4 Growth and reproduction

Have you ever wondered...

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

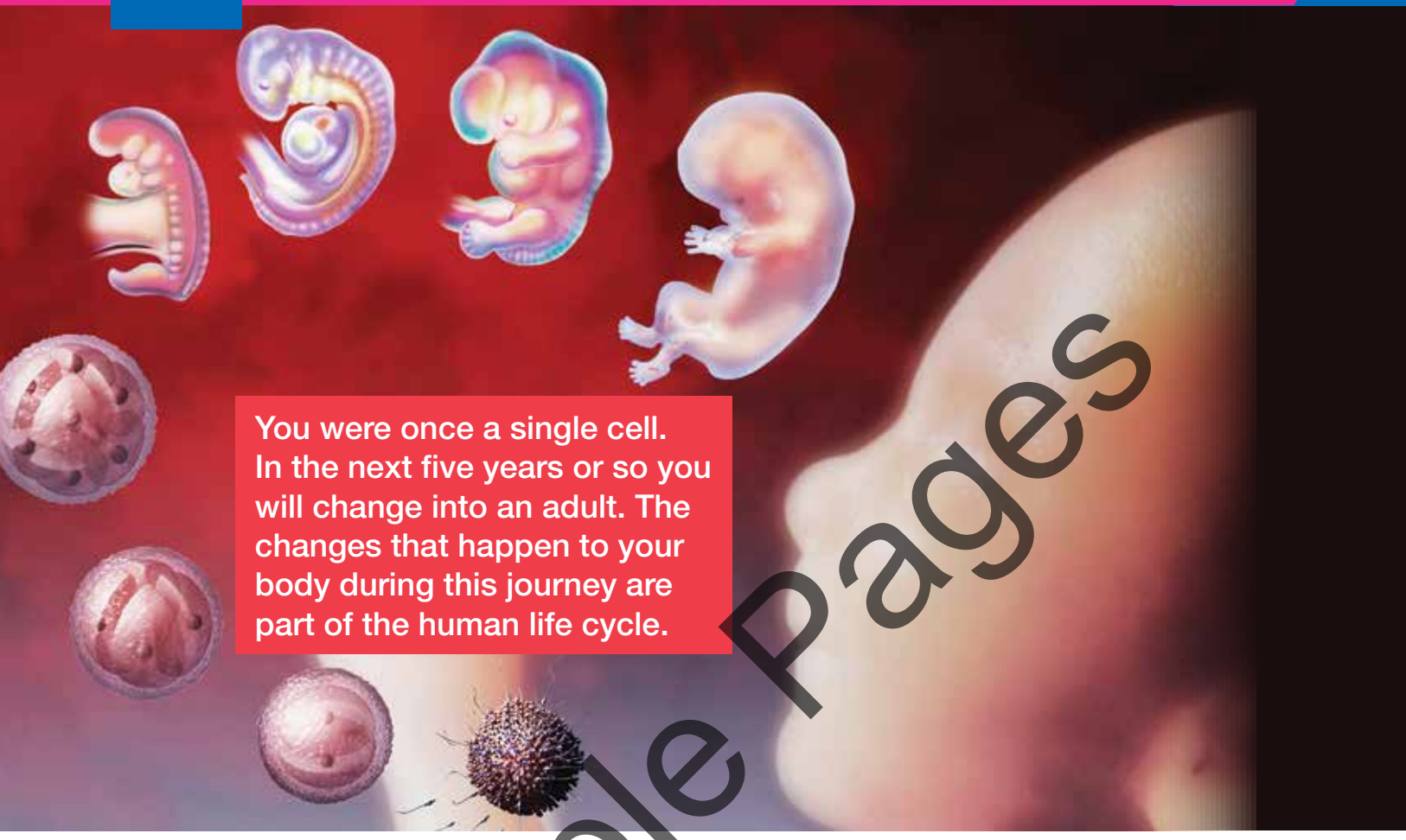
After completing this chapter students should be able to:

- identify that new cells are produced by cell division
- outline the role of cell division in growth, repair and reproduction in multicellular organisms
- describe the role of the flower in flowering plants L CCT
- outline the role of the reproductive system in humans
- research how changes in scientific knowledge have contributed to finding a solution to a human health issue CCT EU
- recall how scientific discovery has contributed to solving a real-world problem L PSC
- describe how developments in technology have contributed to finding solutions to a contemporary issue ICT L
- describe how people can hold different ideas about the application of a solution to a contemporary issue CCT DD PSC L

ADDITIONAL

- discuss how an understanding of the life cycles of native plants is used by Aboriginal and Torres Strait Islander peoples AHC
- propose reasons why society should support biological research. CCT PSC EU

4.1 Life cycles



You were once a single cell. In the next five years or so you will change into an adult. The changes that happen to your body during this journey are part of the human 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 in which parents produce new individuals, or offspring. For example, in humans, the **life cycle** goes through the stages of baby, toddler, child, adult and finally parent.

At each stage the organism might look different and have different roles. For example, a kitten is dependent on its mother. As a mature cat, it 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.

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. **Growth** is when an organism becomes larger, increasing its mass, length or volume. Development is about changes such as wings or legs forming. Usually as an organism grows, it also develops.

The life cycle of an insect

The life cycle of the wanderer butterfly is shown in Figure 4.1.1. It has four stages.

- 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, a life stage that 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 to form a butterfly.
- 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.

These four stages look very different—the wanderer butterfly has gone through dramatic changes known as metamorphosis. Most insects undergo metamorphosis during their life cycle, including moths, bees, wasps, flies, mosquitoes and beetles.

4.1 4.2

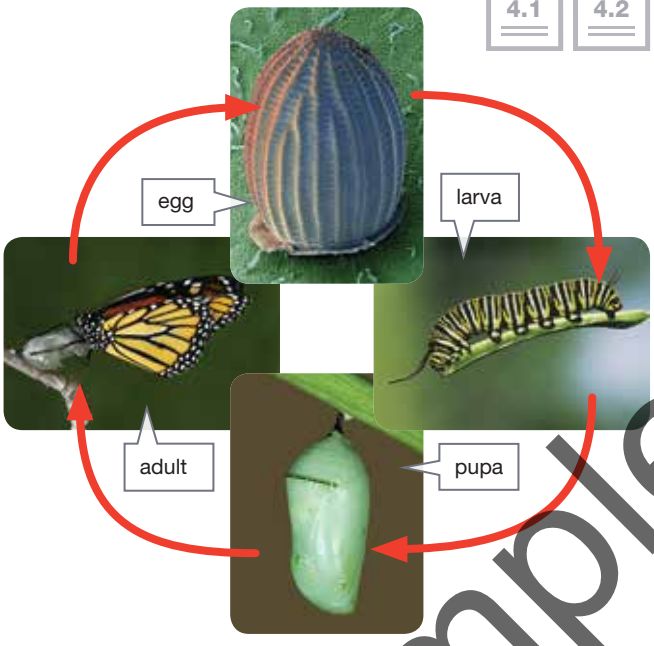


Figure 4.1.1 The life cycle of the wanderer butterfly shows four different life stages—egg, larva, pupa and adult.

The life cycle of a frog

As you can see in Figure 4.1.2, the life cycle of a frog has four stages: egg, tadpole, froglet and adult frog. The life cycle begins with two parents mating. During mating the male clings onto the female until she releases specialised cells called eggs into the water. Then the male spreads a fluid over the eggs that contains specialised cells called sperm. One sperm cell fertilises one egg cell. 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 froglet. The gills it used for breathing in water are gradually replaced by lungs for breathing air.

The froglet slowly absorbs its tail as its legs grow longer. Eventually it becomes an adult frog and can produce its own offspring.

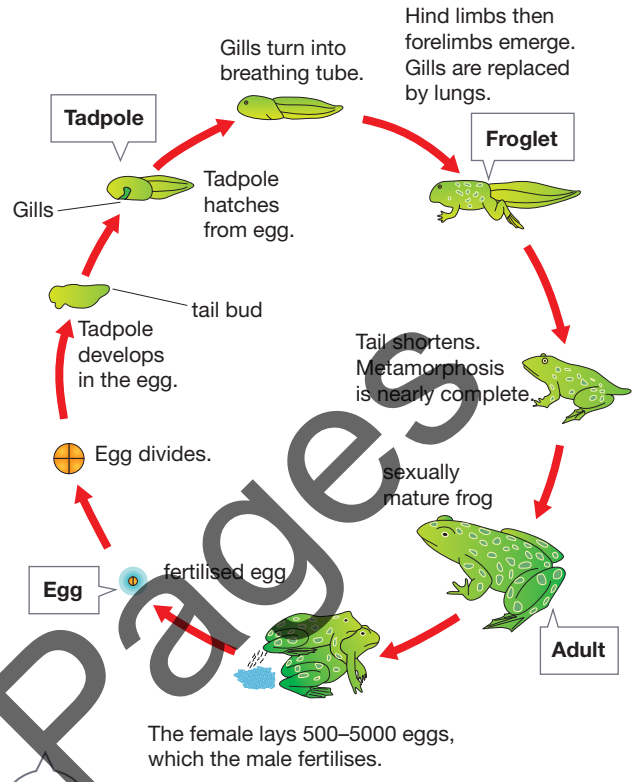


Figure 4.1.2 The life cycle of a frog, showing four main stages: adult, egg, tadpole and froglet

INQUIRY

science 4 fun

The life cycle of a garden

YES

Can you see a life cycle in the garden?

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.

Stomach breeders

SciFile

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 brooding frogs haven't been found in the wild for many years and may be extinct.

