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Contents*

- Course planner
- Flashcard glossary for each chapter
- Interactives
- Lab tech notes for each experiment
- Risk assessments for relevant experiments
- Weblinks to external content
- Videos
- Teacher notes for each chapter
- Teaching programs for each chapter
- Student book questions and answers for each unit
- Literacy support worksheets and answers for each unit
- Student worksheets and answers for each unit
- Video worksheets and answers
- Experiment worksheets and answers for each unit
- Class tests and answers for each chapter
- STEM projects for each chapter
- Assess quizzes to support, consolidate and extend

*This is the contents from your Oxford Digital Dashboard.

COURSE PLANNER

AUSTRALIAN CURRICULUM: SCIENCE YEARS 7–10

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	Science Understanding									Science as a Human Endeavour	Science Inquiry Skills
	Biological sciences			Chemical sciences		Earth and space sciences		Physical sciences			
Year 7		There are differences within and between groups of organisms; classification helps organise this diversity (ACSSU111)	Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions (ACSSU112)		Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (ACSSU113)	Predictable phenomena, including seasons and eclipses, are caused by the relative positions of the sun, Earth and the moon (ACSSU115)	Some of Earth's resources are renewable, but others are non-renewable (ACSSU116) Water is an important resource that cycles through the environment (ACSSU222)		Change to an object's motion is caused by unbalanced forces acting on the object (ACSSU117) Earth's gravity pulls objects towards the centre of the Earth (ACSSU118)	**Nature and development of science** Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world (ACSHE119/134) Science knowledge can develop through collaboration and connecting ideas across the disciplines of science (ACSHE223/226) **Use and influence of science** Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations (ACSHE120/135) Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management (ACSHE121/136) People use understanding and skills from across the disciplines of science in their occupations (ACSHE224/227)	**Questioning and predicting** Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS124/139) **Planning and conducting** Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125/140) In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task (ACSIS126/141) **Processing and analysing data and information** Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate (ACSIS129/144) Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions (ACSIS130/145) **Evaluating** Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method (ACSIS131/146) Use scientific knowledge and findings from investigations to evaluate claims (ACSIS132/234) **Communicating** Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate (ACSIS133/148)
Year 8	Cells are the basic units of living things and have specialised structures and functions (ACSSU149) Multi-cellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce (ACSSU150)			The properties of the different states of matter can be explained in terms of the motion and arrangement of particles (ACSSU151) Differences between elements, compounds and mixtures can be described at a particle level (ACSSU152)	Chemical change involves substances reacting to form new substances (ACSSU225)		Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales (ACSSU153)	Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within systems (ACSSU155)			
Year 9	Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)		Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)	All matter is made of atoms which are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms (ACSSU177)	Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction, mass is not created or destroyed (ACSSU178) Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer (ACSSU179)		The theory of plate tectonics explains global patterns of geological activity and continental movement (ACSSU180)	Energy transfer through different mediums can be explained using wave and particle models (ACSSU182)		**Nature and development of science** Scientific understanding, including models and theories, are contestable and are refined over time through a process of review by the scientific community (ACSHE157/191) Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries (ACSHE158/192) **Use and influence of science** People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions (ACSHE160/194) Advances in science and emerging sciences and technologies can significantly affect people's lives, including generating new career opportunities (ACSHE161/195) The values and needs of contemporary society can influence the focus of scientific research (ACSHE228/230)	**Questioning and predicting** Formulate questions or hypotheses that can be investigated scientifically (ACSIS164/198) **Planning and conducting** Plan, select and use appropriate investigation methods, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165/199) Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data (ACSIS166/200) **Processing and analysing data and information** Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS169/203) Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170/204) **Evaluating** Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data (ACSIS171/205) Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems (ACSIS172/206) **Communicating** Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174/208)
Year 10		The transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184) The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence ACSSU185)		The atomic structure and properties of elements are used to organise them in the Periodic Table (ACSSU186)	Different types of chemical reactions are used to produce a range of products and can occur at different rates (ACSSU187)	The universe contains features including galaxies, stars and solar systems and the Big Bang theory can be used to explain the origin of the universe (ACSSU188)	Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere (ACSSU189)	Energy conservation in a system can be explained by describing energy transfers and transformations (ACSSU190)	The motion of objects can be described and predicted using the laws of physics (ACSSU229)		
Key concepts (Big Ideas)	**The form and features of living things are related to the functions that their body systems perform** (Structure and function)	**A diverse range of living things have evolved on Earth** (Diversity and evolution)	**Living things are interdependent and interact with each other and their environment** (Interdependence)	**The chemical and physical properties of substances are determined by their structure** (Properties and structure)	**Substances change and new substances are produced by rearranging atoms through atomic interactions and energy transfer** (Interaction and change)	**Earth is part of a solar system that is part of a larger universe** (Systems in space)	**Earth is subject to change within and on its surface over a range of timescales as a result of natural processes and human use of resources** (Dynamic Earth)	**Energy can be transferred and transformed from one form to another** (Energy and its transformations)	**A range of forces affect the behaviour of objects** (Forces and motion)		

Chapter 3: Water

3.1 Water can change state

Teacher notes (pages 48–49)

Introducing the chapter

This section focuses on water as both a limited and a renewable resource. Some students may have difficulty with the concept of drinking water running out, when the oceans are full of water and the water cycle is continually producing fresh water. It is important to emphasise the need for clean drinking water around the world, not just in Australia, but also to note that most rainfall occurs over the oceans, where the fresh water cannot be collected. This section explores how water can exist in three states: solid, liquid and gas. When heat is added or taken away, water can change between the three states.

Teaching tip: Discussing the use of water in industry

Hydroelectric power provides immediate power to meet peak demand, and is a very useful addition to the electricity grid because the output can be varied quickly. Students may not be aware of negative impacts on the environment caused by dams and decreased natural water flows. Even in times of drought, some water must be released from dams to provide environmental flows, or else river ecosystems will be destroyed.

Teaching tip: Change of state

Change of state is explored in Year 8. This section provides a good introduction and can bridge concepts between Year 7 and Year 8.

Differentiation

For less able students:

Students can create a cartoon strip showing the changes of state of water, from solid to liquid to gas and back again. This can be done by hand or using a software program such as Comic Life, which allows students to easily create high-quality cartoon strips.

For more able students:

Students can complete a comic strip (as above) and then turn this into a claymation video using plasticine (or other materials) and software such as Movie Maker.

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Additional activity: Entry tickets

An entry ticket is a small piece of paper (shaped like a ticket) that can be used to evaluate students' knowledge before starting the chapter. Ask students to write down what they already know about water and collect tickets to evaluate their existing knowledge.

Going further

A useful weblink is available on your obook / assess. To access it, click the weblink tile on the Dashboard for this unit.

BBC Bitesize: Changing states

This BBC Bitesize website provides more information for students on changing states.

Oxford Science 7 Teacher obook/assess ISBN 9780190300883

3.2 Water cycles through the environment

Teacher notes (pages 50–51)

Introducing the topic

Most students have a fair understanding of the water cycle, and it is useful to relate the processes to everyday observations such as condensation on a cold glass or steam from a kettle. Transpiration can be shown with a potometer if available. If not, placing celery in a solution of eosin dye allows students to observe the movement of water up the stem. This process is very quick and can be sped up further by aiming a blow drier or fan at the celery leaves.

Differentiation

For less able students:

Students will benefit from seeing examples of processes in the water cycle. These may be set up as stations around the class or as teacher demonstrations.

For more able students:

Students can carry out a simple distillation to purify salt water. Test for salts in the distillate by using silver nitrate (which goes cloudy with chlorides).

