8 Ecosystems

Have you ever wondered...

- what it is like for an animal living in the wild?
- why wilderness areas are worth saving?
- if humans could be damaging the Earth?
- whether humans have a responsibility to protect the environment?

After completing this chapter students should be able to:

- recall that ecosystems consist of communities of interdependent organisms and abiotic components
- outline how matter such as nitrogen is cycled through ecosystems
- describe how energy flows through ecosystems and food webs
- analyse how changes in biotic and abiotic components affect populations and communities CCT
- assess how Aboriginal and Torres Strait Islander peoples' cultural practices and knowledge of the environment contribute to sustainable ecosystems AHC S
- evaluate strategies used to balance conserving, protecting and maintaining the environment with human activities and needs CCT PSC EU S

ADDITIONAL

- debate why any investigation affecting animals must be humane, justified and ethical CCT EU
- use models to predict the changes in populations due to environmental changes CCT L
- discuss the strengths and limitations of using models to make predictions about changes in biological systems CCT
- describe examples of advances in science and technology in areas such as environmental science. CCT L WE

Chapter overview

In this chapter students will recall that ecosystems consist of interdependent biotic and abiotic components, outline how matter and energy moves through ecosystems and food webs, and analyse how changes in biotic and abiotic components affect communities. Students will assess how cultural practices contribute to sustainable ecosystems, and evaluate strategies used to balance conserving the environment with human needs.

Content in this chapter identified in the NSW Syllabus as Additional includes debating why any investigation involving animals must be humane, justified and ethical, predicting the changes in populations due to environmental changes, discussing the strengths and limitations of using models to make predictions about changes in biological systems, and describing examples of advances in environmental science.

Pre-prep

Practical investigations in this unit don't need special preparation, but check the forecast when planning to go outside.

Extra activities are included in the learning strategies to suit students' interests. Many of these activities require extension thinking and can be used with advanced students.

Containers need to be made in advance for the science4fun activity on page 294.

This chapter will take 3–4 weeks, but could take longer if excursion activities are included.

Pre-quiz

1 **Explain** why plants don't grow at the bottom of the sea.

There is no sunlight there.

2 **State** the original source of energy used by plants.

The Sun.

3 **Explain** the difference between living and non-living.

Something that is non-living was never alive and cannot become alive.

4 **Describe** how bushfires can sometimes be a good thing for an ecosystem.

Bushfires might get rid of weeds, provide suitable conditions for seeds to regenerate, and release new nutrients into the soil.

What's coming up

Students will look at ecosystems, in detail in this chapter, specifically:

- the components of an ecosystem, the factors that influence them and the adaptations needed to survive
- the way these components interact and the sustainability of the ecosystem
- natural and human impacts on ecosystems.

RESOURCES

Pearson eBook

Teacher support
A comprehensive mapping of *Pearson Science New South Wales 9* against the New South Wales Syllabus and detailed teacher programs are available on Pearson eBook. These documents can be edited and adapted to suit the needs of your students and the requirements of your school.

Chapter 8 safety notes and risk assessments
This single document contains safety notes and risk assessments for all practical investigations in Chapter 8.

Weblinks
These websites support Chapter 8.

8.1 Vocabulary preview

abiotic factor
biotic factor
commensalism
community
competition
ecology
ecosystem
ectothermic
endothermic
environment
interdependence
mutualism
parasitism
photosynthesis
predation

Learning strategies

Questioning

Ecosystems

MI: Verbal/Linguistic, Logical/Mathematical

L

Explain how the following three words relate to each other: ecosystem, environment and habitat.

Literacy strategy

Reading

MI: Verbal/Linguistic

L

Students learn many new words and concepts in this chapter. They also go over words and concepts they already know but may not have associated with science. Ask students to take notes by classifying new words in one of the following ways: abiotic factors, biotic factors, general ecology and ecosystems. Help students recognise how words relate to each other.

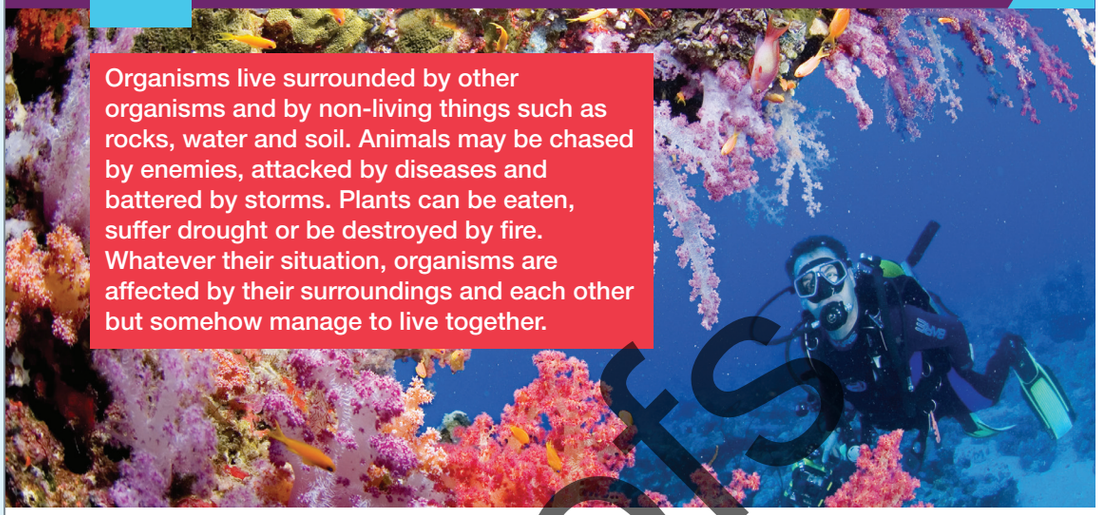
Extra support

Interdependence

MI: Verbal/Linguistic

Ask students to think about and explain what the word interdependence means.

8.1 Components of an ecosystem



Organisms live surrounded by other organisms and by non-living things such as rocks, water and soil. Animals may be chased by enemies, attacked by diseases and battered by storms. Plants can be eaten, suffer drought or be destroyed by fire. Whatever their situation, organisms are affected by their surroundings and each other but somehow manage to live together.

Interdependence

Living things affect each other's survival. For example, termites depend on microscopic organisms called flagellates (Figure 8.1.1). Flagellates live in the termite's intestines and digest the wood for the termite. The termite needs the flagellates to do this because it cannot digest wood even though this is all the termite eats. The termite provides a moist, stable place for the flagellates to live and so the flagellates also depend on the termite.

