13 Landforms and landscapes



LESSON SEQUENCE

13.1 Overview 355
13.2 Why do landscapes vary? 356
13.3 What processes shape landscapes? 362
13.4 What landscapes form underground? 368
13.5 What are the landforms and landform regions of Australia? 372
13.6 What are deserts like in Australia and China? 379
13.7 How do the savanna grasslands of Australia and Africa compare? 386
13.8 What makes a rainforest? 390
13.9 INQUIRY: The value of rainforests 396
13.10 Investigating topographic maps — Features of the Daintree rainforest 398
13.11 What cultural significance do landscapes have for First Nations Peoples of Australia? ... 401
13.12 Why do we preserve and manage landscapes? 406
13.13 Review 410

LESSON
13.1 Overview

Hey students! Bring these pages to life online

Watch videos

Engage with interactivities

Answer questions and check results

Find all this and MORE in jacPLUS



How do human and natural processes shape environments and what impact does this have on the way people manage changing landscapes?

13.1.1 World landscapes and landforms

Landscapes are the visible features of the land, ranging from the icy landscapes of polar regions and lofty mountain ranges of Nepal through the grasslands of Tanzania and the forests of Brazil to the deserts of central Asia and the coastal plains. Shaped by physical processes over millions of years, they have been overlaid by the presence of humans.

FIGURE 1 Wave Rock is a natural rock formation near the town of Hyden, in the south-west of Western Australia.



on Resources

eWorkbook Customisable worksheets for this topic (ewbk-10749)

Video eLesson World landscapes and landforms (eles-1623)

LESSON
13.2 Why do landscapes vary?

LEARNING INTENTION

By the end of this lesson you should be able to identify and classify different environments as part of either the natural or built environment.

You should be able to explain how people might use the environment and classify people's impact on environments as either positive or negative.

TUNE IN

Did you know the Earth has many different types of landscapes and that there are also variations within landscapes?

FIGURE 1 At 8848 metres, Mount Everest in the Himalayas is the highest mountain on Earth.



1. Brainstorm a list of different types of landscapes.
2. What factors do you think influence the formation of landscapes?
3. Select one of the landscapes you identified and suggest:
   a. how people could have a positive impact on this landscape
   b. how people could have a negative impact on this landscape.

13.2.1 Types of landscapes

There are many different landscapes across the Earth, and similarities can be observed within regions. Differences in landscapes are influenced by factors such as climate, geographical features (including mountains and rivers), latitude, the impact of humans, and where the landscapes are located.

FIGURE 2 The Ngilgi cave formations in Western Australia are protected. They are considered to be of both historical and cultural significance.

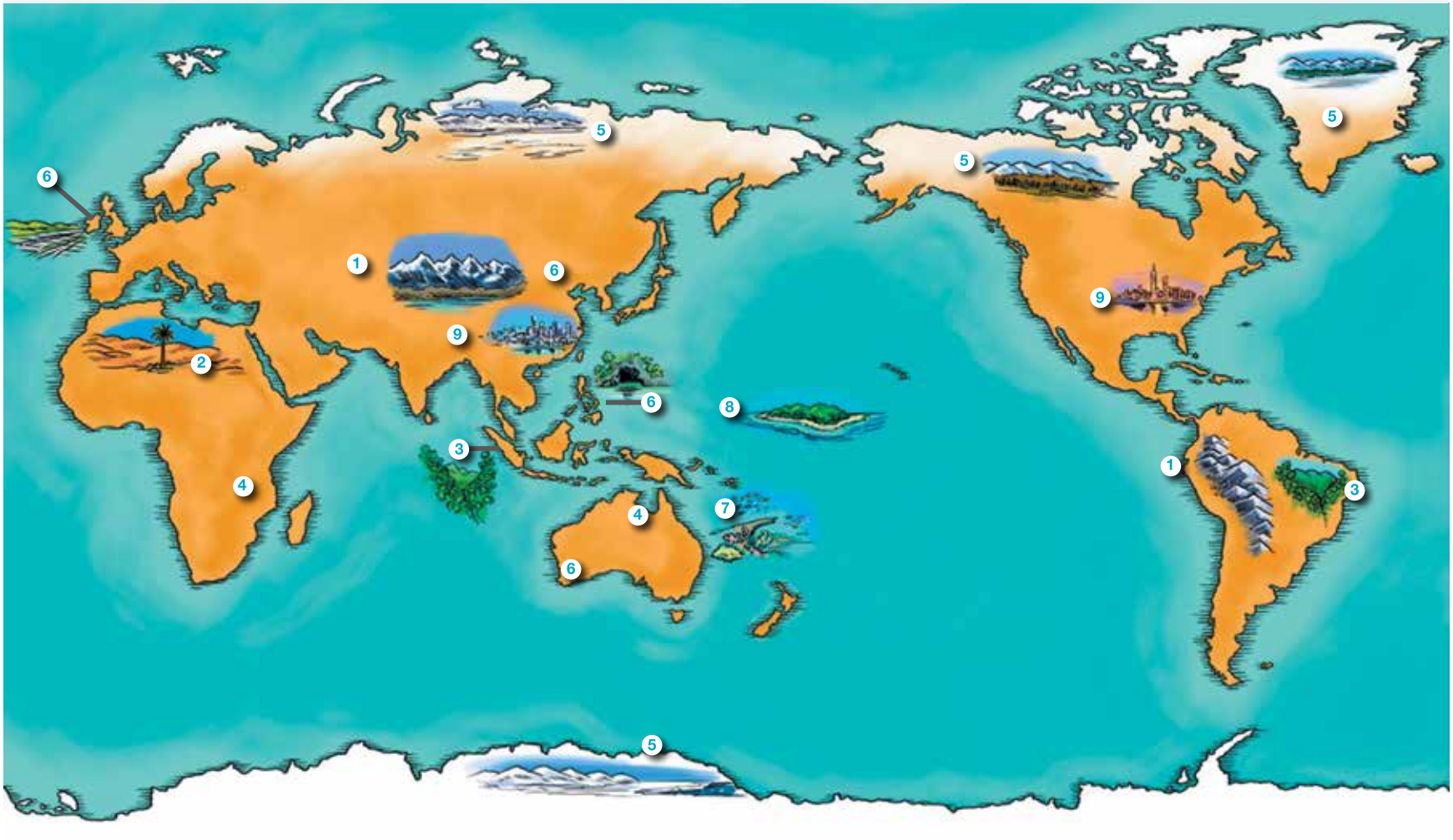


FIGURE 3 The Great Barrier Reef in Queensland is a protected marine environment made up of more than 3000 individual reefs.



int-3604

FIGURE 4 Selected world landscapes



1. Mountains rise above the surrounding landscape. They often have steep sides and high peaks and are the result of processes operating deep inside the Earth. Some reach high into the atmosphere, where it is so cold that snow is found on their peaks.
2. Deserts are areas of low rainfall; they are an arid or dry environment. They can experience temperature extremes: hot by day and freezing at night. However, not all deserts are hot. Antarctica is the world's largest desert, and the Gobi Desert, located on a high **plateau** in Asia, is also a cold desert.
3. Rainforests are the most diverse landscapes on Earth. They are found in a variety of climates, ranging from the hot wet tropics to the cooler temperate areas. The lush vegetation found in these regions depends on a high level of rainfall. Over 50 per cent of all known plant and animal species are found within them. In addition, many of our foods and medicines come from rainforests.
4. Grasslands, or savannas, are sometimes seen as a transitional landscape found between forests and deserts. They contain grasses of varying heights and coarseness, and small or widely spaced trees. They are often inhabited by grazing animals.
5. Polar regions and tundra can be found in polar and alpine regions. Characterised by **permafrost**, they are too cold for trees to grow. Vegetation such as dwarf shrubs, grasses and lichens have adapted to the extreme cold and short growing season. **Glaciers** often carve spectacular landscape features as they move down the mountains under the influence of gravity.
6. Karst landscapes form when mildly acidic water flows over soluble rock such as limestone. Small fractures form, which increase in size over time and lead to underground drainage systems developing. Common landforms include limestone pavements, disappearing rivers, reappearing springs, sinkholes, caves and karst mountains. Around 25 per cent of the world's population obtains water from karst **aquifers**.
7. Aquatic landscapes cover around three-quarters of the Earth and can be classified as freshwater or marine. Marine landscapes are the saltwater regions of the world, and include oceans and coral reefs. Freshwater landscapes are found on land, and include lakes, rivers and wetlands.
8. Islands are areas of land that are completely surrounded by water. They can be continental or oceanic. Continental islands lie on a continental shelf — an extension of a continent that is submerged beneath the sea. Oceanic islands rise from the ocean floor and are generally volcanic in origin. A group or chain of islands is known as an archipelago.
9. Human or built landscapes are those that have been altered or created by humans.

plateau an extensive area of flat land that is higher than the land around it. Plateaus are sometimes referred to as tablelands.
permafrost a layer beneath the surface of the soil where the ground is permanently frozen
glacier a large body of ice, formed by an accumulation of snow, that flows downhill under the pressure of its own weight
aquifer a body of permeable rock below the Earth's surface that contains water, known as groundwater

on Resources

Interactivity Landscapes galore (int-3102)
Google Earth Mount Everest

13.2 SKILL ACTIVITY: Communicating

Scenario

A marketing agency has invited teams of students to create television commercials for a tourism campaign highlighting the landscapes shown in **FIGURE 4**. The aim of the commercials is to provide interesting and accurate information to convince the audience (potential tourists aged from 20–25) to visit different landscapes.

You can present your commercial as a PowerPoint showing what you would include or as an oral presentation with visual aids.

Before the presentation

Select a location somewhere in the world that contains one of the landscapes and **conduct research** on its features.

Your presentation must cover at least four of the following:
- location
- climate
- striking natural features
- unique or interesting animal and/or plant species
- specific cultural or historical human aspects.

During the presentation

Ensure you use geographical language to **describe** the landscape of your chosen place.

Keep in mind who your audience is and adapt your language choices to suit them.

Only include information that will persuade the audience to travel to the place.



13.2 Exercise

learnon

13.2 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. What is the difference between the terms 'natural' and 'built' environment?
   - A. Natural environments are created or altered by humans whereas built environment are not.
   - B. Built environments are created or altered by humans whereas natural environments are not.
   - C. There is no difference as neither of them are altered by humans.
   - D. Natural environments are larger than built environments.
2. Altitude, latitude, geographical features and climate are examples of factors that do not make landscapes different. True or false?
3. Which four of the following are human or built environments?
   - A. Forests
   - B. Zoos
   - C. Camping grounds
   - D. Caravan parks
   - E. Grasslands
   - F. Farms
4. **Explain** why you think people change landscapes.
5. **Select** two of the landscapes featured in this lesson and **explain** how they are different.

Apply your understanding

Communicating

6. Copy the following table into your workbook.

Characteristics	How it formed	How people use it	Positive impacts	Negative impacts	Human impacts both positive and negative

   a. **Select** one of the landscape types described in this lesson and complete the table, **stating** the positive and negative aspects of human use.
   b. Which list is larger — the positive impacts or negative impacts?
   c. Review the column of negative impacts. **Select** three of these impacts and propose a way in which the environment could be used more sustainably.
7. **Describe** how the scale of the following landscapes might differ around the world: deserts, polar regions, aquatic landscapes and islands.
8. Which of the featured landscapes would you like to know more about? **Create** a list of questions that you would like to have answered.

Concluding and decision-making

9. **Explain** why you think rainforests are described as 'the most diverse landscapes on Earth'.
10. **Identify** the featured landscape that you think would be the least diverse. **Justify** your answer.

LESSON
13.3 What processes shape landscapes?

LEARNING INTENTION

By the end of this lesson you should be able to explain the processes that have shaped the Earth and explain how soil is formed. You should also be able to define the key terms weathering, erosion, deposition, tectonic forces and transportation.

TUNE IN

Processes are at work to continuously sculpt and change the landscape. In the future, the Earth's surface will look very different from the way it looks today.

FIGURE 1 The Grand Canyon has formed over millions of years.



1. What actions or steps do you think have produced the Grand Canyon?
2. Describe how you think this landscape looked one million years ago.
3. Explain how this landscape might change over the next one million years.

13.3.1 Are all processes natural?

A variety of natural processes shape and reshape not only the surface of the Earth but also what lies beneath it. Natural processes include uplift, such as that caused by tectonic activity, **erosion**, **deposition** and **weathering**. People change the landscape when they clear land for agriculture or build cities and road networks. Sometimes they alter the course of a river or trap its flow behind the walls of a dam.

erosion the wearing away and removal of soil and rock by natural elements, such as wind and water, and by human activity
deposition the laying down of material carried by rivers, wind, ice and ocean currents or waves
weathering the breaking down of bare rock (mainly by water freezing and cooling as a result of temperature change) and the effects of climate

13.3.2 The role of tectonic forces

The Earth's surface, or crust, is split into a number of plates, which fit together like a giant jigsaw puzzle. These plates sit on a layer of semi-molten material in the Earth's **mantle** — the layer of the Earth between the crust and the core. Heat from the Earth's core creates **convection currents** within the mantle, causing the plates to move. Most of the Earth's great mountain regions were formed as a result of this movement.

When two plates collide, one plate often slides under the other, in a process known as subduction, and it becomes part of the mantle. Other rocks are forced upwards and bent or folded. Large mountain ranges that were formed in this way include the Himalayas in Asia and the Rocky Mountains in North America. You will find more information on how mountains are formed in topic 15.

13.3.3 How is the landscape worn away?

Erosion is the wearing away of the Earth's surface by natural elements such as wind, water, ice and human activity. The landscape is further eroded when agents such as wind, water and ice **transport** these materials to new locations. Eventually, transported material is deposited in a new location. Over time, this material can build up and new landforms result. The Grand Canyon in Arizona in the United States (**FIGURE 1**) is an example of these elements at work. Here the Colorado River has cut deep channels into the landscape to form the Grand Canyon. These processes work more quickly on softer rocks.

Human activity also contributes to erosion. Deforestation, agriculture, urban sprawl, logging and road construction all alter the natural balance and increase erosion by as much as 40 per cent in some areas. Vegetation not only provides valuable habitat for native animals but is also vital for binding the soil together. Once vegetation is removed, it is more easily broken down and removed by wind and water. When topsoil is removed, plants are unable to obtain the nutrients they need for growth. Sometimes wide, deep channels, known as gullies, form (see **FIGURE 2**).

mantle the layer of the Earth between the crust and the core
convection current a current created when a fluid is heated, making it less dense and causing it to rise through surrounding fluid and sink if it is cooled; a steady source of heat can start a continuous current flow
transport the movement of eroded materials to a new location by elements such as wind and water

FIGURE 2 Note the scale of this gully compared to the people.



int-7830

tlvd-10611

FIGURE 3 After tectonic forces cause a section of the Earth to be raised (uplifted), other processes take over and resculpt the landscape.

1 Weathering is the breakdown of rocks due to the action of rainwater, temperature change and biological action. The material is not transported (removed).

It can be physical, chemical or biological.

2 Erosion is the process whereby soil and rocks are worn away and moved to a new location by agents such as wind, water or ice.

3 Transportation is the process that moves eroded material to a new location – examples include soil carried by the wind, sediment or pebbles in a stream.

4 Deposition – materials moved by wind and water eventually come to a halt. Over time new landforms are built. Sand dunes and beaches are common landforms associated with deposition.

Physical – occurs where water is continually freezing and thawing. The water penetrates cracks and holes in the rocks. As water freezes it expands, making the cracks larger. Over time the rock breaks apart.

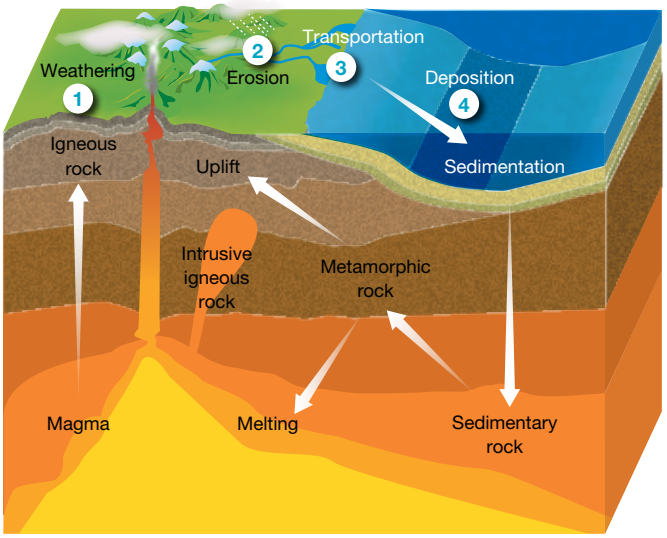


Chemical – some rocks, such as limestone, contain chemicals that react with water, causing the limestone to dissolve.



Biological – living organisms such as algae produce chemicals that break down rocks. They can also be forced apart by plant roots.





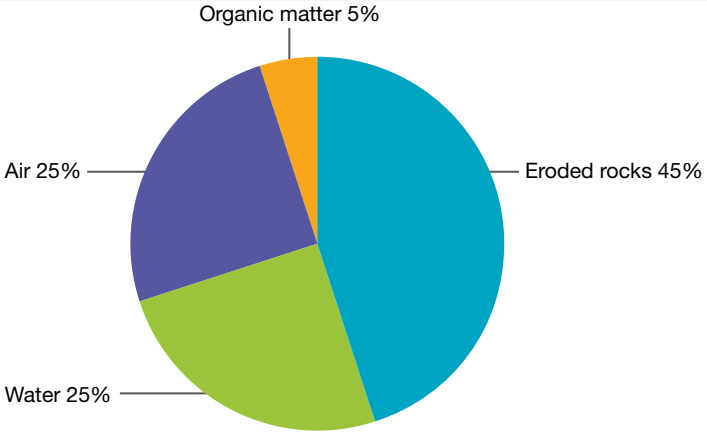
13.3.4 What is soil?

Formed as a result of the processes of weathering and erosion, soil is the basis of all life on Earth, providing the nutrients for plant growth and enabling people to grow crops and raise livestock.

The composition of soil is shown in **FIGURE 4** and the factors that influence soil formation are shown in **FIGURE 5**.

