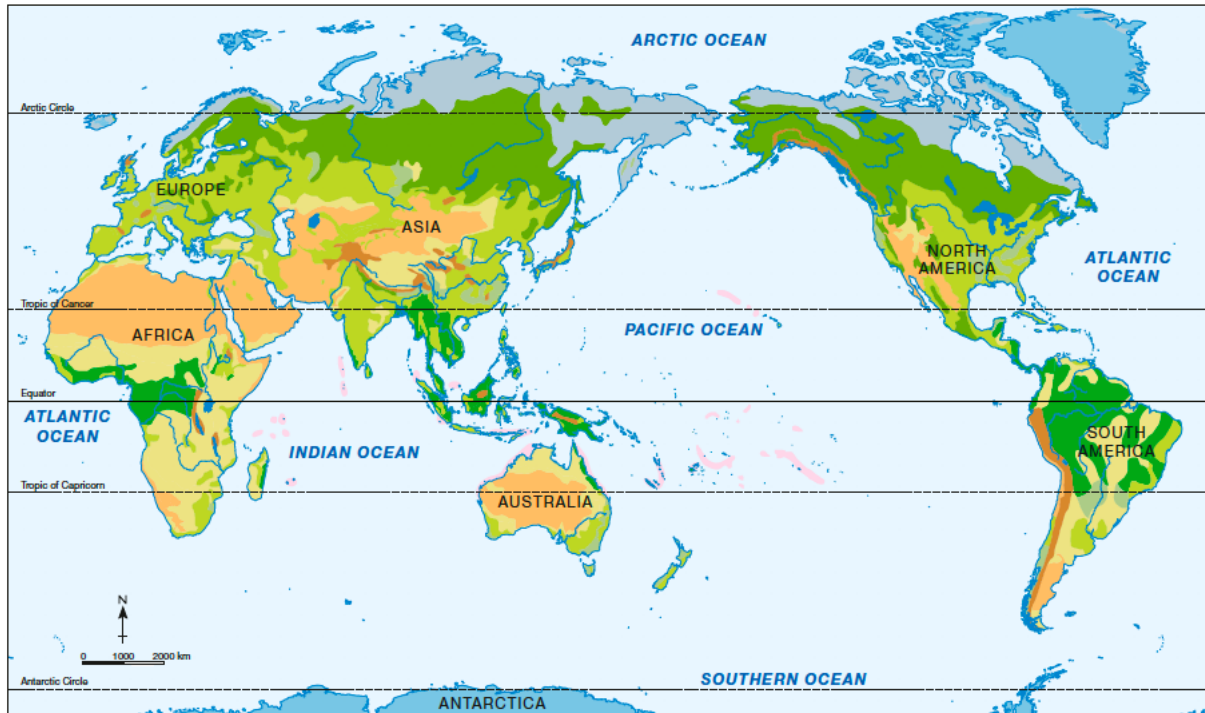


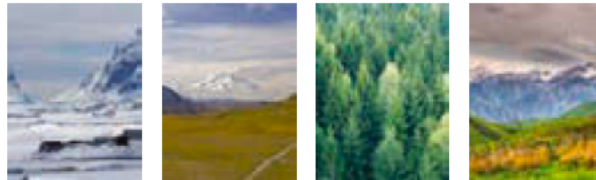


WORLD: BIOMES



#### LEGEND: TERRESTRIAL BIOMES

Polar lands	Tundra	Boreal forest	Mountain vegetation
-------------	--------	---------------	---------------------

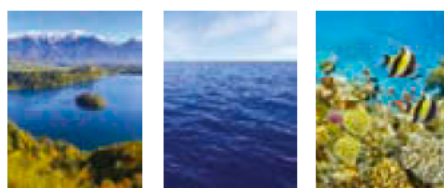


Temperate forest	Grasslands	Desert	Tropical forest
------------------	------------	--------	-----------------



#### AQUATIC BIOMES

Freshwater	Marine	Coral reefs
------------	--------	-------------



Source 4

Source: Oxford University Press

### Check your learning 2.1

#### Remember and understand

- 1 What is a biome?
- 2 What is the difference between terrestrial biomes and aquatic biomes?
- 3 What does the word 'tundra' mean? Where is the tundra biome located?

#### Apply and analyse

- 4 Where are the world's tropical forests located? Why do you think they are located in these places?
- 5 Describe the distribution of different terrestrial and aquatic biomes in Australia.

#### Evaluate and create

- 6 Work with a partner to classify the eight terrestrial biomes shown in Source 4 in order from the biome with the most species to the biome with the least species. Compare your results with other groups in your class. Were there some rankings you all agree on? Were there others that no one could agree on? Discuss the reasons for this.

