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OXFORD SCIENCE 7

HELEN SILVESTER

VICTORIAN CURRICULUM

SAMPLE CHAPTER

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CHAPTER

5

RESOURCES

What makes something renewable?

5.1 Resources on Earth take different times to renew

5.2 Easily renewable resources can be quickly replaced

5.3 Easily renewable resources can be harnessed to provide energy

5.4 Some resources are limited

5.5 Soil is one of our most valuable resources

5.6 Our future depends on careful management of resources

5.6 Green jobs will increase in the future

What if?

Sustainable fishing

What you need:

Buttons, trays, spoons, straws, stopwatch

What to do:

1. Place plates of 20 buttons (representing fish) around the room.
2. Each student should use a straw (no hands) to collect as many 'fish' as they can in 1 minute.
3. After 1 minute, the remaining fish are available for breeding. Add one new button 'fish' for every button left.
4. Repeat steps 2 and 3 several times
5. How long can you keep fishing before all fish will be gone?
6. Is the fishing sustainable?

What if?

» What if you use hands to help move your straws? (This represents fisher people using technology to help find fish.)

» What if you use a spoon instead of a straw? (This represents fishing with a net.)

5.1 Resources on Earth take different times to renew

In this unit, you will learn that:

- resources on Earth can be classified as easily renewable or long-term renewable
- easily renewable resources are either unlimited or quickly renewed
- long-term renewable resources can take millions of years to be produced.

Humans have always relied on the natural resources of the Earth – in the air, the water and the ground. Oxygen and water are essential for keeping us alive. Soil is necessary for us to grow food for ourselves and our livestock. Minerals from the Earth that feed the mining industry are essential to manufacturing and to Australia's economy. Forests provide habitat for animals and timber products for our buildings. In fact, humans have found and used resources in almost every corner of the planet. As the human population continues to grow, we are putting more pressure on our resources than ever before.

Types of resources

Resources on Earth can be classified into two major groups: easily renewable resources and long-term renewable resources.

Easily renewable resources are either available in a continuous and unlimited supply (such as sunlight and wind) or able to naturally regrow in most conditions (such as fast-growing trees in a forest). Despite the fact that they can regrow naturally, renewable resources still need to be managed carefully and used sustainably.

Long-term renewable resources, also known as non-renewable resources, are resources that take a very long time to be replaced and are therefore only available in limited supply. If we use them at a faster rate than they can be replaced naturally, they will run out. Minerals such as coal and oil are non-renewable resources.

long-term renewable refers to resources that are limited because, once used, they take a long time to replace

easily renewable made naturally and available in an almost unlimited amount

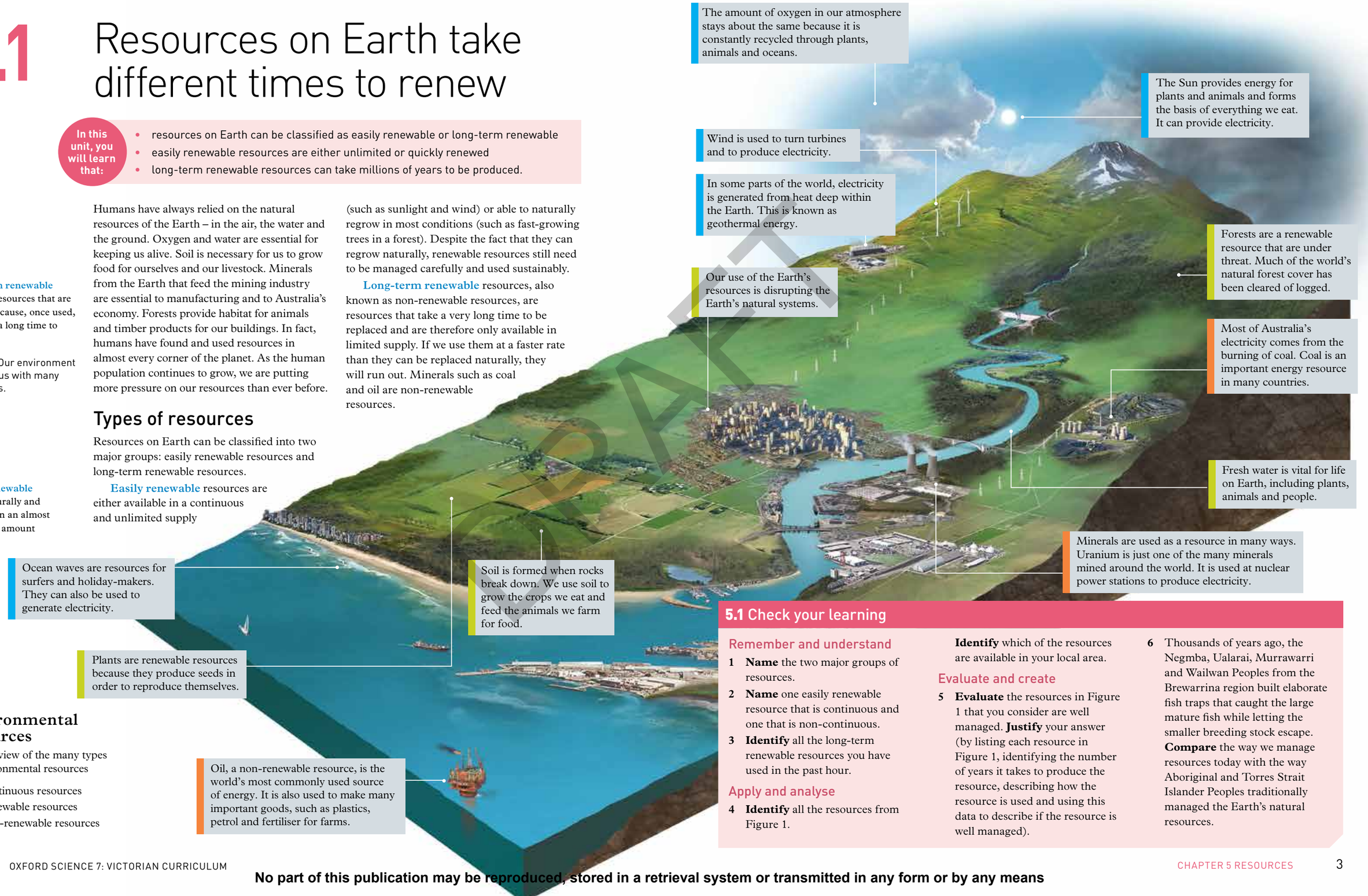

Figure 1 Our environment provides us with many resources.