Australia generally has poor soils when compared with those found on other continents such as North America and Europe. Australian soils are generally low in nutrients and, in some areas, especially arid zones, they have a high salt content. Patches of good soil, though, are scattered throughout the continent.

FIGURE 4 While the composition of soil varies widely across the Earth, an average soil will have these characteristics.



How is soil formed?

Factors that influence soil formation are shown in **FIGURE 5**.

int-7831

FIGURE 5 Influences on soil formation

Climate



Climate affects the rate of weathering of soil. In high rainfall areas, soil develops more rapidly, but excess moisture also washes out or leaches nutrients. In rainforests, for example, the rich supply of **humus** from decaying plant matter produces lush vegetation. However, high rainfall means that without this constant supply of humus, soil fertility is quickly lost. In arid regions, where evaporation is high, soils often contain too much salt to support plant growth. Weather also plays a role; a climate with a freezing and thawing cycle will speed up the breakdown of rocks. In warm climates, the activity of soil organisms is high, and chemical processes also happen more quickly.

Parent material



Surface rocks and bedrock are broken down through weathering and erosion. The type of soil that forms depends on the parent material and the minerals it contains. A coarse, sandy soil will develop from sandstone. Bedrock that is mainly granite produces a sandy loam, while shale turns into heavy clay soil.

Soil



Plants and animals



Decaying plant and animal matter on the soil's surface is broken down by microorganisms into material that is incorporated into the soil, making it nutrient rich.

Topography



Surface features such as hills, valleys and rivers influence soil development. Soil is generally deeper on the top and at the base of a hill than on its slopes. Floodplains next to river valleys are often nutrient rich, due to sediment being deposited as floodwaters recede.

Time



These processes take place over long periods of time. Soils undergo many changes with the passage of time.

For example, there is:

- volcanic soil on the Darling Downs in Queensland and around Orange in New South Wales
- alluvial soil in river valleys such as around the Clarence River in New South Wales and Margaret River in Western Australia.

In many parts of Australia, it takes more than 1000 years for natural processes to produce 3 centimetres of soil.

humus nutrient-rich dark organic matter, created by decaying animal and plant matter

on Resources

Weblink Soil formation

Google Earth Grand Canyon

13.3 SKILL ACTIVITY: Questioning and researching, Communicating

Work with a partner to complete this task.

Use the internet to find an image of the MacDonnell Ranges or a mountain range that you find interesting. You and your partner will need to agree on the chosen landscape feature.

Your task is to create a presentation to:

- **explain** how physical processes have shaped and changed the landscape over time
- **describe** the traditional Dreaming creation story associated with your landscape and **explain** its significance to First Nations Peoples of Australia.

1. **Create** a physical or virtual model of your landform.
2. Copy and paste an image of your created landform into a Word document.
3. Using geographical language, annotate your image or model with accurate and explicit information about the mountain range's location and how it was formed.
4. Add further annotations to **describe** how your landform has changed over time and the processes that have resulted in these changes.
5. **Predict** how this landform might look in the future.
6. Add additional diagrams and annotations to **illustrate** the Dreaming creation story of First Nations Peoples.
7. **Explain** the significance of your chosen landscape or landform feature to First Nations Peoples of Australia.
8. Share your findings with the rest of the class.

FIGURE 6 The MacDonnell Ranges in the Northern Territory have formed over millions of years.



13.3 Exercise

learnon

13.3 Exercise

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
1, 2, 4, 5, 7	8, 10	3, 6, 9, 11

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. **Determine** whether the following statements are true or false.
   a. Soil is the thin layer of material on the surface of the Earth in which plants can grow.
   b. Australia generally has superior soils when compared with those found on other continents such as North America and Europe.
   c. When one tectonic plate slips under another it is known as subduction.
   d. The breakdown of rocks (weathering) is only a physical process.
   e. Soil is generally shallower on the top and at the base of a hill than on its slopes.
   f. Erosion processes work more quickly on softer rocks.
2. Why is soil important?
   A. It is the basis for plant growth, which feeds both people and animals.
   B. It is not important.
   C. 75 per cent of mammals eat soil as their main source of nutrition.
   D. It protects the Earth from damage from the sun.
3. **Consider** the natural processes at work shaping the Earth and complete the following passage.
   _____ refers to the process of eroded or weathered material being moved to new locations by agents such as wind, water and ice. _____ refers to materials being dropped in new locations and may result in the new landforms being created.
4. _____ is the process whereby soil and rocks are worn away and moved to a new location by agents such as wind, water or ice.
   _____ refers to the breakdown of rocks due to the action of rainwater, temperature change and biological action.
5. **Identify** any human factors that might contribute to erosion.
   A. Conservation
   B. Deforestation
   C. Urban sprawl and road construction
   D. Planting trees and shrubs
   E. Logging

Apply your understanding

Communicating

6. **Explain** how and why human activity might contribute to weathering and erosion.
7. Using terms such as uplift, erosion, deposition, weathering and transportation, **explain** the interconnection between physical processes and the environment.
8. In your own words, **explain** how soil is formed and why it is not uniform across the surface of the Earth.
9. Using examples, **describe** two different ways that mountain ranges can be formed.
10. Australia is an ancient landmass. **Identify** which processes described in this lesson are currently shaping Australia's landforms. **Justify** your answer.

LESSON
13.4 What landscapes form underground?

LEARNING INTENTION

By the end of this lesson you should be able to explain how a karst landscape is formed.

TUNE IN

Did you know that the rocks that make up the karst landscape are composed of limestone and dolomite; both are carbonate rocks (a subclass of sedimentary rocks). They are highly susceptible to a form of chemical weathering known as oxidation (a chemical reaction that causes rocks to break down due the presence of water, oxygen or acid).

FIGURE 1 Lake Cave, Margaret River, Western Australia



1. How do you think sedimentary rocks were formed?
2. You can see oxidation at work when you cut an apple and it turns brown. What do you think is causing oxidation?
3. Brainstorm how you think the structures shown in **FIGURE 1** were formed.

13.4.1 What is karst?

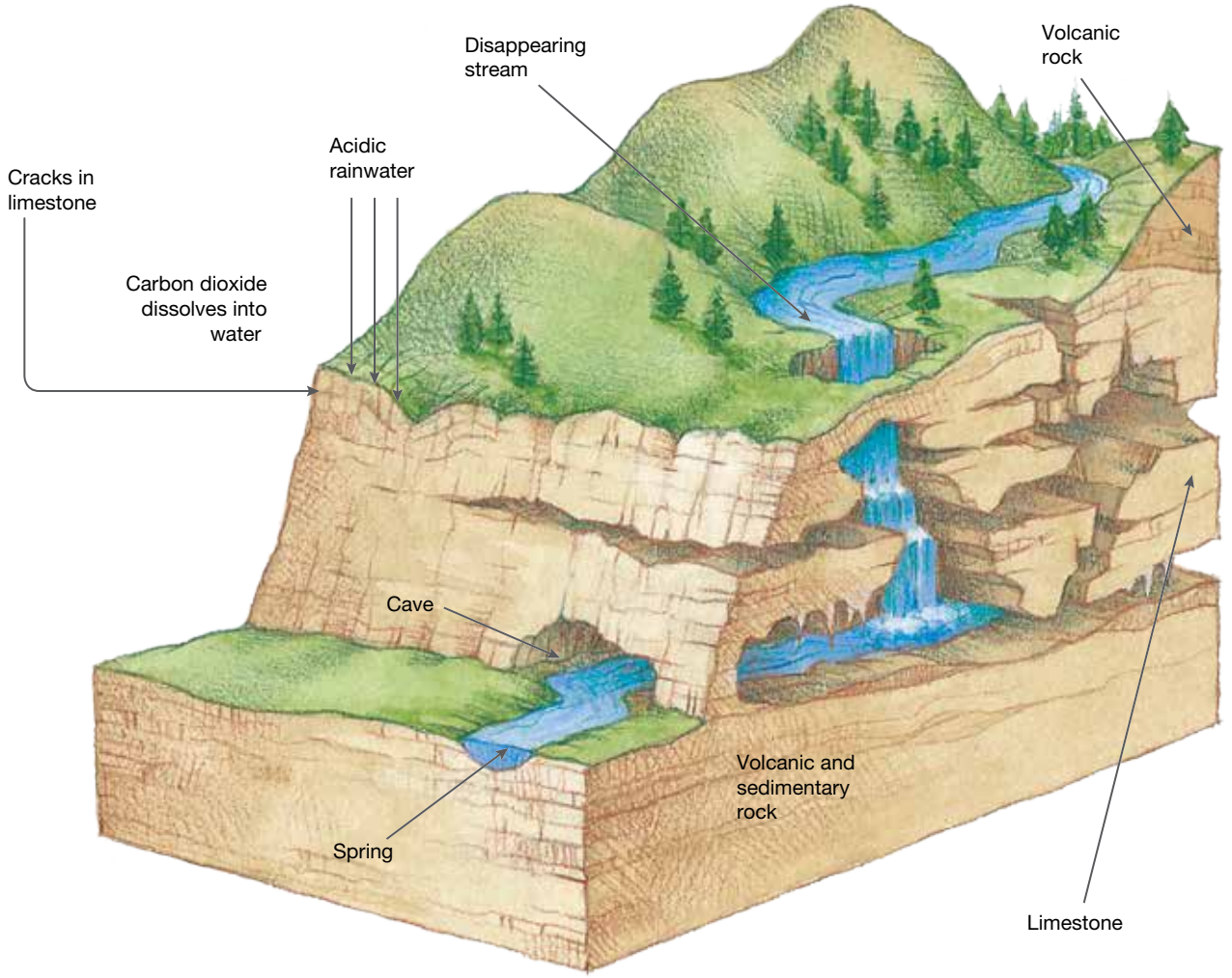
Apart from rivers and streams that flow across the surface of the Earth, vast networks of rivers also exist under the ground. The result is a network of caves and channels that carve a very different landscape, known as karst.

Karst is a landscape formed by water dissolving bedrock (solid rock beneath soil) over hundreds of thousands of years (see **FIGURE 1**). On the surface of the Earth, sinkholes (holes in the Earth's surface), vertical shafts (tunnels), and fissures (cracks) will be evident. Rivers and streams may seem to simply disappear, but intricate drainage networks are underground, complete with caves, rivers, **stalactites** and **stalagmites** (see **FIGURE 2**).

stalactite a feature made of minerals, which forms from the ceiling of limestone caves, like an icicle. They are formed when water containing dissolved limestone drips from the roof of a cave, leaving a small amount of calcium carbonate behind.
stalagmite a feature made of minerals found on the floor of limestone caves. They are formed when water containing dissolved limestone deposits on the cave floor and builds up.

tlvd-10612

FIGURE 2 Formation of a karst landscape



Karst topography makes up about 10 per cent of the Earth's surface; however, a quarter of the world's population depends on karst environments to meet its water needs.

13.4.2 How are karst landscapes formed?

Water becomes slightly acidic when it comes into contact with carbon dioxide in the atmosphere (as it does when raindrops form) or when it filters through organic matter in the soil and **percolates** into the ground. Acidic water is able to dissolve soluble bedrock, such as limestone and dolomite. This creates cracks or fissures, allowing more water to penetrate the rocks.

When the water reaches a layer of non-dissolving rocks, it begins to erode sideways, forming an underground river or stream. As the process continues, the water creates hollows, eventually creating a cave. Some karst landscapes contain aquifers that are capable of providing large amounts of water.

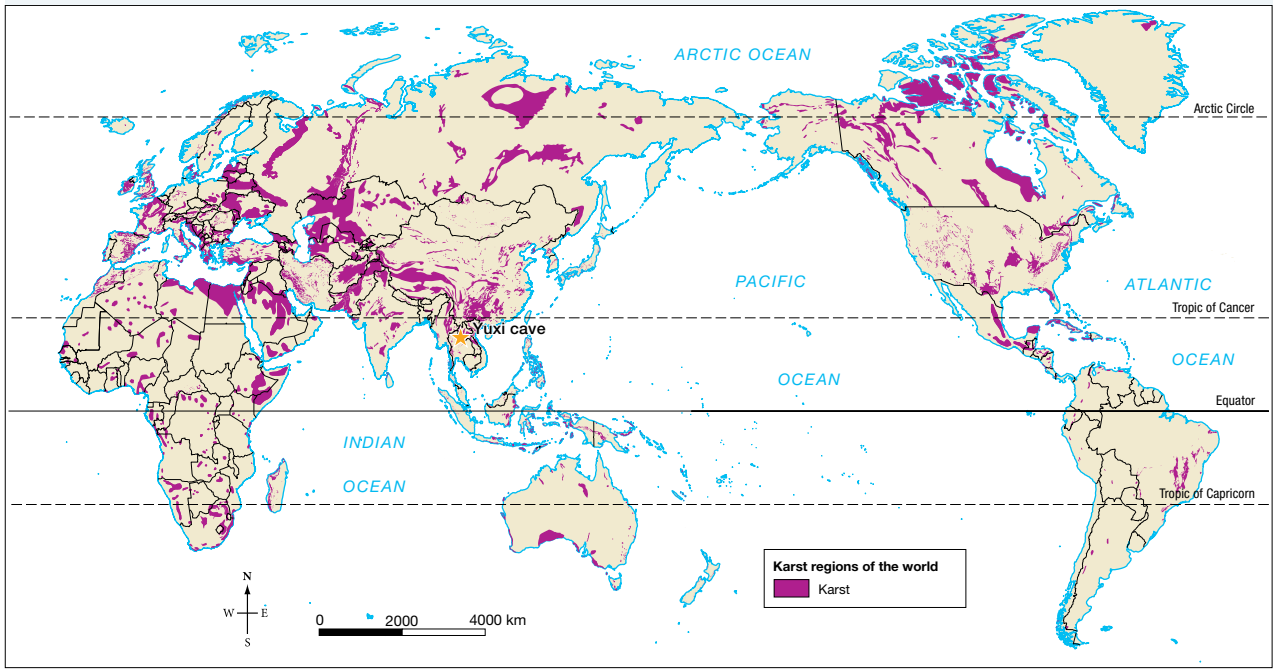
percolate filter through porous material such as soil

13.4.3 Where are karst landscapes found?

Karst landscapes are found all over the world, as shown in **FIGURE 3**, in locations where mildly acidic water is able to dissolve **soluble** bedrock such as limestone and dolomite.

soluble able to be dissolved in water

FIGURE 3 Karst regions of the world



Source: World Map of Carbonate Rock Outcrops v3.0.

In tropical regions, where rainfall is very high, karst mountains sometimes develop. This is because the high rainfall levels wear away the soluble rock much faster than rock is worn away in karst areas with lower rainfall. Examples of tropical karst mountains include the peaks of Ha Long Bay in Vietnam and the Guilin Mountains in China.

The Earth's largest arid limestone karst cave system is located on Australia's Nullarbor Plain, covering 270 000 square kilometres. It extends 2000 kilometres from the Eyre Peninsula in South Australia to Norseman in the Goldfields–Esperance region of Western Australia, and from the Bunda Cliffs on the Great Australian Bight in the south to the Victoria Desert in the north.

The extensive cave system provides a unique habitat for a variety of native flora and fauna. Within the caves are fossils that can reveal much about our distant past; indeed, fossils of thylacines (Tasmanian tigers) have been found in the cave systems south of Perth. These caves are also often important First Nations heritage sites.

on Resources

Interactivity Underground wonders (int-3103)

13.4 SKILL ACTIVITY: Questioning and researching, Communicating

Examples of karst landscapes in Australia include Buchan, Naracoorte, Jenolan, Labertouche, Princess Margaret Rose, Judbarra, Abercrombie caves and the Nullarbor Plain.

1. Working with a partner, **investigate** one of these environments and **create** an annotated visual display.

   Show the location of your karst environment on a map and include:
   - the scale
   - features
   - land use
   - any concerns or threats to the environment.

   Include information on what is being done to ensure the sustainable management of the place and the significance of this place to First Nations Peoples.

2. **Communicate** your findings with the rest of the class in a brief presentation.

13.4 Exercise

learnon

13.4 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. How are karst landscapes formed?
   - A. Chemical reaction
   - B. Transportation
   - C. Uplift
   - D. All of the above
2. Karst topography makes up about _____ per cent of the Earth's surface.
3. **Identify** two reasons why karst landscapes should be preserved.
   - A. For their natural beauty
   - B. 25 per cent of the world's population depends on karst aquifers as a water supply.
   - C. 90 per cent of the world's tourist attractions are found in karst landscapes.
   - D. 99 per cent of the world's population depends on karst aquifers as a water supply.
4. Karst landscapes are predominantly found underground. **Identify** evidence on the surface of the Earth that might indicate the existence of a karst landscape.
5. **Describe** the global distribution of karst landscapes.

Apply your understanding

Communicating

6. The world's largest arid limestone karst system is found on the Nullarbor Plain, Australia.
   - a. The Nullarbor Plain is an example of a desert landscape. **Propose** how an environment formed by water can occur in this location.
   - b. **Describe** how you think this landscape would be different if it were located in Australia's tropical north.
7. **Explain** how the karst landscape can provide us with a link to our distant past.
8. **Explain** how the karst landscape can provide a quarter of the world's population with water.

Concluding and decision-making

9. Karst is often described as a 'hidden landscape'. **Identify** reasons for this description.
10. **Propose** a reason for the absence of 'discovered' karst landscapes in Antarctica.

LESSON
13.5 What are the landforms and landform regions of Australia?

LEARNING INTENTION

By the end of this lesson you should be able to identify the key features of the Australian landscape and describe the processes that have shaped it.

TUNE IN

Many of Queensland's mountain peaks were formed by volcanic activity around 20 million years ago. The Glasshouse Mountains, north of Brisbane, are volcanic plugs. Over millions of years the volcano that once surrounded the plug has been worn away by weathering and erosion.

1. What do you think led to the formation of the volcanic plug?
2. Distinguish between weathering and erosion.
3. Why do you think the weathering and erosion wore away the volcano but not the plug?

FIGURE 1 The Glasshouse Mountains, Queensland



13.5.1 What processes have shaped Australasia?

The tectonic forces of folding, faulting and volcanic activity have created many of Australia's major landforms. Other forces that work on the surface of Australia, and give our landforms their present appearance, are weathering, mass movement, erosion and deposition.