## 2.2 Forest biomes

There are two main types of forest biomes – boreal forest and temperate forest.

### Boreal forest biome

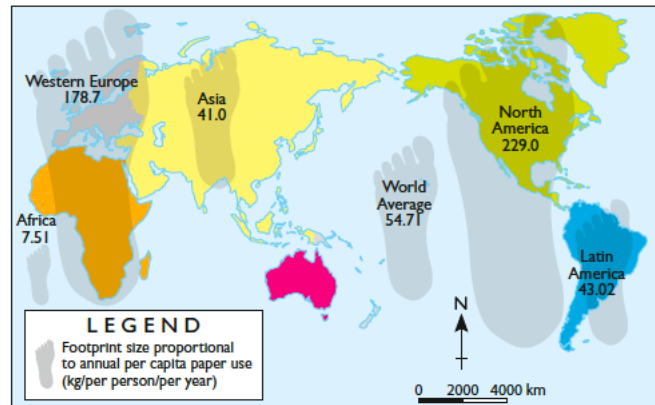
The largest biome on land is the boreal forest biome. Boreal forest, sometimes called coniferous forest, is made up of evergreen trees that have needle-like leaves and cones, such as pine cones. This biome is home to a low number of species of plants when compared to other forests in more temperate regions or in the tropics.

The boreal forest biome covers vast areas in the northern hemisphere, between the Arctic tundra and the north of Europe, Asia and North America. While the climate in these regions is not as harsh as that experienced in the polar lands or on the tundra, it is still cold enough to limit the number of plant and animal species that can survive, and winter is long. In fact, the boreal forest's longest season is winter. Average temperatures fall to about  $-15^{\circ}\text{C}$  and snow is common. In summer, which lasts only one to three months, temperatures climb towards  $20^{\circ}\text{C}$  and humidity is relatively high.



**Source 1** This paper mill is situated by a large body of water. Paper is made by pulping woodchips from logs and mixing the pulp with water.

WORLD: AVERAGE PAPER CONSUMPTION



Source 2

Source: Oxford University Press

The plants and animals that survive in this biome must be able to handle great variations in rainfall and temperature, as well as large areas of permanently frozen ground and poor soils.

### Threats to the forest

Boreal forests have provided many important resources for people both in the past and the present. Historically, wood for construction, heating and cooking came from boreal forest trees. More recently, boreal forests have supplied the increased global demand for cheap wood and paper, spurred by population growth and a change in global markets.

However, many boreal forests are under threat. One of the main threats to the boreal forest biome is the clearing of trees to make way for oil and gas exploration. It is estimated that huge reserves of petroleum products lie under the forests, and the ever-increasing demand is pushing exploration into these areas.

In Canada and Russia, forests are logged extensively and many are being attacked by insect plagues and acid rain. Forests are also at risk from bushfires during the summer period. Climate change is causing some forest areas to spread further north. Rising temperatures in the Arctic region have seen the edge of the boreal forest slowly advancing northward, replacing tundra in some places.





## 2A What are biomes?

### Source 3

The spectacular deciduous trees in the town of Bright in Victoria's high country are mainly oaks and elms, native to England half a world away.

## Temperate forest biome

Between the tropics and the cold polar regions is a large zone that is neither excessively hot nor excessively cold. For this reason it is called the temperate zone.

The forests that grow in the temperate zone experience a range of seasonal climate conditions. In winter, temperatures may fall below freezing and in summer they can climb above 40°C. In some temperate forests, rain falls reliably throughout the year. In others, there are more distinct wet and dry seasons.

Most of the world's population lives in the temperate zone and this has had a huge impact on the temperate forest biome over time. As the world's population spread and grew, temperate forest biome areas gradually

became smaller. Cities were formed on land that was once covered in forest, and trees were cut down to clear land and to provide fuel and building materials. The forests gradually disappeared from these places. This happened in Europe, then in Western Asia and North America. Currently, little temperate forest remains in some of these places.

However, as explorers set out from Europe to colonise new lands, they often carried with them seeds and saplings of the trees with which they were familiar. They planted these in the places they travelled to, such as Australia, New Zealand and South Africa, and in this way temperate forest trees were spread around the world.

## Check your learning 2.2

### Remember and understand

- 1 Describe the temperature variations experienced in the boreal forest biome.
- 2 How have trees from temperate forests spread around the world?

### Apply and analyse

- 3 What are some of the differences between boreal and temperate forests? What are some of the similarities?
- 4 Use the map in Source 4 on page 47 to compare the distribution of temperate and boreal forests.
- 5 Why do you think the consumption of paper has increased dramatically in the last 50 years?

- 6 What influence has this growth in demand for paper had on the world's forests?