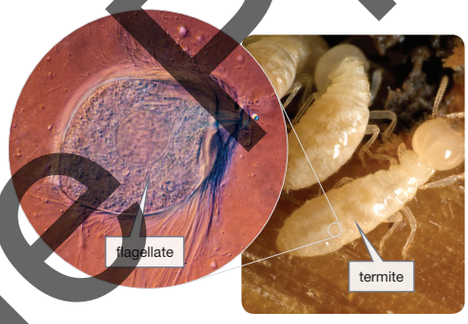


Figure 8.1.1 Termites and the flagellates that live in their intestines are interdependent. They rely on each other for survival.

Unlike the termite and flagellate, organisms do not always help each other to survive. A hawk that kills and eats a mouse is dependent on the mouse for its survival. The mouse is dependent on plants for its food. Therefore, the hawk also depends on the plants because they keep its food source alive. The hawk, mouse and plant are therefore interdependent, because a change affecting one will affect all three. **Interdependence** means that all organisms in a food web are interconnected, affecting each other's survival in helpful and harmful ways.

Prac 1 p301

The environment

When biologists talk about the **environment**, they are talking about all the factors in an organism's surroundings that affect its survival. Some of these factors are very visible, such as the landscape and the types of rock, soil, plants and animals found there. The environment also includes less visible factors such as the number of days of sunshine, the amount of rainfall and the number of predators in the area. Every organism has its own unique environment.

RESOURCES

Practical investigations

Prac 1 on page 301 investigates organisms that live inside termites.

Prac 1 p301

Skills support

Science and inquiry 1 has additional support for understanding ecosystem interactions.

Science and Inquiry 1 Skill 4.10

Ecology

Ecology is the study of how organisms interact with each other and with their non-living surroundings. To interact means to affect each other, in either harmful or helpful ways. These interactions are just some of the factors that form the environment in which an organism lives. Scientists who specialise in ecology are known as ecologists.

Ecosystems

To help understand how organisms live where they do, ecologists classify the surroundings into two components:

- the physical surroundings (such as rocks and water)
- the living organisms (animals, plants, fungi, bacteria and other microorganisms)

Together these components make up an ecosystem. An **ecosystem** is a place where the organisms and their physical surroundings form an environment that is different from other environments nearby.

Natural ecosystems can exist on their own. They are balanced, meaning that they keep working without any outside help from humans. The lake in Figure 8.1.2 is an example. Humans can create artificial ecosystems such as the aquarium in Figure 8.1.3, but these need to be managed to keep them balanced. This may involve adding food materials and removing wastes.

Figure 8.1.2 A freshwater lake is a natural ecosystem.

Figure 8.1.3 An aquarium is an artificial ecosystem. Without human help, it quickly becomes unbalanced.

Factors influencing organisms

Organisms in an ecosystem are affected by two main sets of environmental factors:

- **abiotic factors**: These are non-living factors such as air quality and humidity, the amount of sunlight, rainfall, wind, tides, waves, lightning and fires. Abiotic factors are also known as physical factors.
- **biotic factors**: These are living factors such as predators, parasites, fungi, infectious organisms, competitors for food and shelter and collaborators (such as a breeding partner).

Some abiotic and biotic factors in the human environment are shown in Figure 8.1.4.

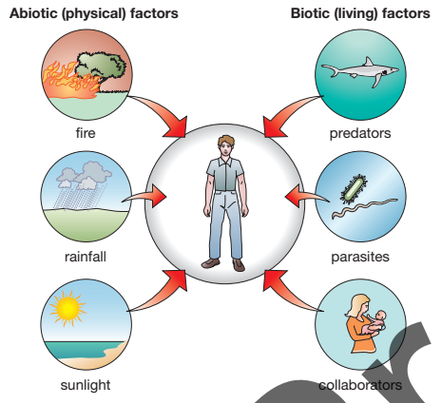


Figure 8.1.4 Abiotic and biotic factors affect all organisms, including humans.

Abiotic factors

Water, temperature, fire, light, soil type and oxygen levels are important abiotic factors for most organisms.

Water

Water is essential for all living organisms. It is the solvent for all materials in cells and allows the chemical reactions of life to occur. Chemicals must move around to participate in chemical reactions—water allows this movement to occur. When water is limited, chemical reactions within the cells cannot occur and cells die. As a consequence, the organism also dies.

Inquiry activity

Temperature and heart rate

MI: Visual/Spatial, Bodily/Kinaesthetic, Interpersonal

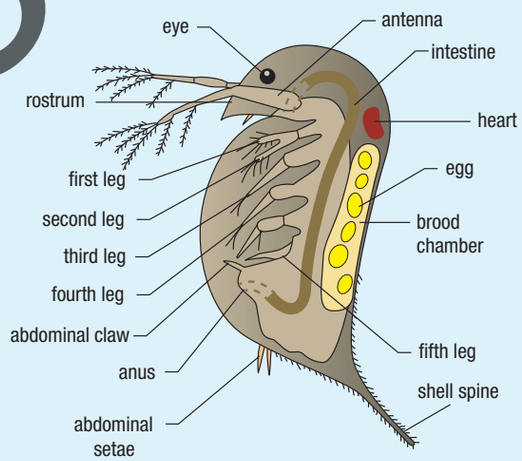
PSC CCT

Purpose: To study the effect of temperature on the heart rate of a water flea.

Materials: *Daphnia* (water fleas; one kept in the fridge for 10 minutes and one at room temperature), thermometer, Pasteur pipette with wide opening large enough to pick up a water flea (or thin glass tubing), monocular microscope, 2 depression slides (one kept in a beaker of ice), 2 coverslips, paper towel, stopwatch, ice, prepared slide of any organism (water flea if possible), lens tissue, tweezers

Hypothesis: How will the temperature effect heart rate? Ask students to write a hypothesis before beginning the activity.

Procedure



A water flea

1 Leave the water fleas in the fridge and the microscope slides in the ice until needed. Set up your microscope using natural light, not a lamp. Use the prepared slide to help obtain a focus.

2 Collect the cold slide and the water fleas from the fridge. Use the Pasteur pipette or thin glass tubing to transfer a water flea to the depression slide. Make sure the pipette is wide enough to pick up the animal.

3 Add a coverslip. Wipe any water off the bottom of the slide and quickly transfer it onto the stage of the microscope. You don't want the slide to warm up.

4 Quickly obtain a low-power focus (about 100×) on the water flea. Try to locate a pulsing object behind its dark eye spot near the middle of its back. This is its heart.

5 When you are sure you have located the heart, count the number of beats in 30 seconds. Double this to obtain the heart rate. Write this down in your notes.