Environmental resources

An overview of the many types of environmental resources

- Continuous resources
- Renewable resources
- Non-renewable resources

5.1 Check your learning

Remember and understand

1. **Name** the two major groups of resources.
2. **Name** one easily renewable resource that is continuous and one that is non-continuous.
3. **Identify** all the long-term renewable resources you have used in the past hour.

Apply and analyse

4. **Identify** all the resources from Figure 1.
   Identify which of the resources are available in your local area.

Evaluate and create

5. **Evaluate** the resources in Figure 1 that you consider are well managed. **Justify** your answer (by listing each resource in Figure 1, identifying the number of years it takes to produce the resource, describing how the resource is used and using this data to describe if the resource is well managed).
6. Thousands of years ago, the Negmba, Ualarai, Murrawarri and Wailwan Peoples from the Brewarrina region built elaborate fish traps that caught the large mature fish while letting the smaller breeding stock escape. **Compare** the way we manage resources today with the way Aboriginal and Torres Strait Islander Peoples traditionally managed the Earth's natural resources.

CHALLENGE

5.2: Can you increase the output of a power station? Go to page 221.

5.2 Easily renewable resources can be quickly replaced

In this unit you, will learn that:

- the Earth's energy resources are limited
- easily renewable resources such as sunlight are resources that can be replaced
- fossil fuels such as oil, petrol and coal are long-term renewable resources because they take millions of years to be produced.

Easily renewable and long-term renewable resources

When you burn gas in a Bunsen burner, you are using a non-renewable resource. If you burn 1 litre of gas, then there is 1 litre less of that gas in the world. Many long-term renewable resources are continually being made, but on a time scale of hundreds of thousands or even millions of years. This makes them practically non-renewable in our lifetime. If we continue to use a long-term renewable resource and it is not recycled, then it will run out.

It is estimated that Australia's brown coal will last for another 500 years. By 2030, coal may still be one of our main energy resources, but there will be a shift to resources such as gas and easily renewable energy such as solar and wind.

Easily renewable resources are made naturally and are available in an almost unlimited amount. **Solar energy** is energy that comes from the Sun. It is a renewable resource: an unlimited amount of it is available while the Sun shines in the sky. Of course, if the weather is cloudy, solar energy is not available; so it can have some disadvantages too. Other examples of easily renewable resources include clean air, timber and fish. Given the right conditions, they will be available if we do not use them too fast. We need to consider the consequences of taking too much.

Australia's energy resources

Australia has a variety of **energy resources**. For a long time, we have relied on resources such as coal and petrol for our energy needs.

solar energy
energy made by atoms colliding with each other in the centre of the Sun

energy resources
resources that can be used for the production of energy

Figure 1 Some of the Earth's natural resources: **a** timber, **b** fish and **c** solar energy

a 

b 

c 

Table 1 Use of Australia's energy resources

Resource	Use	Percentage of total electricity production 2007–08 (%)	Percentage of total electricity production in 2018 (%)
Long-term renewable resources			
Coal (brown and black)	Electricity generation	76.3	65
Gas	Electricity generation	15.9	21
Liquefied petroleum gas (LPG)	Transport fuel	0	0
Uranium	Exports	0	0
Crude oil	Transport fuel	0.9	2
Easily renewable resources			
Wind	Electricity generation	1.5	7
Solar	Solar heating and electricity generation	<0.1	7
Geothermal	Demonstration projects only	<0.1	<0.1
Hydro	Electricity generation	4.5	5
Wave, tidal	Demonstration projects only	0	0

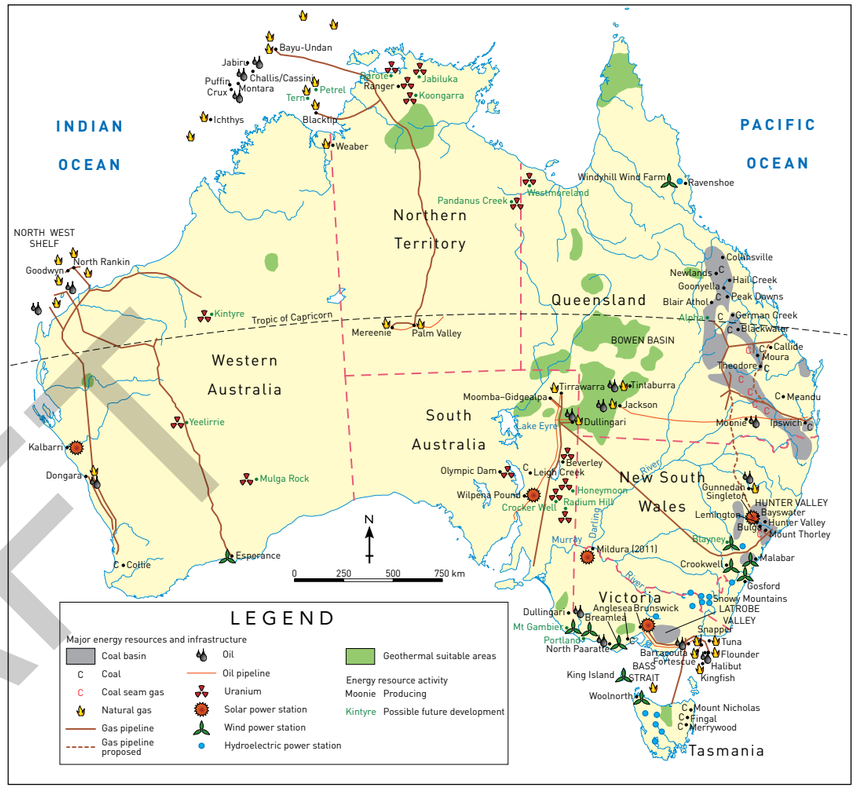

Figure 2 The location of Australia's energy resources

According to recent research, Australia is one of the highest **greenhouse gas** emitters per capita in the world. Our use of long-term renewable energy resources for transport and generating electricity around the home makes up approximately one-fifth of these **emissions**.