Additional activity: Drawing the water cycle from memory

Ask students to draw a labelled diagram of the water cycle without using their books. This task is best performed in small groups so that students remind each other of prior knowledge. As a class, brainstorm the processes involved in the water cycle and make a list on the board. Higher ability students should be able to name most processes. Lower ability students may benefit from having a landscape diagram provided, with or without arrows for processes.

Additional activity: Different clouds

Ask students to investigate the different types of clouds – how do they form? Why do they look so different?

Additional activity: Rainfall

Ask students to use the Bureau of Meteorology's website to consider rainfall patterns over the last week. Why do some locations receive more or less rainfall? What factors can affect this?

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Going further

A useful weblink is available on your obook / assess. To access it, click the weblink tile on the Dashboard for this unit.

Natural water cycle game

This website contains the droplet game where you navigate through the water cycle.

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3.3 Factors in nature affect the water cycle

Teacher notes (pages 52–53)

Introducing the topic

Although water has been cycling since the Earth was first formed, this cycle can be affected by many things. Changes in temperature, the direction of the wind and the number of plants all affect how fast water evaporates, and therefore the amount of water vapour in the air. This section explores El Niño and La Niña events, and how volcano eruptions can affect the water cycle.

Differentiation

For less able students:

Students with low literacy or English as a second language may struggle with the text and terminology in this section. A cloze task may be a good reading comprehension task for these students.

For more able students:

Students could research La Niña events more extensively and present the information to their classmates. They could incorporate a map of where La Niña events have occurred in the last decade. What affect have these events had?

Additional activity: El Niño and La Niña

Students can investigate the effects of El Niño and La Niña events on South America. Does South America also experience drought during El Niño and flooding during La Niña?

Additional activity: Other factors affecting the water cycle

Aside from El Niño and La Niña events, what other things can affect the water cycle? In groups, students could find case studies of other factors that may affect the water cycle and present them to the class.

Assessment

Students can investigate the effect of major volcanic eruptions on weather patterns. What countries have been affected? Can anything be done? (Tip: research cloud seeding.) This can be presented as a research report with a bibliography to show further research.

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3.4 Human management affects the water cycle

Teacher notes (pages 54–55)

Introducing the topic

This section looks at the use of water as a resource. Only 3 per cent of water is drinkable, the rest is salt water. Of that 3 per cent, not all of it can be used, most is stored in ice caps and glaciers. Despite what we know about how little water is available for use, Australia is one of the highest users of water per capita (per person) in the world and yet is also the driest populated continent on Earth.

Differentiation

For less able students:

Students can research the use of water in agriculture. Which agricultural sector requires the most water? Which requires the least?

For more able students:

Students use the graph on page 54 to split up into smaller groups and consider each of the purposes that water is used for. Students make three recommendations on how to save water per purpose. This will require further research online.

Additional activity: Hydroelectric power

Students can complete a case study of the Snowy Mountains Hydro-Electric Scheme. What was the impact on areas near the dam? What was the impact on the Snowy River? How could this impact be minimised in future? Where else in Australia is hydroelectricity used?

Additional activity: Desalination

The desalination process can be replicated in a science classroom with the correct glassware. An inverted funnel leading to a condenser is placed above a beaker of salt water. The beaker is then heated, and the water will evaporate into the condenser. It will then cool back to liquid, and can be caught by a beaker at the other end of the condenser, providing clean fresh water. Students then discuss the benefits and drawbacks of desalination. Things to consider include the abundance of salt water, cost, energy usage and necessity.

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Additional activity: Using water in agriculture

Agriculture is one of the greatest users of fresh water in Australia. Students can research methods to reduce water use on farms. These include drip irrigation, no-till farming, water efficient crops and computer-controlled watering systems.

Additional activity: From salty to fresh

Ask students to find out the names of countries that use desalination for their fresh water supply. What do they have in common? Where is desalination used in Australia?

Additional activity: Researching recycling water at Toowoomba

Research the Toowoomba debate over water recycling. Assign different teams of students to find out why there was a water shortage, what process was proposed for recycling the water, whether recycled water would be safe for drinking, and why the proposal was rejected. Have each group present their part of the story to the class so that the whole class gets the full picture. This may be followed with a debate about whether you would be willing to drink recycled water.

Ethical behaviour

Considering that Australia is the driest populated continent on Earth, it should surprise students to hear that Australians are one of the highest users of water per person in the world. Ask students to research the new initiatives that the Australian Government has put in place to save water. How does our use of water affect the global water cycle?

Going further

A useful weblink is available on your obook / assess. To access it, click the weblink tile on the Dashboard for this unit.

Department of the Environment

This government website contains information about water management including the Murray–Darling Basin Plan.

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3.5 Water is a precious resource

Teacher notes (pages 56–57)

Introducing the topic

This section investigates how much usable water is available on Earth. When you see the Earth from space, it seems so blue, and that water is so readily available. However, when you investigate further it is surprising to discover that only 0.007 per cent of the Earth's water is available for drinking. That's not much at all!

Teaching tip: Additional information

Australians are among the biggest water users in the world, despite living on the driest continent. Two-thirds of Earth's population uses less than 60 litres of water per day, while Australians use more than twice that in the average shower and use about 340 litres per day. The drought in 2003–09 prompted the introduction of water-saving programs ranging from low-flow shower heads to rainwater tanks. Water restrictions were also enforced in most areas.

The Australian dual flush toilet saves up to 67 per cent of water when compared to a traditional toilet. The original 1980 Caroma design saved 32 000 litres of water per household. Designs have been further refined. In a drought-affected country, dual-flush toilets have been made compulsory in most Australian states.

Teaching tip: Recycled water

The greatest misconception people have is that recycled water is unfit for drinking. This shows that they have little understanding of the natural water cycle, in which water is constantly recycled. This controversy was played out in 2006 in Toowoomba when residents rejected the introduction of fully treated sewage back into drinking water supplies. Despite the continued unpopularity of this option in Australia, the practice is used successfully overseas in many forms. Water recycling in Australian communities involves dual systems where treated effluent is used for industry, gardens or toilets. Treated effluent is also discharged into rivers that eventually feed the drinking water reservoirs of some cities.

The process of distillation was used in early desalination plants, but modern plants use reverse osmosis. A virtual tour of the Sydney Desalination Plant can be taken at the Sydney Water website. The process of desalination requires great amounts of electricity, and has been criticised for this reason.

Additional activity: Monitoring water quality with Waterwatch

You can help Waterwatch by taking some measurements at your local waterway. Tests include turbidity and pH. Many schools have water-testing equipment available and if not, equipment can be made (for example the turbidity meter). Visit the Waterwatch website for more information on how to become involved.

Additional activity: Saving water

Ask students to list all of the ways they already save water at home and at school. They should include water-saving devices such as dual flush toilets, low-flow shower heads and rainwater tanks. When the obvious options have been considered, bring up options such as drought-resistant plants for the garden, washing the car infrequently, mulching the garden, and using a dishwasher rather than washing dishes by hand. Create a master list of the ways in which everyone conserves water.

Additional activity: Why do we need water?

Students can look at their home water bill. How much does water cost per litre? How much does bottled water cost compared to tap water? The average household uses about 900 litres per day – how does their water use compare to this average? Students will have to make calculations to answer these questions.

For students with lower abilities, provide a scaffolded worksheet to assist with calculations. Water bills generally provide an average daily usage in litres as well as the price of water per kilolitre (1000 litres). Use the teacher's water bill as an example for calculations if students cannot get the information from home.

Higher ability students can calculate additional savings that may be made by installing low-flow shower heads, having shorter showers, installing rainwater tanks for toilets and laundry, and so on.