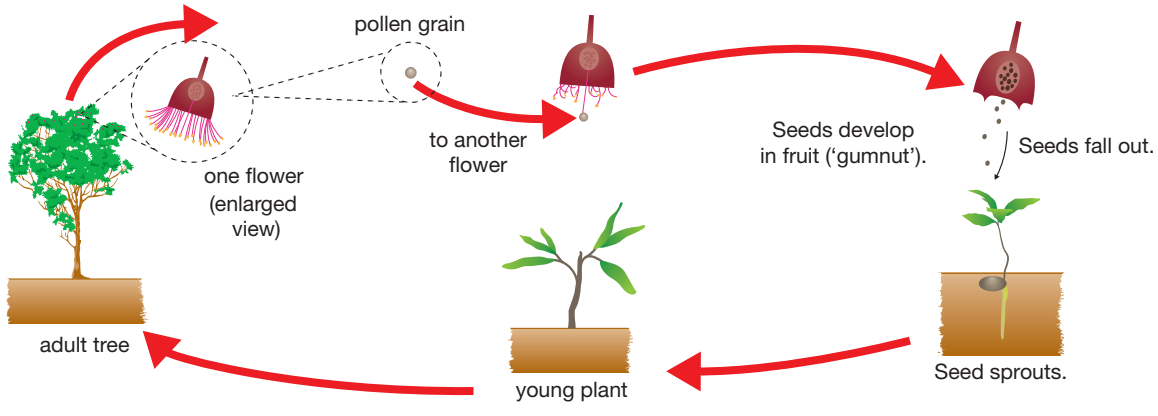
Figure 4.1.3 A gastric brooding frog giving birth to its young after they developed in its stomach. The paperclip shows how small this frog is.

Plant life cycles

Plants have many different types of life cycle. In Figure 4.1.4 you can see the life cycle of a eucalyptus tree (gum tree). The tree produces flowers, which are the organs that make its seeds. Flowers produce tiny particles called pollen, which contain sperm cells. This must join with the female egg in a different part of the flower. When these two reproductive cells join up, they develop to form seeds. The seeds will sprout (germinate) and grow into a new adult tree.

Prac 1 p144

Figure 4.1.4 The life cycle of a eucalyptus tree



Cell division, growth and repair

When multicellular organisms grow, they do so by making new cells. Each cell can divide into two new cells in a process called **cell division**. By repeated division, a few cells can produce the many cells that make up the tissues and organs that form the organism's body.

Cell division also allows multicellular organisms to repair themselves. **Repair** is the process of fixing damaged body tissues. Repair is necessary to rebuild:

- tissues that break or tear, such as your bones, muscles, tendons and ligaments
- tissues or organs that have been damaged by disease such as chickenpox, like that in Figure 4.1.5
- cells that break down or die as you get older
- tissues that are damaged by continual contact with materials from the environment. For example, your skin is constantly being worn away by the gases and dust of the air. The lining of your mouth is worn away by food and drinks that you consume.

Your body is continually repairing itself. Millions of your cells are dividing to form new cells right now! If it did not happen, your skin would wear away and so would the inside of your intestines. Cuts in your skin, torn muscles and broken bones would never heal. You would also run out of blood.

GO TO Unit 2.2

New blood

SciFile

Your body replaces almost 1% of its red blood cells every day. Each red blood cell only lives about 110 days, and so new blood cells constantly need to be formed through cell division in your bones and spleen.

Figure 4.1.5 The production of new cells in multicellular organisms enable tissues to grow and repair themselves. This child's skin will repair the damage caused by chickenpox.

Splitting the nucleus

When a cell splits into two, the most important part that must divide is its nucleus. The nucleus is the 'control centre' of a cell. It contains genetic information, which controls everything a cell does, such as making chemicals or repairing itself. **Mitosis** is the process in which a nucleus divides to form two cells with identical genetic information. You can see mitosis happening in Figure 4.1.6.

Mitosis gives each new cell its own nucleus. But each nucleus is an exact copy of the nucleus from the original parent cell. In this way, each newly formed nucleus contains all the genetic information that the parent nucleus contained. In multicellular organisms like you, mitosis causes skin cells to form new identical skin cells. Likewise, muscle cells divide to form identical muscle cells and fat cells split to form identical fat cells.

If the nucleus is not copied correctly, then the new cells may be missing the genetic information needed to function properly. The new cells might even die.

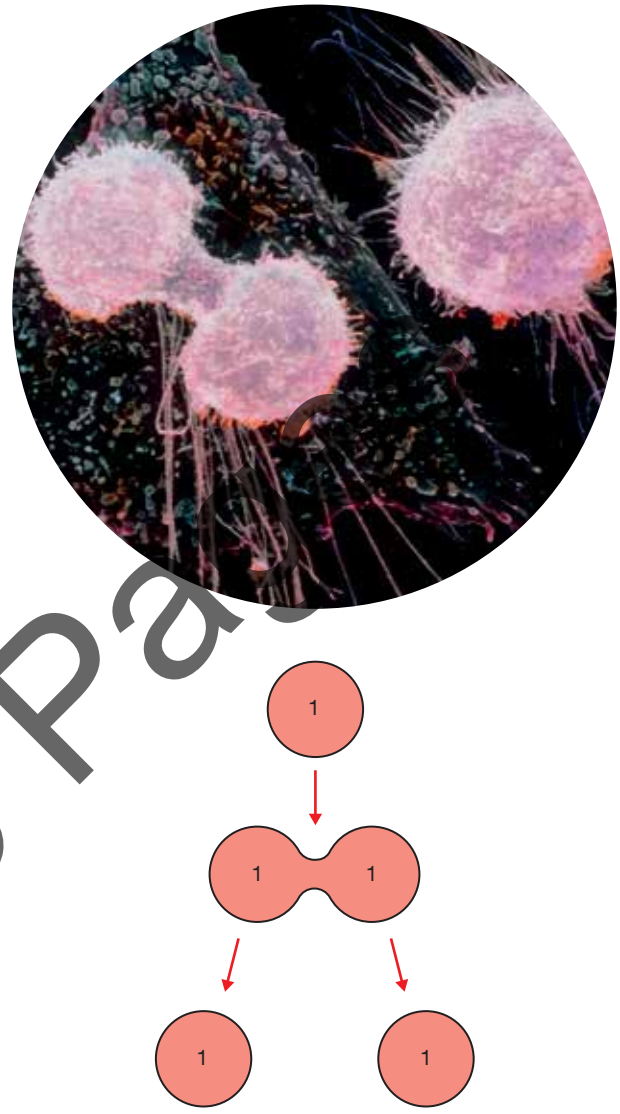


Figure 4.1.6 Mitosis produces two identical cells.

When division goes wrong

Sometimes cell division goes wrong in multicellular organisms. The cells keep dividing out of control. Their genetic information can become changed by this continual division, resulting in new cells that are not able to perform their normal functions. The altered cells may also spread to other parts of the body and cause damage to other tissues. This is cancer.

SciFile

Prac 2 p144

LEARNING ACROSS THE CURRICULUM

ETHICAL UNDERSTANDING

IAN FRAZER AND THE HPV VACCINE

Cervical cancer is cancer of the cervix, part of the female reproductive system. This cancer kills about 250 000 people worldwide each year.

Some cancers are caused by infectious micro-organisms such as viruses and bacteria. A virus called the human papilloma virus (HPV) causes 70% of all cervical cancers.

Immunisation is the process of injecting a chemical (called an antigen) into the body, which stimulates the body to defend itself against the chemical. The body produces several types of white blood cells that can destroy the foreign chemical. Some of these cells (called memory cells) then remain in the body. If the virus enters the body in future, the memory cells detect the chemical on the surface of the virus. The memory cells then stimulate the body to produce large numbers of white blood cells that can destroy the virus before it can multiply and damage the body. This is called the immune response.

In 2006, Australian scientist Professor Ian Frazer (Figure 4.1.7) developed a new vaccine called Gardasil®. Gardasil is now routinely used to immunise young women, making it unlikely that they will develop cervical cancer from any future HPV infection. (Figure 4.1.8)

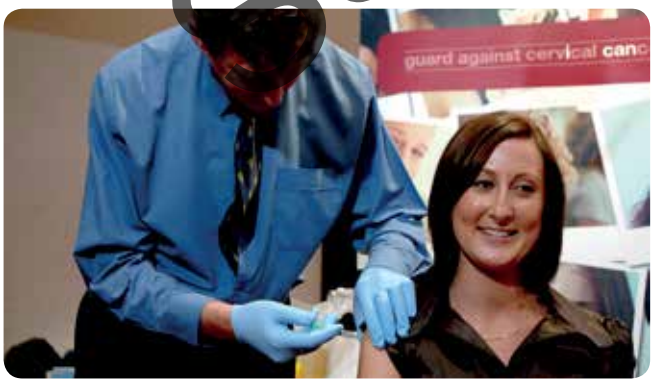


Figure 4.1.8 Professor Ian Frazer immunises a young woman with his Gardasil vaccine.

Figure 4.1.7 Ian Frazer developed a vaccine for HPV, a virus that can cause cervical cancer in women.

REVIEW

1. **Name** the disease that Ian Frazer is helping to prevent.
2. **State** how many people die of the disease around the world each year.
3. **State** the name and type of organism that causes the disease.
4. **Describe** the how Gardasil vaccine causes the body to respond.
5. **Describe** how a person who has been immunised with Gardasil responds if they become infected by HPV.

ADDITIONAL

6. **Discuss** why society should support research in biological science, such as that of Professor Frazer.

ADDITIONAL

4.1 Unit review

Remembering

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

2 **Name** the specialised:
- a male reproductive cell
- b female reproductive cell.

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

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

5 **List** the evidence you might find in a garden that indicates that insects and plants have life cycles.

6 **List** four ways in which cell division is important in multicellular organisms.

Understanding

7 **Define** the following terms. L
- a reproduction
- b life cycle
- c mitosis

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

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

10 **Explain** why the nucleus is the most important part of the cell.

11 a **Explain** why the nucleus must be copied exactly during mitosis.
- b **List** what might happen if the nucleus is copied wrongly.

12 a **List** three injuries and illnesses you have had.
- b **Explain** how cell division was important in helping you get better again.