How a power station works

Coal-fired power stations burn coal to produce electricity. When coal is burnt, heat is released. This heat is used to boil water to make steam. The steam flows past a turbine, causing it to spin. A **turbine** is a large wheel with angled sections called vanes, like a propeller. The turbine is connected to a generator. A **generator** converts the movement from the turbine into electrical energy.

greenhouse gas
a gas (carbon dioxide, water vapour, methane) in the atmosphere that can absorb heat

emissions
the production and release of a substance into the air (e.g. gas)

turbine
a large wheel with angled sections called vanes, like a propeller, that is used to generate electricity

generator
a machine that uses the electromagnetic effect to separate charges and produce electricity

5.2 Check your learning

Remember and understand

1 **Identify** an example of a long-term renewable resource. **Explain** why it is sometimes considered non-renewable.
2 **Identify** an example of an easily renewable resource. **Justify** your decision (by describing how the resource is renewed).
3 **Describe** how long it takes for long-term renewable resources to form.
4 **Identify** Australia's third-largest electricity production resource in 2007–08.

Apply and analyse

5 **Explain** why the time scale of renewal of a resource is an important issue.
6 **Analyse** Table 1. **Compare** energy production in 2007–2008 and 2018.

Evaluate and create

7 **Describe** one reason that explains why electrical energy production has changed in Australia in the last 20 years.

5.3 Easily renewable resources can be harnessed to provide energy

In this unit, you will learn that:

- resources can provide a source of energy to meet our needs
- renewable resources can provide unlimited amounts of energy to generate electricity
- wind, solar, hydroelectric, tidal and geothermal power can be used to generate electricity.

Video 5.3
Creating solar energy from trash

Video 5.3
The future of wind energy

fossil fuels
a non-renewable energy source formed from the fossilised remains of plants and animals

wind turbine
a wheel with blades that turn in the wind

wind farm
a large group of wind turbines in the same location

solar cell
a device that transforms sunlight directly into electrical energy; is usually in the form of a panel; also known as a solar panel

Wind power

A very important step in generating electricity is turning a turbine. **Fossil fuels** are often burned to produce the steam that turns a turbine. Wind can also turn a turbine without steam and without emitting carbon dioxide.

To generate a significant amount of energy, many **wind turbines** are placed in long rows in a **wind farm**. The stronger the winds, the faster the turbines turn and the more energy is produced.

Figure 1 A wind farm in Australia

Solar power

In Australia we are familiar with solar power for things such as hot water, outdoor lighting and speed limit signs in school zones.

Solar energy is made when **solar cells** (in solar panels) convert sunlight into electrical energy. They do not release greenhouse gases; however, the mining and construction of the individual panels can have environmental impacts. This can be minimised by the recycling the minerals that are used in their construction.

Figure 2 Solar power has many uses (**a**–**c**). Which of these have you seen?

CHALLENGE
5.3: Can you increase the power of solar cells? Go to page 222.

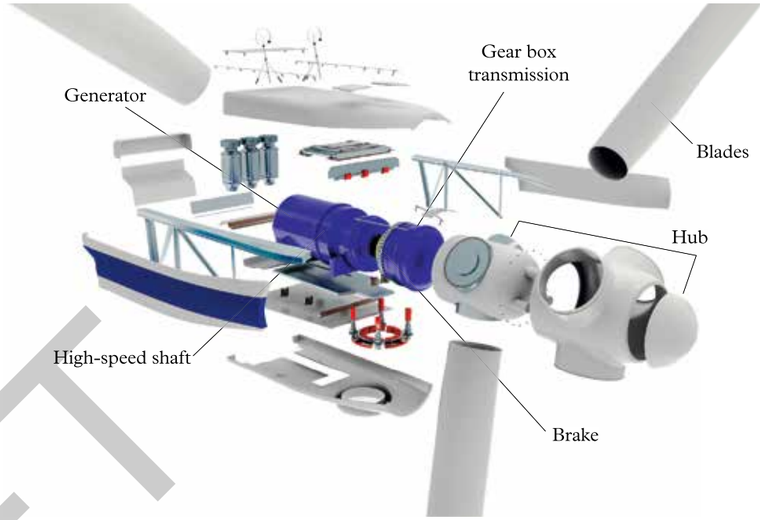

Figure 3 The parts of a wind turbine

Two-thirds of the Australian population live in cities and about 70% of the mainland can be classified as arid or semi-arid desert. This means that Australia has large areas of sun-exposed land that can be used to convert the energy of the Sun into energy that can be stored in batteries.

Hydroelectric power

Hydroelectric energy (*hydro* meaning 'water') is produced by water falling through pipes to turn turbines to produce electricity. It accounts for approximately 19 per cent of the world's energy production. Hydroelectric schemes need a constant water supply and are often built high above sea level, like mountains. The water supply is held in dams and then released to cause fast-flowing water, which turns the turbines efficiently. Hydroelectric power in Australia meets approximately 5 per cent of our electricity needs.

Hydroelectric energy
energy produced by falling water that turns turbines to generate electricity

Case Study: Australian oceans to power floating wind and wave project

The Land Downunder is well known for its beaches, its sunshine and its oceans. We are the country that is 'girt' by sea, after all. Now we are set to harness the power of our oceans in a significant floating wind and wave project that will generate 6 MW of power.

The offshore platform is the brainchild of Australia and UK-based energy company Bombora in collaboration with global energy infrastructure and engineering group TechnipFMC.

This project will centre around mWave technology that Bombora developed in Perth. A sister project will also test the technology in a Marine Energy Testing Area off Pembrokeshire, Wales.

The process involves air-filled concave cell modules covered by a rubber membrane being placed under the ocean to capture the optimal amount of power.

'As waves pass over mWave, under-water pressure increases, causing each rubber membrane to compress sequentially, forcing air from inside the cells into a duct. Valves control a one-way airflow to the turbine — directly spinning a generator converting this rotation into electricity' the Bombora website explains https://bomborawave.com/.

'After passing through the turbine, the air is recycled to re-inflate each membrane in a continuous sequence. The sustainable power generated is transferred to the electrical grid via the same sub-sea cable used for the wind turbine.'