Additional activity: Desalination plants

Desalination refers to removing salt from water in order to make it usable and/or drinkable. Desalination plants already exist in Australia, but their use is controversial.

As an extension activity, students could research desalination plants and investigate the pros and cons of their use.

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Energy

3.1 Energy can be transferred

Teacher notes (pages 40–43)

Introducing the chapter

Students should have prior knowledge of energy forms and transfer and transformation processes from their science learning in their primary years. This chapter will build on previous knowledge and skills and extend it to a greater depth. Energy appears in many different forms, including movement (kinetic energy), heat, potential energy, nuclear and biomass. The wide variety of energy forms allows something to be done, be it due to an object's height or chemical make-up, in its motion, its temperature or in the way that it is stretched or compressed.

Any detailed study of energy begins by identifying the different forms that energy can take. All devices we use transform or modify the energy type from one form to another.

Teaching tips: Establishing prior knowledge

Questioning of students or using a pre-test would be useful in revealing student understanding and any misconceptions. The concept of energy is difficult to communicate to students. The most effective way to introduce the idea of energy is to describe it as the 'ability to do something'. If there were no energy, then nothing would change. 'Show me how you look when you've got no energy', might be a good statement to pose to the class.

Differentiation

For less able students:

Students could be instructed to focus on the energy forms that are more familiar, such as movement, sound and electricity. This will help boost their confidence.

Students may benefit from being shown examples of the different energy forms as an 'energy line-up' (similar to a criminal line-up) and asked to identify, for example, the chemical energy.

Some students may need assistance with some calculations in this chapter's experiments.

For more able students:

Students could investigate the nuclear energy processes occurring in the Sun.

Additional activity: Common misconceptions

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It may be helpful to discuss any common misconceptions early on. These are some examples:

- ‘There is only one meaning of energy’ (The term ‘energy’ is hard to define because it has many meanings depending on the context in which it is used.)
- ‘Energy is associated only with movement.’ (Non-moving objects have potential energy; the composition of an object or its position determines what kind of energy it has.)
- ‘Energy is a fuel.’ (Fuel is a source of energy, but is not itself energy.)

Additional activity: Sound energy

Increase students’ awareness of sound energy by having them:

- compare how sound travels through different objects
- examine and contrast the sounds made by different objects
- demonstrate how sound travels through solids, liquids and gases (specifically via vibrations)
- learn about how the vocal cords produce sound
- explain how the ears transmit sound and how the brain interprets it.

Additional activity: Energy uses

Ask students to draw up a table similar to the one below, leaving the second column ‘Use’ blank. They can work in groups of three or four to brainstorm as many uses of each energy as possible. Below are some suggested answers.

Energy	Use
light energy	helps us to see in the dark, allows for life on Earth
heat energy	used in cooking, keeping warm
electrical energy	used in electrical devices
elastic potential energy	the stored energy in trampolines, elastic bands and springs
gravitational potential energy	the stored energy when an object is lifted up to a height that can be converted into other types of energy
chemical potential energy	the energy found in food, drinks, batteries and fuels
biomass energy	the energy that is stored in plants and animals; a type of chemical potential energy
nuclear energy	used in explosive weapons
kinetic energy	the energy found in all moving objects
sound energy	a type of kinetic energy that produces sound (e.g. in musical instruments)

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

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Energy story

This website contains comprehensive information about all aspects of energy.

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3.2 Potential energy is stored energy

Teacher notes (pages 44–45)

Introducing the topic

This section explores potential energy – energy that is stored in objects and available to be used. There are several different types of potential energy. This section focusses on gravitational potential energy, chemical potential energy and elastic potential energy.

Additional activity: Elastic potential energy

Students could investigate the elastic potential energy of different types and sizes of rubber bands. Students could let go of the rubber band, aiming it towards a wall, to measure the kinetic energy. The elastic potential energy is converted to kinetic energy when the rubber band is released.

Additional activity: Gravitational potential energy

Have students hold a basketball over their heads and release it onto a firm surface. They should note the height it reaches each time it bounces. Ask students why the ball doesn’t maintain the same bounce height. (Gravity pulls the ball towards the Earth, creating kinetic energy as the ball drops until it hits the ground, converting the energy back into gravitational potential energy as the ball rises again. This conversion from gravitational potential to kinetic energy is repeated as the ball bounces up and down. For the ball to bounce back to the same height at which it was dropped would require that all the gravitational potential energy is converted into kinetic energy. This is not the case because gravitational potential energy and kinetic energy are not the only two types of energy involved. Students can be prompted to think of what other energy forms are involved.)

Additional activity: Chemical potential energy

Have students create a lemon battery. A lemon battery is a simple way to show chemical potential energy. Students make a small incision at either end of the lemon. In one end insert a small piece of copper, in the other end a piece of zinc. Connect these to wires which in turn connect to a light emitting diode (LED). Multiple lemons are lined up in order to produce enough energy. Full instructions can be found online.

Additional activity: Chemical potential energy in energy drinks

A discussion about energy drinks may be useful to gauge students’ perceptions. Most students don’t know or understand the risks associated with these drinks, especially in people under 18 years of age.

Going further

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A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Brain pop: Potential energy
This website contains an animated video about potential energy.

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3.3 Moving objects have kinetic energy

Teacher notes (pages 46–47)

Introducing the topic

This section investigates the energy of motion: kinetic energy. Heavy, fast-moving objects have the greatest kinetic energy. Whenever objects or people move, they are using kinetic energy. This section discusses light energy, electrical energy, heat energy and sound energy.

Teaching tips: Types of energy

Some energy forms will be more familiar to students than others (e.g. kinetic over biomass or nuclear) and students may be familiar with an energy example (e.g. fireworks) but not know the name (chemical potential energy). Making these connections and grouping energy examples under headings of their type is important. Students may be aware of nuclear power through TV shows such as *The Simpsons*.

Teaching tips: Thermal energy

Conduction

Heat is transferred from one object to another when the objects touch each other. This transfer is most effective in solids, but can happen in fluids. For example, a spoon in a cup of hot soup becomes warmer because the heat from the soup is conducted along the spoon.

Convection

Heat is transferred through the mass movement of molecules within fluids. Convection currents circulate the warm and cool molecules: warm molecules are less dense, so they rise, whereas cool molecules sink because of their increased density.

Teaching tips: Electrical energy

Electrical energy can be demonstrated through a battery in a torch. In batteries, chemicals are used to separate electrons (negative charge) from protons (positive charge). When a battery is connected to an electric circuit (e.g. the torch is switched on), the electrons leave the negative terminal of the battery and move (flow) through the circuit to the positive terminal.

Differentiation

For less able students:

Students could use the principles of kinetic energy to explain why a heavier ball used in bowling might have greater kinetic energy than a lighter one. How would this affect the results of the game?

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For more able students:

Students could be tasked with designing an experiment that shows two different levels of kinetic energy. This could take the form of something simple (two different weighted balls) or something more complicated (a miniature roller coaster).

Additional activity: Movement energy

Increase students' awareness of kinetic/movement energy by using the following activities:

- Identify objects with kinetic energy in the classroom, outside and at home.
- Identify the differences and similarities between fast- and slow-moving objects.
- Examine and compare how various objects move (e.g. walk, roll, jump). Students could also investigate different types of walking; for example, how a dog walks compared with how a giraffe walks. (A dog has a diagonal walk, in that it uses diagonally opposing legs when walking, namely the front left and right back legs, then the front right and left back legs, and so on. A giraffe, however, moves both legs on one side and then both legs on the other side.)
- Analyse whether still objects are really moving (e.g. a plant, bottle, pencil case).
- Investigate and determine what makes objects move.
- Explain how muscles enable human movement.