6 Take the slide off the stage and gently lift the coverslip and return the water flea to the cold beaker.

7 Obtain a water flea from the room temperature container. Place it on a slide at room temperature and cover with a coverslip. Wipe the slide to remove water and again do a count of the heart rate. Write it in your notebook.

8 Return the water flea to the beaker and clean up.

Discussion

1 State any difference you found between the heart rate of the cold water flea and that of the warm water flea.

2 Compare results of all the groups in your class.

3 State the function of a heart in an animal.

4 Explain why the heart rate was faster in the warm water.

5 Predict whether the same thing would happen with your heart rate if you were cooled down for a few minutes.

Questioning

Effect on a human

MI: Logical/Mathematical

L N

Look at Figure 8.1.4 on page 293. Explain how all the factors shown in the diagram could affect a human. Consider Figure 8.1.5 and the information about endothermic animals in the text headed 'Temperature'. Why would it be useful for an animal to be able to keep its body temperature constant?

science 4 fun

Fish shapes

Background

The streamlined shape of many fish enables them to swim fast, which helps them escape predators or catch prey. In this activity, students investigate whether the shape of a fish affects how it moves through water. This leads into the concept of adaptation.

Hints and suggestions

1. It is best to use a pipe about 75 cm diameter so that you can drop up to four fish and cubes and still see them reach the bottom. This saves having to empty the tube after each trial.
2. Some data: In a 1.7 m pipe of water, a cube of mass 24.4 g and volume 8 cm^3 takes 3.0 seconds to reach the bottom of the tube, while a fish takes about 1.7 seconds. This plasticine of mass 14.4 g had 10 g of lead added to it to increase the weight. They tend to fall straighter if they are heavier, so adding lead or steel is a good idea. Smaller things such as a 13.7 g cube take about 2.8 seconds and the fish about 2.0 seconds.
3. Either provide many fish models for the students to use, or instruct the students to tip the water out of the tube into a bucket, recover the fish and refill the tube.
4. If you intend to use short tubes or measuring cylinders, it helps to 'thicken' the water if students are going to time the fall, because it will be over very quickly and the timing is subject to more error. Alternatively, drop a fish and a cube at the same time, although they might interfere with each other as they fall. You can 'thicken' the water with salt.

Possible results and looking forward

Read on about biotic factors that animals have, to help them survive in their environments.

Water affects any organisms that live in it, such as fish, sponges, seaweed and algae. Water does not evaporate from their body surfaces as it does from land organisms. Instead, aquatic animals and plants lose water through diffusion. Water diffuses out of their body cells into the ocean, river or lake.

INQUIRY science 4 fun

Fish shapes

YES

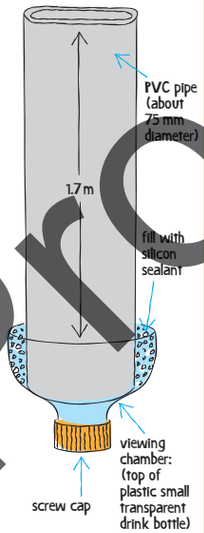
What is the best shape for a fish?

Collect this ...

- water
- test container as shown
- plasticine
- bucket
- timer

Do this ...

1. Make the test container as shown in the diagram. It will need to be 1.7 m in height.
2. Cut five cylinders of plasticine about 2 cm wide by 2 cm long.
3. Use the plasticine to make a fish shape (with tail) and different shapes such as a sphere, cube, pyramid and rectangle. These should all be approximately the same size.
4. Fill the test container with water. Drop the shapes into the top of the container and time how long it takes each to reach the bottom.



Record this ...

Describe how the shape affected the movement through water.

Explain the advantage of fish being a particular shape.

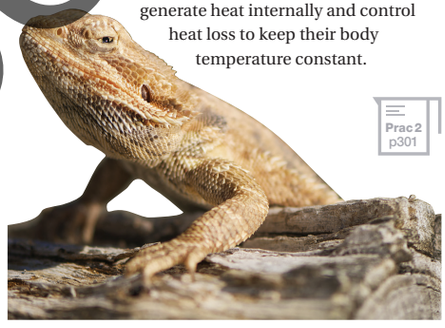
Water provides buoyancy (uplift), so organisms that live in water need less support for their bodies than creatures that live on land. However, water is very difficult to move through and so marine animals are usually streamlined to minimise water resistance.

Temperature

Heat affects the rate (speed) of chemical reactions in the cells. As temperature increases, the rate of a reaction usually increases too.

The body temperature of fish, amphibians and reptiles (like the one in Figure 8.1.5) depends on the temperature of the environment. Biologists use the term **ectothermic** to describe these animals, rather than 'cold blooded'. This is because many of these animals are not 'cold' but have body temperatures that vary as the environment warms and cools. These animals can also regulate their temperatures by lying on warm rocks or in sunlight to heat up, or by hiding in burrows if they need to cool down. Ectothermic means the organisms must obtain body heat from the environment rather than by generating it internally through body chemistry.

Birds and mammals such as humans and kangaroos are **endothermic**. Endothermic means that the organisms are warm blooded—they have the ability to generate heat internally and control heat loss to keep their body temperature constant.



Prac 2 p301

Figure 8.1.5 A reptile is ectothermic. Its body temperature will be very low overnight and on cold mornings, and high after it has been lying in the sunlight.

The price of being an endotherm SciFile

Up to 80% of food consumed by an endothermic animal (like you) goes to generating heat to maintain a constantly warm body. This means an endothermic animal must find and consume much more food than a comparable ectothermic animal.

RESOURCES

Practical investigations

Prac 2 on page 301 tests how temperature affects animals.

Prac 2 p301

Pearson eBook

Interactive activity: Ecosystems

This interactive activity explores the abundance of connections between species inhabiting an ecosystem, and their connections with the abiotic environment.

Fire

Some fires start because of lightning hitting trees, or because of human activity. Australian Aborigines have used fire for many thousands of years to keep the bush open and to improve the growth of plants. They knew that many Australian plants re-grow quickly after fire.

A bushfire like the one in Figure 8.1.6 can kill some plants, but it may help others. Some plants flower better after a fire and some drop their seeds. Many Australian plants will germinate after a fire in response to the chemicals released in the smoke.

Figure 8.1.6 Fire can kill some organisms but help others.

8.1 Prac 3 p302

Light

Light is necessary for photosynthesis. **Photosynthesis** is the process by which plants manufacture their food materials using water, carbon dioxide and light. Changes in the amount of light over the seasons trigger plant growth and flowering in many species.