News item provided courtesy of Energy Matters Australia, https://www.energymatters.com.au

tidal energy
the energy in the rise and fall of tides, which can be used to drive turbines in the water, producing electricity

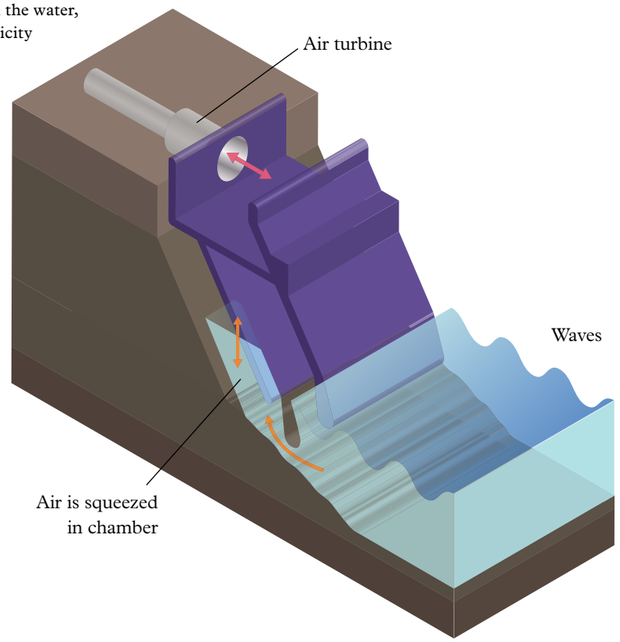

Figure 4 How wave power drives air turbines

Tidal and wave power

Have you ever been to a surf beach and experienced the strength of the waves? It has been estimated that wave energy alone could power the entire Earth five times over! The problem has been working out how to do it. Wave energy uses the energy of waves to spin air turbines.

Tidal energy can also be used to drive turbines in the water. The major disadvantage of tidal power is that it only provides a relatively small amount of electricity and has a negative impact on the nearby natural environment. The world's largest tidal power station is in France.

Figure 5 Superheated water is produced at the geothermal power plant in Birdsville, Queensland.

Geothermal energy

Geothermal energy comes from heat beneath the Earth's surface. The super-heated liquid rock under the Earth's surface is called magma. Magma heats the layers of rock above and below it. This heat is geothermal energy and some of it is released as steam. The steam can be used to turn a turbine in a generator, producing electricity.

Australia's only geothermal power station is in Birdsville, in western Queensland. The power station has a bore (pipe) that extends 1230 metres into the ground and taps into 98°C water from the Great Artesian Basin. This power station provides approximately one-quarter of Birdsville's energy supply. After the steam has been used to drive the turbine, the cooled water becomes the town's water supply.

Australia has access to a technology that could produce electricity for many years. This technology is called **hot dry rock geothermal energy**. Australia has the world's best geology for this type of energy. Hot dry rock has been found in Central Australia, and reserves in the Hunter Valley in New South Wales are being tested. To use the energy from the hot dry rock, water is injected through bore holes into hot granite rock that is 5 kilometres underground. The steam produced can be used to generate electricity. This technology consumes none of the Earth's valuable resources because the steam can be condensed back into liquid water and injected again.

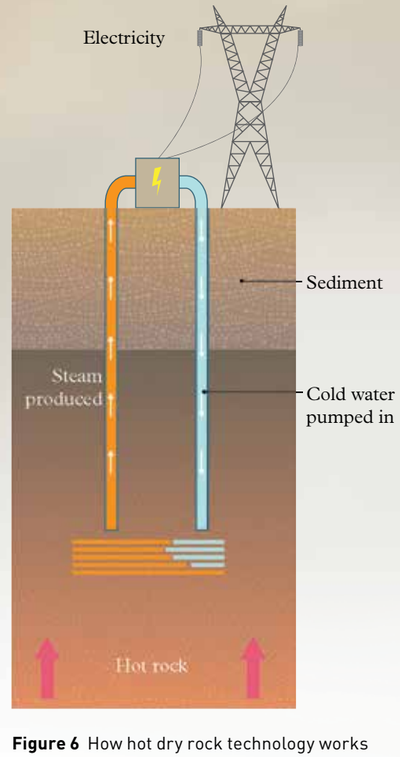

Figure 6 How hot dry rock technology works

geothermal energy
energy that comes from heat beneath the Earth's surface

hot dry rock geothermal energy
a method of pumping water into deep hot rocks in the ground in order to produce steam, which is then used to drive a turbine to provide electricity

5.3 Check your learning

Remember and understand

1 **Describe** two advantages of hydroelectric power over fossil fuels.
2 **Describe** how energy in generatedby a hydroelectric power station.

Apply and analyse

3 A large group of wind turbines in the same location is called a wind farm. **Identify** the important features of a suitable location for a wind farm.
4 **Explain** why most wind turbines are mounted on towers 40–100 metres high.
5 The major hot dry rock resource is in Central Australia. **Identify** why this location could be a disadvantage for energy generation.

Evaluate and create

6 Coal-fired power stations in Victoria run 24 hours a day, 7 days a week. **Explain** why this is considered more reliable than wind power.
7 New Zealand produces a large amount of its energy from geothermal power. **Explain** why Australia does not rely on geothermal power for all of its electricity.

EXPERIMENT

5.4A: What if a muffin was mined in different ways?
Go to page 223 .

EXPERIMENT

5.4B: What if a metal was obtained from a mineral?
Go to page 224.

5.4 Some resources are limited

In this unit, you will learn that:

- fossil fuels are produced when fossilised plant and animal remains decompose
- uranium is a radioactive substance that can be used to heat water in energy generation.

Coal and other fossil fuels

Most of the energy used to produce electricity in Australia comes from coal (a fossil fuel). The energy stored in the coal is converted into electrical energy in a power station. In Victoria, most electricity is generated by power stations in the Latrobe Valley using brown coal. Large black coal resources are found near Sydney and in central and eastern Queensland. Coal is mined in open-cut mines if it is close to the surface, or in underground mines.

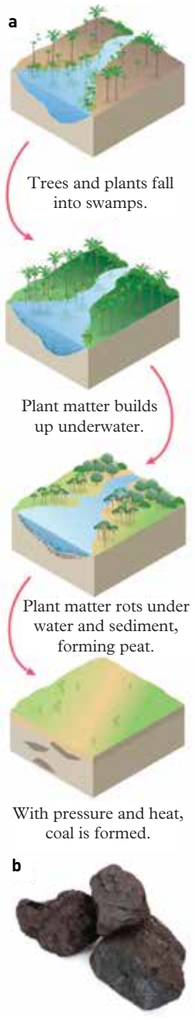

Figure 1 a Formation of fossil fuels; **b** a piece of brown coal

Figure 2 Loy Yang Power, in the Latrobe Valley in Victoria, generates approximately one-third of Victoria's electricity.