### Evaluate and create

- 7 Examine Source 2, showing the average consumption of paper by person in each continent.
  - a Who are the biggest paper users? Who are the smallest?
  - b Australian consumption is not shown on this graphic. Draw the size you estimate Australia's paper footprint to be compared to one other continent. Explain how you decided on the size of Australia's footprint.



## 2.3 The grasslands biome

In places that are too dry for forests and too wet for deserts lies a biome dominated by shrubs and grasses – the grasslands biome. In different parts of the world, the grasslands biome is referred to by a few different names. In Africa, grasslands are often referred to as savannas. In North America, they are often called prairies, and in parts of Siberia and south-eastern Asia, they are often known as steppes.

Much of the world's food and fibre comes from plants and animals that live in the world's grasslands. Rice, wheat and corn, all grasses, provide the bulk of the human population's food, and many animals that are farmed to provide meat and milk also live in the grasslands biome.

Much of Australia can be considered grassland and many of our native animals, such as kangaroos, wallabies and wombats, thrive in this biome.

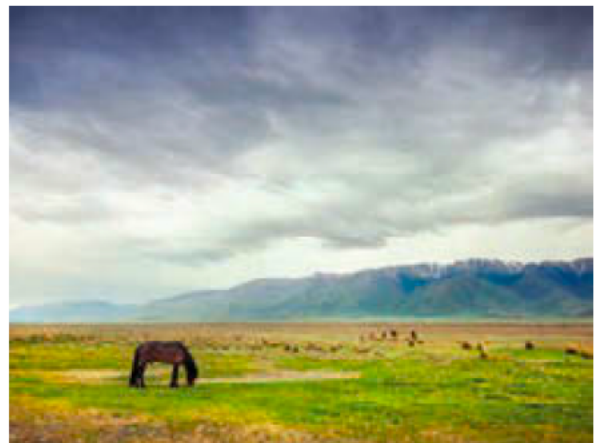
In Africa, too, grasslands dominate, covering more than half the continent. In this landscape the grassland is dotted with individual trees, providing little cover for the wildlife that live there.

These grasslands support a variety of plant-eating mammals as well as predators that feed off them. The animals living here have developed an amazing array of physical and behavioural changes to adapt to the challenges of the open environment. The zebra's stripes, for example, make it difficult for a predator to see it clearly. The giraffe, one of the larger kind of grasslands inhabitant, has evolved in such a way that its long neck allows it to source food at the tops of trees. Many other animals that live in the grasslands are nocturnal, allowing them to avoid the main heat of the day and venture out at night to hunt and gather food. These animals include the prairie dog, barn owl and gray wolf, which scout for food at night. Smaller mammals also venture out in the cool of the night, often when the moon is full or near full, to allow them to better spot animals that may be seeking them out as prey.

Many grasslands around the world have changed greatly over time. Some of these changes are the result of human activities, such as introducing grazing animals to a grasslands environment. Grazing animals such as cattle, sheep and goats compete with native species for food and often trample the ground, damaging the roots and soil structure.



Source 1 Elephants on the savanna in Africa



Source 2 A wild horse on the steppe in Asia



Source 3 A bison on the prairie in North America

**keyconcept:** Change**The North American prairie**

The prairies of North America were once dominated by Indigenous American tribes, such as the Cheyenne, Apache and Comanche tribes.

The Comanche lived in the grasslands in the region that now includes Texas, Oklahoma and Kansas, in the United States. They were typical of many of the Indigenous tribes of North America. As their main food source was bison, they followed the great herds across the plains, as the bison travelled to find the best grazing. When the bison stayed in one location to eat the plentiful grass, the Comanche set up temporary villages. Then they moved with the bison when better grazing lands were needed. The bison provided more than food for the Comanche, their hides were used to make clothing and the distinctive pyramid tents, called tepees.

Some tribes hunted bison by building fences from fallen logs, then herding the bison into a small area where they were killed with arrows and knives. Herding massive animals such as bison was difficult for tribesmen on foot. However, life for Native Americans changed dramatically with the arrival of European explorers, and their horses, about 400 years ago.

Many tribes, including the Comanche, quickly realised the potential of the horse in their culture and soon became expert horsemen. As well as being faster and more nimble than a bison, the horse had one other great advantage for the grasslands tribes. Like bison, horses are grazing animals that eat grass. This meant



**Source 4** It is estimated that 30 million bison lived in North America in the 1500s. Within 400 years this had fallen to about 1000. In this photograph, taken in the 1870s, a pile of bison skulls waits to be crushed for fertiliser.

that the tribes could move easily across the plains following the gradual movement of the bison herds, the grasslands now feeding both bison and horses.