As Figure 8.1.7 shows, hilly ground can affect the amount of light reaching plants. The Sun's rays do not penetrate into valleys early in the morning or in the late afternoon so plants growing in valleys receive less light than plants growing on hilltops.

In places outside of the Tropics of Capricorn and Cancer, the Sun never passes directly overhead during the day. For example, all of New South Wales lies below the Tropic of Capricorn and so the Sun never passes directly overhead. Instead, it moves across the sky in a path that lies towards the north. This path shifts north in winter and is more overhead in summer. For this reason, plants on the south side of hills in New South Wales receive less sunlight than those on the northern side. Hence, plants tend to grow taller on the northern slopes of hills and only plants that can survive with less light will be found on the southern slopes.

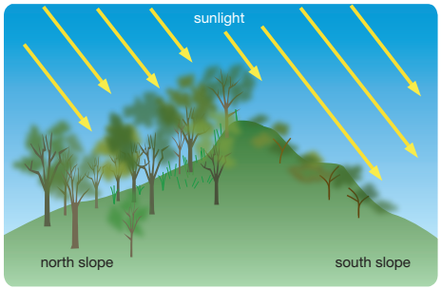


Figure 8.1.7 Plants on a north slope usually grow larger because they receive more sunlight over a year.

The amount of light influences the flowering of most plants. Plants sense how much light they receive every day. As winter progresses into spring, the number of daylight hours and the amount of light increase. Many plants respond by flowering (Figure 8.1.8). As summer progresses into autumn and the hours of daylight become shorter, some plants respond by changing colour and dropping their leaves.

Figure 8.1.8 Plants such as this waratah detect the change in daylight with the seasons and respond by flowering.

Inquiry activity

Student-designed investigation: Smoke and germination

MI: Visual/Spatial, Bodily/Kinaesthetic

PSC CCT

Purpose: To investigate whether the germination of wattle seeds after a fire is due to heat or chemicals released in burning.

Materials: Depends on student design, but probably wattle seeds, containers, matches, newspaper or leaves to burn, tin, beakers, water.

Hypothesis: Ask students to write a hypothesis before completing the activity.

SAFETY SPOT

- Any burning should be done either in a proper fireplace, or in a tin on a tripod stand surrounded by a fire break and well away from anything that could catch fire.
- Do not enclose the fire in a tin with a lid, as it will blow off the lid. Put a wire mesh (such as fly wire) over the tin lid. Sparks are a problem with fires, so do not do this during a fire ban or when conditions could start a fire from glowing embers that escape out of the tin. Rinsing the burnt ash should produce enough chemicals. You do not have to capture the smoke.

Procedure

1 In groups, design a way of testing whether it is the heat that makes wattle seeds germinate after a fire, or chemicals in the smoke.

2 Decide on aspects of the design such as:
   - how to test the effect of heat on the seeds (putting them directly in a fire will kill them)
   - will you subject the seeds to fire (which would need to be done outside) or some other source of heat, such as hot or boiling water
   - how you could capture chemicals from a fire that you can then use on the seeds (capturing smoke is difficult in a school setting without special equipment)
   - how to decide whether the heat or chemicals in the burnt wood improved germination
   - how many seeds to use, where you will put them after treatment with heat or chemicals, and how long the experiment will last.

4 When students have done some research and answered the questions above, have them draw a diagram of their set-up.

Results

Collect all the results in the class.

Discussion

1 Draw a conclusion from your experiment.

2 Evaluate your experiment.

RESOURCES

Practical investigations

Prac 3 on page 302 tests whether ash makes seeds germinate rather than the heat of the fire.

Prac 3 p302

Activity Book

8.1 Smoke and germination
MI: Verbal/Linguistic
LATC: Sustainability, Literacy

8.1

Extension

Acid in soil

MI: Verbal/Linguistic, Logical/Mathematical, Visual/Spatial

ICT CCT

Have students imagine they are planning a garden of Australian plants. Ask them to consider which plants need more acidity and which need alkaline soils and then plan them in a garden. Have students find out the requirements for at least 10 different plants and then demonstrate on a basic sketch where they would plant each in their garden. Have students also consider the spacing required for larger and smaller plants.

Summarising

Gas

MI: Verbal/Linguistic

L

Have students write a summary sentence about oxygen levels in water, and then a sentence that makes a conclusion about this information. The sentences could be something like the following (use the start as a prompt):

The amount of oxygen in water increases if it is colder, increases if it is stirred up, and decreases the deeper you go in water. This affects what can grow and live in a variety of water environments.

Making connections

Using analogies

MI: Verbal/Linguistic, Interpersonal, Intrapersonal

While discussing biotic factors, analogies can assist the students to appreciate the finer details and implications of each. For competition, suggest that students consider the school tuckshop. If the tuckshop only has six hot dogs on offer each lunchtime and there are more than six students wanting to buy a hot dog, then there is competition. Ask students what factors affect who gets the hot dogs, and if it is the same for other animals.

Light also affects animal behaviour. For example, rock lobsters (crayfish) avoid bright moonlight. Many other animals stay out of direct sunlight during the hottest part of the day to avoid overheating.

Soil type

Plants usually grow in soil that provides them with the water and minerals they need to help make their food. Not all soils are the same—they differ in mineral content, water-holding ability and acidity.

Two nutrients needed by plants are nitrate and phosphate. Where there are only tiny amounts of these in the soil, only specially adapted species such as banksias can survive.

Loam soil usually contains more plant nutrients than sandy soil because the clay particles in loam have more plant nutrients in them than sand grains do. While fertilisers stick to the clay particles in loam, they are often washed away and lost from sandy soils.

Some soils hold more water than others. Loam soils hold onto water more strongly than sandy soils. Therefore, it is more difficult for a plant to extract the water it needs from loam soils than it is from sandy soils.

Acidity and alkalinity of soil are also important to plants (Figure 8.1.9). Plants such as azaleas, camellias and most Australian native plants need acidic soils. High alkalinity will kill them or prevent them growing well. Other plants, such as some acacias (wattles) and eucalypts (gum trees), grow better in alkaline soils.

Figure 8.1.9 Testing soil for acidity (pH level) is useful because it helps decide whether a particular plant will grow well in it.

GO TO Unit 1.3

Oxygen levels

The amount of oxygen in the environment affects most organisms because they require oxygen to carry out respiration, the reaction that provides their cells with energy. There is usually enough oxygen in the air for land-based organisms, but the amount dissolved in water can change greatly and affect aquatic organisms living there.

The amount of oxygen in water depends on several factors.