To produce and provide electricity to homes and businesses, we use a 'big circuit'. This circuit begins with the generators at a **power station**. Electrical energy is transported from the power station to homes, businesses and factories by transmission wires.

Forming fossil fuels

Fossil fuels were formed about 300 million years ago during the Carboniferous period, before the time of the dinosaurs. **Coal** is formed from the remains of trees and other plants that grew in tropical swamps during the Carboniferous period. When the trees and other plants died, they fell into the swamps. Because they were underwater where there was not much oxygen, the dead plants could not rot completely. The partly rotted plant material gradually built up, forming a layer of peat.

Figure 3 An artist's impression of a tropical swamp in the Carboniferous period

Over time, the layers of peat built up and then rocks formed on top of them. The pressure from the rocks on top and the heat from the Earth's crust underneath caused chemical reactions that gradually changed the peat into coal.

When coal is burnt, the chemical energy originally stored in the plants is released. Carbon dioxide and water are also produced in the burning of the coal.

Uranium

Uranium is the most common radioactive element on Earth, and Australia has the world's largest supply. Uranium is a non-renewable resource because it is formed in an exploding star. Uranium gives out energy, called radiation, as it splits into other elements. Many of these other elements are also radioactive. This splitting process continues for a long time until a stable element is formed.

Figure 4 A nuclear power station

Figure 5 Bauxite ore contains aluminium.

Figure 6 This Mount Isa Mine in Queensland produces lead, zinc, copper and silver.

The energy from the splitting of uranium heats water, turning it into steam. The steam drives turbines, which drive generators, just as in a conventional coal-fired power station. Unlike coal-fired power, nuclear power produces hardly any carbon dioxide emissions; however, it does produce radioactive waste that takes a long time to become safe or stable. Too much exposure to radiation can be harmful for humans.

Minerals

Most of the human-made objects we use every day are made from materials that come from the Earth. The process of extracting useful minerals from the Earth is known as mining. **Minerals** are tiny grains or crystals that are the building blocks of rocks. Only a few minerals are found in a pure state, such as gold. Mostly they are combined with other substances and need to be purified before they can be used.

Aluminium, for example, is not found as solid sheets in the ground. It is part of the **ore** called bauxite, which is made of aluminium, oxygen and iron. Ores are materials that contain a lot of a useful minerals mixed in with other substances. Australia is rich in ore deposits and many mines have been in operation for a long time.

How a mineral is mined depends on the location of the ore body. If the ore is on or close to the surface, then open-cut mining is used (see Figure 6). If the ore body is deeper, then underground mining is used and shafts are cut down into the ground to reach the ore. This attempts to protect the surface environment but can be expensive and sometimes dangerous.

power station
a place where energy is converted to electricity

mineral
a naturally occurring solid substance with its own chemical composition, structure and properties

ore
a mineral containing a large amount of useful metal

5.4 Check your learning

Remember and understand

1 **Name** three examples of a fossil fuel.
2 **Outline** how coal is formed.
3 **Explain** why minerals are classified as a long-term renewable resource.

Apply and analyse

4 **Compare** (describe the similarities and differences between) energy generation from a nuclear power station and a coal-fired power station.
5 **Contrast** (describe the differences between) a mineral and an ore.

Evaluate and create

6 **Describe** one reason why some people in Australia may be reluctant to agree with establishing a nuclear power station.
7 Arthur wants to design an experiment for a school project to observe how long it takes to for trees to transform into coal.
   a **Evaluate** this idea for an experiment. Do you think it is possible? Why or why not?
   b Suggest one quantitative and one qualitative observation that Arthur could realistically make about coal instead.

5.5 Soil is one of our most valuable resources

In this unit, you will learn that:

- soil consists of minerals, gases, liquids, and living and dead organisms
- soil provides the essential nutrients for all plants.

Figure 1 Soil is a valuable resource.

Figure 2 Crops do best in soils that are carefully maintained.

Most people think of soil as dirt, but good soil contains everything plants need to stay alive and grow. Without plants, many of our food sources would not exist. Pick up some soil – you will be holding your life in your hands.

Ingredients of soil

Soils are complex mixtures of many materials, including sand, silt, clay and humus (decomposed plants and animals), as well as various minerals that plants need for healthy growth. Soils are formed when weather breaks down rocks over extremely long periods of time. Sand, silt and clay are all valuable natural resources because they can be mixed for use in construction and supply the essential nutrients for the plants we rely on for food.

Soil for life

Good gardeners know what makes good soil and they add different things to the soil to improve it. They might add compost or animal manure to the soil to improve its organic content. They might add fertiliser, wetting agents or chemicals to change the soil structure. Gardeners also need to monitor the tiny organisms that live in the soil. Many organisms, such as worms, help to keep the soil healthy.

Figure 3 Sand is one of the materials in concrete mix.

Water-loving soil

Many Australians are frustrated by soils that do not let water soak in. How well a soil holds water plays a big part in how well plants will grow in that soil. Water drains easily through sandy soils, but sandy soils dry out easily. Heavy clay soils drain slowly; however, if the water cannot run off, the clay becomes waterlogged and muddy.

Figure 4 Healthy soil grows healthy plants.

Managing soils

When Europeans arrived in Australia, they used the land in very different ways from Aboriginal and Torres Strait Islander Peoples. The Europeans cleared the forests and had large numbers of sheep and cattle grazing the grasslands. This meant there were few grasses and plants to absorb the rain. As a result, water stored underground (the water table) rose, bringing salty water closer to the surface. In addition, much topsoil was compacted by

EXPERIMENT

5.5: What if different soils were exposed to water?
Go to page 225.

Figure 6 Many plants and trees cannot survive in soils that are high in salt.

Figure 5 Additives are used to improve soil.

animal hooves. Land clearing and grazing have caused significant amounts of soil to be washed away in a process called **erosion**. Thankfully, many farmers now practise sustainable agriculture (including rotating crops, limiting the tilling of soil and the careful management of water resources), and land care groups help manage damage to the land.