Assessment: Mousetrap cars

This section transfers students' existing knowledge of how energy transforms to an unfamiliar context. Completing this activity should further consolidate students' understanding of the topic and test their awareness. In order for students to complete this task they need a comprehensive understanding of this chapter. In particular, they need to understand how devices transform energy from one form to another – in this case, using the potential elastic energy in the mousetrap to propel a simple machine (a car).

Many videos and instructions for how to build mousetrap cars are available online.

Students could conduct research as part of their planning and designing stage. After constructing their car, they should test and improve it until they are happy with their mousetrap car.

At the conclusion of the task, the class could have a race to determine, for example, which car is the fastest, most streamlined, or best design.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

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Energy in a roller coaster

This website contains an animation that shows the kinetic and potential energy conversions during a roller coaster.

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3.4 Energy can be transformed

Teacher notes (pages 48–49)

Introducing the topic

This topic looks at how energy conversions occur. We regularly need to change energy from one form into another to meet our needs. For example, a hairdryer turns electricity into heat or thermal energy. A battery converts chemical energy into electricity. A power station coverts the chemical energy in fuels to electricity through a number of steps.

Teaching tips: Transformation versus transfer

It is important to make sure students know the difference between a transformation and a transfer of energy for this section. The essential concept for students to understand is that the total amount of energy in a system remains constant over time. So, the only thing that can happen to energy is that it can change form.

Teaching tips: Flow diagrams

Students need to remember that the arrows point in the direction of the change and, in essence, the arrow is showing the transformation between the input and output.

Differentiation

For less able students:

Less able students may require assistance in creating their flow charts to show energy transformation. Physical models or specific examples (i.e. turning on a light) may benefit them greatly.

For more able students:

Students with higher abilities could investigate remote controls. They could bring in any old remotes they may have at home and carefully dismantle them to identify the components they contain. The same could be done with an old mobile phone. The phones can then be posted off for recycling.

Additional activity: Class discussion

Conduct a class discussion around common misconceptions regarding energy. These are some possible topics:

- ‘Energy can be created and lost.’ (Energy can neither be created nor destroyed.)
- ‘Energy is created as the result of an activity.’ (Energy is transferred from one system to another.)

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- ‘Energy types are independent of one another.’ (Energy can change or be transformed from one form into another.)

Additional activity: Transformations for motion

Ask students to consider the forms of transport they have used that day, week, month and/or year. Get them to list the energy used for each transformation that occurred.

Additional activity: Cartoon strip

Ask students to use the information on pages 48 and 49, as well as online research, to prepare a minimum eight-box cartoon strip that shows the generation of electricity from coal. Students could either draw this by hand or use a computer program such as Comic Life.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

BBC Bitesize: Energy transfer and storage
This website contains an interactive presentation and a short quiz about energy transfers.

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3.5 Energy cannot be created or destroyed

Teacher notes (pages 50–51)

Introducing the topic

Many students may have heard that energy cannot be created or destroyed. This is the law of conservation of energy and can be seen in any energy transformation. It can be a difficult law to understand and students may require additional time and support to grasp it fully.

Teaching tips: Links to other concepts

You can link the law of conservation of energy to Newton's laws. For example, an object would remain in motion forever unless another force is exerted on it, the energy doesn't just disappear.

Differentiation

For less able students:

Less able students may wish to check their understanding by explaining the law of conservation of energy to a peer.

For more able students:

Students with higher abilities should be able to prepare a list of other examples (aside from the given example of a trampoline) and estimate the useful energy output and energy input for each in order to calculate efficiency (see efficiency equation on page 50). For example, 100 units of a hairdryer (input) and useful output of 70 would have an efficiency of 70%.

Additional activity: Racing cars

Ask students to consider a very fast racing car that suddenly brakes – what happens to the energy in this situation? It can't just disappear. Where does it go? How does this example show the law of conservation of energy?

Additional activity: Hinge questions

A hinge question is a type of formative assessment that allows you to gauge whether students are ready to move on from a concept to a new one. After asking a hinge question, you can tell whether to go on with a new concept, revisit the old one or even completely start again with a different approach. When constructing a hinge question, remember to keep it simple. You want a quick response, not a lengthy one; the whole question and answer should be completed in under a minute. It can be good to give the students a multiple-choice question and ask them to hold up paper with their answer or hold up the correct number of fingers.

Going further

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A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Scientific American: Fact or fiction?
This article discusses the law of conservation of energy.

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3.6 Energy efficiency can reduce energy consumption

Teacher notes (pages 52–53)

Introducing the topic

Energy efficiency refers to how efficiently the energy is transformed from one form to another. The less energy being wasted during transformation, the more energy efficient an appliance.

Teaching tips: Energy efficiency

Discuss the energy-efficiency star rating system, which students may have seen before. Examine the concept of conservation of energy (energy cannot be created or destroyed), where the total amount of energy in a system remains constant but the energy can be changed into useful forms or 'lost' as non-useful forms. Energy efficiency just means how good an appliance is at converting the energy into the useful form and minimising the non-useful or 'waste' energy.

Differentiation

For less able students:

It may be beneficial to complete a few more examples with students, and have them apply this knowledge to other situations in their lives, such as shopping and test scores. This could then be related back to energy-efficiency calculations.

For more able students:

A good starting point for more able students is to turn the lights on in the science room and ask students how flicking the switch makes the lights come on. Develop the idea that electricity needs a pathway of wires in order to reach each light. This will build up the concept of an electric circuit and current travelling along the pathways.

Additional activity: Investigate efficiency

Students could investigate the energy efficiency of appliances at home and at school. Ask students whether old appliances should be replaced purely on energy efficiency, or are there other costs (e.g. environmental and/or economic) that need to be taken into account?

Additional activity: Energy debate

Students could explore the debate that the planet is running out of energy. These are some questions to get students thinking:

- If the Earth is running out of energy, why is the planet heating up?

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- If energy is always conserved, how can we run out of energy?
- If we are constantly receiving energy from the Sun, how can we be running out?
- Most of our energy sources are from fossilised animals or plants. Why can't we just continue to use these, given they are being continually replaced?

Additional activity: Energy use

Ask students to create a list of all the things they do for entertainment that require energy. They could then list the energy used and any transformations that occur.

Additional activity: Personal energy use

As an extension, students could investigate the demand that our current lifestyles have for energy and whether this is sustainable in the long term. Ask students to determine what changes may have to occur to ensure their lifestyle is energy efficient, or at least energy sustainable.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Energy animations
This video shows an animated cartoon family wasting energy and how their wastage can be easily overcome.

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3.7 Solar cells transform the Sun's light energy into electrical energy

Teacher notes (pages 54–55)

Introducing the topic

This topic considers how energy from the sun can be harnessed through solar cells. The number of households using light energy to heat water or power heating and cooling devices is growing rapidly every year.

Teaching tips: Radiation

Heat is transferred through electromagnetic waves, such as the Sun warming the Earth. Radiated heat travels very quickly because it does not rely on the movement of particles to move energy from one place to another. Every student in the room radiates infrared radiation all the time.

Differentiation

For less able students:

Ask students to make a list of as many things as possible that they can think of that use solar power to function. Some examples may include calculators, solar panels, solar hot water heaters and so on.

For more able students:

Ask students to prepare a table that lists the advantages and disadvantages of solar power. Students will need to perform additional research when undertaking this task.