Australia is an ancient landmass. The Earth is about 4600 million years old, and parts of the Australian continent are about 4300 million years old.

Over millions of years, Australia has undergone many changes. Mountain ranges and seas have come and gone. As mountain ranges eroded, sediments many kilometres thick were laid down over vast areas. These sedimentary rocks were then subjected to folding, faulting and uplifting. This means that the rocks that make up the Earth's crust have buckled and folded along areas of weakness, known as faults. Sometimes, fractures or breaks occur, and forces deep within the Earth cause sections to be raised, or uplifted. Over time the forces of weathering and erosion have worn these down again. Erosion acts more quickly on softer rocks, forming valleys and bays. Harder rocks remain as mountains, hills and coastal headlands.

Because it is located in the centre of a **tectonic plate**, rather than at the edge of one, Australia currently has no active volcanoes on its mainland, and has very little tectonic lift from below. This means its raised landforms such as mountains have been exposed to weathering forces for longer than mountains on other continents and are therefore more worn down.

About 33 million years ago, when Australia was drifting northwards after splitting from Antarctica, the continent passed over a large **hotspot**. Over the next 27 million years, about 30 volcanoes erupted while they were over the hotspot.

tectonic plate one of the slow-moving plates that make up the Earth's crust. Volcanoes and earthquakes often occur at the edges of plates.
hotspot an area on the Earth's surface where the crust is quite thin and volcanic activity can sometimes occur, even though it is not at a plate margin

The oldest eruption was 35 million years ago at Cape Hillsborough, in Queensland, and the most recent was at Macedon in Victoria around 6 million years ago. Over millions of years, these eruptions formed a chain of volcanoes in eastern and south-eastern Australia, known today as the Great Dividing Range (see **FIGURE 2**). At present, the hotspot that caused the earlier eruptions is probably beneath Bass Strait.

The present topography of much of Australia results from erosion caused by ice. For example, about 290 million years ago a huge icecap covered parts of Australia. After the ice melted, parts of the continent subsided and were covered by **sediment**, forming sedimentary basins (a low area where sediments accumulate) such as the Great Artesian Basin. On a smaller scale, parts of the Australian Alps and Tasmania were also eroded by glaciers during the last ice age.

sediment material carried by water

FIGURE 2 Relief map of Australia. The Great Dividing Range stretches from north of Cairns in Queensland to Mount Dandenong near Melbourne in the south.



Source: ©WorldSat International, 2017

Rivers and streams are another cause of erosion, having carved many of the valleys in Australia's higher regions.

When streams, glaciers and winds slow down, they deposit or drop the material they have been carrying. This is called deposition. Many broad coastal and low-lying inland valleys have been created by stream deposition. These areas are called floodplains.

13.5.2 Australia's landform regions

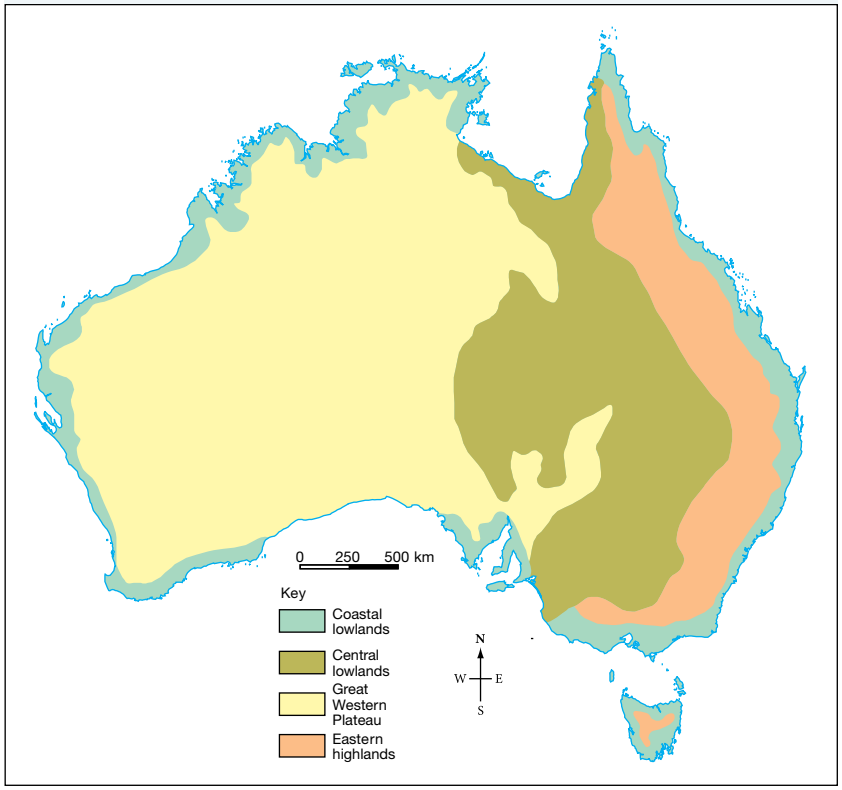
The topography of Australia can be divided into four major regions (see **FIGURE 3**).

Coastal lowlands

int-3606

The coastal lowlands around Australia's edge are narrow and fragmented. The plains often take the form of river valleys, such as the Hunter River Valley.

FIGURE 3 Australia's four major landform regions



Source: MAPgraphics Pty Ltd Brisbane

Eastern highlands

The eastern highlands region, which includes the Great Dividing Range, is mainly a series of tablelands and plateaus. Most of the area is very rugged, because rivers have cut deep valleys. It is the source of most of Australia's largest rivers, including the Fitzroy, Darling and Murray. The highest part is in the south-east, where a small alpine area is snow-covered for more than half the year.

Central lowlands

The central lowlands are a vast area of very flat, low-lying land that contains three large **drainage basins**: the Carpentaria Lowlands in the north, the Lake Eyre Basin in the centre (see **FIGURE 4**) and the Murray–Darling Basin in the south.

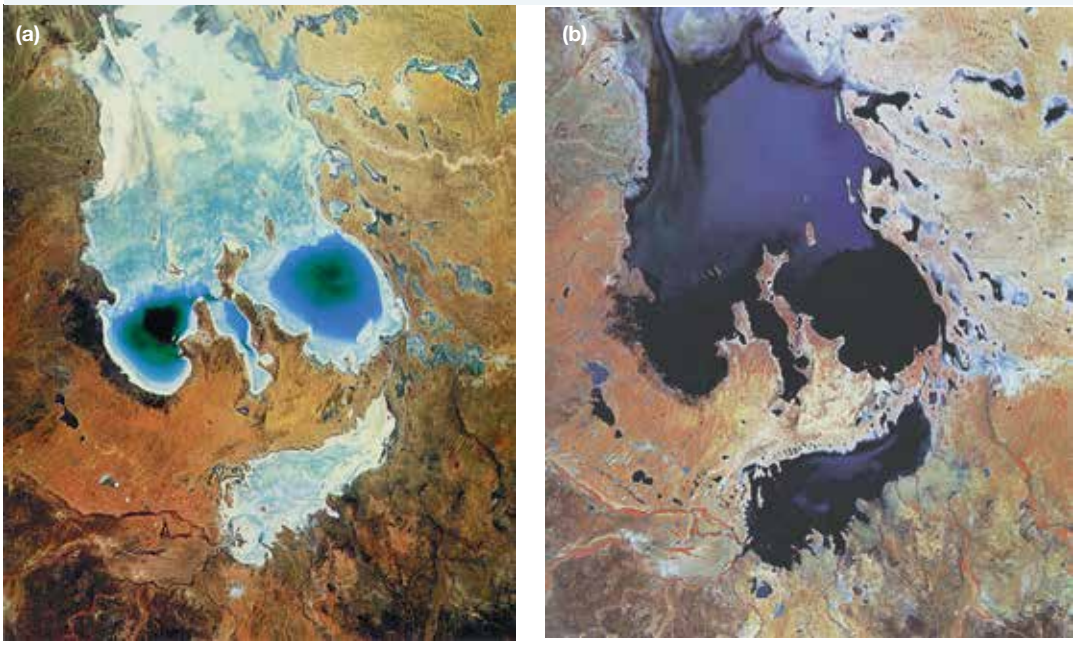
Great Western Plateau

The Great Western Plateau is a huge area of tablelands, most of which are about 500 metres above sea level. It includes areas of gibber (or stony) desert and sandy desert. There are several rugged upland areas, including the Kimberley and the MacDonnell Ranges.

drainage basin an area of land that feeds a river with water; or the whole area of land drained by a river and its tributaries

int-9006

FIGURE 4 Kati Thanda–Lake Eyre, the lowest point on the Australian mainland, is part of the Great Artesian Basin. It is 15 metres below sea level. Once a freshwater lake, the region is now the world's largest salt pan. The evaporated salt crust shows white in the satellite image (a) below. The lake fills with water only three or four times each century, transforming it into a haven for wildlife. Deep water is shown as black in image (b) below.



CASE STUDY: Water issues in the Murray–Darling Basin region

The Murray–Darling Basin covers about one million square kilometres, and more than 20 major rivers flow into it. It has a wide variety of landscapes, ranging from alpine areas in the south-east to plains in the west. The basin produces 43 per cent of Australia's food and over 40 per cent of Australia's total agricultural income.

The Murray–Darling Basin is the largest and most important drainage basin in Australia, covering one-seventh of the continent. However, the amount of water flowing through it in one year is about the same as the *daily* flow of the Amazon River.

FIGURE 5 Aerial view of the Murray River, where it enters the Coorong and Lake Alexandrina in South Australia



The basin is facing severe problems:

- Only about 20 per cent of the water flowing through the basin ever reaches the sea. The rest is diverted for agriculture, industry and domestic use.
- The Murray supplies about 50 per cent of Adelaide's drinking water. The quality of the water continues to decline, mainly because of salinity levels.
- Approximately 50 to 80 per cent of the wetlands in the basin have been severely damaged or destroyed, and more than a third of the native fish species are threatened with extinction. The number of water birds in the basin has halved.

- River system inflows vary from year to year. The long-term average is 9030 GL. In 2018, inflows were around 2740 GL, among the lowest on record.
- An estimate of weather trends shows that the flow to the Murray River mouth may be reduced by a further 25 per cent by 2030. However, with the added problem of climate change, it is predicted that precipitation in the Murray–Darling catchment will decrease, so that the reduction in flow to the mouth could be as high as 70 per cent.

13.5.3 How does water flow across the land?

Permanent rivers and streams flow in only a small proportion of the Australian continent. Australia is in fact the driest of all the world's inhabited continents. It has:

- the least amount of run-off
- the lowest percentage of rainfall as run-off
- the least amount of water in rivers
- the smallest area of permanent wetlands
- the most variable rainfall and stream flow.

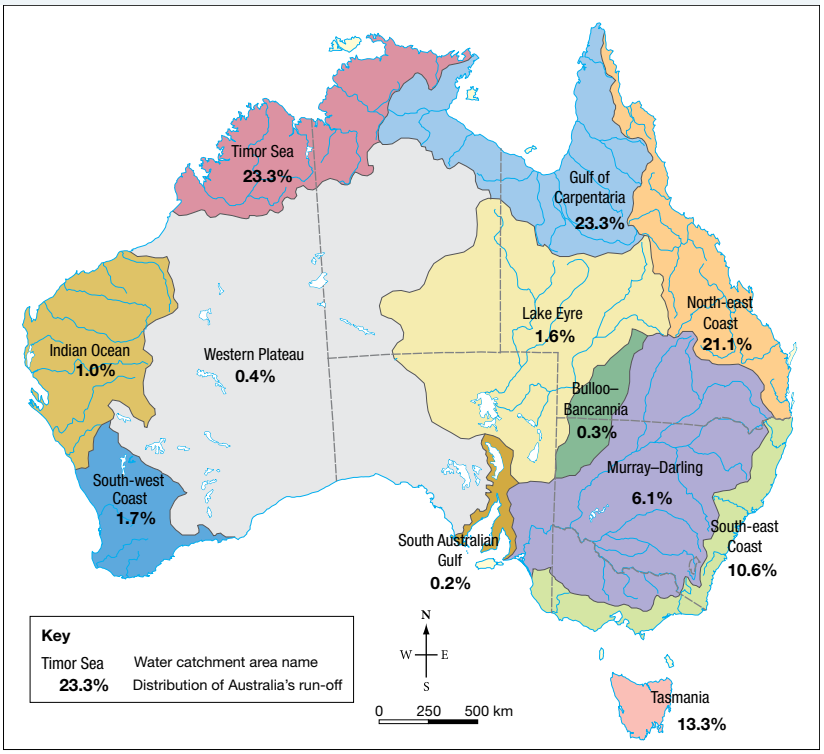
Australia has many lakes and drainage basins (see **FIGURES 7** and **8**). Many of our lakes hold little water compared with those found on other continents. The largest drainage basins are in the tropical north of Australia and they are far from our major population centres.

The Ord River Scheme in Western Australia was constructed near Kununurra to try to utilise some of the water that flowed into the Timor Sea. The Ord River dam can hold up to 5641 gigalitres, which is the equivalent of 11.2 Sydney Harbours. The water in the Ord River Scheme provides irrigation for farms throughout the region. It has created land suitable for a range of crops where previously only cattle ranches were economically viable. This is controversial, however, because some see the scheme as a waste of money and an environmental disaster. Others see the scheme as a potential bread basket for Western Australia and a provider of thousands of jobs and export dollars.

FIGURE 6 Lake Argyle

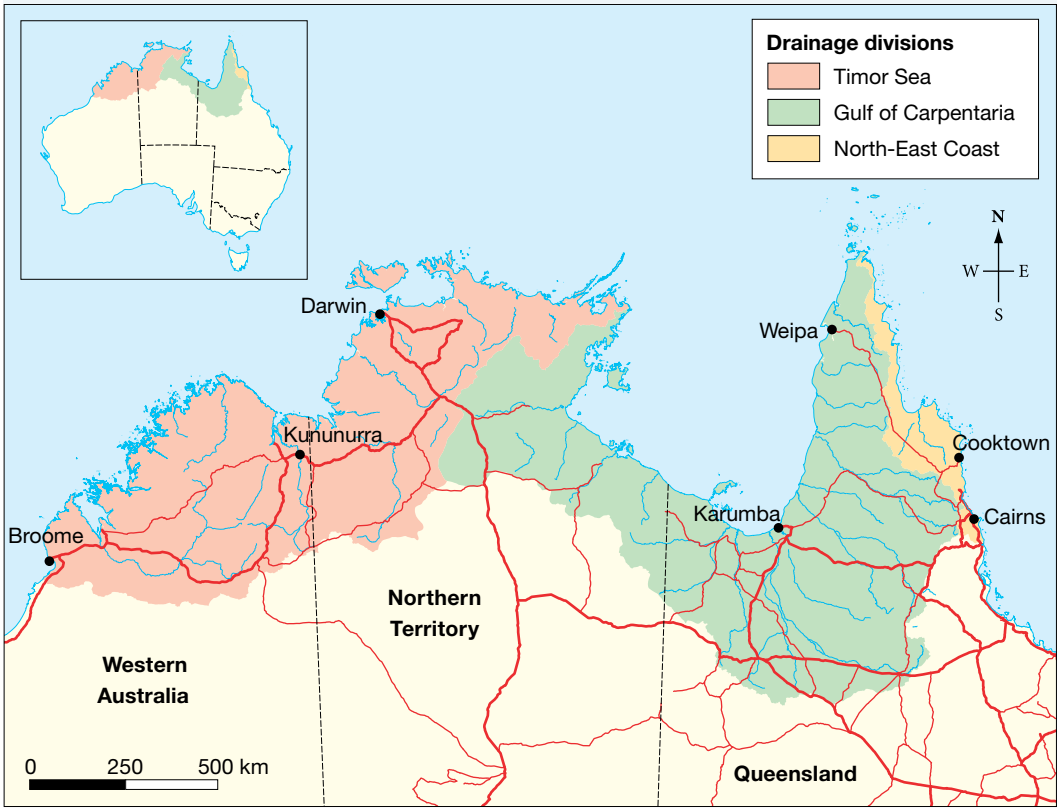


FIGURE 7 Australia's drainage basins



Source: MAPgraphics Pty Ltd Brisbane

FIGURE 8 The Northern Australian drainage basins



Source: Department of Sustainability and the Environment

on Resources

Google Earth Kununurra
Murray–Darling River

SkillBuilders to support skill development

- 13.10 SkillBuilder: Understanding thematic maps

13.5 SKILL ACTIVITY: Questioning and researching using geographical methods, Communicating

Divide your class into five groups and assign groups 1 to 4 one of Australia's landform regions to investigate. Collectively **compile** a list of landforms that are found in each region, have each member of the group **investigate** a different landform and prepare a series of PowerPoint slides that show the following:

a. the landform
b. where it is located
c. how it was formed
d. its importance to First Nations Peoples
e. reasons why it is or is not a popular place that people want to visit.

Group 5 should use their atlas to **locate** the highest mountains in each Australian state and territory.

a. What is the height of this mountain?
b. Where is it located?
c. How has it changed over time?
d. Its importance to First Nations Peoples — what creation story explains its formation?

Groups should work collaboratively online using Google Slides or a similar program to put their presentation together for viewing by the rest of the class.

13.5 Exercise

learnon

13.5 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. Circle the correct options to complete the passage below.
   The Murray–Darling Basin covers **one-seventh** / **one fifth** of the Australian continent and is the largest drainage basin in Australia. It covers about **one** / **two** million square kilometres and is fed by more than **10** / **20** / **30** major rivers. The basin produces **25** / **43** / **62** per cent of Australia's food and over **40** / **60** / **90** per cent of Australia's agricultural income, making it the most important drainage basin in Australia.
2. Complete the following passage.
   Folding, faulting and uplift are processes that occur as a result of _____ activity. Pressures deep within the Earth's _____ cause the rocks that make up its _____ to buckle and fold, in much the same way that an aluminium can does when squeezed. Sometimes breaks occur or fractures develop, known as _____, and blocks or sections of the crust are pushed upwards, known as _____.
3. Australia is so low in altitude and flat compared with other continents because the continent is located in the middle of a tectonic plate, has no active volcanoes and very little tectonic uplift from below. True or false?
4. **Describe** some of the physical changes Australia's landmass has undergone.
5. **Describe** the major characteristics of Australia's four main landform regions.