- **Temperature**: there is more oxygen in cold water than warm water.
- **Movement**: moving water dissolves a lot of gases from the air. Hence, a fast-flowing stream has more oxygen than a swamp.
- **Depth**: as water gets deeper, there is less mixing of water with the air, which reduces the amount of oxygen available. Animals living in the depths of the ocean (such as the anglerfish in Figure 8.1.10) tend to move slowly because the energy available from respiration is limited by a lack of oxygen.

GO TO Unit 2.3

Figure 8.1.10 Anglerfish are slow-moving fish that live in the deep ocean where there is limited oxygen available.

Biotic factors

Organisms rarely live alone—they are surrounded by other plants, animals and microorganisms. All the living things in an ecosystem are known as a **community**. Different relationships exist between the organisms in a community and these relationships are classified by how the organisms interact.

There are many different interactions between living organisms. These interactions involve biotic factors, and they play an important role in the survival of all species. Sometimes organisms assist each other, and sometimes they harm each other.

Summarising

Abiotic and biotic factors

MI: Verbal/Linguistic

L

Make a table to describe and summarise the biotic and abiotic factors listed on pages 293 to 298. List the biotic and abiotic factors separately and give a sentence in point form about each.

Competition

Organisms are said to be in **competition** when they both try to obtain the same resource, which may only exist in limited amounts. Competition occurs between members of the same species (like the chicks shown in Figure 8.1.11), and between different species. There is only a limited supply of food and resources, and so some individuals will not survive. In natural communities, competition is often fierce. There is a constant struggle for survival, and many die, especially the young, the old and the weak.

Figure 8.1.11 Baby birds compete with each other for food by trying to attract their mother's attention.

Predation

When one organism kills and eats another, the attacker is called the predator and the one being eaten is called the prey. This feeding relationship is known as **predation**. An example is shown in Figure 8.1.12.

Mutualism

Mutualism is a relationship where two organisms live closely together and both benefit. The flagellates in a termite's guts are a good example. Without the flagellates, the termite would not have any food. The flagellates receive food and the correct temperature and moisture levels for survival. Both organisms depend upon each other.

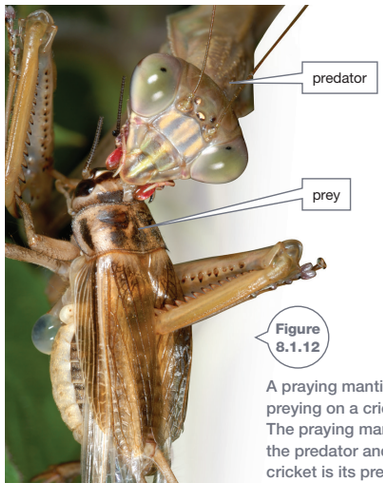


Figure 8.1.12 A praying mantis preying on a cricket. The praying mantis is the predator and the cricket is its prey.

The cleaner shrimp shown in Figure 8.1.13 eats parasites on the skin of the fish. Both the cleaner shrimp and the fish it cleans benefit, so this is an example of mutualism.

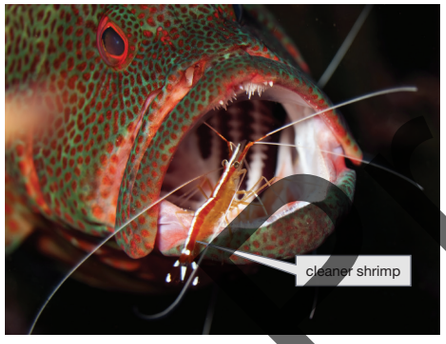


Figure 8.1.13 Cleaner shrimp and the fish they clean are an example of mutualism.

Pollination is another example of mutualism. Many flowering plants depend on animals (like the honeyeater in Figure 8.1.14 on page 298) to pollinate them. Pollination is the transport of pollen (containing the male sex cells) to the female parts of the flower. Pollination results in seeds. The honeyeater benefits from the relationship by obtaining food in the form of a sugary liquid (nectar).

Applying skills

Summarising

MI: Visual/Spatial, Verbal/Linguistic, Intrapersonal

Have students construct a table of terms, definitions and examples for the relationships between organisms described on pages 297 and 298. Give students the opportunity to watch a film such as Finding Nemo or The Lion King to observe additional examples of relationships. The following table is an example:

Relationship	Definition	Example
Mutualism or symbiosis	Both species benefit	Clown fish on anemones receive protection while the anemone receives food scraps
Commensalism	One species benefits, the other is unaffected	Remora fish travelling on shark receive a free ride and food scraps
Amensalism	One species is harmed, the other is unaffected	A large tree shades out a small tree
Competition	Fight for resources	Puppies compete for a nipple on their mother

Homework

Relationships in a community

MI: Verbal/Linguistic, Visual/Spatial

PSC ICT

Ask students to find one example each of competition, mutualism, parasitism and commensalism in an Australian ecosystem and share it with the class.

Homework

Travelling parasites

MI: Visual/Spatial, Verbal/Linguistic, Intrapersonal

Have students research one parasite that affects humans and answer the following questions. Ask them to present the information as a travel brochure advising travellers about the parasite, including a picture of the parasite. The internet would be the best source of information, although this task could be done in the library.

1. What is the common and scientific name of the parasite you have chosen?
2. How does the parasite infect its host?
3. What does the parasite do to the host as a consequence of living and growing in it or on it?
4. Where does this parasite occur? Use a map to show the worldwide or local locations of the parasite.
5. Describe any treatments available for the host.

Extension

Parasitism

MI: Verbal/Linguistic, Visual/Spatial, Interpersonal

PSC ICT

Have students work in groups to investigate a set of animals that live with parasitism. Ask students to first research an example of a parasite and its host and then present information about the relationship as a poster.

ICT

Human parasites

MI: Visual/Spatial, Logical/Mathematical, Verbal/Linguistic

ICT

Read the SciFile about river blindness and then research other examples of human parasites that cause issues for us.

Creating

Commensalism

MI: Verbal/Linguistic

L CCT

To explain commensalism have students write and illustrate a basic children's picture book to demonstrate the properties of commensalism. They could use the example of the whale and barnacles as depicted in Figure 8.1.16, or choose another example. This activity could be completed for parasitism, predation, mutualism or competition as well to help visual or linguistic learners.

ICT

Local examples

MI: Verbal/Linguistic, Logical/Mathematical

ICT

Have students find a local example of a habitat, animal or plant that has been affected by an abiotic factor in some way. Describe how it has been affected, based on information in Table 8.1.1 on page 299.