Applying

13 A Year 8 boy fell off his skateboard and badly grazed his knee. A scab formed and remained there for several weeks. When the scab fell off, the skin below had healed. **Use** your understanding of cell division to **explain** what happened beneath the scab.

Analysing

14 **Use** the life cycle of the wanderer butterfly to help you **contrast** growth with development.

15 a **List** some of the ways a person's body changes through life.
- b **Classify** each change as growth or development.
- c **Demonstrate** the importance of cell division in these changes.

16 **Compare** cancer with normal cell division.

Evaluating CCT

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 CCT

19 **Construct** a table listing five organs of the human body and the role that cell division plays in the function of each organ.

Inquiring

1 Research how changes in scientific knowledge have contributed to finding a treatment for a particular form of cancer. In particular:
- name the cancer you researched
- discuss recent advances in knowledge about the cancer
- discuss treatment methods that developed or are being developed from the new knowledge of the cancer.

Present your research in digital or written form. ICT EU

ADDITIONAL

2 Research how for thousands of years Aboriginal and Torres Strait Islander people benefited from their knowledge of the life cycles of the plants around them.

Present your findings in written or digital form. AHC ICT

ADDITIONAL

4.1 Practical investigations

1 Animal and plant life cycles

Purpose

To compare different animal and plant life cycles.

Materials

- specimens from the life cycle of animals such as fruit flies, mosquitoes, houseflies or silkworms
- specimens or images from the life cycle of plants such as flowering plants, mosses, ferns, conifers or cycads
- hand lenses or stereomicroscopes
- information sheets on each organism
- glass jars (if using live animals)
- food scraps (if using live animals)
- cotton wool

Procedure

Move around the room from one specimen to another. Carefully observe the specimen and record as many observations about it as you can.

Results

1. Decide on the order in which the stages occur in the life cycle.
2. Construct a simple diagram that shows each stage for each specimen you investigate.
3. Annotate your diagram with the name of the animal or plant. Label each stage and connect the stages with arrows. Write down on your diagram any additional information that may be on an information sheet near the specimens.

Practical review

1. **Compare** the life cycles of the animals you observed.
2. **Compare** the life cycles of the plants you observed.

2 Observing cell division

Purpose

To observe cell division (mitosis) in plant roots.

Materials

- prepared slide of root tip (such as that from an onion)
- monocular microscope

Procedure

1. Use the low power lens on the microscope to focus on the root tip.
2. Search the few millimetres at the end of the root tip for nuclei that look like threads instead of dark circles. The cells with these nuclei are undergoing division.
3. Switch to high power and find a cell where the threads are clearly visible. Sketch this cell in your notebook.
4. Look for other cells that seem to be in different stages of dividing. For example, look for evidence of two newly formed cells.

Results

Draw and record the stages of division that you see.

Practical review

1. **Assess** whether all cells divide at the same time.
2. **Discuss** whether all the cells were dividing in the area of the root tip you looked at.

4.2 Methods of reproduction

Nothing lives forever. An insect may live for only a few weeks. A tree may last thousands of years. Since every individual will eventually die, there must be a way of producing new individuals or the species would become extinct. This production of new individuals by parents is called reproduction. It is one of the most amazing processes in nature.

INQUIRY
science 4 fun

Flowers

What is in a flower?

Collect this …

- 2 different garden flowers
- pair of tweezers
- knife or fine pair of scissors

SAFETY

Make sure you do not pick poisonous flowers such as oleander.

Take care with the knife and scissors.

Do this …

1. Look at each flower and identify parts of the two flowers that look similar.
2. Carefully pull each flower apart and place its different parts into separate piles. Each pile should have parts that look similar.
3. Try to find some seeds.
4. Think about the function (role) of the different parts of the flower.

Record this …

Describe what you observed.

Explain how each part might contribute to the life of the flower.

No one else is like you, unless you have an identical twin. However, all the plants in a crop of potatoes can be identical. This is because humans and potatoes reproduce in different ways.

There are two basic methods of reproduction:

- sexual (most species having two parents)
- asexual (needing only one parent). 'Asexual' means 'without sex'.

Although most plants and animals use only one of these methods, some can use both.

Sexual reproduction

Sexual reproduction happens when a sperm (from a male) and an egg (from a female) join together in a process called **fertilisation**. Sperm and eggs are special reproductive cells, known as **gametes**. The male gamete is sperm and the female gamete is the egg. Fertilisation results in a new cell called a **zygote**. The zygote then grows by dividing to form many copies of itself. The zygote eventually grows and develops into a new individual. In Figure 4.2.1 on page 146 you can see many human sperm around a single egg.

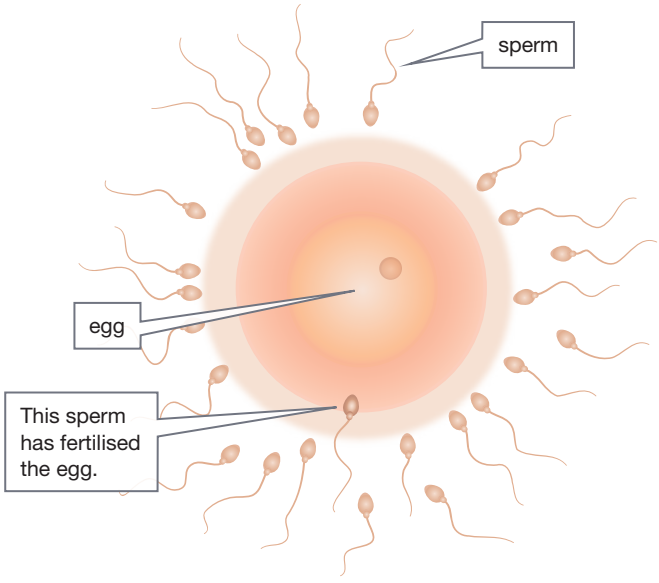


Figure 4.2.1 Human sperm and an egg. Sperm have a tail to help them swim. During fertilisation only one sperm enters the egg.

Humans, dogs, cattle, birds and kangaroos undergo sexual reproduction and need two parents, one male and one female.

A few species like tapeworms have individuals that have both male and female sex organs. They can therefore produce both sperm and eggs. Individuals with both sex organs are known as **hermaphrodites**. For example, snails (like the ones shown in Figure 4.2.2), slugs and flatworms are hermaphrodites. The ovaries make the female gametes and the testes make the male gametes.

Figure 4.2.2 Snails are hermaphrodites, and have both male and female sex organs.

Sex-change fish

Clownfish all start off life as males, but can change sex to female. This happens if the dominant female in an area dies. The dominant male then changes sex to female. Some wrasse fish can change sex from female to male.

SciFile

Cell division and gametes

Gametes are formed by a type of cell division that occurs only in the male and female reproductive organs. This process is called **meiosis**. The cell division that forms gametes is very different from the cell division that forms new body cells for growth and repair. In mitosis, a cell splits into two to form two identical cells, each containing all the genetic information the cell needs. However, in meiosis each cell splits into four. These four newly formed cells are different from each other.

In males, four sperm are formed from each parent cell. In females, four egg cells are formed. Each new gamete is different from the body cells, because it only has half the genetic information that a normal cell has.

To obtain the full amount of genetic information, a sperm cell needs to fertilise an egg cell. If this doesn't happen, then no new individual can form. The single fertilised cell that is formed (the zygote) has all the required genetic information that will allow it to grow into a new individual.

The zygote then divides repeatedly by cell division (mitosis). Every new cell in the individual comes from copying the original zygote cell formed at fertilisation. This is shown in Figure 4.2.3.

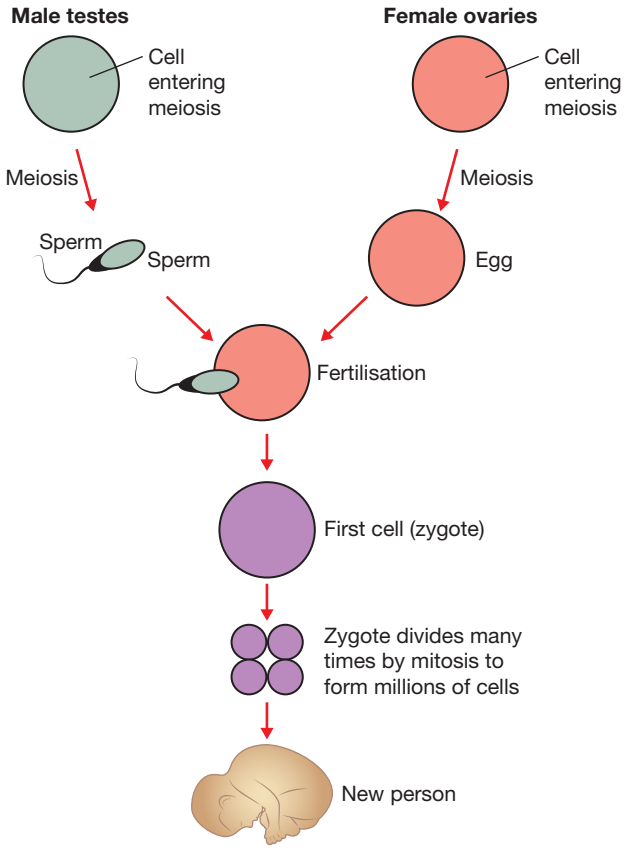


Figure 4.2.3 Meiosis forms gametes with only half the required genetic information. On fertilisation, the zygote cell has all the genetic information it requires and so a new individual is formed.

Sexual reproduction in animals

Depending on the animal involved, fertilisation takes place outside or inside the body.

External fertilisation happens outside the body. Figure 4.2.4 shows a male frog fertilising eggs laid by the female in water. Most fish reproduce externally, and so do sea urchins and jellyfish. The water stops the sperm from drying out, and the sperm can swim through it.

Internal fertilisation happens inside the body. All land animals use internal fertilisation, as do some water-based (aquatic) species. Internal fertilisation is better for land environments because sperm shed into the air may dry out and die. The act of joining together of the male and female to transfer sperm is called **copulation**. There are many different ways this happens. In dogs, the male inserts his penis into the female. In the octopus, the male transfers sperm with one of his tentacles.