Figure 7 Planting trees helps prevent further soil erosion.

erosion
the movement of sediment to another area

5.5 Check your learning

Remember and understand

1 **Identify** the basic components of soil.
2 **Describe** how soils are formed.
3 **Define** the term 'erosion'.

Apply and analyse

4 **Outline** (list the main ways) how your life would be affected if there was no soil.
5 **Propose** four ways that a good gardener might improve their soil.
6 **Explain** how clearing all the plants from an area can cause the soil to become salty.

Evaluate and create

7 **Explain** how the soil drains water can affect the growth of a plant.

5.6 Our future depends on careful management of resources

In this unit, you will learn that:

- resources can be sustainably managed
- designers are considering the end of life of a product during the design process
- a circular economy considers how materials can be reused rather than 'used up'.

hybrid
describes a car that uses both petrol and electricity

The large increase in solar panels in Australia has encouraged people to look for ways to use this renewable resource. Electrical energy is being used to power cars and stored in batteries so that houses can have energy overnight. Minerals used in the batteries are becoming increasingly difficult to find. This encourages the producers of the batteries and other electronic devices to consider how the items can be recycled and the materials reused in the future. Planning this before the batteries are made will make it easier to dismantle the electronic waste (ewaste) at the end of its life. This process of extracting and reusing materials is part of a circular economy.

Electric cars

low-emissions vehicles
cars or buses that release very little exhaust gases, including carbon dioxide

In Australia, gas emissions from cars are a major contributor to greenhouse gases. Most car companies have designed one or more **low-emissions vehicles** (LEVs). These cars include hybrids, as well as very efficient petrol and diesel models. Cars with efficient engines use very little fossil fuel.

Figure 1 The Tesla company produces a variety of sustainable electric cars and batteries.

Hybrid cars use a mix of petrol and electricity. The electric motor works with the petrol engine to reduce fuel consumption and emissions, but it does not eliminate them. Some car manufacturers, such as Tesla, are completely electric.

New types of batteries have made electric vehicles a reality. Although these cars can only run a certain distance before they need to recharge, the battery life is improving all the time.

Figure 2 Electric cars can be charged using a normal household power point.

CHALLENGE

5.6: Resources for your future
Go to page 226 .

The largest battery

When the Sun shines on a solar panel, it generates electricity. This electricity is either used by the people in the house, or it is put into the energy grid. The energy grid includes all the high energy wires connecting houses and the electrical substations that control the level of electrical energy houses can use. As the number of solar panels on people's homes increases, the amount of energy in the grid increases. If it becomes too high, it could damage the electrical equipment in the houses. To prevent the energy produced by wind or the Sun from being wasted, some Australian states have large batteries to store the extra energy. If there is a sudden need for energy on a cloudy day, or if there is a sudden drop in wind, the supersized battery can maintain the energy supply.

Figure 3 South Australia's Tesla big battery, officially known as the Hornsdale Power Reserve

Homes of the future

Scientists are collaborating with engineers and architects to make our homes smarter and more energy efficient. Homes of the future will have technology that switches off lights when the Sun comes out, will be built from 'smart materials' (including paint that helps insulate the walls) and will have plants and solar panels on the roof. 'Smart plugs' will monitor electricity use of each appliance, and you could get an alert at school or work if you have left your television on, allowing you to switch it off remotely. Rainwater tanks will be located under the eaves, meaning that the water can flow into toilets and laundry appliances using gravity rather than a pump. Every external window and surface will have a role in the overall efficiency of the home, and surfaces will be designed to store heat during the day and release it at night. Homes will be smaller and will be designed to not only save energy but also generate energy.

Figure 4 Homes of the future will be designed to be 'smarter' and more energy efficient.

5.6 Check your learning

Remember and understand

1. **Describe** a hybrid car.
2. **Explain** why the energy grid needs to cope with different amounts of energy.
3. **Describe** how a supersized battery can be used to stabilise the electricity in the energy grid.
4. **Define** the term 'circular economy'.

Apply and analyse

5. Some people do an audit of all the energy they consume. Suggest one reason why a person might do an energy audit of their home.

Evaluate and create

6. Should a designer consider what will happen to the minerals and parts at the end of a product's life? **Justify** your response.
7. The longest range of current electric cars is 500–550 kilometres. **Evaluate** how easy it would be to use this car in different parts of Australia (by describing the advantages and disadvantages of using an electric car in different parts of Australia and deciding the locations that would benefit from electric cars).

5.7 Green jobs will increase in the future

With the importance of renewable energy becoming widely acknowledged, more jobs in the 'green' sector are being created. There are many jobs and industries to choose from. Most of these jobs involve preparing a report on local resources.

Adrian Morphett, Senior Emissions Auditor at Carbon Planet Australia

My typical day at work: I work with businesses to help them understand their environmental impacts and then come up with ideas to reduce their emissions. I go out to businesses and do energy audits, where I look for energy and greenhouse gas savings and then tell the business how to make the changes.

Why I love my job: Hopefully it makes a difference. This industry must go well, and be smart, effective and help other businesses drive their emissions down if we are to have a chance of making a difference.

Worst thing about my job: The science of climate change is actually pretty scary, and the worst-case scenarios are frightening!

Figure 1 Adrian Morphett, Senior Emissions Auditor at Carbon Planet Australia

Skills, courses or training people need for this job: You need a degree in something like mechanical engineering. Good research skills are essential, and a good head for figures and data analysis skills are important. Good people skills are essential too.

Why my work and Carbon Planet's work are important: We are working towards reducing greenhouse gas emissions, informing businesses about climate change and what they can do about it.

General salary range for this type of job: $75 000–110 000.

Melissa Supangat, Environmental Engineer at Earth Systems

My typical day at work: I write proposals on energy efficiency projects, usually for developing countries, calculate greenhouse gas emissions of specific sites and research new ways to reduce greenhouse gas emissions.

Why I love my job: I can help other people and companies to cut down their emissions by applying what I learnt in school.

Worst thing about my job: I encounter people who are still sceptical about global warming or who are reluctant to implement emissions reduction strategies because they may affect the money the organisation makes.

Skills, courses or training people need for this job: You need to study something like environmental science, environmental engineering or other areas of engineering (chemical, civil, mechanical, electronic and electrical).

