vulnerable?
9 Imagine if these non-vulnerable areas were as common in the rest of the world. What would need to change? What areas would you target first?

WORLD: DESERTIFICATION



Source 1.54

Source: Oxford University Press

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

» Concepts: Environment, Interconnection, Scale, Sustainability
» Inquiry skills: Processing geographical information, Communicating geographical information
» Tools: Visual representations, Maps

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

CHECKPOINT