Issues in science

Relationships change

MI: Logical/Mathematical

Once students have read the Skill Builder on page 299, ask them to consider other areas or other relationships in science where the research is still developing our understanding of the relationships. Discuss with students and then ask them to consider how this research might be occurring. If you have an aquarium facility nearby, take an excursion to look at the animals and relationships there. Alternatively, other settings can be explored besides those underwater.

Figure 8.1.14 Flowering plants rely on pollinators such as this honeyeater to transfer pollen, which enables the plants to make their seeds.

Parasitism

Parasitism is a relationship where one organism (the parasite) lives on or in another organism (the host) and feeds off it. The parasite cannot survive without the organism in which it lives. The parasite usually harms the host, but rarely kills it. The caterpillar in Figure 8.1.15, which has been attacked by a wasp parasite is an example of parasitism killing the host.

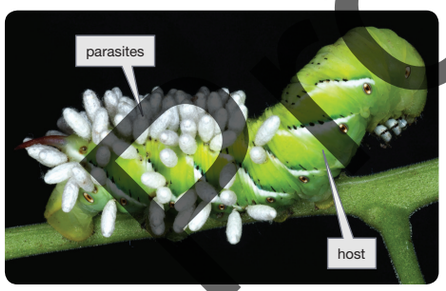


Figure 8.1.15 A parasitic wasp has laid its eggs on this caterpillar. They will hatch and eat the caterpillar.

River blindness

River blindness is caused by a parasitic worm that lives in human eyeballs. The worm is transmitted by a bite from a type of fly called a blackfly. The worm is estimated to have made about half a million people blind.

SciFile

Commensalism

Commensalism is a relationship in which one organism benefits and the other is unaffected. An example of commensalism is the relationship between a whale and the barnacles it carries, shown in Figure 8.1.16. The barnacles attach themselves to the outside of the whale, but do not harm the whale or gain food from it. The barnacles collect their food by filtering microscopic animals out of the water as the whale swims. The whale does not eat the same animals as the barnacles and so is unaffected by them.

Figure 8.1.16 Barnacles attached to the tail of this whale collect food but do not harm the whale. This relationship is an example of commensalism.

Environmental changes and populations

Changes in the environment affect the population sizes of all species living in it. These changes involve both biotic and abiotic factors. The most common environmental changes are those due to seasonal changes in abiotic factors such as temperature, light and water.

In southern Australia, native plants have a growth spurt in spring when there is adequate water and light and temperatures are around 20°C. Many plants also flower at this time, providing food for animals that drink nectar or eat flowers. Therefore, the changes in abiotic factors affect the biotic factors. Increased quantities of plant matter result in increased numbers of herbivores (plant-eaters) and the carnivores (meat-eaters) that feed on the herbivores and on each other.

The size of a population changes because environmental factors affect the rates of birth, death, immigration and emigration. Some examples are shown in Table 8.1.1.

Defining relationships

Scientists sometimes reclassify relationships as more research is carried out and they learn more about them. An example is the relationship between clownfish and anemones (Figure 8.1.17).

Figure 8.1.17 Clownfish in a sea anemone

Anemones are related to jellyfish, and have stinging tentacles. They kill small animals and eat them. The clownfish are immune to the stings and feed on the anemone's leftover food, and receive protection from predators.

1 Recent research has shown that some anemones grow better if clownfish live in them. So there must be a benefit to those anemones. Some species of clownfish scare away butterfly fish, which can eat anemones. Both the anemone and the clownfish benefit and so the relationship is mutualism.

2 In aquariums, one type of clownfish catches small fish and drags them over to the anemone. The anemone stings the small fish and kills them. Both the clownfish and the anemone then feed on the dead fish. Both benefit, so once again the relationship is mutualism.

3 It is not clear whether all clownfish and their anemones show mutualism. Some species of anemones may neither benefit nor be harmed by the clownfish. Only the clownfish is benefiting, and so the relationship is one of commensalism.

Table 8.1.1 Factors that affect population size in an area

Factor	Example
Birth rate	The number of animal births often increases when food is plentiful. Adults have more energy and breed. More breeding adults can survive because more food is available.
Death rate	Plentiful food reduces the number of animals that die, which keeps the population high. In contrast, exposure to unusually low temperatures can increase the death rate (Figure 8.1.18).
Immigration	More animals move into an area when there are more resources such as food and water.
Emigration	Animals usually move out of an area when they do not have enough food and water.

Figure 8.1.18 Emperor penguin adults and young huddle together to keep warm in an Antarctic blizzard. Very low temperatures increase the death rate, decreasing the size of the population.

RESOURCES

Activity Book

8.2 Biotic and abiotic factors
MI: Verbal/linguistic
LATC: Literacy, Sustainability

8.3 Biotic and abiotic factors in the ocean depths
MI: Logical/mathematical & Verbal/linguistic
LATC: Critical and creative thinking, Literacy

Assessment

Evaluate understanding

Summarising

MI: Verbal/Linguistic

D

Ask students to go back over the vocabulary and summarise each word in a paragraph. Have them write this from memory to evaluate their understanding.

Reteach relearn

Competition, mutualism, parasitism, commensalism

MI: Visual/Spatial, Verbal/Linguistic, Interpersonal, Intrapersonal

Ask students to compose an email about each of: competition, mutualism, parasitism and commensalism. They should share that example with their peers.

Alternative assessment

Case study

MI: Visual/Spatial, Verbal/Linguistic, Intrapersonal

CCT ICT

Give students information, either descriptive or visual, about a particular abiotic factor that affects an animal. Have them carry out the following tasks.

1 List the ways the abiotic factor affects animals.

2 Explain how the abiotic factor works.

3 Select one specific animal and describe its reaction to the chosen abiotic factor.

4 How is the animal suited to live in a habitat affected by this abiotic factor (e.g. how does it handle the temperature)?

8.1 ANSWERS

Remembering

1 The living organisms, the physical surroundings and all the living and non-living factors that make up the environment are main components of any ecosystem.

2 Any five of: water, air quality, the amount of light, temperature, wind, soil type, humidity of the air, tides, waves, lightning and fires

Understanding

3 a Environment: all the factors in an organism's surroundings that affect its survival
b Ecology: the study of how organisms interact with each other and with their non-living surroundings
c Parasitism: relationship where one organism lives on or in another organism and feeds off it
d Commensalism: relationship where one organism benefits and another organism is unharmed

4 Mineral content, water-holding ability and acidity

5 The clay particles in loam soils hold on to minerals, but sand particles do not. Fertiliser can drain through the sandy soil and be lost to the plants.