The young can develop inside or outside the parent's body. Most mammals (animals that feed their young on milk) have internal development—the young develop inside the mother's body. This is shown in Figure 4.2.5.

Marsupials such as kangaroos have part internal and part external development. Most other animals, such as spiders, amphibians, birds and most reptiles and fish have external development. For example, birds lay eggs and the young develop inside the egg until they hatch.

Figure 4.2.4 External fertilisation is used mainly by water animals like fish, and internal fertilisation is used mainly by land animals such as insects.

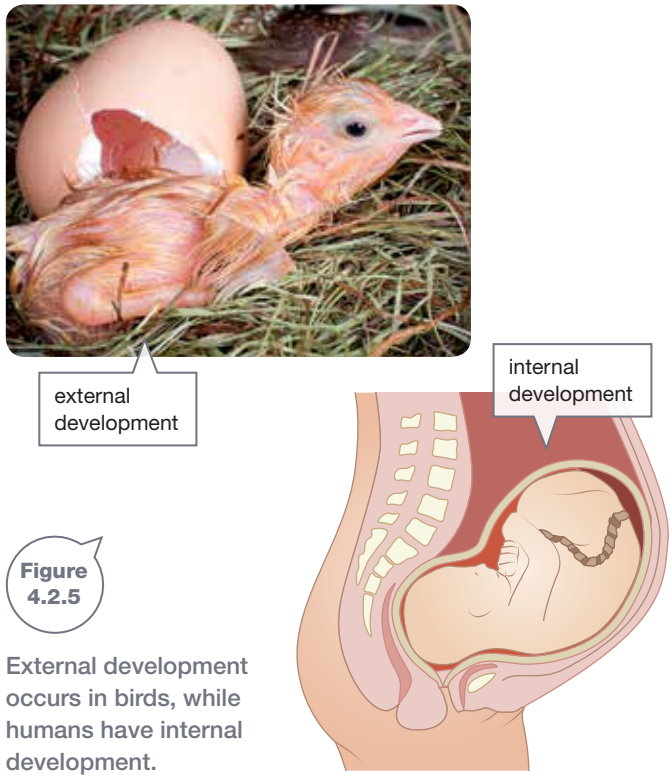


Figure 4.2.5 External development occurs in birds, while humans have internal development.

Sexual reproduction in flowering plants

Flowers are reproductive structures in plants that produce the gametes and allow fertilisation to occur. This results in a seed. The structure of a typical flower is shown in Figure 4.2.6.

To form a seed, the pollen produced in the **anther** needs to be deposited on the **stigma**. The transfer of pollen to the stigma is known as **pollination**. The pollen grain develops into a long tube called the pollen tube. This tube grows down through the **style** to the ovary and into the egg. In flowering plants, the egg is inside a structure known as the ovule. During this process, the male gamete passes down the pollen tube to join the female gamete in the ovule. After this joining of male and female gametes, a seed gradually develops.

Seeds develop in the fruit. A **fruit** is the remains of the ovary, plus all the seeds it contains. In some plants, fruit will appear as seed cases or pods. This means that fruit range from very juicy (like an apple) to hard and dry seed cases like a gumnut.

A seed is a capsule containing a new plant, called an **embryo**. The embryo is at a very early stage of its development, supported by a food supply inside the seed. You can see a seed in Figure 4.2.7.

The embryo in a seed is dehydrated (dried out) and requires water and warmth before it will grow. The seed swells up by absorbing water, and this triggers the growth of the embryo.

The embryo uses the stored food in the seed and begins to grow. The embryo then sprouts out of the seed in a process called **germination**. It will begin making its own food when it reaches the sunlight above the ground.

Prac 1 p153 Prac 2 p154 4.3

Figure 4.2.6 A flower is a reproductive structure.

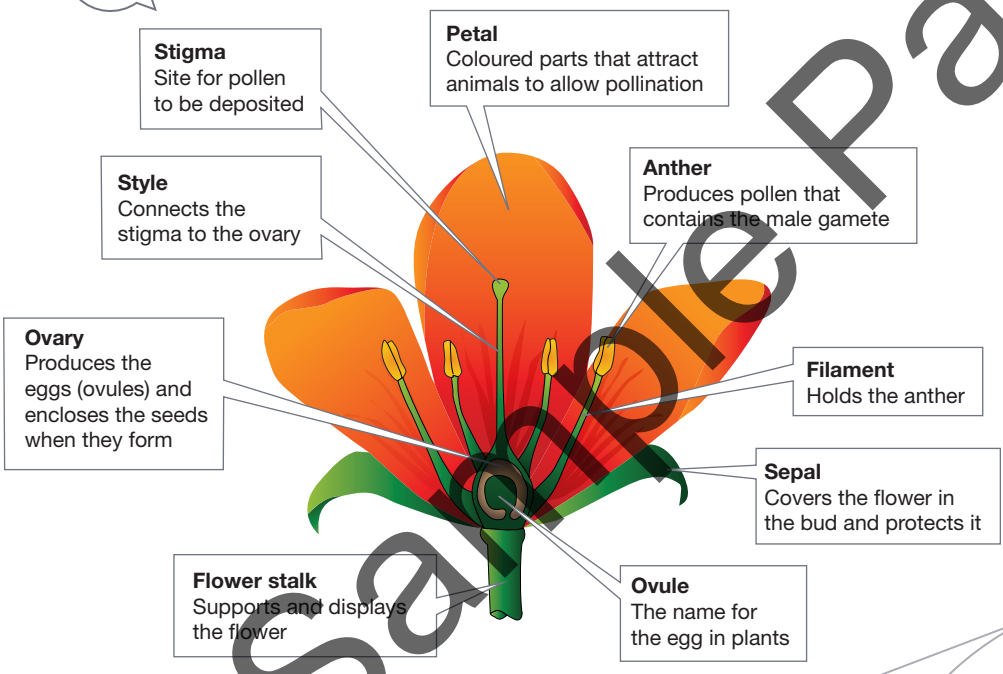
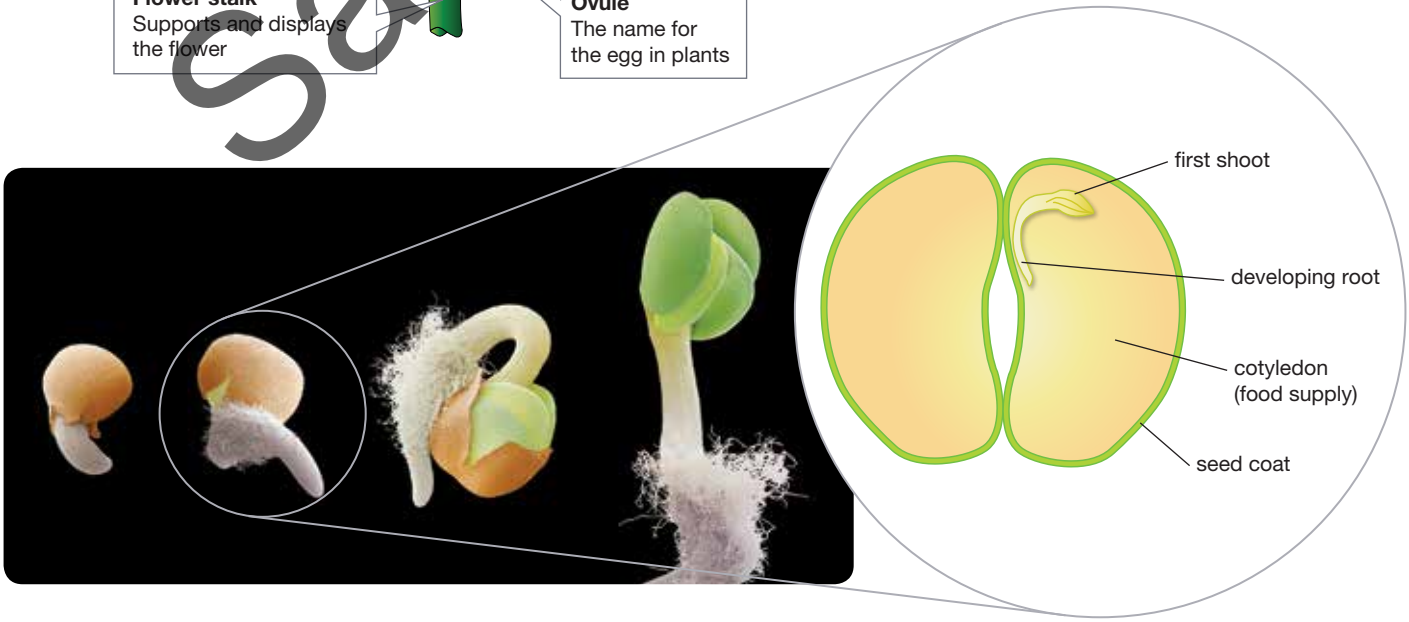


Figure 4.2.7 A seed is an embryo with a food supply. This seed has been split open.



Asexual reproduction

Asexual reproduction requires only one parent. It occurs when a new individual grows from part of the parent's body. It does not involve sperm or eggs. Instead, the individual is produced by cell division using mitosis.

Asexual reproduction in animals

Few animals reproduce asexually. One that does is the freshwater animal called hydra. Hydra are relatives of jellyfish, and can reproduce both sexually and asexually. Figure 4.2.8 shows a young hydra growing from its parent. The young one was formed by asexual reproduction. It will break off the parent and lead a separate life.