Additional activity: Thermometers

How do we measure the heat from the sun? A thermometer works because liquids expand as they absorb thermal energy. So the hotter the liquid, the greater its volume and the more it will rise up the tube. A quick practical activity could be to use unmarked thermometers and place them in melting ice, then boiling water, marking the height of the liquid in each case. The thermometer can then be labelled as 0 and 100 degrees at these points. Simple markings can then scale the thermometer into 1 degree (or greater) markings. This process led to the use of centigrade (centi = 100; grade = 'mark') as a unit of temperature. Students should only be using Celsius for their units.

Additional activity: Diet Coke and Mentos Solar Flare explosion

Explain to students that this activity is only a representation of a solar flare. Real solar flares are produced when magnetic energy has built up and is suddenly released.

Materials

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- 1.25-L or 2-L bottle of Diet Coke
- Half to one pack of Mentos mints
- Geyser tube (this is optional but it makes it easier)

Method

Note: Only do this experiment outside.

1 Stand the Diet Coke bottle upright and unscrew the lid. Put the geyser tube on top of it so you can drop the Mentos mints in all at the same time.

2 Drop the Mentos mints into the Diet Coke bottle and move away from the bottle.

3 A huge geyser of Diet Coke should spurt out of the bottle.

4 A 2006 episode of *Myth Busters* (episode 57, 'Diet Coke and Mentos') concluded that it is the pitted surface of a Mentos mint that enables millions of carbon dioxide bubbles to form on the surface of the Mentos and rise through the bottle to produce the geyser.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Future sparks: Solar energy
This website contains a number of excellent articles about all things solar.

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3.8 Engineers use their understanding of energy to solve problems

Teacher notes (pages 56–57)

Introducing the topic

The word ‘engineer’ comes from the Latin words *ingeniator* or *ingenium*, which literally mean ‘ingenious one’. Engineers provide solutions, shape future developments and generate ideas that make life easier. All engineers are problem solvers, but some know how to solve specific problems better than others. People who study to become engineers often choose an area of interest and concentrate their skills in that field.

Teaching tips: Careers

This topic is a good way to introduce careers in science. As such, it can be good to organise an incursion or excursion to allow students to hear from a real engineer. This will allow them to ask questions and interact with them in ways that they can’t when using a text or a video.

Additional activity: Sustainability

Engineers are often faced with ensuring that something is environmentally sustainable. Students could attempt to do the same by investigating the demand that our current lifestyles have for energy and whether this is sustainable in the long term. Ask students to determine what changes may have to occur to ensure their lifestyle is energy efficient, or at least energy sustainable. As an extension, students could investigate the total energy required for public transport (bus, train, tram) and divide this by the number of people this form of transport can carry. They could then compare this to the energy required for the equivalent number people to use another source of transport, such as cars. Using this information, students could make suggestions for transport options in the future. Students could design a transport survey or audit. Students design a questionnaire that investigates the various modes of transport that people use. Students then survey as many participants as possible in order to build up a large pool of useable data. An idea may be to use a free online survey tool such as Survey Monkey. Students then transform the data into a visual medium (a graph) and use it to draw conclusions about the types of energy conversions that are taking place for most people. An extension of this would be for students to compare the use of various methods of transport by age group to see whether there are any trends or patterns and then attempt to explain these. Students could also form recommendations for the school based on the data (e.g. use of school buses, walking school buses).

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

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Engineers Australia

This Australian website provides further information on careers in engineering, including what the different types of engineers do.

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Chapter 3: Control and regulation

3.1 Receptors detect stimuli

Teacher notes (pages 42–45)

Introducing the chapter

This chapter considers how the body responds to the external and internal environment to maintain homeostasis. For example, if the body is hot it will sweat to cool itself down. Students should have a basic understanding of how we sense the world; however, in most instances, they haven't actually considered how/why this happens and how the body responds. This should be the focus for this chapter. A good way to start could be to brainstorm to elicit current understanding, and continue to get students to think about ways in which the body responds. This would be a good place to start introducing new words such as 'stimulus', 'receptors' and 'homeostasis'. Homeostasis requires responses to change and these responses require coordination. Students are shown the manner in which this communication occurs and some of the threats that exist to the balance in the body.

Teaching tip: Opening discussion

External, physical responses are easier to imagine than the more subtle changes that happen on the inside of the body. Starting with external stimuli and responses is a great way to start a discussion with students. Once they are confident with the basic process, start to question them about how the external responses came about. This can lead to thinking about internal changes.

Teaching tip: Terminology

Students will be aware of many different uses of the words 'nervous' and 'nerves'; for example, 'He really gets on my nerves', 'I have a test tomorrow and I am really nervous' or 'You must have nerves of steel to jump from there'. This would be a convenient place to start the unit and to discuss the students' prior understanding of the topic.

Teaching tip: Responding to change

The material in this unit should be presented in terms of the necessity for a coordinated response to change. Communication throughout the body (or plant) is integral to achieving this. This section gives an overview of the basic requirements for life – discussing how the body communicates its need for these could initiate a good discussion.

Differentiation

For less able students:

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It would be beneficial for lower-ability students to have the discussion of external changes led by the teacher, maybe using visual cues. This would mean that the students could focus on the desired outcome.

For more able students:

As an extension of the task above, students may want to argue the details of each change. This should be used as an opportunity to improve their understanding of the five senses; a chance, for example, to examine the links between taste and smell. Why does holding your nose reduce your capacity to taste things? Is pain just an over-stimulation of the senses?

Additional activity: Optical illusions

Optical illusions rely on our sense of vision being fooled. Looking at some of these with students can spark discussion about the brain and vision, which are explored in more detail later in this chapter. Optical illusions typically offer two (or more) correct interpretations of what is being viewed and the brain flips between the two. There are many optical illusions available online.

Additional activity: Brainstorm

Students can be asked to list as many organs in their body as possible. These can then be grouped together to form organ systems. Are there any organs that are in multiple systems? The pancreas, for example, has an endocrine and an exocrine (digestive) function. These anomalies are used to introduce the interconnectedness of organ systems.

Students could then brainstorm the changes within the body that would cause a response from each of the systems they have identified. This can also highlight how systems work together to respond appropriately and maintain homeostasis.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Interactives: Inner body

This website allows students to explore the human body by clicking on any of the body systems. There are hundreds of interactive anatomy pictures and descriptions of thousands of objects in the body.

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3.2 Nerve cells are called neurons

Teacher notes (pages 46–47)

Introducing the topic

This section investigates nerve cells, which are also called neurons. Neurons are cells in our body that enable us to pass messages quickly. A change or stimuli is detected by the receptor and an electrical message is passed along the neuron to the synaptic terminal.

Teaching tip: Correct terminology

Interneuron nerve cells are also known as connector neurons, association neurons, local circuit neurons and relay neurons. Each of these titles gives an idea of the function of these neurons.

Neuron is often spelt ‘neurone’, which is the more traditional (British) spelling. Either is acceptable in the scientific community, but ‘neuron’ is the more common spelling.

Teaching tip: Common misconceptions

There are 43 pairs of nerves leaving the central nervous system: 12 pairs are the cranial nerves and 31 pairs are the spinal nerves. All other nerves are branches of these 43 pairs.

The brain is a familiar organ, but the way it is portrayed in popular media is as though there are not any distinct areas of the brain and that all parts function the same. A brainstorming activity to explore students’ previous understanding of the role of the brain may expose these misconceptions.

Teaching tip: Sensory and motor neurons

The peripheral nervous system can also be divided into the afferent (sensory) and efferent (motor) nervous systems. It is the efferent system that is further subdivided into the somatic and autonomic nervous systems.

Teaching tip: Word association

Word association can help students remember the branches of the nervous system. The **s**omatic nervous system controls the **s**keletal muscle movements. The **auto**nomic nervous system controls the **auto**matic and involuntary functions of the body. The **s**ympathetic division of the autonomic nervous system activates in times of **s**tress, whereas the **para**sympathetic division brings the body back down to normal conditions, like a **para**chute.