But as European ranchers moved across the prairies through the 16th to 19th centuries, the numbers of Native Americans and their way of life gradually disappeared. Much of the vast grasslands of the prairie were turned into grazing land and farmland by the European settlers. However, the open plains remain an iconic image of American history and the American pioneering spirit. For more information on the key concept of change, refer to page 10 of 'The geography toolkit'.

**Check your learning 2.3****Remember and understand**

- 1 Why is the grasslands biome important for human populations?
- 2 What changed the grasslands of North America?

**Apply and analyse**

- 3 Examine the map in Source 4 on page 43 showing the distribution of the world's biomes.
  - a Describe the distribution of grasslands in each continent.
  - b What relationship do you notice between grasslands and human environments such as cultivated land and urban areas?
  - c Why does this relationship occur?

- 4 Examine the three images of grasslands (Source 1, Source 2 and Source 3) from different parts of the world. In which countries do you think each of these photographs was taken? Give some reasons for your answers.

**Evaluate and create**

- 5 Compare the images of the grasslands with the pictures of a desert in Source 3 on page 52. What are some of the main differences between the two biomes? Explain why these differences occur.



## 2.4 The tropical forest biome

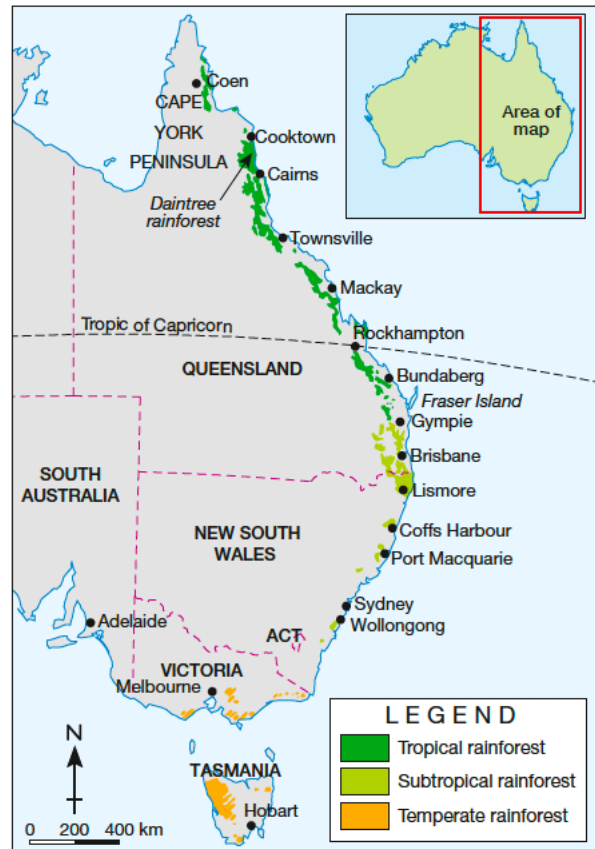
It is estimated that about half of all the plant, animal and insect species in the world live in tropical forests. Many of these are among the wettest places on Earth and are therefore known as rainforests. They can be considered to make up the world's richest biome and the abundance of life can be astounding. In Brazil, for example, researchers found that a single pond contained more fish species than exist in all of Europe's rivers. In Peru, a single tree was found to contain 43 ant species; this is more than the total number in all of the British Isles. One hectare of South American rainforest may contain over 750 different types of trees and one-fifth of all of the world's birds live in the Amazon rainforest. This explosion of life is due to the ideal growing conditions that occur in the tropics.

These places experience the most stable climate conditions on the planet with virtually no seasonal changes in rainfall, temperature or available sunlight throughout the year. Most days are the same in the rainforest: hot and wet. It rains virtually every day, often in torrential downpours. The temperature hovers between about 26°C and 32°C all year round.



**Source 1** Tropical rainforests cover the slopes of many Queensland mountains and experience Australia's highest rainfall. The Daintree rainforest near Port Douglas is the oldest continuously surviving rainforest in the world.

**EASTERN AUSTRALIA: RAINFOREST REGIONS**



**Source 2**

Source: Oxford University Press

### Australia's rainforests

Though much of Australia was once covered in forest, now there are only a few small pockets near the east coast (see Source 2). Rainforests now make up only 2.5 per cent of Australia's remaining native forest. This surviving forest, however, is a real Noah's Ark for many plant and animal species, many of which exist nowhere else in the world. There are more than 1000 species of plants in Australian rainforests, of which about 700 exist nowhere else. These plants support thousands of insect species, hundreds of reptile and bird species and nearly 90 different types of mammals. The subtropical rainforests of New South Wales and Queensland are also internationally recognised for their direct links to the world's first flowering plants, which occurred about 100 million years ago.