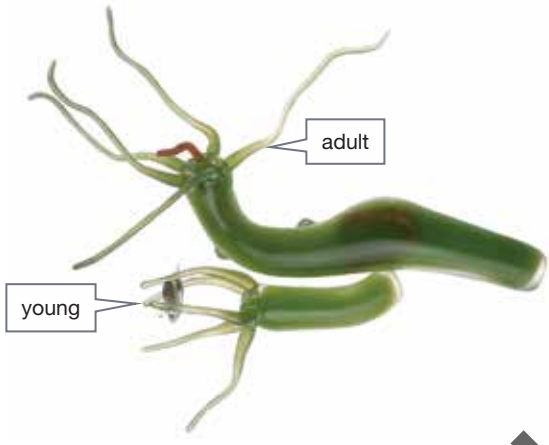


Figure 4.2.8 This adult hydra has a young hydra that was produced asexually still attached to it. The young one has caught a small water animal to eat.

Another type of asexual reproduction is called **parthenogenesis**, where offspring develop from eggs that have not been fertilised by a male. Parthenogenesis happens in water fleas, aphids (Figure 4.2.9), some bees, and a small number of reptiles and fish.

The weird world of rotifers

SciFile

Rotifers are animals about the same size as a single-celled protozoa. However, rotifers have about 1000 cells. Unlike other animals their cells do not seem to have cell membranes. Another strange thing about rotifers is that many species are only female, and all young are produced by parthenogenesis!

Figure 4.2.9 Aphids can reproduce asexually.

INQUIRY

science 4 fun

Asexual organisms

NO

Can you spot asexual reproduction?

Collect this …

- sample of pond water with organisms that reproduce asexually such as water fleas, rotifers, hydra, protozoa
- monocular microscope
- two cavity sides and coverslips

Do this …

1. If you have a hydra, place it on a cavity slide but do not add a coverslip (to prevent crushing the animal).
2. For the other organisms, place two drops of pond water on a cavity slide and add a coverslip.
3. Observe your hydra under low power. Use high power for the smaller organisms. Try to find water fleas, rotifers or other organisms that reproduce asexually.
4. Look for any evidence that the organisms may be reproducing at present.
5. Carefully return any hydra back to the container. Do this by dipping your slide into the container.

Record this …

Describe each organism that you saw. Did you observe any organisms reproducing asexually?

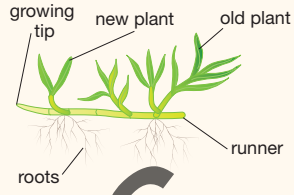
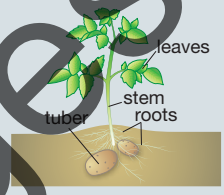
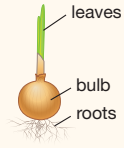
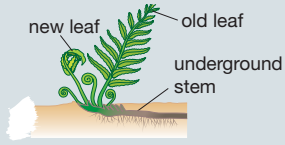
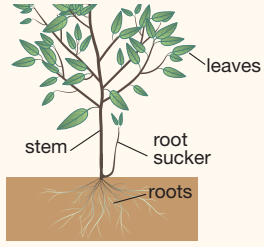
Explain what happens during asexual reproduction.

Asexual reproduction in plants

In plants, asexual reproduction can occur by different methods, as shown in Table 4.2.1.

Prac 3 p155

Table 4.2.1 Methods of asexual reproduction

Asexual reproduction method	Plants that show this	Structures involved	
Runners	Many grasses, strawberries, ivy, violets	Stems run along the ground surface. They send down roots at intervals.	
Stem tuber	Potato, yam	Swellings called tubers are attached to the stem underground and full of stored food.	
Bulbs	Onions, tulips, daffodils	Underground 'leaves' are full of stored food.	
Underground stem	Bamboo, bracken	Stems run along underground and send up leaves at intervals.	
Root suckers	Some eucalypts	Roots send up stems where they come near the surface.	

Reproduction and the environment

Each type of reproduction, sexual and asexual, has advantages and disadvantages. The type of reproduction an organism uses is related to its environment.

In some environments, asexual reproduction is an effective method of reproduction, particularly for organisms that:

- live a long way from others of their kind—they are able to reproduce without having to find a mate
- cannot move very far—they do not have to find a mate
- live in an environment that does not change much—the offspring will all be identical and therefore all will be suited to surviving in the environment.

In contrast, sexual reproduction produces offspring that are all different from each other. This helps a species survive in a changing environment.

The survival of a species depends on some individuals being different enough to survive any changes in their environment. When a change occurs, there are likely to be some individuals that are able to cope with the new conditions. They can then breed and continue the species. So having differences means a greater chance of survival for the species.

4.4

4.2 Unit review

Remembering

1 **Name** the two main types of reproduction.

2 a **List** three different ways that plants reproduce asexually.
   b For each way, **name** one plant that reproduces that way.

3 a **Name** two methods of asexual reproduction in animals.
   b For each method, **name** an animal that uses the method.

4 **Name** the parts of the flower that have the following functions.
   a produce pollen
   b attract pollinators to the flower
   c produce female gametes
   d hold the seeds as they form

5 **State** where fertilisation takes place in:
   a flowering plants
   b frogs
   c dogs.

6 **State** the type of reproduction that made you.

7 **List** three organisms that are hermaphrodites.

Understanding

8 Jo claims that an animal that was produced by sexual reproduction must have two parents. **Discuss** whether Jo is right or not.

9 a **Explain** what is meant by reproduction.
   b **Explain** why reproduction is necessary.

10 **Define** the following terms. L
   a fertilisation
   b copulation
   c embryo
   d internal fertilisation
   e external development
   f hermaphrodite

11 **Outline** some advantages of:
   a asexual reproduction
   b sexual reproduction

12 **Describe** what you might observe in the science4fun on page 149 to indicate that asexual reproduction is occurring in the pond water.

Analysing

13 **Contrast** sexual with asexual reproduction.

14 **Compare** the processes of copulation and fertilisation.

15 **Compare** the processes of internal and external development.

Evaluating CCT

16 Honeyeaters (like the one shown in Figure 4.2.10) are birds that drink sugary nectar made by plants such as eucalypts and banksias. They are attracted to the bright colours of the flowers. **Propose** why these birds are important to these flowering plants.

Figure 4.2.10 Honeyeaters have long thin beaks that allow them to get to the nectar inside flowers.

17 a **Propose** whether internal development is more likely to occur in animals that are internally fertilised or externally fertilised.
   b **Justify** your answer.

18 Whales are mammals. Their ancestors lived on land millions of years ago. The way they reproduce still shows this relationship to their land ancestors. **Propose** whether whales have:
   a internal or external fertilisation
   b internal or external development.

4.2 Unit review

19 Consider the following situations and **rank** them from those producing the most differences among the offspring to those producing the fewest differences. **Justify** your answer.

- **a** Bamboo plants connected to one underground stem
- **b** Plants from the seeds of one flower that was pollinated from another flower on the same bush
- **c** Plants from the seeds of one flower that was pollinated from a flower from a different bush
- **d** Plants from the seeds of a self-pollinated pea plant
- **e** Grass plants in a lawn grown from stem cuttings from three different gardens

20 Self-fertilisation is when an individual fertilises itself.

- **a** **Propose** what the disadvantages of self-fertilisation are, for a species.
- **b** The male anthers and female stigma of geranium plants (like the one in Figure 4.2.11) mature at different times. **Explain** how this would stop the plant from self-fertilising.

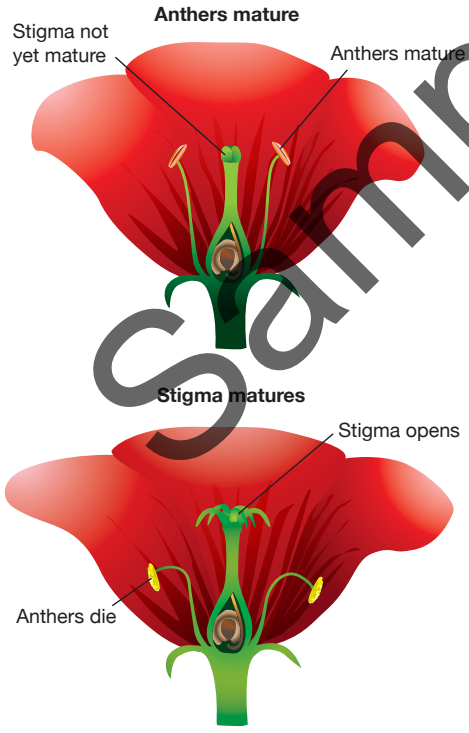


Figure 4.2.11 This geranium does not self-fertilise because the anthers and stigma mature at different times.

Creating CCT

21 **Construct** a table comparing the role of cell division in sexual and asexual reproduction.

Inquiring

1 Research three examples of animals that can change sex once they are born. In particular:

- find the term given to this change in sex
- state what change occurs in each species
- discuss how these changes benefit the species in your examples.

Present your findings as a poster to be displayed at the zoo.

Figure 4.2.12 All barramundi under 3–5 years old are male. After this age, all barramundi are female.

2 Research the growth and reproduction of rotifers. In particular, find:

- where rotifers live
- their general body parts
- their cell structure and how this affects their growth
- their methods of reproduction
- how their ability to withstand drying out helps them survive.

Present your research as a digital presentation. ICT

4.2 Practical investigations

1 Flower structure

Purpose

To compare the structure of different flowers.

Materials

- blade and forceps
- hand lens or stereomicroscope
- selection of flowers

Procedure

Carefully observe the structure of each flower.
To do this you may have to:

- use a stereo microscope or hand lens to study them
- dissect the flowers carefully using the forceps and blade.

Results

1. Construct a quick sketch of the basic shape of the flowers. Do not draw in fine detail. Write the name of the plant species on your diagram.
2. Identify all the flower parts and label these on your diagram.
3. On your diagram, write down the general features of the flower, such as its size and colour.
4. Using the table below, decide which method of pollination the flower may have.

Practical review

For each flower, **justify** your choice of the method of pollination.