Apply your understanding

Interpreting and analysing geographical data and information

6. Use your atlas to find the Cape Hillsborough and Macedon volcanoes, or refer to **FIGURE 2**.
   a. Calculate the distance between them.
   b. Use the information in this lesson to work out the rate at which the Australian landmass is moving.
   c. How far has Australia moved over the Bass Strait hotspot? Now calculate where under Bass Strait this hotspot might now lie.
   d. Use the information in this lesson to **explain** why this hotspot has changed its location over time.
7. It is said that the amount of water that flows down the Amazon River in a day is more than flows down the Murray in a year.
   a. **Consider** what this tells you about how dry Australia's climate is.
   b. **Describe** how this might affect the environment around the Murray River.
8. **Describe** the role of the Bass Strait hotspot in creating the landforms on Australia's east coast.
9. **Describe** how Kati Thanda–Lake Eyre has changed over time. **Identify** a reason for these changes.

Communicating

10. Approximately 80 per cent of the water flowing through the Murray–Darling Basin is diverted.
    a. **Identify** what this water is used for.
    b. **Predict** what impact this might have on people and the environment.

LESSON
13.6 What are deserts like in Australia and China?

LEARNING INTENTION

By the end of this lesson you should be able to describe the global distribution of deserts; identify, and make comparisons between, important desert landscapes in Australia and China; and explain why Uluru is an iconic Australian landmark.

TUNE IN

The actions of wind, and sometimes water, shape the rich variety of landscapes found in the desert regions of the world. Deserts may be hot or cold, and subject to temperature extremes.

1. What processes do you think created the landscape shown in **FIGURE 1**?
2. How can some deserts be hot, while others are cold?
3. Work with a partner to brainstorm a list of characteristics that define the desert landscape.
4. As a class, create a combined list of the characteristics of deserts.

FIGURE 1 While the extreme conditions make it difficult for people to survive, there are many desert locations around the world where people can and do live.



13.6.1 What defines a desert?

A desert is a hot or cold region with little or no rainfall. Around one-third of the Earth's surface is desert and they are home to about one billion people.

TABLE 1 Rainfall levels in different types of deserts

Rainfall (mm/year)	Type of desert	Examples
< 25	Hyper-arid	Namib; Arabian
25–200	Arid	Mojave
200–500	Semi-arid	Parts of Sonoran Desert

FIGURE 2 Although they receive little rainfall, most deserts receive some form of **precipitation**. Rain usually occurs as a few heavy storms that last a short time and can be so intense that normally dry rivers overflow their banks.



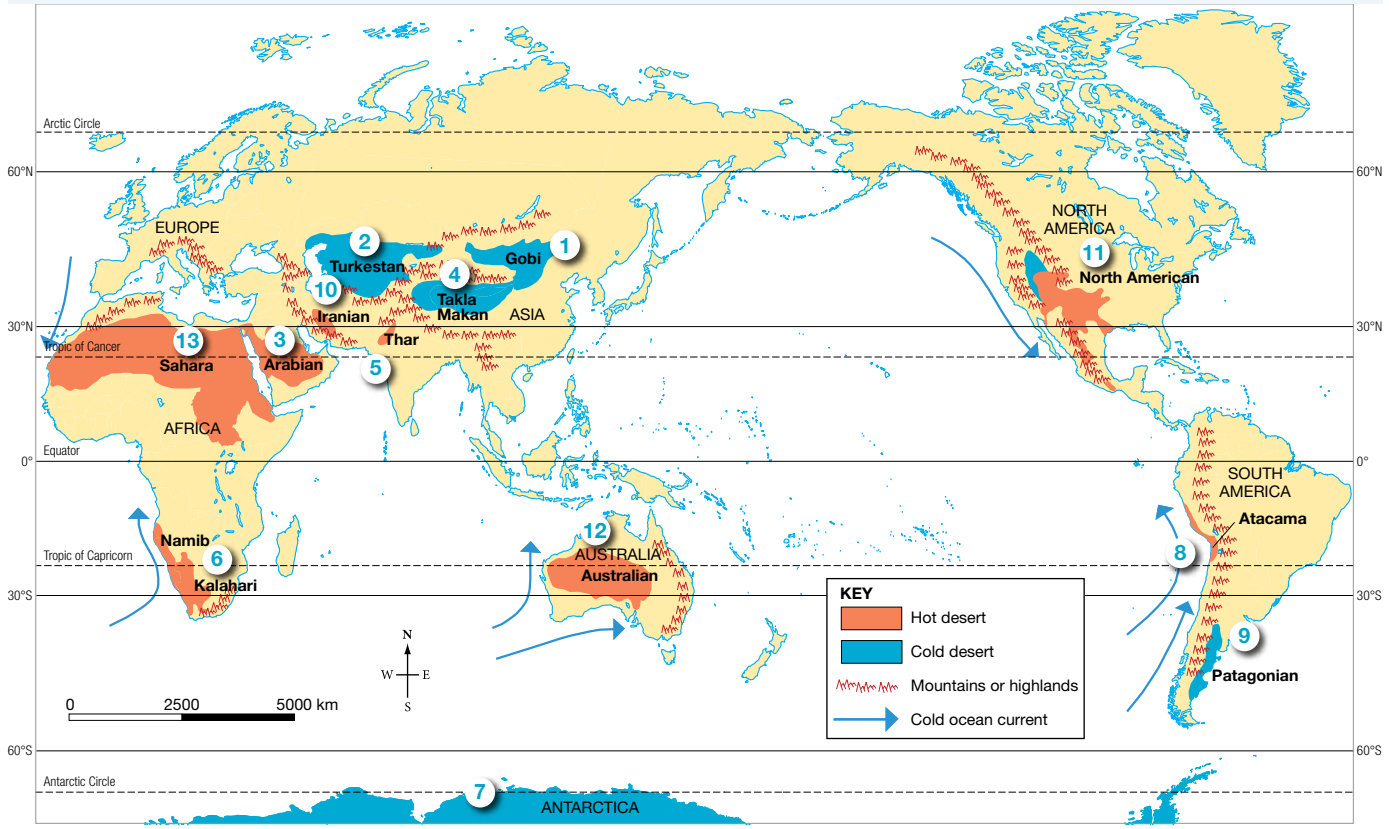
Hot deserts

Most of the world's hot deserts are located between the Tropic of Cancer and the Tropic of Capricorn (see **FIGURE 3**). They have very hot summers and warm winters. Temperature extremes are common, because cloud cover is rare, and humidity is very low; this means there is nothing to block the heat of the sun during the day or prevent its loss at night. Temperatures can range between around 45 °C and –15 °C in a 24-hour period.

precipitation the different forms in which moisture is returned to the Earth from the atmosphere, most commonly in the form of rain, hail, sleet and snow

int-9007

FIGURE 3 The distribution of the world's deserts



Source: MAPgraphics Pty Ltd, Brisbane

1. **Gobi Desert:** Asia's biggest desert, the Gobi, is a cold desert. It sits around 900 metres above sea level and covers an area of some 1.2 million square kilometres. Its winters can be freezing.
2. **Turkestan Desert**: The cold Turkestan Desert covers parts of south-western Russia and the Middle East.
3. **Arabian Desert:** This hot desert is as big as the deserts of Australia. Towards its south is a place called Rub al-Khali (meaning 'empty quarter'), which has the largest area of unbroken sand dunes, or ergs, in the world.
4. **Takla Makan Desert**: The Takla Makan Desert is a cold desert in western China. Its name means 'place of no return'. The explorer Marco Polo crossed it some 800 years ago.
5. **Thar Desert:** The Thar Desert is a hot desert covering north-western parts of India and Pakistan. Small villages of around 20 houses dot the landscape.
6. **Kalahari and Namib deserts:** The Namib Desert extends for 1200 kilometres down the coast of Angola Namibia and South Africa. It seldom rains there, but an early-morning fog often streams across the desert from the ocean. The dew it leaves behind provides moisture for plants and animals. It joins the Kalahari Desert, which is about 1200 metres above sea level.
7. **Antarctic Desert**: The world's biggest and driest desert, the continent of Antarctica is another cold desert. Only snow falls there, equivalent to about 50 millimetres of rain per year.
8. **Atacama Desert**: The Atacama Desert is the driest hot desert in the world. Its annual average rainfall is a tiny 0.1 millimetre.
9. **Patagonian Desert:** The summer temperature of this cold desert rarely rises above 12 °C. In winter, it is likely to be well below zero, with freezing winds and snowfalls.
10. **Iranian Desert:** Two large deserts extend over much of central Iran. The Dasht-i-Lut is covered with sand and rock, and the Dasht-i-Kavir mainly in salt. Both have virtually no human population.
11. **North American deserts**: The desert region in North America is made up of the Mojave, Sonoran and Chihuahuan deserts (all hot deserts) and the Great Basin (a cold desert). The Great Basin's deepest depression, Death Valley, is the lowest point in North America.

12 **Australian deserts**: After Antarctica, Australia is the driest continent in the world. Its deserts are generally flat lands, often vibrant in colour.

13 **Sahara Desert**: The largest hot desert in the world, the Sahara covers around 9 million square kilometres across northern Africa over 12 countries. Only a small part is sandy. It is the sunniest place in the world.

Cold deserts

Cold deserts lie on high ground generally north of the Tropic of Cancer and south of the Tropic of Capricorn (see **FIGURE 3**). They include the polar deserts. Any precipitation falls as snow. Winters are very cold and often windy; summers are dry and cool to mild.

13.6.2 Desert dwellers

Many of the people who live in desert regions ae nomadic and move with the seasons, obtaining their needs from the land or trade. In several parts of the world, nomadic tribes herd animals. The harsh climate and lack of water make it difficult for large cities to develop, although they can develop in coastal areas where permanent rivers provide a reliable water supply.

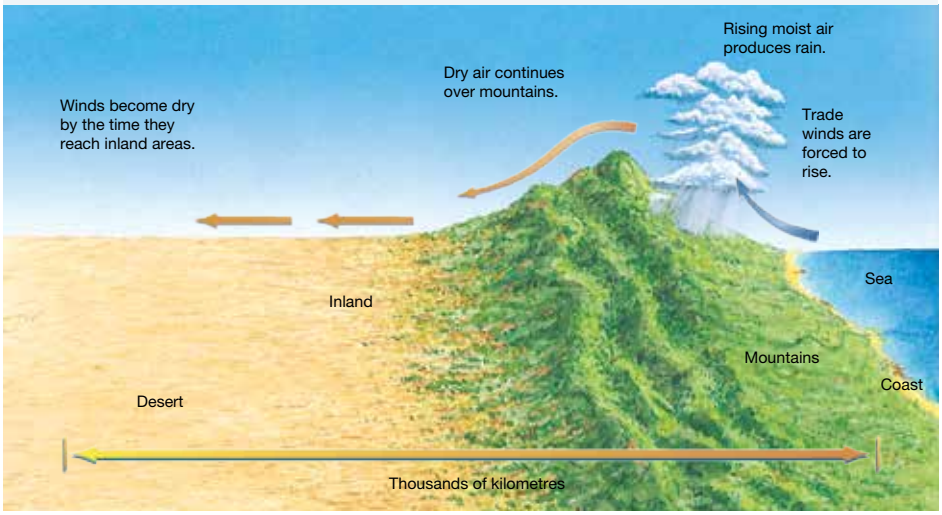
13.6.3 Comparing deserts in China and Australia

FIGURE 3 shows that deserts exist in many different parts of the globe: the subtropics; interior of continents; on the leeward side of mountain ranges; along the coast; and in polar regions. The only common factor is their low rainfall. The Gobi Desert is an example of both a rain-shadow desert (**FIGURE 4**) and an inland desert. While the deserts in Australia are also rain-shadow deserts, cold ocean currents (**FIGURE 5**) have played a significant role in in their formation. Look back at the map in **FIGURE 3**. What factors do you think led to their formation?

int-3628

tlvd-10613

FIGURE 4 The formation of rain-shadow deserts



int-3629

FIGURE 5 The formation of coastal deserts



The Gobi Desert

The Gobi Desert (**FIGURE 6**) is the second largest desert in Asia and the sixth largest in the world, covering parts of both North-western China and Southern Mongolia. It is classified as a cold desert.

FIGURE 6 The Gobi Desert is an example of a cold desert.



The Gobi Desert is a rain-shadow desert, as it lies on the leeward side of the Tibetan Plateau and the Himalayan Mountains prevent precipitation from the Indian Ocean from reaching it. Its location away from the coast and in the high latitudes (approximately 43 degrees north of the Equator) means that winter temperatures can drop as low as –40 °C, at the height of summer the temperature can reach as high as 45 °C, though this is rare.

The landscape in the Gobi Desert is varied, with sand covering only about 5 per cent. The most common landscape is the grassy plains that are exposed when the land is not covered in snow. The region is home to one of the Earth's most important paleontological sites; the cold conditions have led to the discovery of well-preserved fossils that are thought to be more than 88 million years old.

Australian deserts

Australia is the world's driest inhabited continent, with around 70 per cent classified as arid or semi-arid. However, only about 18 per cent of the continent is classified as true desert.

FIGURE 7 Uluru is an **inselberg** that rises above the surrounding desert landscape. To the Anangu People it is a significant landmark created during The Dreaming and seen as the resting place for generations of ancient spirits.



Lying predominantly between the Equator and the Tropic of Capricorn, Australian deserts are classified as hot deserts, as they receive less than 250 mm of rainfall each year and temperatures can soar past 50 °C. Humidity levels are low, with the average humidity lying between 10 to 20 per cent.

- Australian deserts, such as the Simpson Desert, are the result of a combination of factors. Australian deserts are rain-shadow deserts (**FIGURE 4**); the Great Dividing Range prevents warm moisture-laden air from the east coast reaching the interior of the continent.
- Cold ocean currents along the west coast contain little moisture and the winds are essentially dry as they move to the interior of the continent (**FIGURE 5**).

The Australian desert landscape is varied, including sandy deserts, grassy plains and stony areas (gibber plains). The climatic conditions of Australia's deserts have resulted in the preservation of fossil remains.

13.6.4 What processes shape desert landforms?

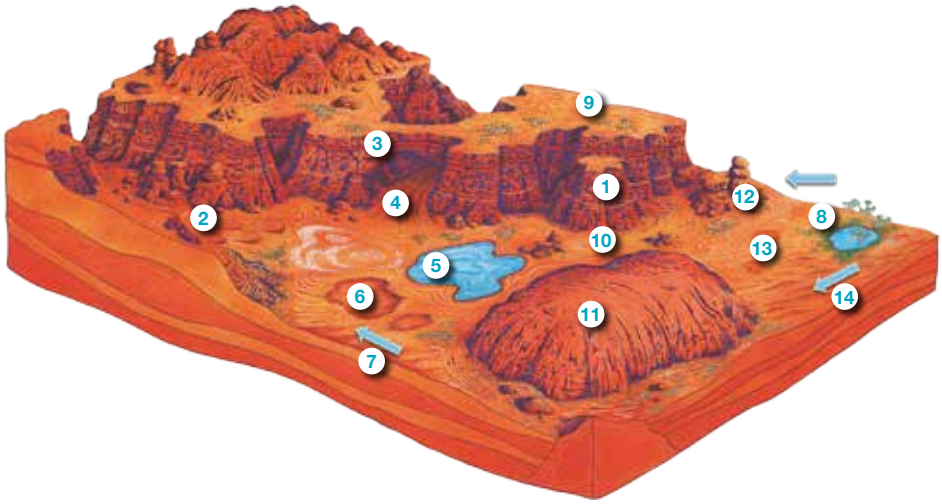
Sand covers only about 20 per cent of the world's deserts. Sand is the product of millions of years of erosion of other landforms such as rock and plateaus that, over time, are worn away by extremes of temperature, wind and water.

inselberg an isolated hill, knob, ridge, outcrop or small mountain that rises sharply from the surrounding landscape

The landforms and patterns of a desert are created by several natural processes. The unprotected land surfaces are prone to erosion. After heavy rain, often a long distance from the desert floodplains, erosion of ancient river channels can be major. Extreme temperatures, along with strong winds and the rushing water that can follow a desert rainstorm, cause rocks to crack and break down into smaller fragments. This process is called weathering.

int-7841

FIGURE 8 A variety of landforms are found in the desert. They result from the actions of wind and water. Can you pick the landforms created by erosion and those created by deposition?



1. A butte is the remaining solid core of what was once a mesa. It often is shaped like a castle or a tower.
2. Crescent-shaped barchan dunes are produced when sand cover is fairly light.
3. An arch, or window, is an opening in a rocky wall that has been carved out over millions of years by erosion.
4. An alluvial fan is the semicircular build-up of material that collects at the base of slopes and at the end of wadis after being deposited there by water and wind.
5. A playa lake may cover a wide area, but it is never deep. Most water in it evaporates, leaving a layer of salt on the surface. These salt-covered stretches are called saltpans.
6. Clay pans are low-lying sections of ground that may remain wet and muddy for some time.
7. The rippled surface on transverse dunes is the result of a gentle breeze blowing in one direction.
8. An oasis is a fertile spot in a desert. It receives water from underground supplies.
9. A mesa is a plateau-like section of higher land with a flat top and steep sides. The flat surface was once the ground level, before weathering and erosion took their toll.
10. Sand dunes often start as small mounds of sand that collect around an object such as a rock. As they grow larger, they are moved and shaped by wind.
11. An inselberg is a solid rock formation that was once below ground level. As the softer land around it erodes, it becomes more and more prominent. Uluru is an inselberg.
12. A chimney rock is the pillar-like remains of a butte.
13. Star dunes are produced by wind gusts that swirl in from all directions.
14. Strong winds blowing in one direction form longitudinal dunes.

Erosional landforms

Most erosion in deserts is caused by wind, and at times running water. Although deserts are areas of low rainfall, they sometimes experience heavy downpours and may receive several years of rain in one such event. Fast-flowing water carves deep channels into the ground forming deep gullies or the walls of a plateau (see **FIGURE 8**). An inselberg such as Uluru is an example of an erosional landform (see **FIGURE 7**).