Figure 2 Melissa Supangat, Environmental Engineer at Earth Systems

Why my work and Earth Systems' work are important: We work with other countries, especially developing countries, that are most in need of education about global warming and ways to prevent it.

General salary range for this type of job: $60 000–70 000 (for someone starting out).

5.7 Develop your abilities

Developing a case study

1 **Examine** your local area. This might be within 10 kilometres of your home or further if necessary – you or your teacher will choose the distance. List all of the natural resources you can locate. **Identify** how each resource is used. Present your findings on a large map in the classroom where every student can contribute their research.

2 Focus on one resource from your list that really interests you. Develop a case study for that resource.

A case study looks in detail at:

- the history of the resource
- how it is extracted or used
- what humans use it for
- the impact on the environment of developing that resource
- issues that affect that resource, now and into the future.

3 Present your case study to your class as an oral presentation, a written paper or a poster.

Figure 3 Examining your local area

REVIEW 5

Multiple choice

1 **Identify** which of the following is considered a non-renewable resource.

A Wind power **B** Solar power
C Nuclear power **D** Wave power

2 **Identify** which of the following is considered a renewable resource

A Metal ore **B** Fossil fuel
C Biofuel **D** Nuclear power

3 Tidal power is obtained from the:

A biosphere **B** hydrosphere
C lithosphere **D** atmosphere.

Short answer

Remember and understand

4 **Define** the terms 'easily renewable' and 'long-term renewable'.

5 **Identify** two examples each of:

a easily renewable resources
b long-term renewable resources.

6 **Examine** Figure 2 in Topic 5.3 on page XX. Identify a resource that is close to your area. Describe how this resource could be used.

7 **Describe** three different uses of electrical energy.

8 **Describe** the role of a generator in a windmill.

9 **Describe** how coal is used to generate electricity.

10 **Explain** what tidal and wave power are.

11 **Define** the term 'geothermal energy'.

Figure 1 What is geothermal energy?

12 **Describe** the factors that can affect the amount of electricity generated by a solar panel.

13 **Describe** the advantages and disadvantages of using uranium as an energy resource.

14 **Explain** why ewaste should be recycled.

Apply and analyse

15 **Explain** the advantages and disadvantages that electric vehicles have over petrol-driven cars.

16 **Explain** why the terms 'easily renewable' and 'long term renewable' are more accurate than renewable and non-renewable.

17 **Explain** the advantages and disadvantages of using wind farming for energy production.

18 Suggest one reason why it is important for soil to be 'water-loving'.

19 Look at Table 1 in topic 5.2.

a **Identify** the percentage of total electricity production 2007–08 for Wind and Solar power.
b **Compare** the 2007–2008 percentage with the 2018 percentage for wind and solar power.

20 **Contrast** a mineral and an ore.

21 **Explain** how soil can become full of salt. Describe how this can affect growing plants.

Evaluate and create

22 **Explain** why coal, oil and gas are described as fossil fuels.

23 Coal is still widely used for generating electricity. **Explain** why some people are concerned about building new coal-fired power stations.

24 Topic 5.6 talks about homes of the future. Create your own version of a future home that has an energy efficient design.

25 **Classify** (select one option) a hybrid car as a low-emission vehicle or a zero-emission vehicle. **Justify** your answer (by defining the terms 'low-emission' and 'zero-emission', comparing the hybrid car to these definitions, and deciding which definition best matches the car).

26 The Victorian government is aiming for government operated buildings to be powered by 100 per cent renewable energy by 2025. **Discuss** the positives of this outcome for the environment.

27 Coal is considered to be a non-renewable fossil fuel. **Discuss** the truth of this statement by presenting arguments for and against.

Figure 2 Cycling to reduce energy consumption

Figure 3 Taking trams to reduce energy consumption

Critical thinking

28 **Create** a name for your own electricity company. Produce an A4 fact sheet with a diagram of your own electricity company, describing how electricity is produced at your power station. **Justify** your choices (by providing a reason for each choice that you make).

29 Write a letter to the Federal Minister for Resources and Energy, suggesting changes you would like to see happen in Australia. In your letter, include evidence that compares the advantages and disadvantages of the current energy sources being used. **Explain** how your plan will be more sustainable than current uses of our country's energy source.

30 Scientists continuously suggest new ways to reduce reliance on coal.

Recently scientists have invented solar powered roads. These roads are built using hexagon shaped solar panels that store power and deliver it to surrounding homes.

However, the solar panels can become covered in dust and shadows from traffic.

Propose a different place solar panels could be placed in the community (e.g. over buildings).

Explain why you have chosen your location and how this would limit the amount of dust and shadows falling on the solar panels.

Social and ethical thinking

31 **Explain** Greenpeace's attitude towards coal and nuclear power. **Describe** the alternatives they support for Australia.

32 **Evaluate** the probability of nuclear power being used in Australia in the future (by defining the term 'nuclear power', describing the advantages and disadvantages of using nuclear power and deciding if the advantages are greater than the disadvantages).

33 Passenger cars, like those your parents drive, are responsible for a significant amount of the population's energy consumption. **Evaluate** the effectiveness of people walking, cycling or taking public transport to reduce their energy consumption (by describing the access to walking and cycling tracks or public transport in your area, and deciding if improvements need to be made to make them more effective).

34 Google plans to calculate the most eco-friendly routes via Google Maps. These directions will show you the route that has the least CO_2 impact. This information empowers individuals to act environmentally friendly, when considering the resources involved in their transport.

a **Identify** how ideas like this can educate society about their CO_2 consumption.
b **Explain** what might stop people from taking the eco-friendly route.
c Research another eco-friendly initiative (e.g. bike lanes in Melbourne and Finland).

Research

35 Choose one of the following topics to research. An important part of your report must be to include references to the 'big picture' – thinking about how your topic relates to the entire planet.

» A simple pencil

Examine a normal wooden pencil and determine all of its component parts, including the lettering on the side. You could even dismantle the pencil and isolate each part. Next, think of all the steps needed to make the pencil. **Describe** the different components. Identify the source of each component's resources. **Describe** the resources that are needed to assemble and finish the pencil in the factory. Present your research in a creative way.

» Clean coal

Explain what is meant by the term 'clean' coal. **Explain** why coal needs to be cleaned. Find out about this technology and how it applies to Australia.