Method of pollination	Flower structure/colour/size	Anther/stamens	Stigma/style
Wind	Often small but many flowers in one head, often no petals, not brightly coloured. No nectar, no scent	Long stamens with large anthers exposed	Long style with exposed stigma. Stigma has large surface area—often look like brushes
Insect	Usually small, some with many flowers in one head, brightly coloured petals especially blues and yellows. Small amounts of nectar, strong scent. Often strongly marked with 'landing guides'	Often has short stamens and small anthers, which are close to nectar source in most flowers. Sticky pollen	Short style, small stigma close to nectar source
Bird	Large strong flowers. Some have petals but many don't. Lots of nectar, often red	Often has long, strong stamens and large anthers a long way from the nectar source	Long style, smallish stigma, a long way from the nectar source
Mammal	Large strong flower heads, much nectar, often not brightly coloured and hidden in plant. Nectar produced at night	Strong and rigid	Strong and rigid

2 Germination

Purpose

To determine what affects the germination of seeds.

Hypothesis

Which variables do you think seeds need for them to germinate—water, light, oxygen or warmth? Before you go any further with this investigation, write a hypothesis in your workbook.

Materials

- 1 mL (cool) boiled vegetable oil
- 10 mL (cool) boiled water

- 5 test-tubes
- 25 wheat seeds
- cotton wool
- labels or waterproof pens
- 100°C thermometer
- lamp
- access to dark cupboard and fridge
- digital camera or mobile phone with camera function (optional)

Procedure

The test-tubes will have the following conditions:

Test-tube	Conditions
A	Light, moisture, oxygen, warmth
B	Dark, moisture, oxygen, warmth
C	Dark, no moisture, oxygen, warmth
D	Dark, moisture, no oxygen, warmth
E	Dark, moisture, oxygen, cold

1 Label the test-tubes with your name and the correct letter A to E.

2 Put a centimetre of cotton wool in the bottom of test-tubes A to E as shown in Figure 4.2.13.

3 Add about 1 mL of tap water to test-tubes A, B and E.

4 Add five seeds to each of test-tubes A to E.

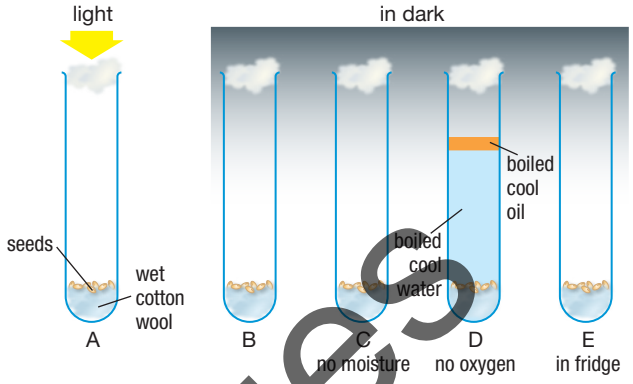


Figure 4.2.13

5 Add about 10 mL of boiled (but cooled) water to test-tube D. Add the boiled (but cooled) oil to this test-tube.

6 Put a loose cotton wool plug in the mouth of each test-tube.

7 Place test-tube A under a fluorescent lamp. Your teacher will place a thermometer next to the test-tubes to check the temperature. Place test-tubes B, C and D in a dark cupboard. Place test-tube E in a fridge.

8 Observe or photograph the experiment each day for about 5 days. Record the results in a table.

Results

Describe the conditions in the test tubes in which seeds germinated.

Practical review

1 **Compare** your results with those of other teams.

2 a **Use** the class results to **construct** a conclusion for the investigation.

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

3 **Propose** a reason why each variable affected germination.

4 **Evaluate** your experiment and **propose** ways to improve it, especially if the results were not clear.

3 Asexual reproduction

Purpose

To observe examples of asexual reproduction.

Materials

- selection of onion, potato, African violet, tree of life (*Bryophyllum*), clove of garlic, leaf of geranium, stem of bamboo or bracken
- soil

- glass jars
- toothpicks
- glass slides
- ice-cream containers
- stereo microscope
- digital camera or mobile phone with camera function (optional)

Procedure

1 Take an onion, a piece of garlic and a potato. Stick some toothpicks in them so that they can be supported on top of a jar of water and just touch the water at the bottom. Figure 4.2.14 shows how to do this using an onion. Fill each jar with water.

2 Place a leaf from a tree of life or a geranium on some soil in an ice-cream container. Place a glass slide over the top of the leaf to keep it pressed against the soil. Water the soil.

3 Place the leaf stalk of an African violet in a jar of water. When roots appear, plant it in soil.

4 Cut a piece of geranium stem about 10 cm long. Strip the leaves off. Stick it in soil, leaving a few centimetres above the soil and then water it.

5 If you have some bamboo stem or bracken stem, break about 10 cm off it and cover it in soil, watering it well.

Results

1 Place each plant sample in a cupboard and check it regularly over the next few weeks.

2 Record your observations, perhaps using a camera or the camera on a mobile phone to record the changes.

Practical review

1 Each plant reproduced asexually. **Identify** the method of asexual reproduction each plant used.

2 **Evaluate** your investigation and **propose** reasons why some plants may not have reproduced.

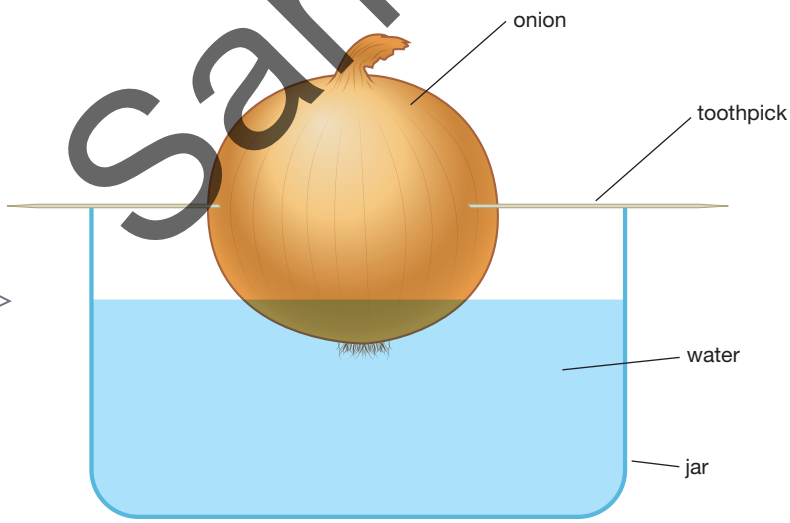
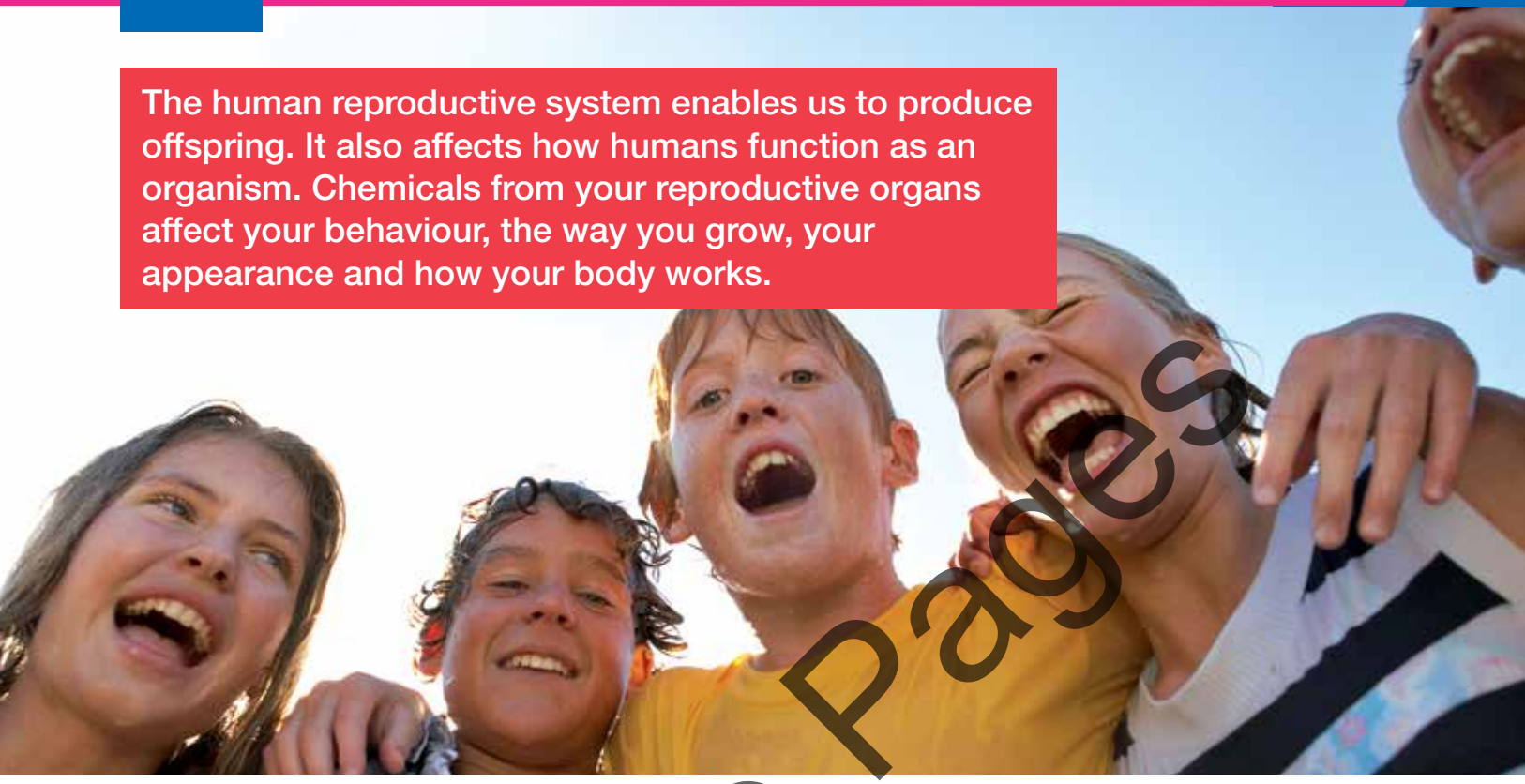


Figure 4.2.14

4.3 The human reproductive system

The human reproductive system enables us to produce offspring. It also affects how humans function as an organism. Chemicals from your reproductive organs affect your behaviour, the way you grow, your appearance and how your body works.