## The gifts of the rainforest

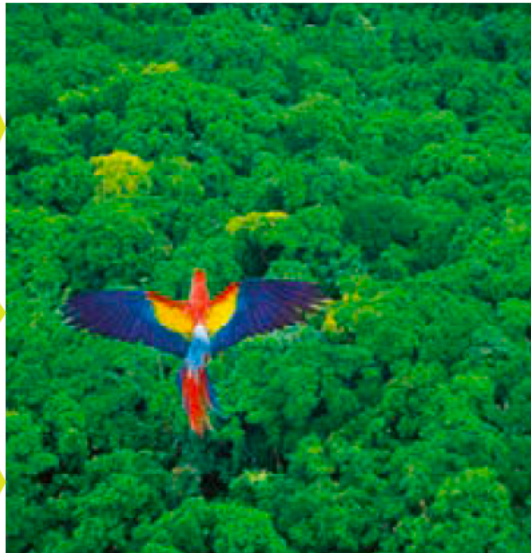
Rainforests have provided humans with many resources for thousands of years. These resources are known as ecosystem services. Rainforests provide many services, including the ones described in Source 3.

### Ecosystem services

About 80% of the plants we eat began in the world's tropical rainforests. Potatoes, corn, rice, avocados, oranges, bananas, coffee, chocolate and hundreds of other foods are rainforest plants.

About 25% of the drugs we use to treat illnesses, from leukaemia to headaches, come from rainforest plants.

Rainforest plants take in carbon dioxide and produce oxygen. The Amazon rainforest alone is thought to produce about one-fifth of the world's oxygen.



Rainforests regulate the Earth's temperature and rainfall, and hold much of the world's fresh water.

Rainforests in Africa, Asia, South America and Australia are home to Indigenous peoples.

Products such as toothpaste, golf balls, rubber tyres, paints, cosmetics, steroids and cork are all made from rainforest plants.

**Source 3** A scarlet macaw flies over the world's largest rainforest – the Amazon. The Amazon provides many ecosystem services.



**Source 4** Temperate rainforests are found in the temperate climate zone. Like tropical rainforests, they receive an abundance of rain and take in high amounts of carbon dioxide. However, they do not have the same levels of biodiversity as the tropical rainforests. The temperate rainforests of Western Australia, such as these found in Walpole-Nornalup National Park, are characterised by diverse plant life and towering trees.

## Check your learning 2.4

### Remember and understand

- 1 Use the map showing the world's biomes (Source 4 on page 43) to describe the distribution of the world's tropical forests.
- 2 What are some of the links between the world's climate and rainforests?

### Apply and analyse

- 3 Describe the distribution of Australia's rainforests. Refer to particular places and states and use compass **directions** in your answer.
- 4 What are some of the differences between tropical and temperate rainforests?

### Evaluate and create

- 5 Why do you think the amount of rainforest in Australia has decreased so much? Consider both natural processes and human activities.
- 6 What information from these pages would you use to explain the importance of rainforests?
- 7 Clearing of rainforests for farming, mining and urban development makes the tropical forest biome one of the world's most endangered.
  - a How might the clearing of a rainforest impact on people who live in it or nearby?
  - b How might it impact on people living in places that are further away?



## 2.5 Going with the flow in the rainforest

A rainforest, like all ecosystems, is a very dynamic place. Complex relationships between the climate (including rainfall, temperature, wind, humidity and sunlight), the shape of the land, soils, plants and animals have developed over millions of years and keep the rainforest alive and flourishing. A change to any part of the ecosystem can have devastating consequences for the whole ecosystem. The cross-section in Source 1 shows some of the flows of energy (intangible sources of power or nutrition) and matter (tangible sources of power or nutrition) that exist in a rainforest.

### Changes in the rainforest

It might seem logical that rainforests must have a deep rich layer of soil to support the great trees and other plants that flourish there. However, this is not the case. The heavy rain washes the nutrients of the soil deep into the ground where the roots of the plants cannot access them. The rainforest trees are able to survive in these soils because they have developed wide-spreading roots and because the warm temperatures in the tropics allow leaf litter – dead plant material that has fallen to the ground – to be quickly recycled into plant nutrients.

When the rainforest plants are cleared to make way for farms, these nutrients are quickly lost and the soil becomes exposed to the heavy rain and tropical sun. Farmers often find, contrary to expectation, that their plants do not thrive in these conditions as the soil provides few nutrients which the plants need.

### skilldrill

#### Creating a flow diagram

Geographers use **flow diagrams** to show the movement, sequence or stages in a process. Flow diagrams can be created by adding text and arrows to an image, or by creating text boxes from scratch, joined by arrows to describe the flow of a process.

Follow these steps to create a flow diagram.