6 Fish that are thin and have a small surface pushing on the water as they fall ('streamlined') will drop faster.

7 Abiotic factors such as temperature and rainfall change with seasons, and this affects biotic factors such as plant growth and therefore animal food sources. Changes in these biotic and abiotic factors affect the rates of birth, death, immigration and emigration.

8 Birds and mammals can generate heat within their bodies and control the loss of heat. So, in cold climates, they can still be active. Reptiles rely on gaining heat from their surroundings, so if the surroundings are cold, the reptile stays cold and inactive.

9 Some species, such as grass trees, flower more readily after a fire. Some plants release their seeds or germinate only after a fire.

Applying

10 Some species of clownfish are beneficial to the health of anemones (and vice versa), so the relationship is mutualism, but other species do not appear to help the anemones (or vice versa), so the relationship is commensalism.

11 A eucalypt depends on abiotic factors, such as sunlight, water, carbon dioxide, to make food by photosynthesis. A eucalypt depends on biotic factors such as birds eating insects which were feeding on leaves, and on birds and insects to pollinate flowers.

Analysing

12 a A community is part of an ecosystem—the living organisms. The rest of the ecosystem includes the non-living surroundings.
b Abiotic factors are those factors affecting organisms that are due to the non-living environment, i.e. the physical factors such as sunlight. Biotic factors are those due to the living organisms—the habits and lifestyles of the organisms such as how they obtain food (e.g. predation) and where they live.
c A predator (such as a fox) kills and eats organisms (such as rabbits) that are known as its prey.
d A parasite is an organism that lives on or in another organism (known as the host) and obtains food from its body.

8.1 Unit review

Remembering

1 **List** the two main components of any ecosystem.

2 **List** five different abiotic (physical) factors that affect organisms.

Understanding

3 **Define** the terms: L
a environment b ecology
c parasitism d commensalism.

4 **Describe** three abiotic factors of soil that affect land plants.

5 Farmers find that adding fertilisers to loam soils increases crop yield, while adding them to sandy soils does little. **Explain** why.

6 **Predict** the shapes of fish that would drop fastest and slowest in the science4fun on page 294.

7 **Explain** how seasonal changes in abiotic factors can alter the rate of birth, death, immigration and emigration.

8 **Explain** why birds and mammals are not affected by cold weather as much as reptiles are.

9 **Explain** how fire can be beneficial in the Australian bushland.

Applying

10 **Use** the relationship between clownfish and anenomes to **demonstrate** that relationships can sometimes be classified in different ways.

11 **Demonstrate** how a eucalypt depends on both its biotic and its abiotic environment.

Analysing

12 **Compare**:
a a community with an ecosystem
b abiotic and biotic factors
b predator and prey
c parasite and host.

13 a **Discuss** five biotic factors and five abiotic factors in your environment.
b **Compare** these factors with those for a kangaroo.

14 Most of the land animals found in the Arctic and Antarctica are birds or mammals. Few are reptiles or frogs. **Compare** these animals and **explain** this observation.

15 **Compare** the effects of the following five abiotic factors on plants in beach sand dunes and plants in a rainforest: temperature, humidity, soil moisture, sunlight and wind.

Evaluating CCT

16 a **Classify** a human as endothermic or ectothermic.
b **Justify** your answer.

17 a **Classify** each of the relationships listed below as examples of competition, predation, parasitism or commensalism.
b **Justify** your answers.
i falcon and budgerigar
ii tick and bobtail lizard
iii human and pet budgerigar
iv tinea and human
v lion and cheetah
vi sheep and bacteria in its gut
vii rabbits, foxes and wedge-tailed eagles
viii soldier ant and worker ant in a colony

18 **Propose** a reason why mosses are more likely to grow on the southern side of trees in Australia than on their northern sides.

19 Fewer crayfish are caught on nights when the moon is full and the sky is clear than on nights that are overcast or when there is no moon in the sky. **Propose** a reason why.

Creating CCT

20 **Design** an experiment to test the response of a slater, mealworm or millipede to light.

Inquiring

ADDITIONAL

Research the use and humane treatment of animals in scientific research. Once you have gathered your findings, hold a class debate on why an investigation involving or affecting animals must be humane, justified and ethical. CCT EU

ADDITIONAL

8.1 Practical investigations

1 Termite guts

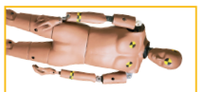
Purpose

To investigate what lives inside termite guts.

Materials

- 0.6% saline solution (non-iodised salt) in dropper bottle
- termite

- small watchglass
- fine forceps
- Petri dish
- microscope slides
- coverslips
- monocular microscope with 40× objective lens
- razor blade
- dissecting needle



SAFETY

Be extremely careful with the razor blade, needle and forceps.

Wash your hands carefully after the dissection.

Procedure

1. This involves killing a termite. If you don't want to do this, then ask your teacher to do it. Grasp a termite with fine forceps and drop it into the saline solution in the watchglass.
2. Using the razor blade, remove the termite's head. Hold the thorax with fine forceps and use a dissecting needle to pull out the abdomen and puncture the gut.
3. Place a drop of saline on a slide and dip the gut into it. Then put the gut back in the Petri dish. Add a coverslip and observe the slide with a light microscope. Observe first on low power, then on high power with a 40× objective.

Results

1. Describe the organisms you see and record how many different ones there are.
2. Sketch the different flagellates you find.

Practical review

1. **Explain** why the flagellates are essential to the survival of the termite.
2. **Classify** the relationship between the termite and the flagellates.

STUDENT DESIGN

2 Temperature and activity

Purpose

To test how temperature affects animals.

Hypothesis

What effect do you think temperature will have on animals? Before you go any further with this investigation, write a hypothesis in your workbook.

Materials

- animals such as slaters, ants, mealworms or other insects
- access to hot and cold water
- ice

- thermometer
- at least four containers such as beakers and Petri dishes
- marking pens

SAFETY

A risk assessment is required for this investigation.

Procedure

1. Design an experiment that will test the effect of temperature on the activity of animals.
2. Brainstorm in your group and come up with several different ways to investigate the problem. Select the best procedure and write it in your workbook. Draw a diagram of the equipment you need.
3. Before you start any practical work, assess all risks associated with your procedure. Construct a risk assessment that outlines these risks and any precautions you need to take to minimise them. Show your teacher your procedure and your risk assessment. If they approve, then collect all the required materials and start work.

Hints

As part of the planning process, decide which animals you will use in the activity. Remember that you must not harm the animals. To design your experiment, you must consider:

- what activity you will measure
- how to change the temperature
- what equipment you will need.