The female reproductive system

The female reproductive system has the role of producing a baby. Its structure is shown in Figure 4.3.1.

The eggs, or ova, are produced in the **ovaries**. The ovaries are similar in size to an olive. They usually release only one ovum (a single egg) each month, alternating between left and right ovaries. The egg forms in a capsule called a follicle.The egg then bursts out of the follicle.

The **fallopian tubes**, or **oviducts**, are tubes down which the egg passes on its way to the uterus. If the egg meets a sperm and becomes fertilised, then it is usually in this tube.

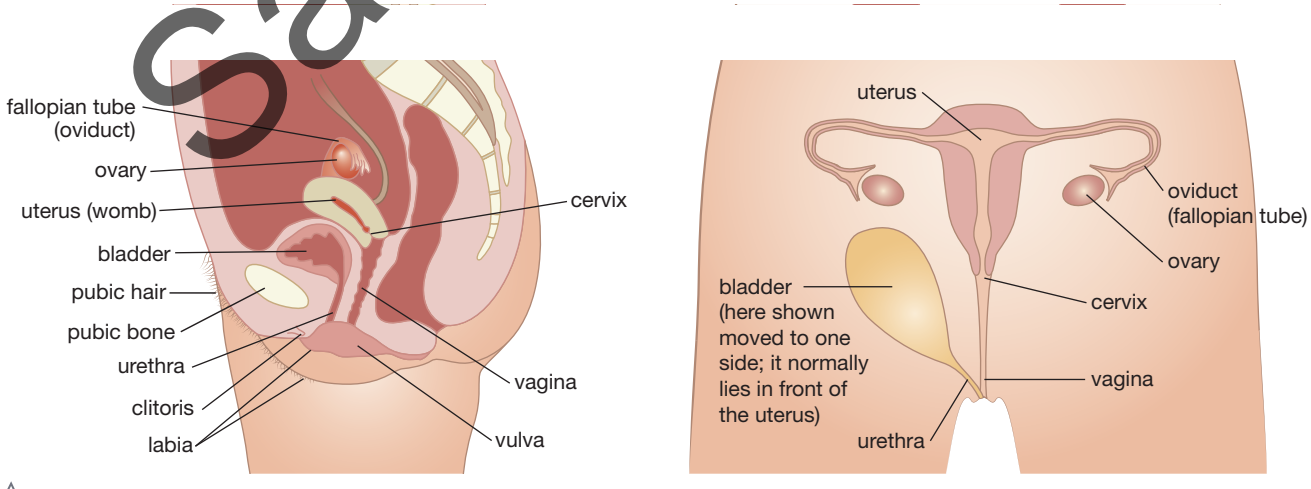


Figure 4.3.1 The human female reproductive system

The **uterus** (or **womb**) is a thick-walled muscular organ that is about 7 cm long and 5 cm wide. It has a lining that can change and become rich in blood vessels. A fertilised egg burrows into this lining. The baby grows and develops in the uterus until birth. The uterus can swell up to many times its normal size to allow the baby room to grow. If the egg was not fertilised, then it passes out of the uterus through the lower end.

At the lower part of the uterus is a ring of muscle called the **cervix**. The cervix has the job of contracting tightly to hold the uterus closed while the baby is developing. This protects the baby in the womb. The cervix opens up when the baby is about to be born.

The **vagina** is where the male penis is inserted to deposit the sperm inside the female body. It is also the birth canal down which the baby passes.

The menstrual cycle

Reproduction in males and females is controlled by chemicals called **hormones** that are produced in the body and travel around in the bloodstream. One female hormone (known as FSH) causes the follicles to mature. A follicle is shown in Figure 4.3.2. Another hormone (known as LH) makes the egg burst out of the follicle. This is called **ovulation**.

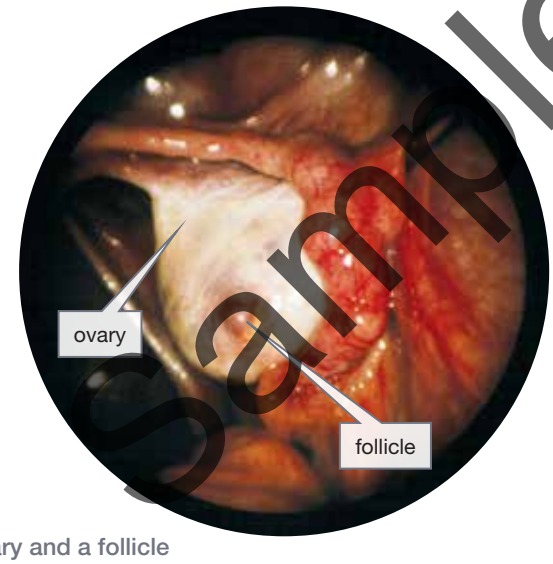


Figure 4.3.2 An ovary and a follicle starting to swell

A third hormone called estrogen (also spelled oestrogen) makes the lining of the uterus grow thicker and develop an increased blood supply. Estrogen comes from the follicles in the ovaries. There are other hormones involved as well. The amounts of these hormones change in a cycle over a month. These changes in the body over the month are called the **menstrual cycle**. The menstrual cycle is shown in Figure 4.3.3.

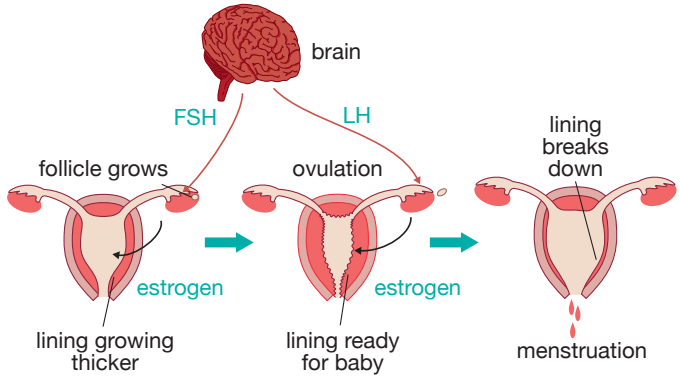


Figure 4.3.3 The menstrual cycle is controlled by hormones.

If the egg is not fertilised and implanted, the thickened lining of the uterus breaks down. Over the next few days some blood, along with much of the lining of the uterus, passes out of the body. These events are **menstruation** commonly known as a **period**.

Menstrual cycles

Menstrual cycles can vary greatly in length, especially when they first begin. Once it becomes fairly regular, a typical menstrual cycle is about 28 days. In this cycle, the first day of menstruation (bleeding) is counted as day 1, and typically lasts 3–7 days. Ovulation occurs at day 14 of the cycle.

You can see this in Figure 4.3.4. In some cycles, ovulation can occur as early as day 9, while in others it may be after day 20. The part of the cycle that usually stays the same is the time from ovulation to the start of menstruation. This is generally 14 days.

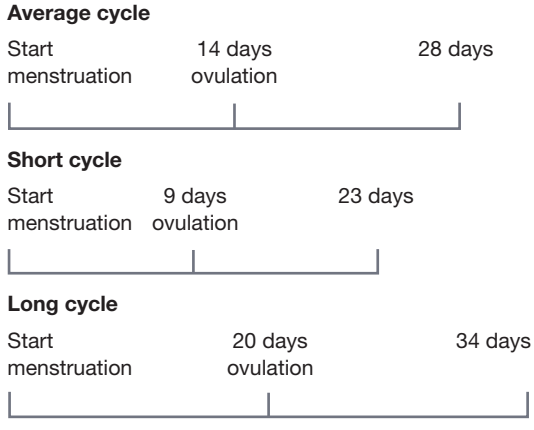


Figure 4.3.4 The menstrual cycle can vary in length.

WORKED EXAMPLE

Menstrual cycles

Problem

In a 25-day cycle, on what day would ovulation most likely occur?

Solution

Time from ovulation to menstruation is usually 14 days.

Therefore 25 – 14 = 11 days

So ovulation would have been on day 11 of the 25-day cycle.

Practice

N

Calculate the day on which ovulation would occur in a:

a 30-day cycle

b 24-day cycle.

The male reproductive system

The role of the male reproductive system is to produce and deliver sperm. Its structure is shown in Figure 4.3.5.

Sperm are produced in the **testes**. There are two testes, each about the size of a golf ball. Testes are also known as testicles. A single testicle is called a testis. The testicles hang outside the body in a sac called the scrotum.

Sperm are killed or deformed if they become too hot. It is cooler in the scrotum than inside the body, which helps to prevent the sperm being killed or deformed. Millions of sperm are produced in tubes inside the testes. Then they are squeezed into a coiled tube called the epididymis. There is one on the outside of each testis. Sperm mature inside the epididymis.

To get to the outside of the body, sperm are squeezed by muscles lining the epididymis. They are pushed into a hollow tube about 45 cm long called the **sperm duct**, or **vas deferens**. This tube has muscles in its walls that squeeze the sperm along. On the way, fluid is added to the sperm from glands called seminal vesicles. This fluid contains various chemicals such as sugars that provide an energy source for the sperm. There is also fluid added to the sperm by the prostate gland and Cowper's glands. This mixture of sperm and other fluid is called **semen**. Semen passes out of the penis through the urethra, the same tube through which urine flows. Urine cannot pass through at the same time as semen.

4.5

SciFile

Acid and base

The vagina produces acid to kill infectious organisms like fungi. This acid would kill sperm if the fluid carrying it (semen) did not contain a chemical called a base. This destroys the acid and allows the sperm to survive.