**Step 1** Decide on a process you want to describe.

For example, you might want to describe the life of an apple, from seed to compost stage.

**Step 2** Jot down the steps you wish to highlight in the process. Try to keep each step clear and separate.

**Step 3** Create a text box for each step, and write or insert your text in each box.

**Step 4** Link each step with an arrow showing the direction of the process. Read through your diagram to make sure the steps are logical and that you haven't missed any important parts of the process you are aiming to describe.

You can also create a flow diagram by adding your arrows and text to an existing image, following the process described here.

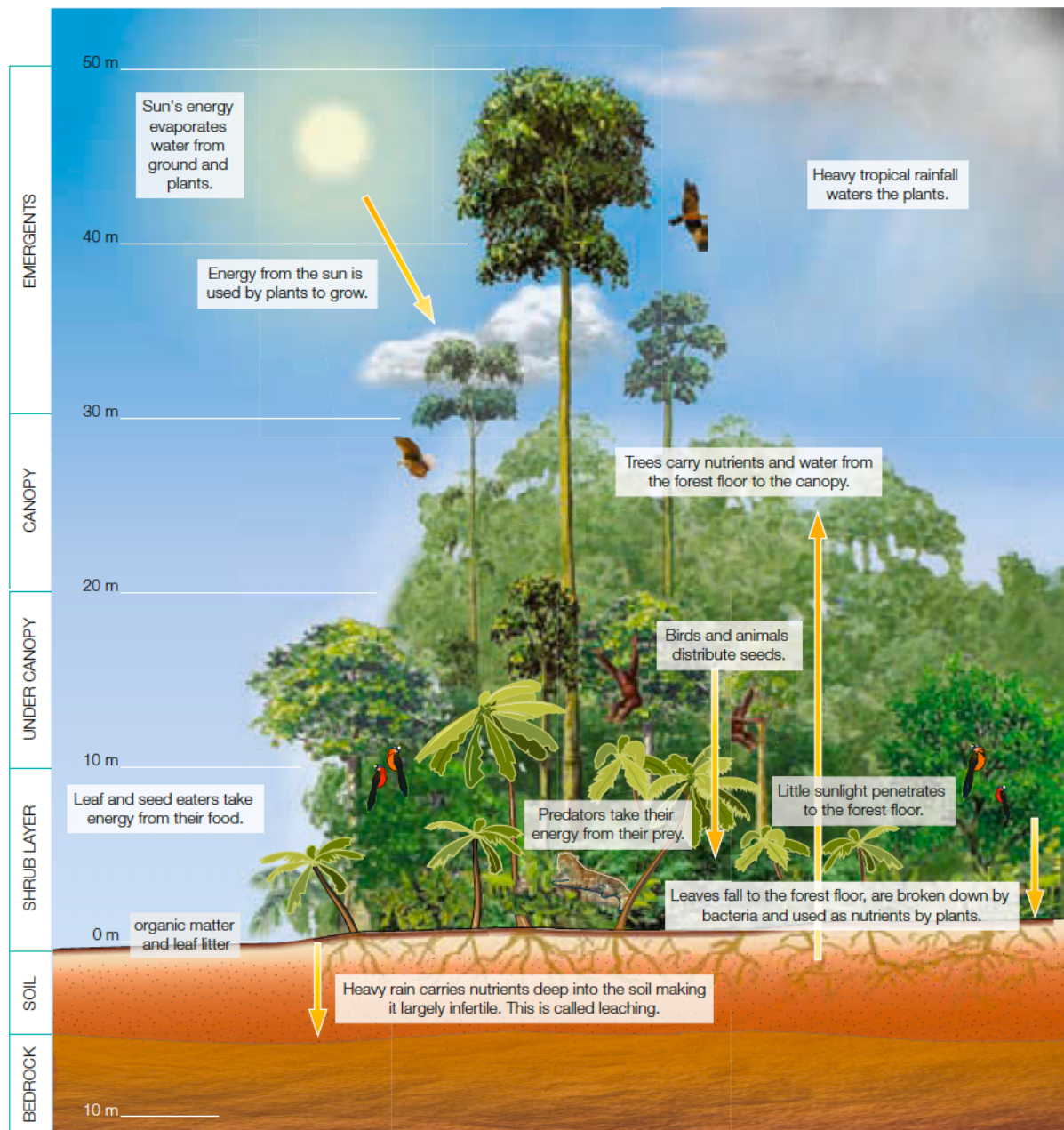
#### Apply the skill

- 1 Follow the steps above to construct a flow diagram of your own. Use the picture and labels of the rainforest in Source 1 to describe the flow of energy and matter that would occur between the different elements of the rainforest and the plants and animals that inhabit it.