» Trapping carbon

The use of fossil fuels causes the release of carbon dioxide into the atmosphere. This has been linked to the gradual increase in global temperatures. Many countries are now finding ways to trap the carbon dioxide and store it in a less destructive way. **Describe** how Australia and other countries are encouraging industry to use fewer fossil fuels. **Describe** one way that carbon can be trapped and stored. **Identify** which countries are using this method of trapping carbon.

Reflect

The table below outlines criteria for successfully understanding Chapter 5 Resources. Once you have completed this chapter, reflect on your ability to do the following:

	I can do this.	I cannot do this yet.	
Contrast easily renewable and long-term renewable resources, and provide examples of each.	☐	☐	Go back to Topic 5.1 'Resources on Earth take different times to renew'. Page XX
Explain the characteristics of a renewable resource. Describe the ways in which electricity is generated in Australia in terms of easily renewable and long-term renewable resources.	☐	☐	Go back to Topic 5.2 'Easily renewable resources can be quickly replaced'. Page XX
Provide examples of easily renewable resources that can be used to generate electricity.	☐	☐	Go back to Topic 5.3 'Easily renewable resource can be harnessed to provide energy'. Page XX
Explain the characteristics of long-term renewable resources of energy and provide examples.Define the terms fossil fuel, mineral and ore.	☐	☐	Go back to Topic 5.4 'Some resources are limited'. Page XX
Explain why soil is an important resource and provide examples of how it is used.	☐	☐	Go back to Topic 5.5 'Soil is one of our most valuable resources'. Page XX
Explain why it is important to use resources sustainably and provide examples for conserving resources.	☐	☐	Go back to Topic 5.6 'Our future depends on careful management of resources'. Page XX
Describe green jobs and their importance to the planet, using examples.	☐	☐	Go back to Science as human endeavour 5.7 'Green jobs will increase in the future'. Page XX

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Launch a quiz for your students on key concepts in this chapter.

EXPERIMENTS

Chapter

10

5.3 Can you increase the power of solar cells?

CHALLENGE

Design brief

Modify the design of the solar cell so that it produces the highest voltage.

Materials

- Small solar cells
- Electrical wires
- Voltmeter
- Transparency sheet

Questioning and predicting

- Describe how you could maximise the amount of sunlight the solar cell receives.
- Describe how a solar panel can be cleaned. Contrast the voltage produced by a clean and dusty solar panel.
- How could you connect more than one solar cell so that the amount of voltage produced increases?

Planning and conducting

1. While inside a building, connect a solar cell to the voltmeter using the electrical wires.
2. Record the voltmeter reading with the limited light available.
3. Cover the solar cell with your hand and record the voltmeter reading.
4. Take the solar cell to a window and record the voltmeter reading.
5. Take the solar cell outside, face it towards the Sun and record the voltmeter reading. If it is cloudy outside, take a reading and then repeat the measurement when the clouds clear or on another day when it is sunny.
6. Cover the solar cell with a thin transparency sheet and repeat the measurement.
7. Connect solar cells together in series (i.e. in a line) and record the voltmeter reading.

Processing, analysing and evaluating

1. Copy Table 1 into your notebook and record your results.

Table 1 Recording the power of solar cells

Location	Number of solar cells	Voltmeter reading (V)
Inside		
Inside, covered		
Window		
Outside, sunny		
Outside, cloudy		
Outside, dusty		
Outside, multiple cells		

2. Use your data to identify the best conditions for generating electricity from a solar cell.
3. Explain why a house with a solar energy installation will have six, eight or more solar cells on its roof.
4. Explain why the solar panels on a house roof should be cleaned regularly.

Communicating

Describe the conditions that will maximise the electricity produced by solar cells.

5.4A What if a muffin was mined in different ways?

EXPERIMENT

Aim

To compare the effectiveness of different methods of mining and their impact on the environment.

Materials

- 2 homemade chocolate chip muffins (each with the same number of chocolate chips – approximately 20)
- Plastic plates
- Spoons

Figure 1 Equipment for 'muffin mining'

Method

1. Imagine each muffin is an area of land that contains a valuable ore: chocolate chips.
2. Use spoons to 'mine' the chocolate from the first muffin using the 'open cut' method, taking layers off the top and collecting the chocolate as it appears.

Inquiry: What if the muffin was mined using the underground method?

1. Describe how you could mine this muffin so that the top remains intact.
2. Identify the *dependent* variable that you will measure and/or observe to determine the most effective method.
3. Identify two variables that you will need to control to ensure a fair test. Describe how you will control these variables.
4. Write down the method you will use to complete your investigation.
5. Draw a table to record your results.
6. Show your teacher your planning to obtain approval before starting your experiment.

Results

Draw or take a picture of your two muffins.

Discussion

1. Describe which method recovered the most chocolate ore?
2. Identify which method produce the chocolate ore in the shortest time.
3. Identify which method was the easiest method to produce the chocolate ore.
4. Explain which method would allow the environment to be quickly rehabilitated.

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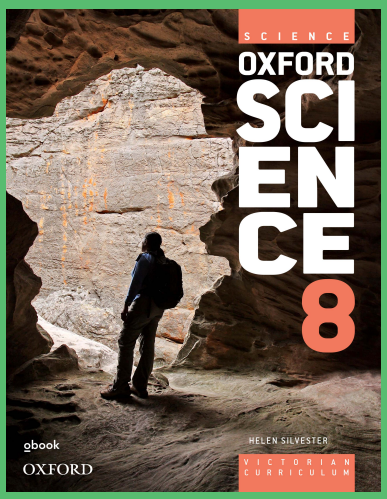

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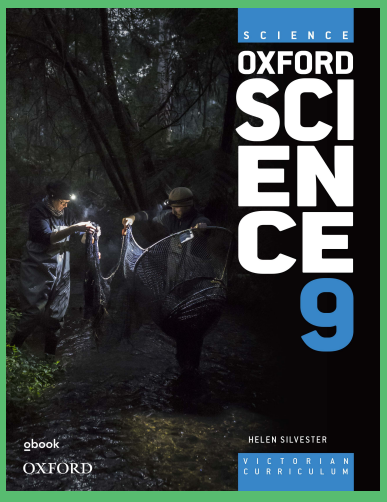

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