Growth and reproduction

4

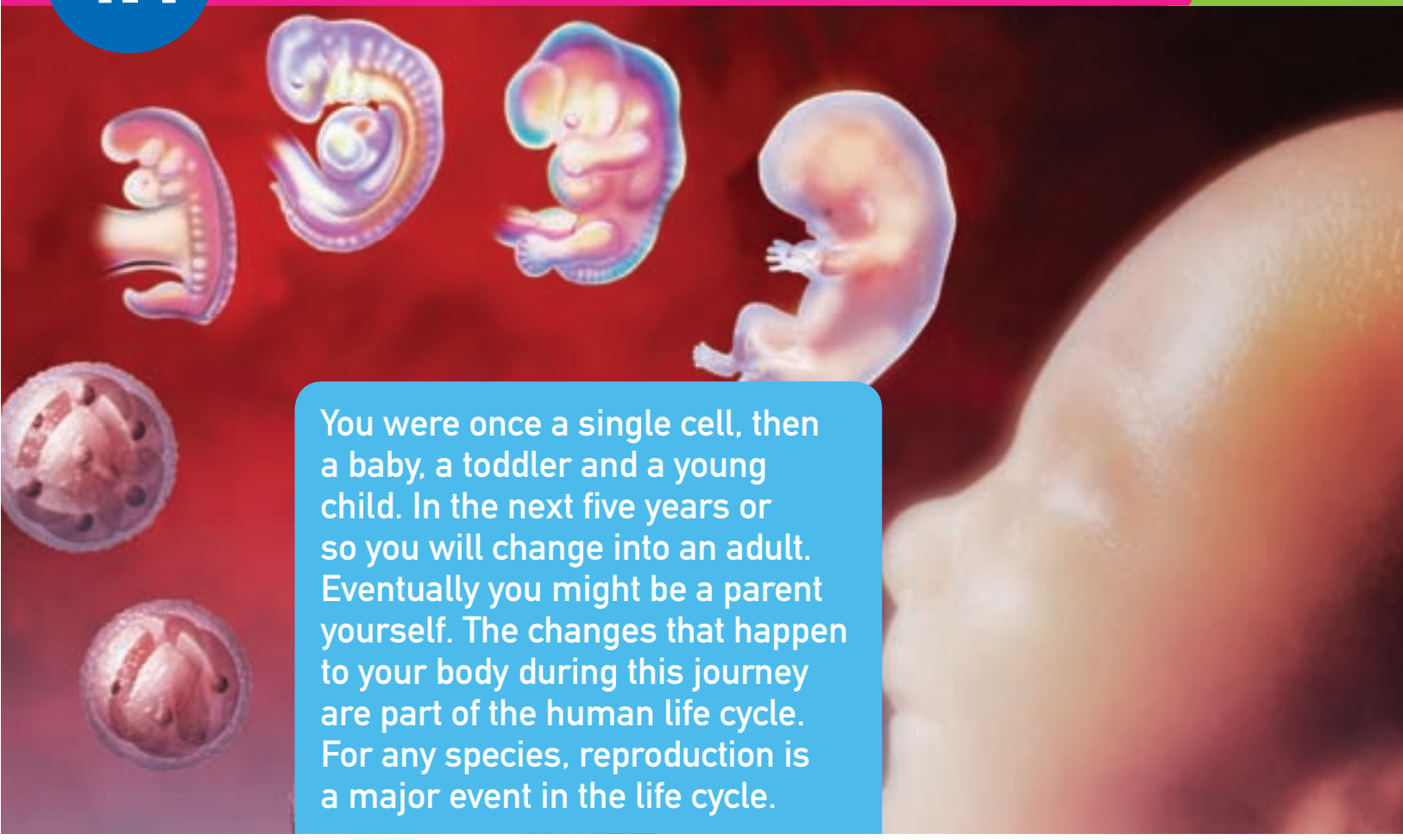
HAVE YOU EVER WONDERED…

- how babies grow inside their mother?
- why there are so many different types of flowers?
- why animals have different sexes?
- why males and females look different?

After completing this chapter students should be able to:

- compare reproductive systems of organisms
- distinguish between sexual and asexual reproduction
- identify the organs and overall function of a system of a multicellular organism
- describe the structure of each organ in a system
- recall that cells reproduce via cell division
- research the use of reproductive technologies.