### Check your learning 2.5

#### Remember and understand

- 1 Look at the illustration of the rainforest in Source 1 and identify an interaction that takes place between animals and plants.
- 2 What effect do you think there would be on the rainforest ecosystem if this interaction no longer occurred?



Source 1 Cross-section of a tropical rainforest

### Apply and analyse

- 3 Why are rainforest soils poor in nutrients?
- 4 How have rainforest trees adapted to the poor soils in the rainforest?
- 5 Describe how water is moved through the rainforest.

### Evaluate and create

- 6 What changes of movement in energy and matter would result if the trees and vegetation in Source 1 were cleared to make way for farming land? Consider the living and non-living inhabitants of the ecosystem.



## 2.6 Australia's biomes

Australia is one of the world's largest countries. The northern part of Australia lies in the tropics, while the southern part stretches towards Antarctica. The sheer size of the land mass which spreads across much of the Earth's southern latitudes means that there is a wide variety of climates and landscapes that form many biomes across Australia.

Many of Australia's original biomes have been changed by human activities. More than half of Australia's total land area is now used for food production, particularly sheep and cattle farming, covering 430 million hectares of land. This has resulted in significant changes to vegetation, land and water across much of the country. Source 1 shows Australia's original biomes before they were changed by human activities.



**Source 2** About one-third of Australia's total land area is used for cattle farming.

### Australia's deserts

Australia is the second driest continent in the world, after Antarctica. The combined area of the 10 biggest Australian deserts makes up about 18 per cent of the total land area of our 'wide brown land'. We can also describe Australia as arid or semi-arid because 70 per cent of the continent receives less than 500 millimetres of rainfall each year. This low rainfall has resulted in large desert areas across much of Australia.

Many people think of deserts as being entirely composed of large sand dunes, with the occasional date palm or cactus the only sign of life. This image may come from movies, or pictures they have seen of deserts around the world.

However, while the Sahara Desert in Africa does have date palms and sand dunes and most North American deserts have cactuses, there are variations within the desert biome. Some desert areas in Australia have large areas of red dunes, for example, but some are covered in vast areas of stones, called gibber plains (see Source 3).

In most of Australia's desert areas, grasses and low shrubs dominate the landscape (see Source 3). In the tropical deserts north of the Tropic of Capricorn, spinifex and tough Mitchell grass cover much of the ground. South of the tropics, woodland deserts are more common, with tough acacia trees, such as the mulga and witchetty bush, in evidence.

AUSTRALIA: BIOMES



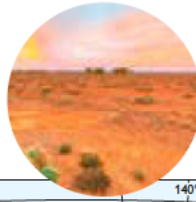
**Source 3** Stony plains in the Simpson Desert

## 2A What are biomes?

Kimberley, WA (grassland)



Simpson desert, SA (desert)



Ningaloo reef, WA (coral reef)



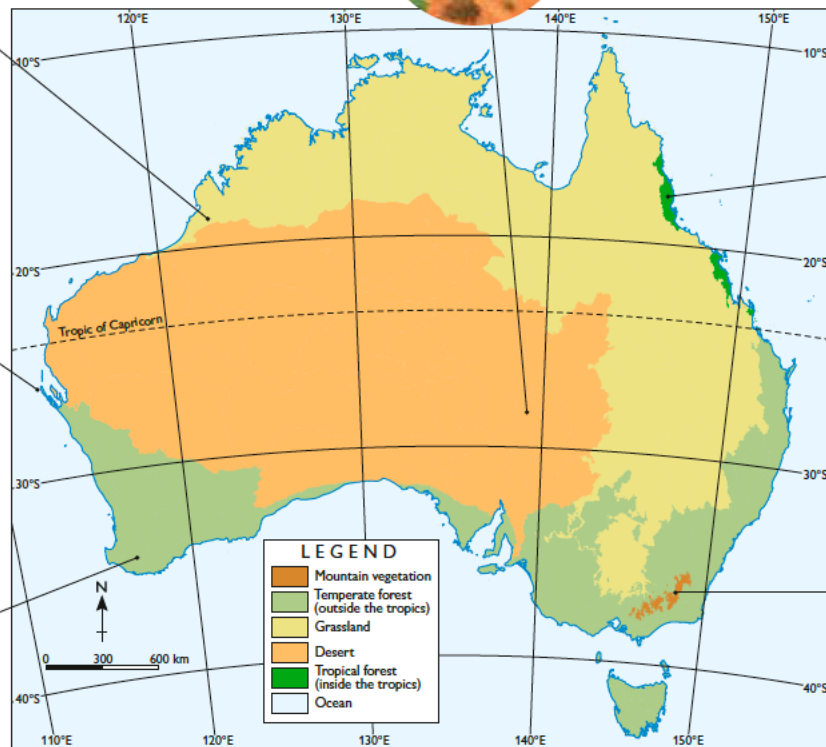
Leeuwin-Naturaliste National Park, WA (temperate forest)



Daintree Forest, QLD (tropical forest)



Kosciuszko National Park, NSW (mountain vegetation)



Source 1

Source: Oxford University Press

### Check your learning 2.6

#### Remember and understand

- 1 Why is there a wide variety of biomes in Australia?
- 2 What is the dominant natural biome where you live? Describe some of the ways in which this has been altered by human activities.