Differentiation

For more able students:

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Ask students to find out about other areas of the brain, such as the pituitary gland, hypothalamus, thalamus, corpus callosum, pineal body, mid-brain, cerebellum, pons and medulla oblongata.

For less able students:

Encourage students to think about the advantages of having quick reflexes. Why are reflexes important?

Additional activity: Pipe-cleaner neurons

To extend students, ask them to find out about the three different types of neuron (sensory, motor and interneuron) and create an example of each using craft items. They could then discuss the similarities and differences between the three types.

Additional activity: Think, pair, share

Think–pair–share activity: Ask students to write down three or four stimuli and the ways in which the body responds to these changes in the environment (internal/external). Pair up and combine their lists, then share with the class. By the end of this activity, students should have a good list of different ways in which we respond to our environment. This activity can be extended to discuss why the body acts/responds in the ways it does – to maintain homeostasis and ensure survival.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Human anatomy – nervous system

This BBC website has an interactive diagram of the nervous system that reveals more information about the various components and links to interactives about the senses.

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3.3 The nervous system provides fast control of the body

Teacher notes (pages 48–49)

Introducing the topic

This section explores how the nervous system coordinates fast responses. To survive immediate danger, you respond quickly to stimuli. Receptors in the nervous system detect the stimulus and pass it on to control centres. Students are also introduced to reflexes and how these occur before the brain has time to think.

Teaching tip: Sight as a stimulus

Sight organs vary dramatically across the animal kingdom, depending on the need of the animal. There are ten different types of eyes currently known. Some are better for dark-dwelling creatures, whilst others can achieve greater sensitivity. Further, the position of the eyes can determine how an animal views the world. For example, rabbits and horses have monocular vision—each eye is used separately to enhance the field of view and enable the animal to see two objects at once, sometimes on either side of their body. In this instance, depth perception is limited. Animals with binocular vision, such as humans and wolves, use both eyes together. These animals have good depth perception, but a more limited field of view.

Additional activity: Hearing, taste, smell and touch

To extend students, ask them to compare their senses to those of other animals and suggest similarities and differences. For some students, suggest they choose animals that aren't necessarily mammals, or have different structures for the senses, for example, dolphins, lizards, worms, beetles.

Additional activity: Brainstorm

Students could be asked to brainstorm words that they associate with coordination and communication. This would allow students to see how the everyday use of these words relates to their scientific (specifically biological) uses.

Additional activity: Navigating without vision

Students work in pairs, with one person blindfolded, and the other guiding them on a walk.

At the beginning of this activity, the path on which students walk their partner should be fairly easy and straightforward. As they get used to having no vision, a basic obstacle course could be set up, where students need to identify an object/scent at various points. Additionally, instead of leading their partner, students could verbally direct their partner around the course/path.

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Some students may become frustrated with this activity if they are blindfolded for an extended period of time as they are used to having sight as their primary sense. Other students may panic or refuse to take part in this activity. These students could be responsible for leading other students, or helping the teacher set up, and ensuring no one is in danger when blindfolded.

As an extension, students could investigate how animals, such as bats, use echolocation to determine and respond to their surroundings.

As another extension, students may like to investigate how people with vision impairment navigate a world that is predominantly based on visual cues. This may include inviting a relevant speaker to the classroom or conducting research.

Additional activity: Age and reaction times

For students with higher abilities, pose the following question: Is there a relationship between age and reaction time? Students can be asked to collect class data and plot this in a graph. They may have to test students (and teachers) of different ages to collect appropriate data.

Assessment

Discuss the process of designing an experiment that tests reflexes, including creating, testing and modifying. Students should be given a significant amount of time to complete this task; however, it can be broken up so students know what’s expected within a certain period of time. For example, one class could be designated to questioning and predicting and the next to planning and conducting. To ensure students are on task, they could be required to get permission from the teacher to continue to the next stage. Their results could be presented in a number of ways including a traditional write-up, a presentation to the class or a movie showing the entire process. This could be used as an assessment task.

Assessment

To extend the above assessment, students could investigate the effect that alcohol has on reaction times. Students could be asked to research this effect and produce a road-safety leaflet explaining why drink driving is against the law. An alternative to this would be to research the effect that marijuana has on reflexes and again relate this to road safety.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Test your reaction time

This website has an online reaction-time tester and compares the student’s results with other participants.

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3.4 The central nervous system receives information from the peripheral nervous system

Teacher notes (pages 50–51)

Introducing the topic

This section introduces the central and peripheral nervous systems. The nervous system coordinates other body systems through electrical signals. The nervous system is made up of the central nervous system, including the brain and spinal cord, and the peripheral nervous system.

Teaching tip: The nervous system

The nervous system can be a difficult concept for students to understand, as it's quite abstract. The nervous system can be split into two components – the central nervous system (CNS), which consists of the spinal cord and the brain, and the peripheral nervous system (PNS), which consists of all other nerves that lie outside the central nervous system (sensory nervous system and motor nervous system). The sensory nervous system has somatic and visceral neurons that bring information from the CNS to the sensory receptors. The motor nervous system contains motor neurons that convey signals from the CNS to effector cells, and can be further separated into autonomic and somatic systems.

Teaching tip: The brain

Most students will not have trouble remembering that the brain and spinal cord make up the central nervous system because they are in the middle of the body. However, some students may struggle to remember the lobes of the brain and their major functions. Mnemonics, models and repetition will help them recall this information.

Differentiation

For more able students:

- Ask students to find out about other areas of the brain, such as the pituitary gland, hypothalamus, thalamus, corpus callosum, pineal body, mid-brain, cerebellum, pons and medulla oblongata.
- Provide students with a diagram of a reflex arc and ask them to investigate the roles of the different neurons in the arc

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- Ask students to suggest how control can be exerted over reflexes. For example, a person is able to keep a hand on a hot surface, over-riding the reflex. What is the brain's role in this and at what point in the reflex arc would it exert this control?

For less able students:

- Encourage students to think about the advantages of having quick reflexes. Why are reflexes important?
- Ask students to work through an interactive tutorial about reflex actions on the BBC website.

Additional activity: Models

Students can make a three-dimensional model of the human brain using plasticine or any other suitable materials. Encourage students to provide detailed labels for each particular structure. More advanced students may like to create their model in hemispheres so that the internal structures, as shown on page 51 of the Student Book, can be displayed.

Additional activity: Colour the lobes

To help students remember and understand the location of the lobes, ask them to colour in a picture of the brain and label the lobes. As part of labelling, they could write a description of what each lobe is responsible for.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

BBC – nervous system information and quiz

The BBC Bitesize website has information, two interactive animations and a short test on the nervous system.

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3.5 Things can go wrong with the nervous system

Teacher notes (pages 52–53)

Introducing the topic

This section describes what happens when something goes wrong with the nervous system. For example, when things press on the nerves in the spinal cord (slipped disc), the myelin sheath becomes damaged (multiple sclerosis), the motor neurons fail (motor neurone disease) or interneurons are lost (Alzheimer's disease), then people's lives are affected.

Differentiation

For less able students:

Students could prepare a short creative story about how their life is affected by damage to the nervous system – they could take the perspective of someone with spinal damage (quadriplegic or paraplegic) or multiple sclerosis.

For more able students:

Students could outline a human body (either as a miniature or their own body on butcher's paper). They then mark the neural path that the impulse takes when someone is walking. Then with a different coloured pen, students annotate the pathways that could be affected by spinal damage, explaining why the person can't walk.