4.1 Life cycles



You were once a single cell, then a baby, a toddler and a young child. In the next five years or so you will change into an adult. Eventually you might be a parent yourself. The changes that happen to your body during this journey are part of the human life cycle. For any species, reproduction is a major event in the life cycle.

What is a life cycle?

A cycle is something that goes around and around, repeating itself. The seasons occur in a cycle, where the weather changes through spring, summer, autumn and winter, and then back to spring again. All organisms go through a cycle in their lives. Organisms change as they grow, but they do not return to their starting point. Instead, the organisms reproduce, and the pattern of growth begins again in their young. **Reproduction** is the process of parents producing new individuals, or offspring. For example, in humans, the **life cycle** goes through the stages of a developing baby, a toddler, a child, an adult and finally a parent.

At each stage the organism might look different and have different roles. For example, when young, an organism may be dependent on its parents. Later in life, the organism may care for its own young. Life cycles can be very different in different types of organisms. For example, the life cycles of insects, frogs and grasses are very different from the life cycle of humans.

Insect life cycles

The life cycle of the wanderer butterfly is shown in Figure 4.1.1. It starts when an adult male and an adult female mate. Mating results in the female laying an **egg** on a leaf. In the next stage, the egg hatches into a **larva**, which is commonly called a caterpillar. The caterpillar eats steadily and grows bigger. It then changes into a **pupa** (plural: pupae), a life stage where it does not eat. Inside the hard case of the pupa some amazing changes take place. The caterpillar's body completely rearranges and re-forms itself into a butterfly. It grows wings, different eyes, antennae, legs and many other body parts. The butterfly is known as the adult, or **imago** stage. The butterfly breaks out of the pupal case and flies away to find a mate and start the whole cycle again.

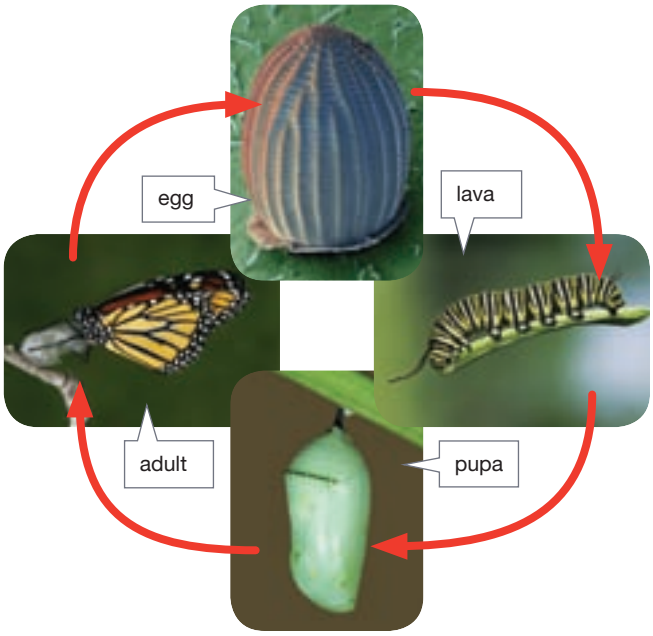


Figure 4.1.1 The life cycle of the wanderer butterfly shows four different life stages—egg, larva, pupa and adult.

INQUIRY

science 4 fun

Garden life cycles

Can you see a life cycle in the garden?

Yes

Do this…

1. Search in a garden for insects. Look for evidence of different stages in the life cycle of an insect, such as egg, larva, pupa or adult.
2. Carefully observe the area to see if there are different stages of the life cycle in the same place. You could use your mobile phone or camera to take a photo if you are not sure what you have found and identify it later in class.

Record this…

Describe what you observed.

Explain what happens to the insect in this part of the life cycle.

Growth and development

The changes in body form and shape in the course of an organism's life are called **development**. Development is different from growth. For an insect, **growth** means becoming larger, whereas development in an insect is about changes such as wings or legs forming. Usually as an organism grows, it also develops.

Metamorphosis

The life cycle of the wanderer butterfly has four stages—egg, larva, pupa and adult. These stages look very different, and show a metamorphosis. **Metamorphosis** means 'changing form', referring to the changes in structure that happen as an organism develops into an adult.