Erosion can also result from the action of wind and from chemical reactions. Some rock types, such as limestone, contain compounds that react with rainwater and then dissolve in it. Wind is a very important agent of transport and deposition and can change the shape of land by abrasion — the wearing down of surfaces by the grinding and sandblasting action of windborne particles.

Depositional landforms

Materials carried along by rushing water and wind must eventually be put down. Over time these materials build up, forming different shapes and patterns in the desert. This process is called deposition.

Depositional landforms in deserts include alluvial fans and sand dunes (see **FIGURE 8**).

13.6 SKILL ACTIVITY: Communicating

The significance of Lake Mungo

The hot dry climate of Australia's deserts has meant that much of our distant past has been preserved. At Lake Mungo in the Willandra Lakes Region of New South Wales, for example, evidence of continuous human settlement by Australia's First Nations Peoples has been discovered.

The Willandra Lakes region is a World Heritage Area. It is important because of its archaeology and geomorphology. It is culturally significant to Australia's First Nations Peoples.

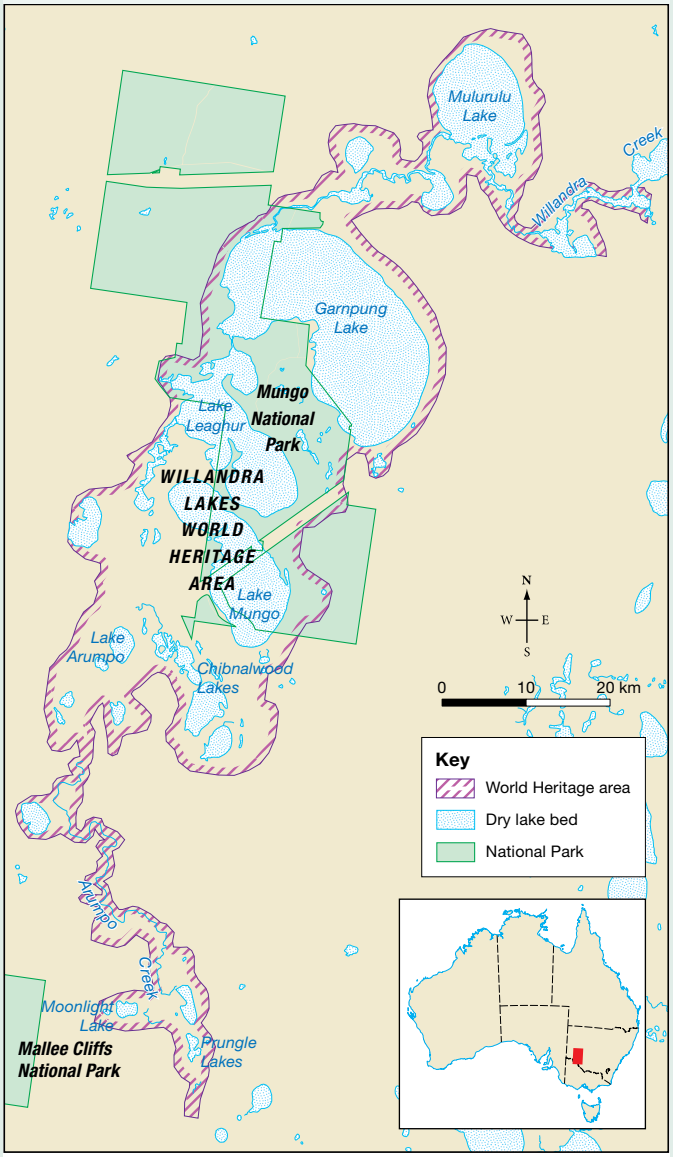
Use the internet to **investigate** the following:

1. How has Lake Mungo changed over time? Begin with its formation through to the present day. Use the **Timeline maker** weblink to **communicate** your findings.
2. **Create** a poster to **explain** what World Heritage listing means and why this place is culturally significant to First Nations Peoples.

FIGURE 10 Traditional custodians clean fossilised footprints at Lake Mungo.



FIGURE 9 Location of Willandra Lakes, including Lake Mungo



Source: Spatial Vision

Resources

Interactivity Location of Willandra Lakes, including Lake Mungo (int-3615)

13.6 Exercise

learnon

13.6 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. **Identify** the sunniest place in the world from the following list.
   - A. Antarctica
   - B. Australian Desert
   - C. Sahara Desert
   - D. Namib Desert
2. Refer to the **FIGURE 3** map and **identify** two deserts in the Asia–Pacific region.
   - A. Patagonian
   - B. Thar
   - C. Australian
   - D. Iranian
   - E. Gobi
   - F. Arabian
3. **Determine** if the following statements are true or false.
   - a. Hot deserts are located between the tropics of Cancer and Capricorn.
   - b. Cold deserts are found only at high altitudes.
   - c. Hot deserts are always hot.
   - d. Cold deserts are always cold.
   - e. In cold deserts precipitation falls as snow.
4. **Describe** the climate conditions that are needed for hot and cold deserts to form.
5. **Identify** the major line of latitude on which Australian deserts are located.

Apply your understanding

Communicating

6. The Gobi Desert is a land of climate extremes. **Justify** the classification of the Gobi Desert as a cold desert.
7. **Describe** why Uluru is considered an iconic Australian landmark.
8. **Explain** the factors that have resulted in the formation of Australia's desert region.
9. **Compare** the characteristics of the Gobi Desert and the Australian desert region.
10. **Discuss** reasons that account for the rich source of well-preserved fossil remains in desert regions.

LESSON
13.7 How do the savanna grasslands of Australia and Africa compare?

LEARNING INTENTION

By the end of this lesson you should be able to describe the distribution of grasslands, explain the characteristics of grasslands and compare Australia's grasslands with those in the Serengeti.

TUNE IN

Indigenous communities use fire sticks to light fires, referred to as 'cool burns' as a method of land management. Only small areas are burnt, and careful attention is paid to the condition of the grass, temperature and winds. Fires are low and lit in the early morning or late afternoon when it is cooler to help prevent them from getting out of control. The dry undergrowth is burnt, reducing fuel load. The practice helps encourage new growth and maintains the grassland.

1. Discuss with a partner the benefits of landscape burning.
2. It has been suggested that more selective burning of bushland should take place during winter to reduce the threat of bushfires in summer. Brainstorm a list of advantages and disadvantages of this suggestion.

FIGURE 1 A cool burn

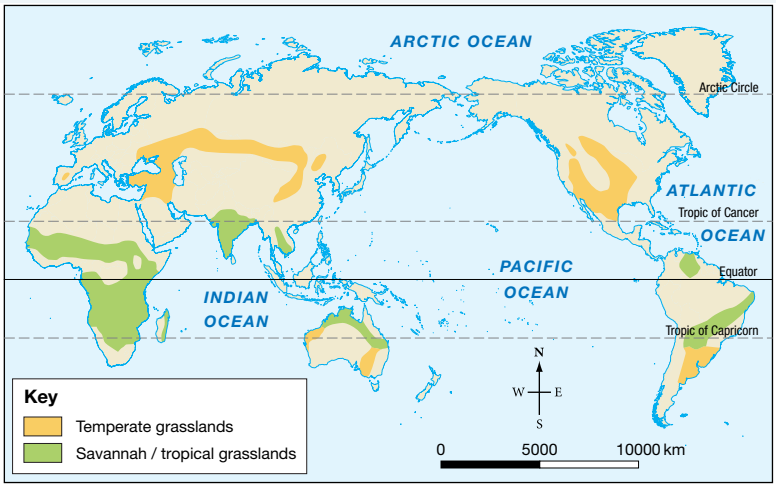


13.7.1 What are grasslands?

FIGURE 2 shows the location of both temperate and tropical grasslands that are often referred to as savannas (or savannahs). Grasslands are a landscape dominated by an almost continuous cover of grass. They are often referred to as a transitional landscape as they lie between rainforests and deserts. Rainfall is too high for the landscape to be classified as a desert but not high enough to support the tall trees and vegetation found in a rainforest.

Grasslands have sometimes been described as looking 'like a park', due to the absence of trees. When present, trees are scattered and often 'flat topped' or little more than stunted shrubs. Where water flows through the landscape in rivers or streams, narrow strips of forest referred to as 'gallery forests' may develop.

FIGURE 2 Grasslands are found on every continent except Antarctica.



Source: Based on data from Geography Teachers Associations of NSW. Map redrawn by Spatial Vision.

The ecosystem is maintained by grazing animals and Indigenous communities have used fire as a method of maintaining this landscape. Fire prevents the growth of trees and encourages the growth of grass, which in turn attracts grazing animals. Grasslands exist in a delicate state of balance and can easily be converted to desert if not managed carefully.

Climate in savanna grasslands varies; however, there are three main characteristics:

- wet summer — the wet
- dry winters — the dry
- hot all year round.

13.7.2 The Serengeti grasslands

The Serengeti is a savanna grassland located in northern Tanzania and southwestern Kenya. The grassland ecosystem is supported by rich volcanic soils; the mass migration of animals has had a positive ecological impact on the area.

Indigenous communities such as the Maasai traditionally lived a nomadic lifestyle as cattle herders and subsisting off their herds and the land. They believed that sedentary agriculture is damaging to the environment.

Today the lifestyle of the Maasai is threatened by restrictions imposed upon them due to drought; the government places limits on how land can be used within a national park. The tourism industry operates under strict controls (**FIGURE 3**).

FIGURE 3 The lifestyle of the Maasai and the opportunity to go on a wildlife safari has resulted in a massive influx of tourists into the Serengeti.

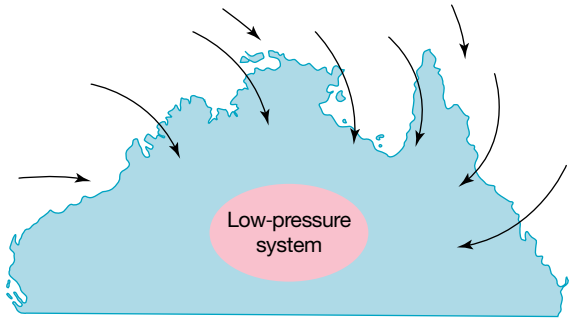


13.7.3 Australian grasslands

Australia's top end, stretching from Broome on the west coast to Townsville on the east coast, is a tropical grassland or savanna landscape. First Nations Peoples have maintained the grassland environment for thousands of years, relying on fire to regenerate the grasslands by using cool burns (see **FIGURE 1**) to encourage new plant growth. There is a distinct wet season that corresponds with the monsoon season (**FIGURE 4**). The lives of First Nations Peoples in northern Australia are governed by changes that occur during and between the wet and dry seasons.

tlvd-10614

FIGURE 4 Australia's wet and dry seasons are the result of air movements and pressure systems.

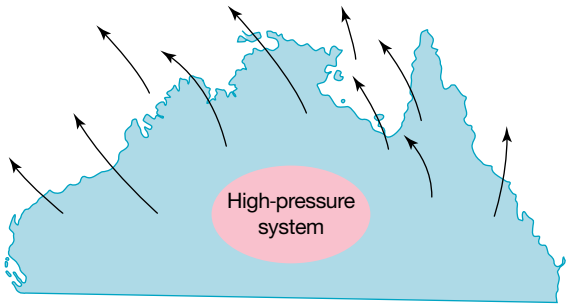


a. Summer months

→ Major wind direction

In summer

- The land heats up; the air is hot and light.
- Hot air rises and cools, creating a low-pressure system.
- Air moves in from over the ocean to replace the rising air.
- This air is wet and brings rain to northern Australia.



b. Winter months

→ Major wind direction

In winter

- The land cools down.
- The air is heavy and sinks, creating a high-pressure system.
- The air is dry as it has passed over the interior of the continent.
- Dry air moves to the north, bringing dry weather to northern Australia.

13.7 SKILL ACTIVITY: Interpreting and analysing geographical data and information, Communication

TABLES 1 and **2** contain the climate statistics for Cloncurry in Australian and Serengeti National Park in Tanzania. The lives of Indigenous communities are often governed by the climatic changes that take place throughout the year.

TABLE 1 Cloncurry Australia 21°S

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp °C	31	30	29	26	22	19	18	20	23	27	30	31
Rain mm	112	108	61	18	13	15	8	3	8	13	33	69

TABLE 2 Serengeti National Park Tanzania 2°S

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp °C	28	28	28	26	25	25	25	26	27	28	27	27
Rain mm	81	100	121	137	68	23	9	19	34	51	100	97

1. **Create** climate graphs, using geographic conventions, for both Cloncurry and Serengeti National Park.
2. Both places have a wet and a dry season. **Explain** what you understand by the terms wet and dry season.
3. The lives of the people in the Northern Territory recognise six seasons and their lives are governed by these seasons. Use the **Ngurrungurrudjba** weblink in the Resources panel to learn more about the way First Nations Peoples recognise changes in the environment. **Create** a calendar of seasons, or annotate your climate graph to show what occurs in each season.

Resources

Weblinks Serengeti
Ngurrungurrudjba

13.7 Exercise

learnon

13.7 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. Refer to **FIGURE 2**. The largest area of grasslands is found in
   - A. Africa
   - B. Australia
   - C. Europe
   - D. Antarctica.
2. **Identify** which continent does not have any grasslands.
   - A. Europe
   - B. Asia
   - C. Antarctica
   - D. Africa
3. The Maasai people live in the top end of Australia. True or false?
4. **Explain** why grasslands are described as a transitional landscape.
5. Which of the following statements is true?
   - A. The Serengeti is hotter and wetter than Australia's grasslands.
   - B. The Serengeti is cooler and drier than Australia's grasslands.
   - C. The Serengeti is hotter and drier that Australia's grasslands.
   - D. The Serengeti is cooler and wetter than Australia's grasslands.

Apply your understanding

Communicating

6. **Explain** why there are few trees in grasslands.
7. **Define** the term 'gallery forest'.
8. **Propose** a reason why gallery forests are usually found along watercourses, even when the watercourse is dry.
9. **Identify** the threats faced by the Maasai people of the Serengeti.

Interpreting and analysing geographical data and information

10. Refer to **FIGURE 4**. **Explain** the relationship between pressure systems and the climate of northern Australia.

LESSON
13.8 What makes a rainforest?

LEARNING INTENTION

By the end of this lesson you should be able to describe the characteristics and distribution of rainforests. Additionally, you should be able to explain the importance of rainforests.

TUNE IN

Did you know that rainforests have been described as the 'Earth's lungs' and play a key role in regulating the global climate?

1. What do you understand by the terms 'Earth's lungs' and 'regulators of global climate'?
2. Describe what you can see in **FIGURE 1.**
3. What message do you think **FIGURE 1** is sending?

FIGURE 1 The global climate is linked to our rainforests.

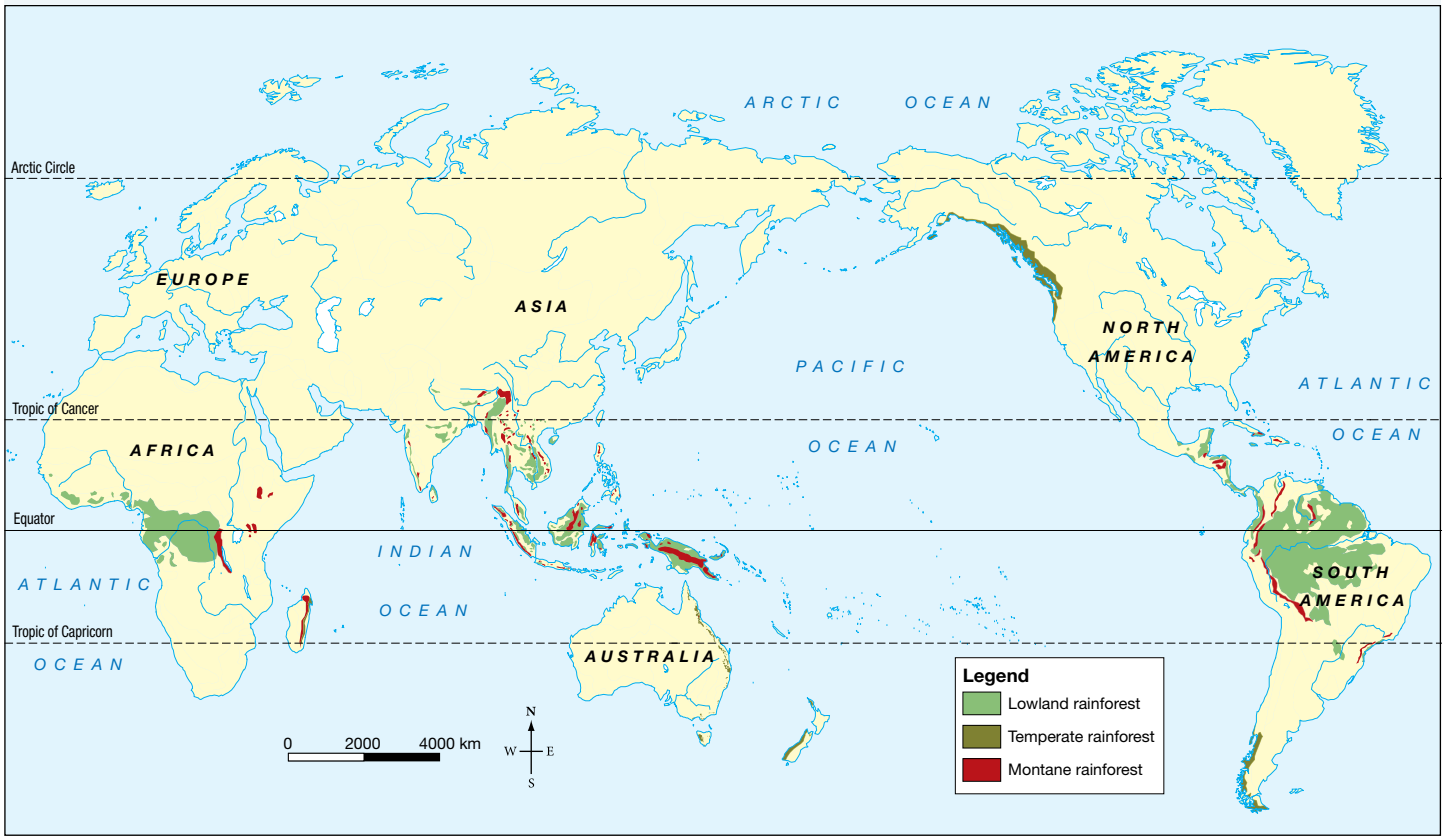


13.8.1 Where are the world's rainforests?

Rainforests grow in areas that are constantly wet. More than 1300 millimetres of rain spread evenly throughout the year is needed to support the rainforest ecosystem.

int-7852

FIGURE 2 World rainforest types



Source: MAPgraphics Pty Ltd Brisbane

Tropical rainforests are found where there are both high temperatures and high rainfall. These conditions stretch from the Equator to the Tropic of Capricorn (in the south) and the Tropic of Cancer (in the north).