Additional activity: Spinal injury

Discuss Figure 3.24 on page 52. It is important to emphasise that quality of life is still achievable even with spinal injury. If you have time, it could be beneficial to watch some of the Paralympic events.

Students can research more about spinal injury and its effects at the Spinal Injuries Association website.

Additional activity: MS Readathon

Students could find out about the MS Readathon, including why it was started, how much money it raises and for what purpose. As an extension project, students could organise the MS Readathon for their school or class.

Students could raise the profile of the MS Readathon by creating posters to display around the school, presenting information at an assembly and so on.

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Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Spinal life Australia – what is a spinal cord injury?

The Spinal Life Australia website has information about spinal cord injuries and a short video about the levels of function of spinal cord injury.

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3.6 The endocrine system is slower but more sensitive to change

Teacher notes (pages 54–55)

Introducing the topic

This section introduces the endocrine system. Hormones are produced by endocrine glands and work by regulating cell activities, including increasing or decreasing the activity of the target organ. Hormones find their target organ through a 'lock and key' mechanism, which is also known as an 'induced fit' model. This model explains how each hormone only reacts with or binds to a specific substrate due to their complementary shapes.

Teaching tip: Nervous vs endocrine

It is a good idea to use the students' prior knowledge to summarise the main differences between the endocrine and nervous systems. If the students are given the examples of growth hormone and the knee-jerk reflex, they should be able to comment on the speed of the response (endocrine = slow; nervous = fast), the longevity of the response (endocrine = long; nervous = short) and how specific the message is (endocrine = often general; nervous = often targeted).

Teaching tip: Organs of the endocrine system

The organs of the endocrine system are also part of other systems. Students can examine Figure 3.29 on page 55 of the Student Book and determine which other systems involve organs of the endocrine system. This can be a great starting point to discuss the overlapping and integrated nature of the body systems in functioning multicellular organisms.

Differentiation

For less able students:

- Students may need to be reminded about the circulatory system and the role of the heart and blood as transporters.
- Linking hormones to their sites of production and sites of action by a card-sorting activity would be an effective means of consolidating information.
- The link between hormone activity and disorder is easiest to make with the thyroid, and most difficult to establish with obesity.

For more able students:

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- The text refers to negative feedback as a means by which hormones exert their control. Oxytocin is a hormone that produces its effect by positive feedback. Students could research this in relation to childbirth or breastfeeding.

Additional activity: Classifying hormones

Ask students to use the Internet to research three conditions caused by imbalances in the endocrine system. Students should be divided into three working groups, in which they are to become experts in the symptoms, treatment and causes of one of the conditions. The working groups should be prepared to report back to the rest of the class.

Additional activity: Summarising the endocrine and nervous systems

Students can prepare a table to compare the nervous and endocrine systems. Headings could include mode of information transfer, speed of transmission, response, longevity and specificity.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

BBC – endocrine system information and quiz

The BBC Bitesize website has information and interactive activities about a wide range of topics to do with hormones and the endocrine system, followed by a short test.

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3.7 Homeostasis regulates through negative feedback

Teacher notes (pages 56–57)

Introducing the topic

This section explores the state of homeostasis. Your body works to maintain constant levels of important nutrients and water and temperature in order to stay healthy. The process of regulating the internal conditions of the body is called homeostasis.

Teaching tip: Blood glucose

Diabetes occurs in two forms:

- diabetes insipidus, which is a rare form that results from a deficiency of antidiuretic hormone, which controls the composition of urine in the kidney
- diabetes mellitus, which is the more common type, often referred to as sugar diabetes.

There are two forms of diabetes mellitus:

- type 1 (insulin-dependent), which is caused by a failure of β-cells in the Islets of Langerhans in the pancreas to secrete insulin. For a case study on type 1 diabetes and its treatment, see the BBC weblink on the obook resources describing how Sir Steve Redgrave won rowing gold for Great Britain in five consecutive Olympic Games while having type 1 diabetes.
- type 2 (non-insulin-dependent), which is caused by a tolerance to insulin such that it stops being effective in its regulatory role. This type of diabetes is linked to obesity.

Differentiation

For less able students:

The link between hormone activity and disorder is easiest to make with the thyroid, and most difficult to establish with obesity.

For more able students:

The text refers to negative feedback as a means by which hormones exert their control. Oxytocin is a hormone that produces its effect by positive feedback. Students could research this in relation to childbirth or breastfeeding.

Additional activity: Jigsaw

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A key concept of this chapter is for students to consider that human body systems do not work in isolation, but function as a coordinated integration of all systems. Students can work in groups of three throughout this chapter. Each member of the group is responsible for either the nervous, endocrine or immune system. All the students with the same system, one from each group, can work together to become experts in their system, its major organs and its role in maintaining a functioning organism. They then return to their original group to report back and share their expertise. Students can then debate which of the three systems covered in this chapter is the most important for maintaining a healthy multicellular organism and discuss how the systems interact with each other, as well as other systems.

Additional activity: See, Know, Wonder

See, Know, Wonder activities always involve a visual cue like a photo or video. Give students an image to consider, for example, a person running. Students draw a three-column table and start by working individually, listing three things that they can see in the image. For example, a girl, who is in motion, sports clothes and sweat. They then complete the column for Know – what do they know when they look at the image? For example, I know that this person can't run forever. I know she will need rest and water after the exercise. The final column is Wonder – what does the image make them wonder? For example, what else does this person need to live? What is powering this activity? Is this person a healthy person? Students then pair up and, in a different coloured pen, add any See, Know, Wonder points that their partner had that were different from their own. This comparison can be repeated in different pairs or even among the whole class. See, Know, Wonder activities help students to develop observational skills as well as questioning and working with others.

Additional activity: Mind maps

Ask students to use the requirements for life – oxygen, nutrients, water and removal of wastes to form a mind map. This will assist them to see how the different systems work together (i.e. respiratory and circulatory).

Students' mind maps will vary, and many answers are possible. Any feasible answers should be accepted. Students should aim for between three and five links per requirement for life (oxygen, nutrients, water and removal of wastes). The bolded Glossary words in this section can also be used for a more in-depth mind map.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Interactives: Homeostasis

This website explains homeostasis with five interactive sub-modules.

3.8 Hormones are used in sport

Teacher notes (pages 58–59)

Introducing the topic

This section looks at how hormones are used in sports with a focus on erythropoietin, a hormone normally produced by the kidneys to increase the number of red blood cells in the body. Athletes can use this version of the negative feedback mechanism naturally or artificially to increase their performance on the sporting field.

Differentiation

For less able students:

The content in this section is fairly advanced and less able students may benefit from using a visual medium to understand the topic. A simple mind map (or similar) could be used.

For more able students:

Students could explain how erythropoietin works, in their own words, to a younger peer or sibling. Part of the explanation needs to focus on why increasing the number of red blood cells would assist an athlete. This will also demonstrate an understanding of how various body systems interact.

Additional activity: Misuse of hormones

Sports drug cheats have used anabolic steroids to enhance their performance. Students should investigate reasons why this is not allowed and could include consideration of ethical issues as well as the health risks to the athlete.

Additional activity: Reaction times

Quick reflexes are an advantage to sprinters, so they can respond faster to the starter's gun. Students should be encouraged to find out how sprinters train to improve their starting times.

Additional activity: Debate

Students could research and debate the use of performance-enhancing drugs by athletes. How do we ensure that athletes are competing in a level playing field? Ask students: 'Would you allow performance-enhancing drugs? Why or why not?'

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

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BBC – diabetic UK Olympic rower

The BBC website contains an interview with a former UK Olympic rower who now has diabetes.