The butterfly life cycle is known as complete metamorphosis. Most insects have this type of life cycle, including moths, bees, wasps, flies, mosquitoes and beetles.

Other insects have different life cycles. An example is the grasshopper, which has a life cycle called incomplete metamorphosis. You can see in Figure 4.1.2 that grasshoppers have no pupa. The young is called a **nymph**, and looks like a smaller version of the adult but with a few parts still undeveloped. The nymph slowly changes into the adult, developing wings as it matures. Insects such as cockroaches, earwigs, termites, dragonflies and all the true 'bugs' have this type of life cycle.

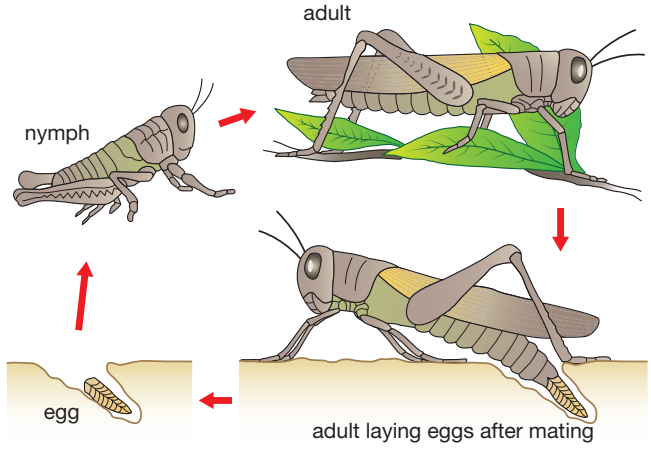


Figure 4.1.2 The life cycle of the grasshopper shows incomplete metamorphosis, with three stages—egg, nymph and adult.

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4.1

Frog life cycle

As you can see in Figure 4.1.4, frog and toad life cycles have four stages—egg, tadpole, metamorph and adult frog. The life cycle begins with two parents mating. During mating the male clings onto the female until she passes her eggs into the water. Then the male sheds (spreads) a fluid over the eggs that contains special cells called sperm. Sperm are special cells involved in reproduction. One sperm cell fertilises the egg. Most frog parents then leave the eggs and give them no parental care. Tiny tadpoles develop inside the fertilised eggs, then break out of the egg and gradually grow larger. As the tadpole grows, it develops legs. It is now known as a metamorph (or froglet). The gills it used for breathing in water are gradually replaced by lungs for breathing air. The metamorph slowly absorbs its tail as its legs grow longer. Eventually it becomes an adult frog and can produce its own offspring.

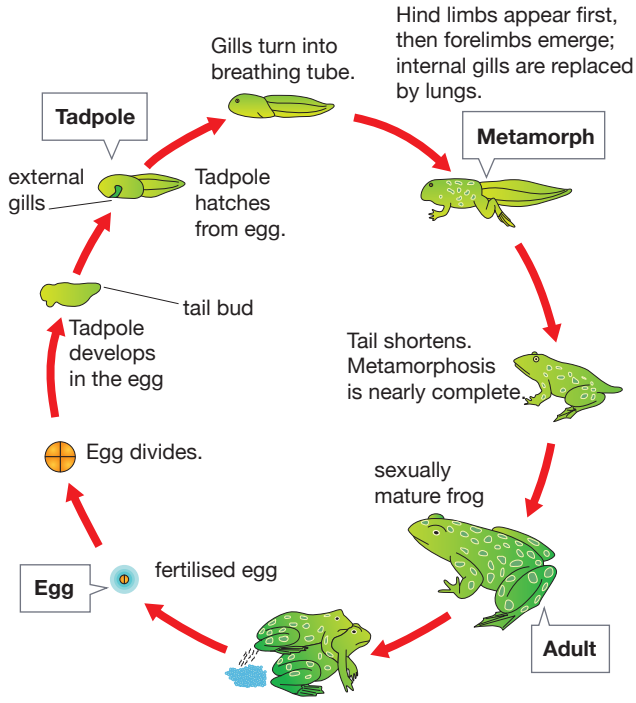

Figure 4.1.4 The female lays 500–5000 eggs, which the male fertilises.