Tropical rainforests that occur in the mountains more than 1000 metres above sea level are called montane rainforests, whereas those growing below 1000 metres are known as lowland rainforests. Temperate rainforests, on the other hand, are located between the tropics and the polar regions in what is known as the **temperate zone**.

13.8.2 The rainforest ecosystem

Rainforests are unique **ecosystems** consisting of four different layers — the emergent, canopy, understory and forest floor (**FIGURE 3**). Each layer can be identified by its distinct characteristics.

Emergents

These are the tallest trees, ranging in height from 30 to 50 metres. They are so named because they rise up or emerge out of the forest canopy. Huge crowns of leaves and abundant animal life thrive on plenty of available sunlight.

Canopy

This describes the array of treetops that form a barrier between the sunlight and the underlying layers. Their height can vary from 20 to 45 metres. This layer contains a distinct **microclimate** and supports a variety of plants and animals. The taller trees host special vines called lianas that intertwine the branches. Other plants called epiphytes use the tree trunks and branches as anchors in order to capture water and sunlight.

Understorey

This layer contains a mixture of smaller trees and ferns that receive only about five per cent of the sun's energy. Many animals move around in the darkness and humidity, using the vines as highways.

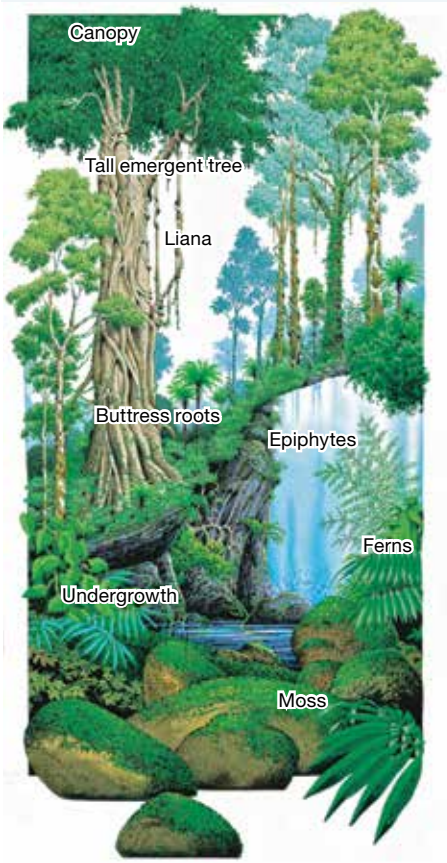
Forest floor

This bottom layer is dominated by a thick carpet of leaves, fallen trees and huge buttress roots that support the giant trees above. Rainforest soils give the impression of being fertile because they support an enormous number of trees and plants.

However, this impression is wrong, as the soil in rainforests is generally poor. Leaves and other matter are recycled by the many organisms to create a living **compost**. The roots of trees must 'snatch' these nutrients from the soil before heavy rains wash them away and they are lost through a process called **leaching**.

Larger animals also roam through this layer in search of food.

FIGURE 3 Layers in a tropical rainforest



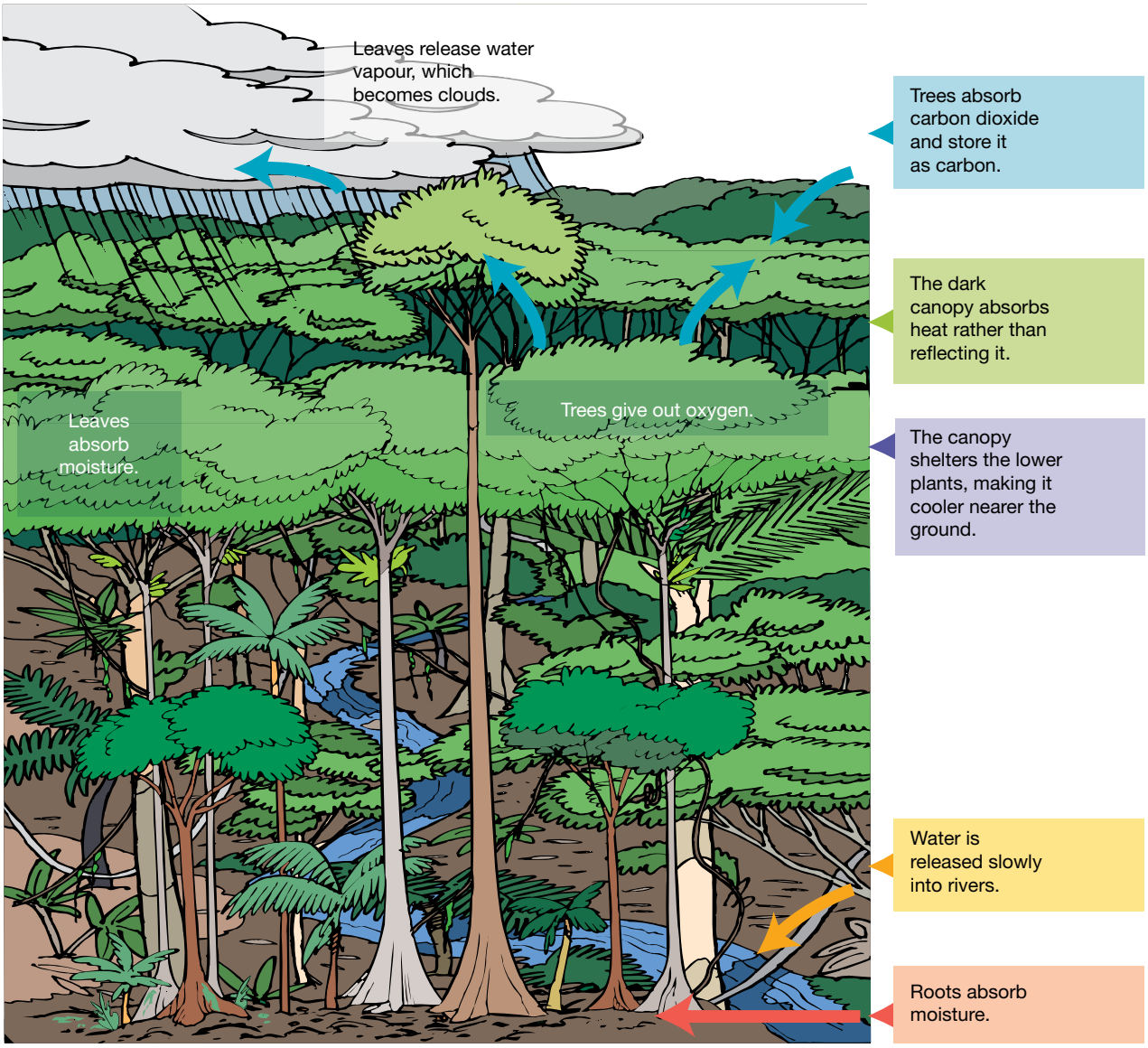
temperate zone describes the relatively mild climate experienced in the zones between the tropics and the polar circles
ecosystem an interconnected community of plants, animals and other organisms that depend on each other and on the non-living things in their environment
microclimate specific atmospheric conditions within a small area
compost a mixture of various types of decaying organic matter such as dung and dead leaves
leaching a process that occurs in areas of high rainfall, where water runs through the soil, dissolving minerals and carrying them into the subsoil. The process can be compared to a coffee pot in which water drips through the grounds.

13.8.3 Amazing rainforests

Most of us use rainforest products every day. More importantly, however, rainforests help control the world's climate and our oxygen supply (see **FIGURE 4**). So the next time you eat chocolate, treat your asthma, play a guitar or even take a deep breath, you should thank a rainforest.

tlvd-10679

FIGURE 4 Rainforests play a vital role in controlling the world's climate and oxygen supply. Scientists believe that half of the world's oxygen is produced by the Amazon rainforest alone.



- At least 50 million indigenous peoples live in rainforests worldwide. From the Kuna people of Panama and the Yanomami of Brazil to the Baka people of Cameroon and the Penan of Borneo (Indonesia), these people have traditionally lived a way of life that has little impact on their forest home.
- Rainforest trees are generally hardwood trees, making them resistant to decay and attractive for building. Well-known rainforest timbers are mahogany, teak, ebony, balsa and rosewood. Rosewood is particularly interesting, as it is considered the best timber in the world for guitar making. In many tropical countries, people also collect timber as fuel for cooking or heating.

- Chocolate first came from the cacao tree native to the Amazon rainforest. Today the chocolate you eat is most likely to come from cacao plantations in West Africa.
- Most of the fruits and nuts mentioned here are now grown by farmers rather than harvested directly from the forest, but it was in the rainforests that they originated.
- Brazil and cashew nuts, cinnamon, ginger, pepper, vanilla, bananas, pineapples, coconuts, paw-paws, mangoes and avocados were all originally rainforest plants.
- The gum used in chewing gum comes from a rainforest plant, as does the tree that produces rubber.
- More than 7000 modern medicines are made from rainforest plants. They can be used to treat problems from headaches to killer diseases like malaria. They are used by people who suffer from multiple sclerosis, Parkinson's disease, leukaemia, asthma, acne, arthritis, glaucoma, diabetes, dysentery and heart disease, among many others.
- The cacao tree is a source of compounds used to lower cholesterol, blood sugar levels and the risk of heart disease.
- Tree frogs from Australia give off a chemical that can heal sores, and a similar chemical from a South American frog is used as a powerful painkiller.
- Quinine, a key ingredient in the treatment of malaria, comes from the cinchona tree.
- The poisonous venom from an Amazonian snake is used to treat high blood pressure.
- Twenty-five per cent of all cancer-fighting drugs originate in the rainforest.

FIGURE 5 Many of the foods we eat come from rainforests.



FIGURE 6 Only one per cent of known rainforest plants and animals have been analysed for their medicinal potential.



13.8.4 Where have our rainforests gone?

Rainforests have the potential to provide a wide variety of useful resources. The temptation to use these pristine areas is often too difficult for people to resist, especially if they live in poverty. As a result, all around the world, rainforests are being destroyed for economic gain (see **FIGURE 7**).

- Around 31 per cent of the Earth's surface is covered by rainforests.
- Only 18 per cent of the Earth's rainforests are protected from deforestation.
- More than 8 million hectares of forest were lost between 1990 and 2020.
- Globally, around 2400 trees are cut down each minute — enough to fill one soccer field.
- NASA estimates that in 100 years there may be no rainforests left.

Factors causing deforestation

Agricultural production — removal of forest for plantation crops such as soy and palm oil, agricultural pasture, settlements and infrastructure. Beef and soy production account for more than two-thirds of deforestation.

Forest fires — millions of hectares are lost each year. Degraded forests are more prone to uncontrolled natural fires. Fires are also deliberately lit to clear the area for other uses.

Illegal and unsustainable logging — rainforest trees produce hardy timber that is in demand for commercial use in international markets.

Fuelwood harvesting — over-harvesting as a cheap source of fuel for locals living in poverty or for the commercial use in the production of charcoal.

Mining — mineral resources are abundant in rainforest regions. The land is cleared to extract these resources and build roads and other infrastructure to gain access to mines.

Climate change — climate change reduces rainfall and increased temperatures dry out the rainforest, increasing the risk of fire and further reducing rainfall.

FIGURE 7 Illegal gold mining in the Amazon not only destroys the rainforest but also contaminates rivers with mercury.



on Resources

Interactivities Deforestation dilemma (int- 3113)
Our living green dinosaurs (int- 3112)
Protecting or plundering rainforests (int- 3114)

13.8 SKILL ACTIVITY: Questioning and researching, Communicating

More than 3 million species call rainforests home, making them the most biodiverse places on Earth.

1. As a class, **brainstorm** a list of plants, animals, insects, amphibians and so on that are found in the rainforest. You might need to use the internet to help you.
2. Have each member of the class select a different species to **investigate**.
   a. Find an image of your species.
   b. **Annotate** your image to **explain** the characteristics of the species shown.
   c. **Create** a class collage to showcase your collective findings.

13.8 Exercise

learnon

13.8 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. Rainforests thrive in locations that receive _____ of rainfall evenly spread throughout the year. This is most commonly experienced in the equatorial regions of the planet, where climatic conditions are moist and warm all year round.
2. **Compare** montane and lowland rainforests by inserting the correct type into the spaces.
   _____ rainforests are found at altitudes below 1000 metres. Trees are tall and include a greater variety of fruiting trees.
   _____ rainforests are found at an altitude of 1000 metres or higher. These rainforests are not as threatened as others.
3. **Compare** the different layers of rainforest environments by matching each layer with the amount of light it receives.

Emergent and canopy	
Understorey	
Forest floor	

- Dark
- Dark, only 5 per cent of the sun's light and energy
- Plenty of sunlight available

4. Why are rainforests sometimes called 'the lungs of the Earth'?
5. What percentage of deforestation is caused by agriculture in the Amazon?
   A. 20%
   B. 30%
   C. 55%
   D. 77%
   E. 90%

Apply your understanding

6. Refer to **FIGURE 2**. **Describe** the distribution of rainforests around the world. On which continents and between which latitudes are they found?
7. a. What name is given to the tallest trees in the rainforest?
   b. Why do you think they were given this name?
8. **Describe** the distribution of rainforests around the world. Think about in which continents and between which latitudes they are found, the size and scale of them, and whether they are continuous or scattered.
9. Many rainforest environments are located in developing countries. Why does this make the problem of rainforest destruction harder to solve?
10. Soils in the rainforest are generally poor but they support a diverse range of dense vegetation. **Explain** why the rainforest is able to support so much vegetation, but cannot sustain agricultural production without the addition of fertilisers.

LESSON
13.9 INQUIRY: The value of rainforests

LEARNING INTENTION

By the end of this lesson you should be able to explain why rainforests are important, describe the threats to rainforests and develop strategies for the preservation of rainforests.

Background

Newsflash — rainforests will soon be gone

Over the past 10 000 years, human activities have reduced the Earth's forest by about one-third. Trees have been felled to make way for urban development and agriculture, and to obtain fuel and building materials. Today, approximately 34 per cent of the world's land area is covered by forest.

Rainforests are one of the most complicated environments on Earth. Mostly found in warm, moist areas near the equator, rainforests contain nearly three-quarters of all varieties of life on Earth and perform several important functions on our planet. Australia's rainforests are very important, as they contain half of our plant and one-third of our native animals in a very small area (20 000 square kilometres).

Until this century, tropical rainforests were hardly touched by humans because the excessive heat, mosquito plagues, torrential rain and mountainous surroundings made tropical rainforests inaccessible to most humans. However, with increasing demand for timber and clear land, these rainforests are disappearing at a rapid rate all over the world.

Urgent action is needed, but we need more information before the important decisions are made. Reliable sources suggest the Department for Natural Resources and Environment are compiling a top-secret document detailing many factors in the 'Rainforest Debate'.







Before you begin

Access the **Inquiry rubric** in the digital documents section of the Resources panel to guide you in completing this task at your level. At the end of the inquiry task you can use this rubric to self-assess.

In this inquiry you will work in a team to complete an in-depth study on tropical rainforests to learn why they are important and present strategies for the conservation of the world's remaining rainforests.

You may choose to focus on a specific rainforest, such as the Daintree in Queensland, the Amazon in Brazil or the rainforests of Indonesia, Malaysia, Papua New Guinea or the Congo.

Inquiry steps

Read the background information provided and **decide** what additional information you need. You can also use the topographic map of the Daintree Rainforest in lesson 13.9 in your research. Assign roles within your group.

Step 1: Questioning and researching using geographical methods

- **Create** your inquiry question.
- **Research** your question. Use the following weblinks from the Resources panel to get you started:
  - **Living rainforests** to find out more about the rainforest landscape.
  - **Rainforest threats 1** and **2** and to learn about the threats to rainforests.
  - **Protecting rainforests** to discover more about:
    - what is being done to protect rainforests
    - the structure of rainforests
    - their role in regulating climate
    - their role in oxygen production
    - rainforest habitats
    - rainforests as a source of food and medicine
    - threats to the rainforest
    - conservation strategies and their success.

Step 2: Interpreting and analysing geographical data and information, Concluding and decision-making

- **Analyse and evaluate:** do you need to adjust your inquiry question? Which information is relevant to your inquiry? Incorporate relevant maps and statistics.

Step 3: Communicating

- **Communicate:** what is the answer to your inquiry question? Present your findings. This could be in the format of a webpage, oral presentation or recorded documentary, for example.

Complete your self-assessment using the **Inquiry rubric** or access the 13.9 exercise set to complete it online.

on Resources

Digital document Inquiry rubric (doc-39535)

Weblinks
Living rainforests
Rainforest threats 1
Rainforest threats 2
Protecting rainforests

LESSON
13.10 Investigating topographic maps — Features of the Daintree rainforest

LEARNING INTENTION

By the end of this lesson you should be able to locate and describe the features of the Daintree rainforest on a topographic map.

13.10.1 Daintree rainforest

The Daintree rainforest, located in the Daintree National Park in far north Queensland, is one of the oldest surviving rainforests on Earth. It holds such significance to the biological diversity and geological history of Australia that it was recognised as a World Heritage Area in 1988.