#### Apply and analyse

- 3 Compare Australia's biomes in Source 1 with the world's biomes in Source 4 on page 43 and answer the following questions.
  - a Which biomes do not exist in Australia?
  - b Give a reason for each of these biomes being 'missing' in Australia.
- 4 How has latitude influenced the distribution of biomes in Australia?

#### Evaluate and create

- 5 The world biomes map (Source 4 on page 43) shows large areas of desert, while the three images in Source 3 show us that there are significant variations in landscape within the desert biome.
  - a What are the limitations of describing places according to their dominant biome?
  - b Why do you think there are such variations within the desert biome?
  - c Research one of the other biomes to find out if such variations exist in that biome's regions too.
- 6 Construct a collage or create a PowerPoint or Prezi display of Australia's major biomes. Include at least one image of each biome.



## 2A rich task

# The Kokoda Trail

Papua New Guinea is a country with vast areas of rainforest. The forest covers the slopes of rugged mountain ranges such as the Owen Stanley Range. The Kokoda Trail crosses this range and was the location of fierce battles between the Australian and Japanese armies in World War II.

The area is notable for steep mountainsides, dense rainforests and heavy rainfall. This turns the trail into a sea of mud and makes progress along it very difficult. Many Australians attempt to walk the trail every year to achieve personal goals, which perhaps include gaining an appreciation of the difficulties faced by the soldiers during the war.

### skilldrill

## Estimating gradient and aspect on topographic maps

Estimating gradient (angle of the slope) and aspect (direction of the slope) is an important skill for geographers to master.

### Estimating gradient

Using a topographic map, it is possible to estimate the gradient between two points, by following these steps.

- Step 1** Determine the height of the two points. For example, examining Source 2, Owens Corner (186, 530) is at 600 metres and The Gap (241, 588) is at 2190 metres.
- Step 2** Estimate the difference in height between these two points (known as the rise):  $2190 - 600 = 1590$ .
- Step 3** Estimate the straight line distance (known as the run) between these two points using the line scale. This is 40km or 40 000 metres in this example.
- Step 4** Divide the rise by the run and multiply this by 100:  $(2190/40\ 000) \times 100 = 5.5\%$  slope.

### Estimating aspect

The aspect refers to the compass direction that the slope is facing. This is also simple to work out by following these steps.

- Step 1** Using the information we found out when estimating the gradient we can tell that the terrain slopes down from The Gap (at 2190m) to Owens Corner (at 600m).
- Step 2** Imagine an arrow from The Gap to Owens Corner and estimate the direction of this arrow using the north arrow. This arrow would be pointing south-west. The aspect therefore is south-west.

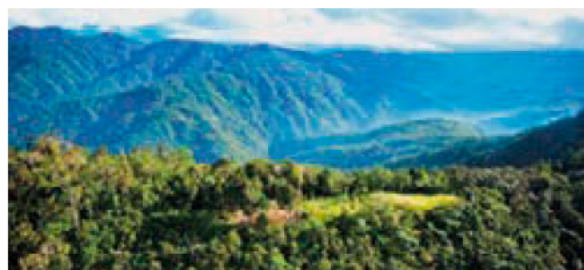
### Apply the skill

- 1 Estimate the aspect and gradient of the slope between The Gap and Kokoda (241, 638).
- 2 Is this slope less steep or steeper than the slope between Owens Corner and The Gap?
- 3 Estimate the gradient and aspect for the slope between The Gap and Mt Kenevi (266, 584).
- 4 Estimate the gradient and aspect for the slope between The Gap and Mount Victoria (197, 635).
- 5 Provide three pieces of evidence that this landscape is very rugged and mountainous.
- 6 Estimate the total length of the Kokoda Trail from Owens Corner to Kokoda.

### Extend your understanding

Conduct some further research on the Kokoda campaign and then complete the following tasks.

- 1 Which of the world's major biomes are shown on this map of the Kokoda Trail area?
- 2 What is the relationship between forest and terrain in this environment?
- 3 Explain why you think this relationship occurs.



**Source 1** The rugged terrain of the Owen Stanley Range, Papua New Guinea



Source 2

Source: Oxford University Press