The life cycle of a frog, showing four main stages: adult, egg, tadpole and metamorph (or froglet)

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Figure 4.1.3 A gastric brooding frog giving birth to its young after raising them in its stomach. The paperclip shows how small this frog is.

SciFile

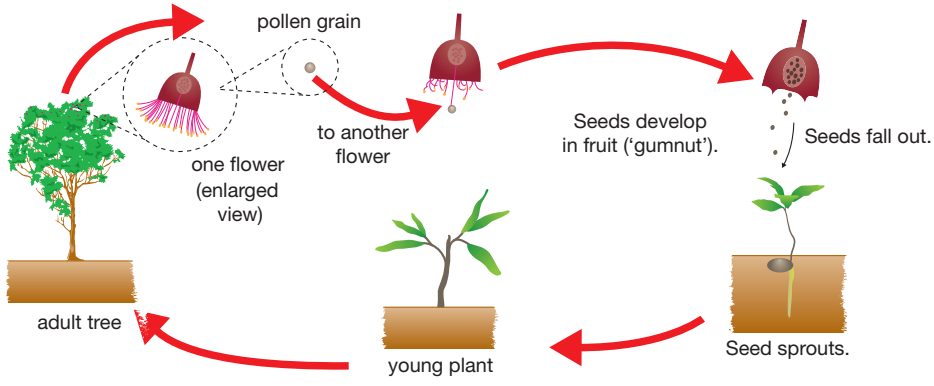
Stomach breeders

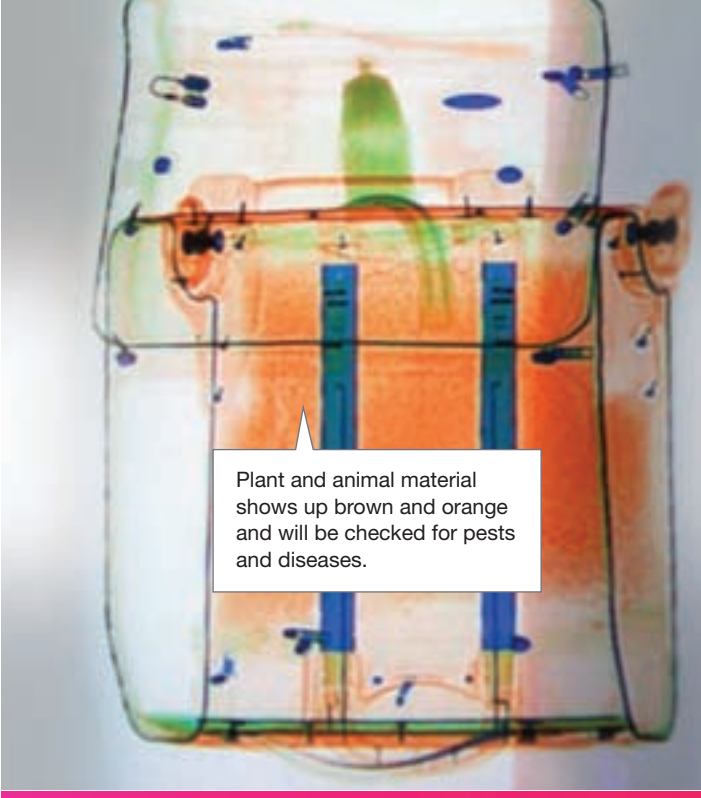
The females of Queensland's gastric brooding frogs protected their young by swallowing their fertilised eggs. The female frogs did not eat while the young frogs developed in their stomach. They gave birth by vomiting out the froglets just when their legs were developing. Gastric breeding frogs haven't been found in the wild for many years and may be extinct.

Plant life cycles

Plants have many different types of life cycle. In Figure 4.1.5 you can see the life cycle of a eucalyptus tree (gum tree), which is a flowering plant. The tree produces flowers, special structures that make seeds. Flowers produce tiny particles called pollen, which contain a special male reproductive cell called a sperm. This must join with the female egg in a different part of the flower. When these two particles join up, they develop to form a seed. The seed will sprout (germinate) and grow into a new adult tree.

Figure 4.1.5 The life cycle of a eucalyptus tree





SCIENCE AS A HUMAN ENDEAVOUR

Use and influence of science

Customs and quarantine

Figure 4.1.6 This is what a quarantine inspector might see when your bag is X-rayed.