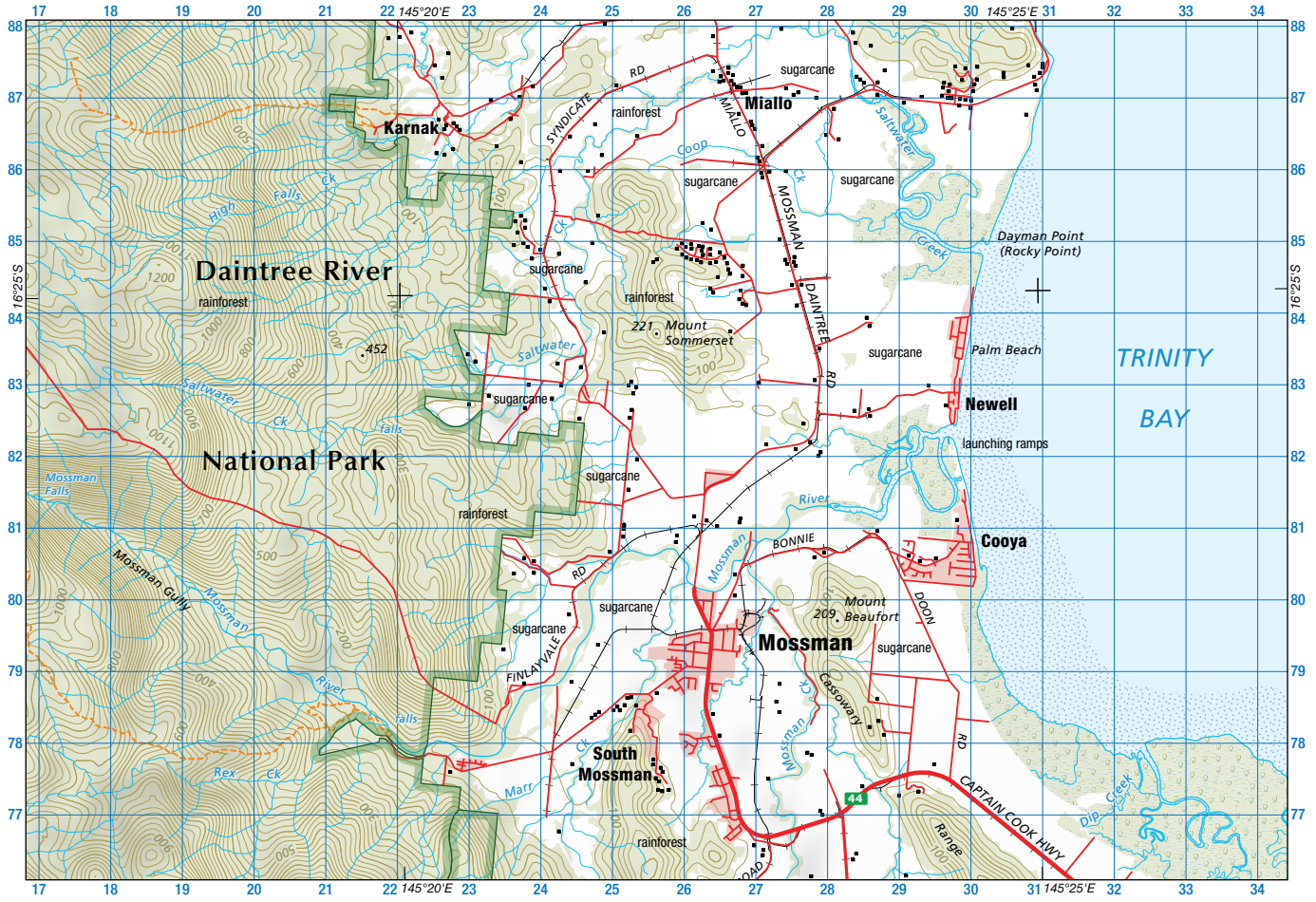
This area forms part of the Wet Tropics of Queensland, which stretches along the northeast coast of Australia for 450 kilometres.

FIGURE 1 The Daintree area of northern Queensland: (a) A mangrove on the mudflats of Cooya Beach; (b) Newell beach; (c) Mossman Gorge



int-8410

FIGURE 2 Topographic map extract of the south-eastern section of the Daintree River National Park



Legend

- Spot height (121)
- Building
- Index contour
- Contour (interval: 25 m)
- Highway (route no. B56)
- Major road
- Minor road
- Track
- Rail
- Stream
- River
- Water body
- Intertidal zone
- Vegetation
- Mangrove
- Urban area
- National park

N, W, E, S

0 2 4 km

Source: Map redrawn by Spatial vision, based on information taken from QSpatial, State of Queensland (Department of Natural Resources, Mines and Energy, Department of Environment and Science), http://qldspatial.information.qld.gov.au/catalogue/

on Resources

eWorkbook	Investigating topographic maps — Features of the Daintree rainforest (ewbk-10753)
Digital document	Topographic map of Daintree River National Park (doc-36254)
Video eLesson	Investigating topographic maps — Features of the Daintree rainforest — Key concepts (eles-6109)
Interactivity	Investigating topographic maps — Features of the Daintree rainforest (int-8410)

FIGURE 3 The Mossman River winds through the Daintree Rainforest.



13.10 Exercise

learnon

13.10 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

1. According to **FIGURE 2**, the most common type of farming to occur in the area is _____.
2. **Identify** the features found at the following locations.
   a. GR262792
   b. GR332775
   c. GR311788
   d. GR307760
3. **Describe** what the landscape would look like if you were at the following locations.
   a. GR195768
   b. GR335765
   c. GR272867
4. **State** the six-figure grid references for:
   a. Dayman Point
   b. Port of Mossman
   c. Miallo.
5. **Identify** which features shown on the map provide evidence that this is a rainforest landscape.
6. **Explain** three ways that humans have had an impact on this rainforest environment.

LESSON
13.11 What cultural significance do landscapes have for First Nations Peoples of Australia?

LEARNING INTENTION

By the end of this lesson you should be able to explain the cultural significance of landscapes.

TUNE IN

First Nations Peoples are recognised as the first Australians. Evidence of their presence in Australia is found across the continent in archaeological records and their cultural heritage has been passed down through the generations.

FIGURE 1 This rock art depicting a cloud or rain spirit was found in Western Australia's Kimberley region.



1. What do you understand by the term 'rock art'?
2. Working with a partner:
   a. Develop a shared understanding of where this image may have been found and what you can see.
   b. What element of First Nations Peoples do you think is depicted in this rock art?
3. Share your thoughts with the rest of the class.

13.11.1 The Australian context

Landscapes are the product of processes that have operated for millions of years. While all humans have come to realise the importance of the landscape and the role it plays in our lives, First Nations Peoples of Australia have always known that it is important to work alongside nature rather than always seek to change and exploit it.

They rely on and nurture the plants, animals and the environment for their survival, and so have an understanding of the complex nature of Australia's varying landscape.

Europeans, on the other hand, arrived in 1788 and occupied areas of Australia. They had a very different view of the landscape, based on ideas they brought with them from Britain. They sought to change the landscape and adapt it to meet their needs. They established permanent settlements and depended on farming introduced species to provide for their needs.

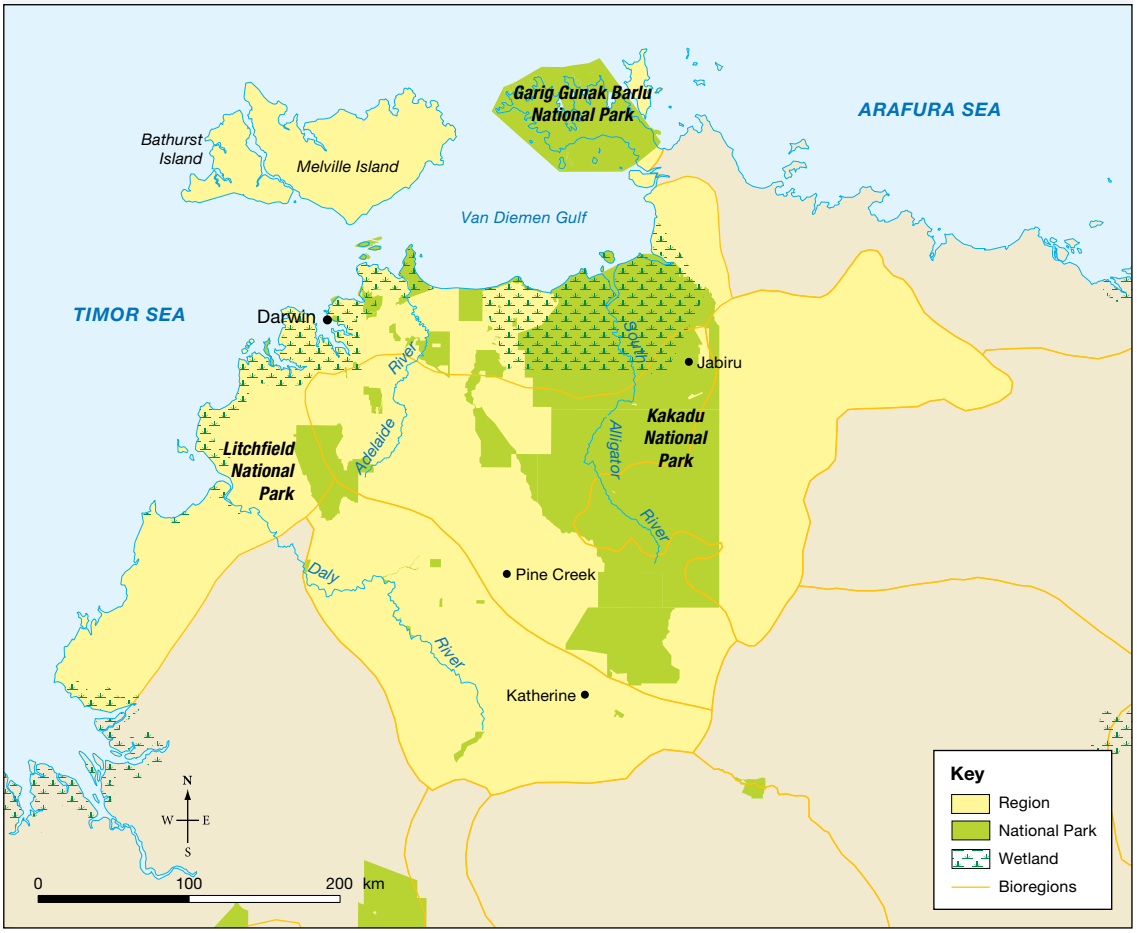
The perspective of First Nations Peoples of Australia is one of belonging to the landscape, while the European perspective is based on the idea of owning land.

13.11.2 Kakadu — Australia's first World Heritage Area

Kakadu National Park, as seen in **FIGURE 2**, covers an area of approximately 20 000 square kilometres of the Northern Territory — an area roughly a third the size of Tasmania. It stretches 200 kilometres from north to south, and spans 100 kilometres from east to west. Within the boundaries of the park are vast uranium deposits. Kakadu is unique in that it is recognised for both its natural beauty and its cultural value.

int-3609

FIGURE 2 Map of Kakadu National Park



Source: Spatial Vision

13.11.3 Kakadu and its resources

More than 200 000 tourists visit Kakadu National Park annually. Kakadu is a UNESCO World Heritage List site that is recognised for both its cultural and natural importance. Culturally, the area features some of the oldest rock art in the world, with Bininj/Mungguy paintings dating back 20 000 years. It is believed that Kakadu has been home to the Bininj and Mungguy peoples for over 65 000 years. The natural heritage of the area includes diverse native plant and animal species, vast wetlands, steep gorges and waterfalls (see **FIGURE 4**).

FIGURE 3 Consider how the Kakadu landscape is viewed and valued

1. More than 7000 sites preserve Bininj/Mungguy heritage; the rock art of Kakadu is one of the oldest and longest running accounts of culture on Earth.

2. Kakadu is home to a variety of plant and animal species that are unique to this region.

3. The land provides food such as wallabies and fruit; the rivers, fish and turtles; and the wetlands, bulbs and waterfowl.

4. Culture, traditions and nature are all linked, and connect people to their Country. People are responsible for looking after the land; they do not own it.

10. When Kakadu became a National Park, three possible uranium mining areas – Jabiluka, Ranger and Koongarra – were excluded from the park, even though they were surrounded by it. The Jabiluka mine site began development but has never been mined because of successful protests by the Mirarr people. Koongarra was added to the National Park in 2013 after campaigning by a senior Traditional Owner of the Djok clan. The Ranger mine is due to close at the end of 2020.



5. First Nations land management is very different to European farming; European settlers did not understand.

6. European land management involves ownership: building fences, restricting access and extracting resources to make a profit.

9. The region is remote, so there was much less European colonisation of the area, and little commercial interest until Uranium was found.

8. Native flora and fauna have been affected and some small native mammals have become extinct.

7. Europeans brought in new rules, religion, laws and diseases that affected the human experience and natural cycles of the landscape.

Kakadu also has vast deposits of uranium ore, which is a potentially valuable export for Australia. Opponents of uranium mining are concerned about the possibility that Australia's uranium could be processed and used to make nuclear weapons. Others fear the effects of mining on the environment and the potential for a devastating pollution event. Health studies on the First Nations population living in the vicinity of the mine have found that stillbirth rates are double the rate seen in women living in other parts of the Top End. Cancer rates were also 50 per cent higher.

FIGURE 4 Jim Jim Falls at Kakadu is a popular tourist destination.



The Ranger uranium mine has been operating since 1980 and lies within the boundaries of Kakadu National Park. Three kilometres downstream from the mine, the Mirrar people (a local First Nations community) swim and fish. Since the mine opened, there have been more than 200 leaks and spills, and the mine has generated some 30 million tonnes of liquid radioactive waste (see **FIGURE 5**). Uranium mining ended in 2012, but the processing of stockpiled ore continued until January 2021. The owners of the mining lease will continue to rehabilitate the area beyond its lease expiry date in 2026. The final cost of returning the site to its original state is expected to cost up to $2.2 billion.

on Resources

Google Earth Mount Everest
Kakadu

13.11 SKILL ACTIVITY: Interpreting and analysing geographical data and information, Concluding and decision-making

Review the information in this lesson related to Kakadu and its resources, and carefully study both **FIGURES 5** and **6**.

FIGURE 5 Timeline of major breaches at the Ranger uranium mine since 2002

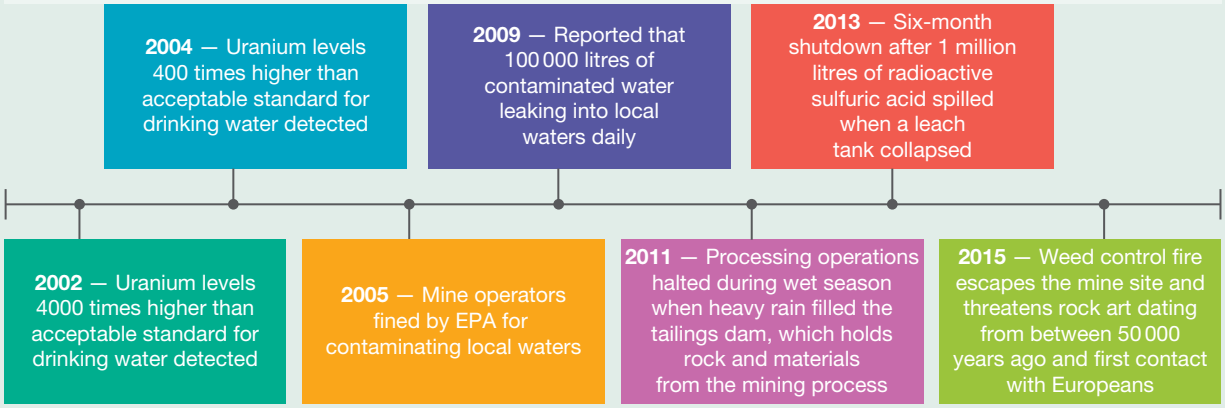


FIGURE 6 Aerial view of the rehabilitation and vegetation regrowth on the Jabiluka mine site from 2006 to 2018.



1. Referring to **FIGURE 5**, **describe** the impact of breaches at the Ranger Uranium mine on both people and the environment.
2. Annotate a diagram of **FIGURE 6**:
   a. **Describe** the changes that have taken place to the landscape at the Ranger Uranium mine from 2006 to 2018.
   b. Add an additional image and annotation to **predict** what the landscape might look like today.
3. **Determine** if you think the Kakadu region be completely restored. Use evidence to support your conclusion.

13.11 Exercise

learnon

13.11 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. Refer back to the information about Kakadu National Park.
   a. **Identify** the location of Kakadu National Park.
      A. Northern Territory
      B. New South Wales
      C. Queensland
      D. Western Australia
   b. **Select** the option that best explains why Kakadu National Park is important.
      A. Most of Australia sources water from there.
      B. It has cultural significance.
      C. Most of Australia sources fish from there.
      D. It is not important.
2. **Consider** the Australian landscape and the way it is viewed by First Nations Peoples and non-Indigenous Australians.
   Identify whether the following statements are true or false.
   a. First Nations Peoples of Australia see the land as something to farm and develop, whereas the European tradition views people as custodians of the land.
   b. First Nations Peoples of Australia look after the land as a community, whereas the European tradition is that people live on and own one specific piece of land.
   c. First Nations Peoples of Australia, exploited the land, whereas the European tradition involved careful management of the land and its resources.
3. Where are the more densely populated regions of Australia?
   A. Coastal regions
   B. Inland regions
   C. Population is evenly distributed across Australia.
   D. Forest regions
4. **Describe** the interconnection that First Nations Peoples of Australia have with the landscape. What evidence of this interconnection is found in this lesson?
5. **Consider** the resources in the Kakadu region.
   a. **Explain** what is uranium is used for and why it is considered a valuable resource.
   b. What risks does uranium mining pose in the Kakadu region?

Apply your understanding

Communicating

6. Think about your personal values and beliefs and **analyse** how they might be similar or different to those reflected in **FIGURE 3**.
7. Think back to section 13.7.3 on mining in the Kakadu region.
   a. **Predict** three possible impacts on the landscape if a new uranium mine was opened in the Kakadu region.
   b. Do you think changes would have a large-scale or a small-scale impact? **Explain**.
8. **Predict** what pressures decision-makers in Australia might face in future when balancing the needs of the different groups who have an interest in Kakadu's resources.
9. **Explain** how we have such an extensive knowledge of Bininj and Mungguy peoples' culture, history and beliefs.
10. **Propose** one argument for and one argument against granting leases to mine resources such as uranium in the Kakadu region.