Temperature and activity continued on next page

8.1 PRACTICAL INVESTIGATIONS

RESOURCES

Pearson eBook

Teacher support

To help in the preparation of practical investigations, the following resources are available on Pearson eBook:

- risk assessments
- safety notes
- technician checklist and recipes.

1 Termite guts

Hints and common mistakes

Suggest research into the termite *Trichonympha* for background information and extension information.

Possible results

Student observations and drawings

Suggested answers

1. The digestive enzymes produced by the termite cannot digest wood, the termites' only food. The flagellates produce enzymes that are able to digest wood. The termites allow the flagellates to live in their gut in order to obtain the products of the digestion of wood. The flagellates live in the gut of the termites in order to have a stable and suitable environment in which to live.
2. The relationship between the termites and flagellates is an example of mutualism.

13 a Student responses will vary.

b A kangaroo may have some similar biotic factors such as parents, plants for oxygen, but it would not have other kangaroos that raise food and cure illness. However, it will have strong males to defend the family, experienced animals which can locate foods, etc. The abiotic factors would be similar to humans—sunlight, rainfall and temperature would affect food plants, temperature affects amount of disease causing bacteria and fungi, fires could affect kangaroo survival, wind affects amount of pollen and dust in the air (affects breathing of asthmatics). Hunters trying to kill kangaroos for sale or food would be different from human factors. Answers will depend on the factors discussed in part **a**.

14 Birds and mammals are endothermic; reptiles and frogs are ectothermic. The Arctic and Antarctica are extremely cold and would be a difficult place for an animal to live if it could not produce its own heat. Reptiles and frogs would find it extremely difficult to find a place where they could absorb heat from the surroundings. Their body temperatures could fall to freezing and they could freeze to death.

15 Temperature—less variable and probably lower during day in the rainforest

Humidity—fairly stable and high in rainforest, variable and often low in sand dunes

Soil moisture—more stable in rainforest, variable in sand dunes

Sunlight—rainforest floor has little light whereas sand dunes have long hours of direct sunlight

Wind—little in rainforest, especially at ground level; very windy at sand dunes

2 Temperature and activity

SAFETY SPOT

- Check the students' procedures, risk assessments and safety equipment before they begin.
- Discuss how animals will be collected, to minimise the risk of bites and stings. Wear gloves.

Hints and common mistakes

Do not let students expose the animals to temperatures that may harm the animals. The highest temperature that should be tried is 30°C, and the lowest 10°C. Also avoid experimental designs where animals could come directly into contact with ice.

Use two Petri dishes, each with a 1 cm square graph grid drawn on the bottom. Float the dishes on water in two trays. One tray has hot water, the other cold. Count how many sections each ant passes through in 2 minutes.

Possible results

Student results

Suggested answers

1,2 Students should find that animals are more active at higher temperatures.

3 The enzymes that catalyse the chemical reactions in the animals work best at warmer temperatures. The animals are 'cold-blooded' and cannot warm their own blood. Warming the animals allows the chemical reactions, including muscular contractions, to work more efficiently.

4 a Small animals are more active at warmer temperatures.

b The hypothesis is supported if the conclusion agrees with the hypothesis.

5 Discuss whether the experiment produced clear results or not.

3 Plants and fire

SAFETY SPOT

Check the procedures, risk assessments and safety equipment of the students before they begin. Any fires should be located outside in a safe environment.

8.1 Practical investigations

Temperature and activity continued

Results

Present your data in a suitable way.

Practical review

1 **Describe** any pattern or patterns you found in the data.

2 **Summarise** the relationship between temperature and animal activity.

3 **Explain** the relationship between temperature and activity.

4 a **Construct** a conclusion for your investigation.

b **Assess** whether your hypothesis was supported or not.

5 **Evaluate** your procedure. Pick two other prac groups and **evaluate** their procedures too, identifying their strengths and weaknesses.

STUDENT DESIGN

3 Plants and fire

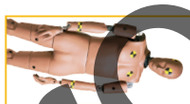
Some Australian native plants germinate after a fire because of a chemical in the smoke and not because of the heat from the fire. The chemical is released into the air in smoke and can also be found in ash produced after a fire.

Purpose

To test whether ash makes seeds germinate rather than the heat of the fire.

Materials

- as selected by students (probably wattle seeds, featherflower (*Verticordia*) or fringe myrtle (*Calytrix*) seeds, containers, matches, newspaper or leaves to burn, can, beakers, water)



SAFETY

A risk assessment is required for this investigation.

Fires must only be lit outside the classroom in an appropriate container. Teachers must supervise at all times.

Procedure

1 Design an experiment that will test whether it is the ash or the heat from a fire that causes seeds to germinate.

2 Brainstorm in your group and come up with several different ways to investigate the problem. Select the best procedure and write it in your workbook. Draw a diagram of the equipment you need.

3 Before you start any practical work, assess all risks associated with your procedure. Construct a risk assessment that outlines these risks and any precautions you need to take to minimise them. Show your teacher your procedure and your risk assessment. If they approve, then collect all the required materials and start work.

Hints

Your team will need to decide aspects of your design such as:

- how you will test the effect of heat on the seeds (putting them directly in a fire will kill them)
- whether you will subject the seeds to a fire (which would need to be done in a tin can outside the classroom) or some other source of heat such as hot or boiling water
- how you will capture chemicals from ash so that you can then use on the seeds (capturing smoke is a bit difficult in a school setting without special equipment).

Results

Construct a table showing your results and the results of other prac teams.

Practical review

1 **Construct** a report on the experiment.

2 **Propose** how the results could be of use in repairing ecosystems.

3 **Evaluate** your procedure. Pick two other prac groups and **evaluate** their procedures too, identifying their strengths and weaknesses.

Hints and common mistakes

When seeds are heated they will need to be protected from extreme heat. This may be achieved by using an oven, which has the added advantage of measuring the temperature accurately, or burying the seeds in the soil below the fire, as would occur naturally, or boiling the seeds in water.

Ash may be collected from a cold, extinguished fire. The ash can be made into a paste using water, and the seeds added to the paste.

Don't forget to use a control, i.e. seeds that have not been treated with ash or heat.

A known number of heat-treated, ash-treated and untreated seeds can then be placed in potting mix in three labelled pots, kept moist, and allowed to germinate. Calculate the percentage of seeds that germinate in each pot.

Possible results

The ash-treated seeds should have the highest germination rate.

Suggested answers

1 Student report.

2 In some areas, plant species may die out because the conditions for seed germination are not present. This situation could be addressed by spraying the area with the chemical in the ash that promotes seed germination.

3 Student response.