At airports and shipping ports, Australian Customs Service officers can be seen inspecting passengers' luggage. Sometimes instead they check X-rays of the luggage. This is shown in Figure 4.1.7. They are not just looking for drugs. They are also looking for items that could accidentally bring serious diseases or pests into Australia that could affect our health or destroy our agriculture and tourism. Preventing the entry of disease-causing organisms and pests into a country is known as **biosecurity**.

Items brought back from overseas can carry live organisms at various stages in their life cycles. For example, the souvenirs you bring home might contain insects as eggs, larvae, pupae or adults. Some may be hard to see, such as insect larvae living inside wood or plants. Pupae can be found inside wood or on leaves. Adult insects, such as weevils, can be found inside seeds. Food can contain microscopic bacteria and viruses and these will be impossible to find on inspection at the airport. Soil can carry all these organisms too.

For these reasons, the following items are not allowed into Australia:

- dairy products (such as cheese)
- uncanned meat (such as salami)
- seeds (such as spices)
- fruits and vegetables
- live animals and plants (some might be hidden inside souvenirs made of wood or cane)
- soil, dirt or mud (some might be trapped in the treads of your shoes).

Sometimes living organisms can be imported under licence. For example, racehorses, dogs and cats can be imported but need to be placed in quarantine (away from other organisms) and observed to make sure they do not have infectious diseases. Non-living items such as wood and cane furniture and souvenirs can be fumigated with chemicals to kill any live insects, worms and bacteria they may contain. A specialist division of the customs service called the Australian Quarantine Inspection Service (AQIS) carries out these tasks. One of their posters is shown in Figure 4.1.8 on page 136.

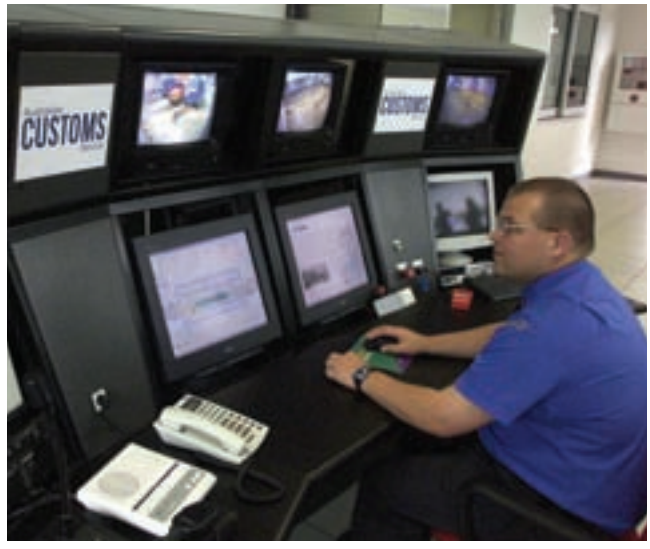


Figure 4.1.7 A customs officer checking X-ray images for prohibited items in passengers' luggage

Figure 4.1.8 This poster from the Australian Quarantine Inspection Service (AQIS) shows organisms that pose a threat to our health and industries.

Figure 4.1.9 Varroa mites on a honey bee

Some of the biosecurity threats to us are shown in Table 4.1.1.

Table 4.1.1 Biosecurity threats to Australia

Threat organism	Where is it found?	What is the threat?
Red imported fire ant	South America, USA	An insect that is aggressive and has a painful sting that can cause allergic reaction and even death in humans. Will prevent an outdoor lifestyle and can kill native wildlife.
Varroa mite (Figure 4.1.9)	Worldwide	A mite that feeds on European honey bee larvae and adults, destroying the colony. Could destroy beekeeping and the orchards and nurseries that depend on bees.
Asian longhorn beetle (Figure 4.1.10)	China, Korea, Japan, USA	An insect that burrows into the wood of trees and into timber. Could destroy Australia's forests and timber industry.
Guava rust	North and South America	A fungus that affects eucalypts, corymbias, bottlebrushes and paperbarks and other plants in the myrtle family. Can kill young trees and seriously slow the growth of adult trees.
Rabies virus	Most of the world except Australia, New Zealand, UK	A virus that infects animals such as dogs, foxes and humans, causing death in about four days. Can be treated, but about 40 000 people die each year from it.
Bird flu virus	Worldwide, though rarely in Australia	A virus that infects and often kills birds. Some strains can infect humans and some deaths have occurred.