LESSON
13.12 Why do we preserve and manage landscapes?

LEARNING INTENTION

By the end of this lesson you should be able to explain why landscapes need to be protected.

TUNE IN

Did you know that Australia's Gondwana Rainforest is made up of 50 separate reserves and national parks? Comprising 366 000 hectares of remnant rainforest across Queensland and New South Wales. Within these rainforests are fossil records dating back to the supercontinent Gondwanaland. It is on the World Heritage List because it has high conservation value for both its natural beauty and cultural significance.

FIGURE 1 Crystal Falls in Australia's Gondwana Rainforest



1. What do you understand by the concept of World Heritage listing?
2. Why do you think the Gondwana Rainforest comprises so many reserves and national parks?
3. Brainstorm a list of the types of evidence from Australia's past that might be found in the Gondwana Rainforest.
4. Have a class discussion about whether the Gondwana Rainforest should be preserved.

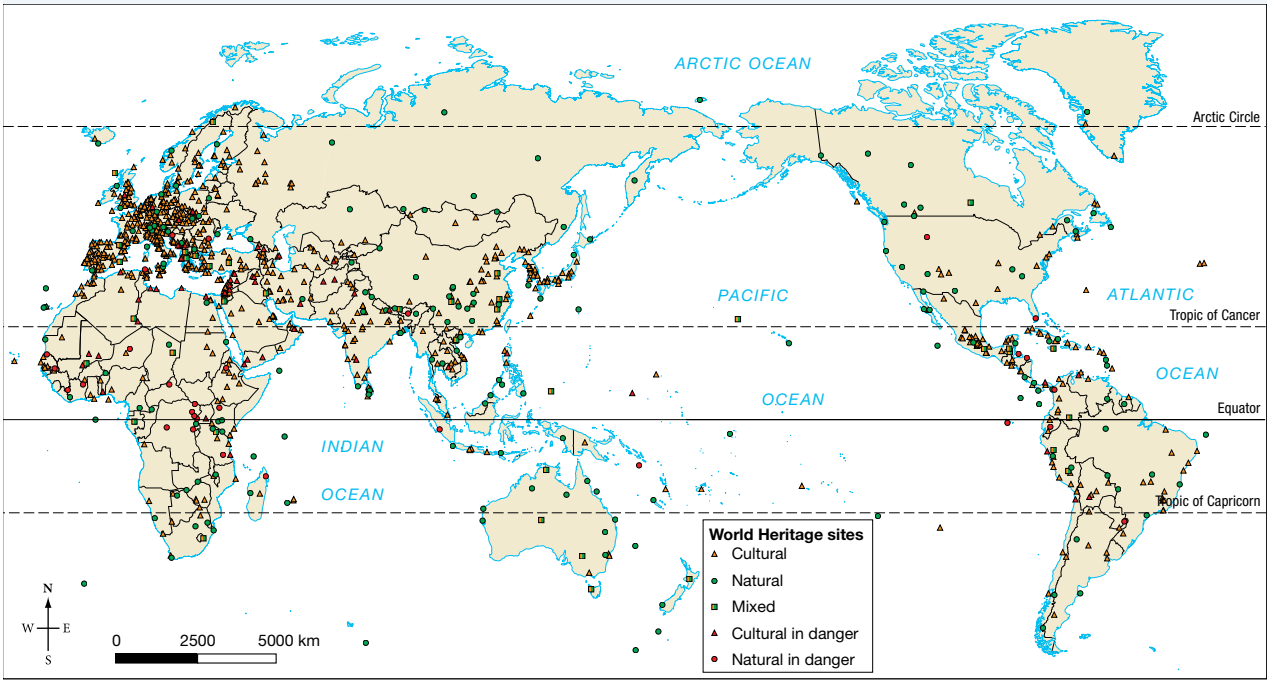
13.12.1 The World Heritage Convention

Worldwide, people recognise the value of landscapes and the need to protect their natural beauty and cultural heritage, and to manage their resources sustainably. Landscapes are easily damaged or destroyed, but are difficult to recreate and repair. The key is to ensure that they are carefully managed so the landscapes we value today are still present in the future.

From the middle of the twentieth century, concern grew about the need to protect areas of both cultural and natural significance (see **FIGURE 2**).

int-7833

FIGURE 2 The World Heritage List includes 1092 sites of significance.



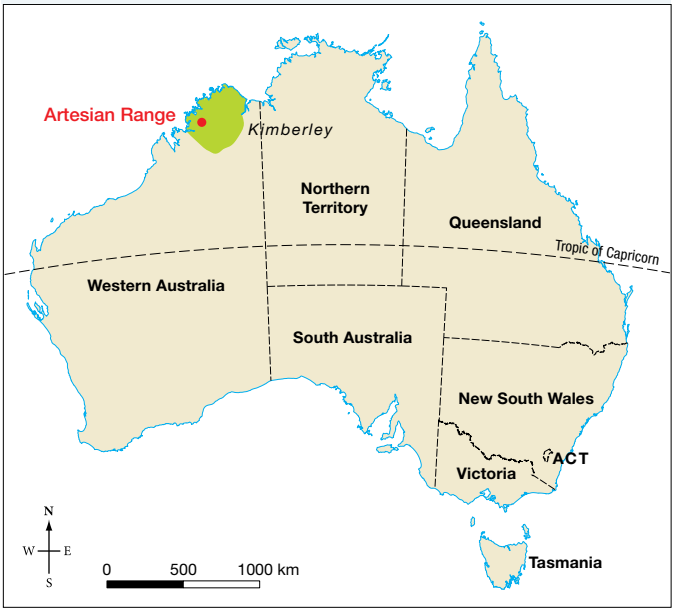
Source: Copyright © 1992–2019 UNESCO/World Heritage Centre. All rights reserved.

13.12.2 The Artesian Range

The Artesian Range is a unique part of the Australian landscape. It has been described as a lost world, a modern-day Noah's Ark, and our last opportunity to protect and preserve a part of the Australian mainland that has had little contact with modern civilisation. Within its hidden valleys and canyons lies a diverse range of flora and fauna. The rich tropical rainforests and woodlands provide vital habitats for some of Australia's most endangered wildlife.

The Artesian Range covers 1800 square kilometres (see **FIGURE 3**). It is largely inaccessible; the only way in is by helicopter or boat. It is a maze of hidden valleys and canyons, rocky ranges and plateaus, towering **escarpments**, wide valleys and deep gorges (see **FIGURE 4**). Its sandstone ranges were formed as a result of tectonic plate activity. These rock formations date back some 1.8 million years.

FIGURE 3 The Artesian Range covers 1800 square kilometres of the Kimberley region.



Source: Spatial Vision

Although it is difficult for humans to reach the area, exotic species such as donkeys, horses, pigs and cats have gradually invaded the Kimberley. And while fire is a natural part of the landscape, changing fire patterns and the increasing number of late-season wildfires are also a threat to the Artesian Range.

escarpment a steep slope or long cliff formed by erosion or vertical movement of the Earth's crust along a fault line

Australian Wildlife Conservancy (AWC), an independent non-profit organisation funded by donations, has now secured the land and manages it for conservation. AWC undertakes fire management, feral animal control, and biological surveys and monitoring, protecting the full length of the Artesian Range.

FIGURE 4 The Artesian Range is a rugged and largely inaccessible landscape, renowned for its natural beauty and unique wildlife.



on Resources

Weblink World Heritage list

13.12 SKILL ACTIVITY: Questioning and researching, Communicating

Use the **World Heritage list** weblink to **investigate** a World Heritage site in more detail.

Select a heritage site from one of the countries listed on the website.

Prepare a visual presentation of your chosen site that includes the following information:

- Show the location of your chosen site on a map that conforms to geographic conventions.
- **Illustrate** the importance of the site.
- **Identify** any threats to your site.
- **Explain** the strategies being used to protect your site.
- **Evaluate** these strategies
  - How successful have these strategies been?
  - Is enough being done?
  - Are any modifications needed?

13.12 Exercise

learnon

13.12 Exercise

Learning pathways

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

These questions are even better in jacPLUS!



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

Find all this and MORE in jacPLUS

Check your understanding

1. a. Where in Australia is the Artesian Range located?
   - A. North-east coast of Australia
   - B. North-west coast of Australia
   - C. South-west coast of Australia
   - D. South-east coast of Australia

   b. Suggest why the Artesian Range is unique.
2. Why has the Artesian Range been largely inaccessible to people?
   - A. Steep escarpments
   - B. Thick forests
   - C. Woodlands
   - D. There are no roads leading into the area
   - E. All of the above
3. **Identify** two management strategies used by the Australian Wildlife Conservancy (AWC) to manage and conserve the Artesian Range.
   - A. Increasing tourist numbers
   - B. Fire management
   - C. Native animal control
   - D. Biological surveys
   - E. Diverting water for public use
4. **Explain** why it is important to protect sites that have cultural or natural significance.
5. **Determine** if you think invasive species or wildfires pose the greatest risk to the Artesian Range. **Justify** your answer.

Apply your understanding

Communicating

6. **Explain** how exotic species such as cats, foxes and camels have been able to become established in the Artesian Range when it is difficult for people to enter the region.

Concluding and decision-making

7. **Evaluate** the ways in which the community demonstrates the value it places on cultural diversity and why this is important to the community.
8. The Artesian Range has been described as a 'modern-day Noah's Ark'. **Explain** what you understand by this description.
9. **Describe** the processes that have led to the formation of the Artesian Range and its different landscape features.
10. Uluru is considered to have both cultural and natural significance. **Propose** a reason for this classification.

LESSON
13.13 Review

Hey students! Now that it's time to revise this topic, go online to:

Review your results

Watch teacher-led videos

Practise questions with immediate feedback

Find all this and MORE in jacPLUS



13.13.1 Key knowledge summary

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

13.2 Why do landscapes vary?

- Landscapes are influenced by factors such as climate, geographical features and latitude.
- The type of landscape that develops is determined by the mix of these factors.
- There are variations within landscapes and they are impacted by human activity.

13.3 What processes shape landscapes?

- Landscapes are continually changing; tectonic forces are at work to build landscapes, and processes such as weathering and erosion wear them away.
- Human activity such as deforestation increases the rate of erosion.
- Soil varies across landscapes and ultimately determines the type of vegetation that a landscape can support.

13.4 What landscapes form underground?

- Karst landscapes are found all over the world, predominantly in tropical regions.
- Karst landscapes form where slightly acidic water filters through soluble bedrock, such as limestone, forming hollows and caves beneath the surface of the Earth.
- The largest arid limestone karst cave system is located on Australia's Nullarbor Plain.

13.5 What are the landforms and landform regions of Australia?

- Australia is an ancient landscape and has undergone many changes over millions of years.
- Tectonic forces have uplifted the land, creating mountain ranges. The landscape was been worn away and sculpted by the processes of weathering, erosion and deposition.
- Australia has also migrated, so that its climate and vegetation are vastly different from what they were millions of years ago.

13.6 What are deserts like in Australia and China?

- Desert landscapes are areas of low precipitation and can be either hot or cold.
- Approximately one-third of the Earth's surface is classified as arid or semi-arid.
- Latitude and topography play a role in determining where deserts are located.

13.7 How do the savanna grasslands of Australia and Africa compare?

- Grasslands are described as a transitional landscape as they are generally located between forests and deserts.
- Savana grasslands located in Africa are maintained by grazing animals and their migrations.
- First Nations communities maintain the savanna grasslands of northern Australia using fire.

13.8 What makes a rainforest?

- Rainforests are areas of very high rainfall and located between the Tropic of Cancer and the Tropic of Capricorn
- Rainforests are important regulators of global climate, produce oxygen medicine and the source of many of our foods and medicines.
- Rainforests are under threat due to exploitation and over-harvesting of their resources.

13.9 INQUIRY: The value of rainforests

- Inquiry into the importance of rainforests and strategies for their conservation

13.11 Investigating topographic maps — Features of the Daintree rainforest

- The Daintree Rainforest is located in far north Queensland.
- The Daintree region is a national park and a significant region with World Heritage status.

13.12 What cultural significance do landscapes have for First Nations Peoples of Australia?

- First Nations Peoples of Australia have been in Australia for over 60 000 years and have a close bond with the land.
- The Australian landscape is culturally significant to First Nations Peoples of Australia and their beliefs conflict with those of the European settlers.
- Addressing the competing needs of culture and resources involves striking a delicate balance.

13.13 Why do we preserve and manage landscapes?

- The World Heritage List ensures that places of natural and cultural significance are preserved and managed so they are not lost for future generations.
- Australia has several sites that are culturally significant and also considered natural wonders, such as the Artesian Range.
- The inaccessible nature of the Artesian Range has protected it from human activity; however, it is threatened by introduced species.

13.13.2 Key terms

aquifer a body of permeable rock below the Earth's surface that contains water, known as groundwater
compost a mixture of various types of decaying organic matter such as dung and dead leaves
convection current a current created when a fluid is heated, making it less dense and causing it to rise through surrounding fluid and sink if it is cooled; a steady source of heat can start a continuous current flow
deposition the laying down of material carried by rivers, wind, ice and ocean currents or waves
drainage basin an area of land that feeds a river with water; or the whole area of land drained by a river and its tributaries
ecosystem an interconnected community of plants, animals and other organisms that depend on each other and on the non-living things in their environment
erosion the wearing away and removal of soil and rock by natural elements, such as wind and water, and by human activity
escarpment a steep slope or long cliff formed by erosion or vertical movement of the Earth's crust along a fault line
glacier a large body of ice, formed by an accumulation of snow, that flows downhill under the pressure of its own weight
hotspot an area on the Earth's surface where the crust is quite thin and volcanic activity can sometimes occur, even though it is not at a plate margin
humus nutrient-rich dark organic matter, created by decaying animal and plant matter
inselberg an isolated hill, knob, ridge, outcrop or small mountain that rises sharply from the surrounding landscape
leaching a process that occurs in areas of high rainfall, where water runs through the soil, dissolving minerals and carrying them into the subsoil. The process can be compared to a coffee pot in which water drips through the grounds.
mantle the layer of the Earth between the crust and the core
microclimate specific atmospheric conditions within a small area
percolate filter through porous material such as soil
permafrost a layer beneath the surface of the soil where the ground is permanently frozen
plateau an extensive area of flat land that is higher than the land around it. Plateaus are sometimes referred to as tablelands.
precipitation the different forms in which moisture is returned to the Earth from the atmosphere, most commonly in the form of rain, hail, sleet and snow
sediment material carried by water
soluble able to be dissolved in water

stalactite a feature made of minerals, which forms from the ceiling of limestone caves, like an icicle. They are formed when water containing dissolved limestone drips from the roof of a cave, leaving a small amount of calcium carbonate behind.
stalagmite a feature made of minerals found on the floor of limestone caves. They are formed when water containing dissolved limestone deposits on the cave floor and builds up.
tectonic plate one of the slow-moving plates that make up the Earth's crust. Volcanoes and earthquakes often occur at the edges of plates.
temperate zone describes the relatively mild climate experienced in the zones between the tropics and the polar circles
transport the movement of eroded materials to a new location by elements such as wind and water
weathering the breaking down of bare rock (mainly by water freezing and cooling as a result of temperature change) and the effects of climate

13.13.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

How do human and natural processes shape environments and what impact does this have on the way people manage changing landscapes?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question, outlining your views.

on Resources

eWorkbooks Customisable worksheets for this topic (ewbk-10749)
Reflection (ewbk-10751)
Crossword (ewbk-10752)

Interactivity Introducing landforms and landscapes crossword (int-7595)

13.13 Review exercise

Students, these questions are even better in jacPLUS

Receive immediate feedback and access sample responses

Access additional questions

Track your results and progress

Find all this and MORE in jacPLUS



Multiple choice

1. Distinguish between a natural and a human environment.
   - A. Natural environments are altered by humans whereas built environments are not.
   - B. Built environments are altered by humans whereas natural environments are not.
   - C. There is no difference because neither of them are altered by humans.
   - D. Natural environments are larger than built environments.
2. Select the statement that best explains how rivers and streams made physical changes to Australia's landmass.
   - A. Through the process of folding, faulting and uplifting
   - B. By transporting materials to new areas, creating floodplains and coastal landscapes
   - C. By forming the Great Dividing Range
   - D. None of the above

3. Why is soil important?
   - A. It is not important.
   - B. It is the basis for plant growth, which feeds both people and animals.
   - C. 75 per cent of mammals eat soil as their main source of nutrition.
   - D. It protects the Earth from damage from the sun.
4. Landscapes are in a state of continual change. Which two natural processes powered by water are most responsible for continually changing landscapes?
   - A. Erosion and weathering
   - B. Erosion and deposition
   - C. Transportation and deposition
   - D. Transportation and calcification
5. Which statements apply to savanna grasslands? Select two correct answers
   - A. They have many trees.
   - B. They have a distinct wet season and dry season.
   - C. They are found on every continent.
   - D. They are a transitional landscape.
6. Where is Kakadu National Park located?
   - A. New South Wales
   - B. Northern Territory
   - C. Queensland
   - D. Tasmania
7. What is the term used to describe the laying down of material carried by rivers, wind, ice and ocean currents or waves?
   - A. Erosion
   - B. Sediment
   - C. Transport
   - D. Deposition
8. Explain the importance of fire in maintaining savanna grasslands by combining two of the following statements.
   - A. It clears out the undergrowth and encourages new plant growth.
   - B. It creates new habitat for animals.
   - C. It prevents trees from taking over, as saplings are burnt in the process.
   - D. The soil becomes more fertile.

Short answer

Communicating

9. **Differentiate** between the terms erosion, deposition and transportation.
10. **Define** the term humus and explain why it is important.
11. **Propose** two reasons for the preservation of landscapes.
12. **Explain** how karst landscapes are formed.
13. **Identify** three factors that influence the formation of landscapes.

Hey teachers! Create custom assignments for this topic

Create and assign unique tests and exams

Access quarantined tests and assessments

Track your students' results

Find all this and MORE in jacPLUS