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3.9 Pathogens cause disease

Teacher notes (pages 60–61)

Introducing the topic

This section introduces the concepts of disease in general, non-infectious and infectious diseases, and pathogens. The role and function of the immune system is explored, as well as medical intervention.

Teaching tip: Discussion

All students will have had some experience with infectious disease, so try to engage them through their own health and the pathogens that caused them to become ill. There are lots of relevant debate topics around infectious disease, such as antibiotic resistance. Encourage students to question and to have an opinion, but to justify their opinion with logical reasoning. Students may be aware of diseases, but not the pathogens that cause them.

Teaching tip: Germ theory of disease

Students may be interested in the development of the germ theory of disease. Prior to the germ theory of disease, people believed that diseases either generated spontaneous or were caused by miasma (bad air). The following people contributed to the development of the germ theory of disease:

- Lazzaro Spallanzani: refuted spontaneous generation
- Ignaz Semmelweis: worked to reduce death rates from puerperal fever
- John Snow: researched cholera
- Louis Pasteur: researched bacterial diseases (particularly in silk worms)
- Robert Koch: discovered the causes of 11 different diseases, including anthrax, tuberculosis and cholera.

The story of the development of the germ theory of disease mirrors technological advances and illustrates how scientists build on the work of others.

Teaching tip: Research

There is a huge range of research opportunities in this topic. Students should be given licence to investigate a disease that they are particularly interested in. There are also many debate topics that are suitable for this section, including prenatal genetic testing, obesity links to diabetes and whether lifestyle disease should be treated with taxpayers' money. Encourage students to investigate these issues and develop informed opinions that they can justify with logical reasoning.

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Additional activity: Brainstorm

As a class, brainstorm non-infectious diseases, then classify them as lifestyle, genetic or environmental diseases.

Additional activity: Mini excursion

A visit to the school canteen would provide students with an insight into the safe handling and storage of food.

Additional activity: Visual cue for disease and pathogens

Conduct a search on the Internet for images of particular pathogens and the diseases they cause. Students could do this themselves, or you could prepare a jigsaw where students can match the pathogen images with their types and examples of the diseases they cause.

Additional activity: Blood donation

People who lived in the UK between 1980 and 1996 for a cumulative period of 6 months or more, or have received blood transfusions in the UK since 1 January 1980, are not eligible to give blood in Australia. Students could research why this is the case. The class could then stage a debate as to whether this is a correct decision given the high demand for donated blood products.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Video: Hantavirus

This video on the How Stuff Works website explains a killer virus known as hantavirus.

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3.10 The immune system protects our body in an organised way

Teacher notes (pages 62–63)

Introducing the topic

Humans and multicellular organisms have an immune system to prevent pathogens from entering the body and to identify and destroy any invaders that make it inside. If the immune system fails to do its job, medicine may help the body fight disease.

Teaching tip: Step and stages

The function of the immune system can be taught as a series of steps and stages. Students could summarise these as a flow chart or pictorially in a comic strip. It can often be helpful to teach this content with analogies, such as the example below.

- The body is a country surrounded by tough border security (skin and mucous membranes). Pathogens are enemy soldiers that are trying to sneak in and overrun the country. Most get stopped at the border, but some sneak through weak or unguarded points in the border (e.g. injured patch of skin).
- The country has lots of scouts (phagocytes) that constantly patrol the country to attack any enemies that may have snuck in. They also repair breaks in the border (blood clotting and scabs) if they find any, and they have radios to call in more troops if an enemy is thought to be in the area to help with the search (inflammation).
- The country has special force units that seek out particular enemies (antibodies).
- Enemy soldiers are recognised by their uniforms (antigens).

Differentiation

For less able students:

Give students a blank flow chart, relevant to the immune response, and prepared text that they have to sort into the correct sequence to complete the flow chart.

For more able students:

Encourage students to use the flow diagram drawing techniques they encountered earlier in this chapter to summarise the response to infection by pathogens.

Additional activity: Antibiotics

Antibiotics are among the most frequently prescribed medications in modern medicine. Although antibiotics are useful against a wide variety of infections, it is important to realise that antibiotics only treat bacterial infections. Antibiotics are useless against viral infections and fungal infections. If an antibiotic is stopped in mid-course, the bacteria may be partially treated and not completely killed, causing the bacteria to become resistant to the antibiotic. This can cause a serious problem if those now-resistant bacteria grow enough to re-infect. Additionally, they may compromise the immune system if prescribed or taken when not needed.

As an extension, students could investigate how antibiotics work and how they may compromise the immune system.

Additional activity: Immune system diagrams

For more visual learners, representing the immune system as a series of concentric circles with the first line of defence on the outside can help them understand that the body's response to pathogens gets progressively more specific. Students can add information and images to each ring to highlight the main responses and defences at each stage.

Additional activity: Discussion

Students could be asked to detail their experiences of vaccination: When did they have them? What do vaccinations do? This would be a good opportunity for the teacher to explore some of the students' misconceptions and to assess their prior knowledge.

Additional activity: Immune system online game

Students can play the immunisation game on the Nobel Prize website to learn about the benefits of immunisation. This is a fairly complicated game and may only be suitable for students with higher abilities.

Going further

A useful weblink is available on your obook/assess. To access it, click the weblink tile on the Dashboard for this unit.

Interactive: Immunisation

This immune system game is part of the Nobel Prize website and allows students to understand the benefits of immunisation.

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3.11 Things can go wrong with the immune system

Teacher notes (pages 64–65)

Introducing the topic

In this section, students will explore some common issues with the immune system. Many students will be familiar with hay fever and other allergies. More serious conditions such as autoimmune diseases, diabetes and HIV are also discussed.

Additional activity: Video

Many excellent documentaries about HIV and AIDS are available online. Students can find this topic and the associated images very confronting and these should be discussed and viewed with care.

Additional activity: Research

Students could research immune diseases/disorders. Some suggestions are rhesus incompatibility, systemic lupus erythematosus (SLE), Grave’s disease, pernicious anaemia, insulin dependent diabetes, rheumatoid arthritis, multiple sclerosis and AIDS.

This activity could be used as an assessment task. Students could research what the disorder is, causes, signs and symptoms, treatments and prognosis/outcomes. It could be submitted in a number of different ways such as a vodcast, podcast, poster, oral presentation or interview with a medical professional.

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Teacher notes

1.1 Scientists review the research of other scientists

Pages 2–3

Introducing the topic:

This topic explains how our scientific understanding of genes and DNA is constantly being reviewed, challenged and refined. Scientists often collaborate and share their research, and sometimes competing to make scientific discoveries. This unit covers the work of scientists Gregor Mendel, the father of genetics, Watson and Cricks' research on the double helix structure of DNA as well as other contributing scientists, including Rosalind Franklin.

Teaching tip:

It is useful to use the analogy of detective work. The five clues given had to be put together to create a molecule that we cannot see. Linus Pauling first proposed a model that used three helical structures. Another model suggested that the bases were on the outside of the molecule with a central backbone.

Additional activity: alternative model to the double helix structure

Develop an alternative model to the double helix structure. Can the students argue their case effectively?

This is a replica of how scientists present their research today. Once they have done the research, they must write a paper and present it to a reputable journal to be published. Once it is published, they must be prepared to present their findings at meetings around the world.

Additional activity: timeline

Create a time line of sequence of events in the search for DNA including the work of other scientists such as Miescher, Morgan, Griffith, Levene, Avery, and Chargaff.

Going further:

Review the work of other scientists that have contributed to our understanding of genetics.

Look at x-ray crystallography images of Rosalind Franklin and show how these gave Watson and Crick the additional evidence they needed to publish their paper on the double helix structure of DNA.

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