Figure 4.1.10 Asian longhorn beetles burrow into the wood of trees

4.1 Unit review

Remembering

1 **Name** the process by which parents produce offspring.

2 **List** the four stages in the life cycle of a butterfly.

3 **List** the three stages of an incomplete metamorphosis life cycle in insects.

4 **Recall** what happens inside a butterfly pupa.

5 **List** five types of item that are not allowed to be brought into Australia.

Understanding

6 **Explain** why reproduction is a necessary part of a life cycle.

7 **Describe** some structural changes that occur when a tadpole becomes a frog.

8 **Describe** some structural changes that occur as a grasshopper nymph becomes an adult.

9 **Define** the following terms.

- **a** reproduction
- **b** life cycle
- **c** growth
- **d** development
- **e** biosecurity

10 **Explain** the role of the Australian Customs Service and AQIS.

11 If you move overseas and take your dog with you, it may have to stay in isolation at a quarantine area for several months. **Explain** why quarantine is necessary.

Applying

12 **Identify** the following stages in the life cycle of a mosquito, which undergoes complete metamorphosis.

- **a** This stage lives in water and feeds on microscopic plants.
- **b** This stage breaks out of its skin at the water surface and flies away.
- **c** These are laid by the parent in water.
- **d** This stage does not feed at all, but develops wings, different eyes and long legs.

13 A person arrives by plane in Australia with some plant seeds, honey and dried flowers in their luggage. **Identify** possible problems they might have with Customs.

Analysing

14 **Compare** the life cycles of a grasshopper and a frog.

15 **Compare** the life cycles of a butterfly and a grasshopper.

16 Refer to the life cycle of the wanderer butterfly to help you **compare** growth with development.

Evaluating

17 The gastric brooding frog protected its young in the mother's stomach. A biologist claims this gave the young a greater chance of surviving than the young of other frogs. **Justify** this claim.

18 The larvae of houseflies are called maggots. They feed on decaying plant and animal matter. Understanding the life cycle of the housefly could help home owners to control houseflies. **Propose** how.

Creating

19 **Construct** a pamphlet for airline travellers about the dangers of bringing banned substances into Australia from overseas.

Inquiring

1 Research how Aboriginal people survived by observing the life cycles of plants and animals that they hunted or harvested. In your answer give relevant examples of a plant and an animal.

2 Research how methods in agricultural science, farming or fishing have improved through knowing about life cycles of plants and animals. Choose one plant and one animal. Some plants you could research are crops, introduced weeds and poisonous native plants. Animals you could research include livestock and native animals.

3 Life cycles such as that of a butterfly puzzled biologists for a long time. Research and report on the advantages to the insect of having very different stages in its life cycle.

4.1 Practical activities

1 Animal life cycles

Purpose
To compare different animal life cycles.

Materials
- live or dead specimens from the life cycle of animals such as fruit flies, mosquitoes, houseflies or silkworms
- information sheets on each animal
- glass jars
- cotton wool
- food scraps
- hand lenses or stereo microscopes

Procedure
Move around the room from one animal to another. Observe each and decide on the order in which the stages occur in the life cycle.

Results
1. Draw each stage in a simple outline diagram. Name the animal, label each stage and connect the stages with arrows.
2. Write on your diagram any additional information that may be on an information sheet near the specimens.

Discussion
Compare the life cycles of the animals you observed.

2 Plant life cycles

Purpose
To compare different plant life cycles.

Materials
- specimens or diagrams from the life cycle of plants such as flowering plants, moss, ferns, conifers and cycads
- hand lenses or stereo microscopes

Procedure
Move from one plant specimen to another. Observe each and decide on the order in which the stages occur in the life cycle.

Results
1. Draw each stage in a simple outline diagram. Name the plant, label each stage and connect the stages with arrows.
2. Write on your diagram any additional information that may be on an information sheet near the specimens.

Discussion
Compare the life cycles of the plants you observed.

Figure 4.1.11 Both the wild chicory plant and the bee have life cycles but each is very different.