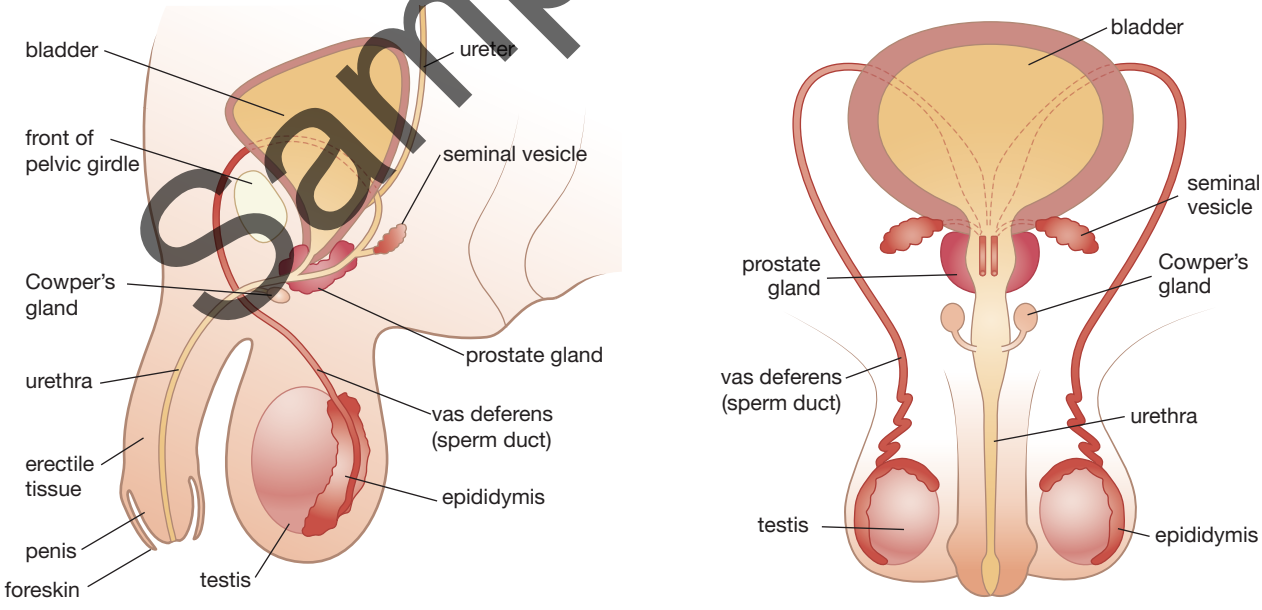


Figure 4.3.5 The human male reproductive system

Puberty

Puberty is the time in a person's life when they become sexually mature and able to reproduce. The physical changes of puberty take several years to complete. For boys, puberty is when fertile sperm are able to be produced. For girls, it is when the first ovulation occurs.

The time in the life cycle when puberty begins varies greatly. In Australia, girls begin puberty on average around 12 years of age, while boys are generally about 13. Every person's body is different. You reach puberty when your body is ready.

Changes in males

The early changes of puberty in males are increased levels of some hormones such as testosterone. These lead to changes, such as:

- enlargement of the testes
- sperm formation by the testes
- growth of the penis
- the voice 'breaking' to become deeper
- hair growth on the face, arms, chest and groin
- increased muscle and bone growth and strength
- sudden increase in height and chest capacity.

These changes are shown in Figure 4.3.6.

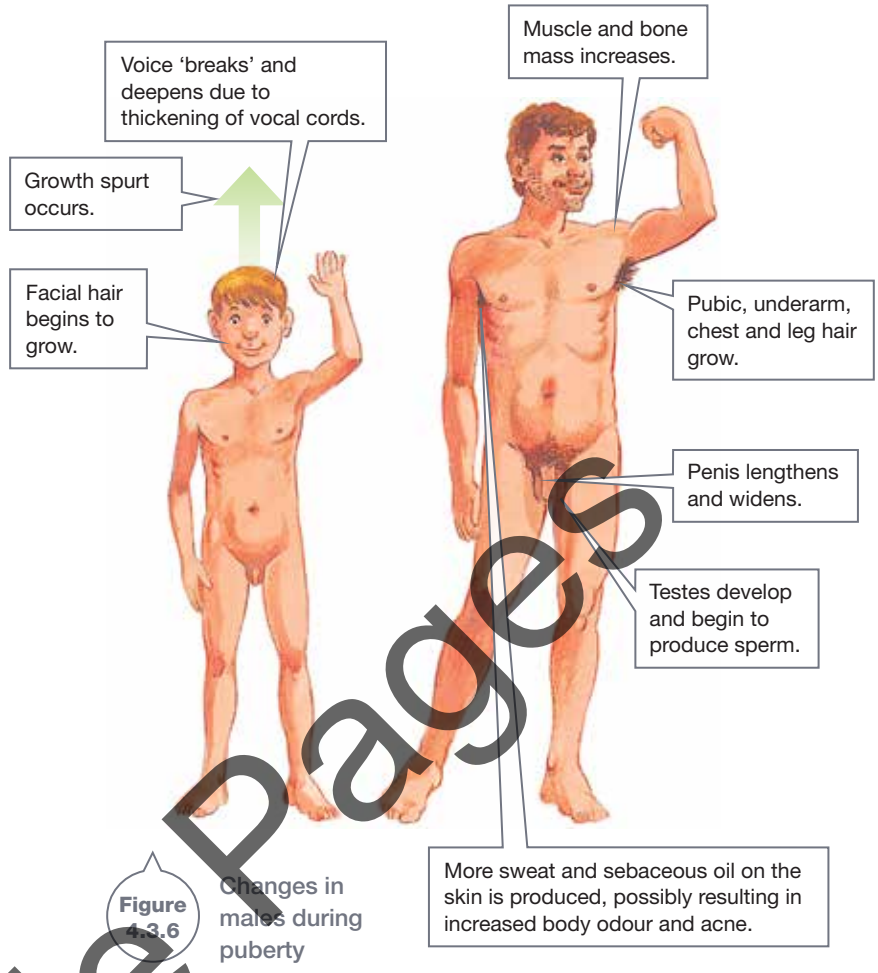


Figure 4.3.6 Changes in males during puberty

Changes in females

In girls, the early changes are increased levels of hormones such as FSH and LH. These hormones cause an increase in estrogen. These hormonal changes result in changes such as:

- the breasts begin to enlarge (generally the first sign of puberty)
- hair growth on the armpits and groin
- a sudden growth spurt
- the first period
- widening of the hips
- more fat deposited in the hips.

You can see these changes in Figure 4.3.7.

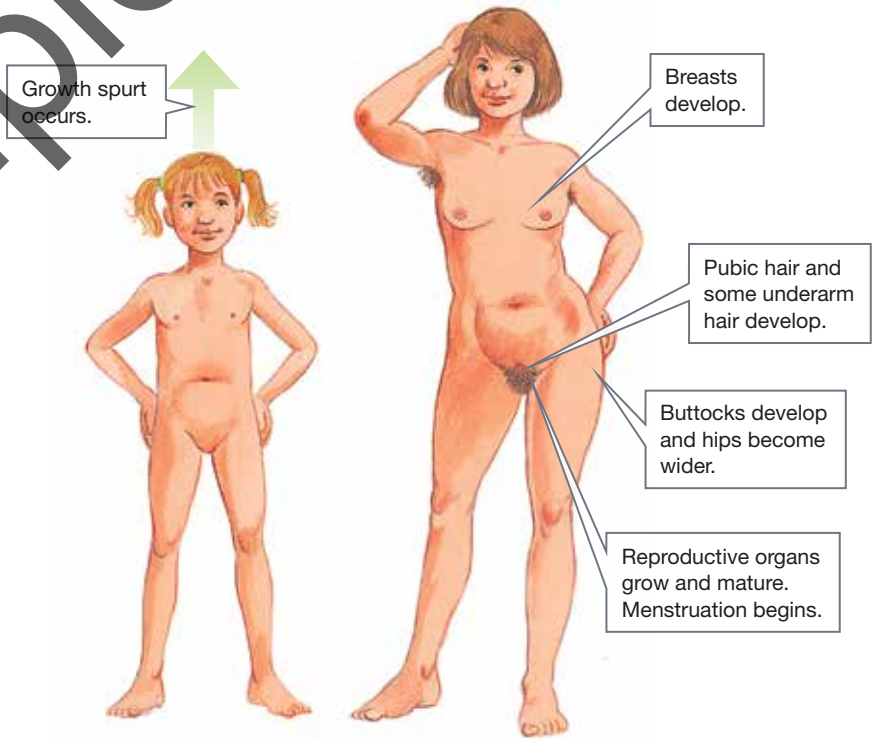


Figure 4.3.7 Changes in females during puberty

Prac 1 p161 Prac 2 p161 4.6

4.3 Unit review

Remembering

1 **Name** the part of the female reproductive system that:
   - a produces eggs
   - b keeps the uterus closed during pregnancy
   - c carries the egg to the uterus
   - d is where the baby grows and develops until birth
   - e is the site of fertilisation.

2 **Name** the part of the male reproductive system that:
   - a produces sperm
   - b carries sperm to the penis
   - c holds the testes
   - d places sperm in the vagina
   - e adds chemicals to the semen.

3 **List** the changes in males and females during puberty.

4 **State** on what day of a 28-day menstrual cycle a woman would ovulate.

Understanding

5 **Explain** what the menstrual cycle is.

6 **Explain** the role of hormones in the menstrual cycle.

7 **Define** the following terms. L
   - a ovulation
   - b period
   - c puberty

8 **Explain** why the testes are held in a sac outside the abdomen.

Applying

9 A particular woman reaches puberty at age 12 and produces one egg each month from puberty until she is 50. **Calculate** how many eggs she releases in her lifetime. N

10 **Calculate** when menstruation occurs if ovulation occurs at day 23.

11 **Calculate** the time from menstruation to ovulation in a 36-day cycle.

12
   - a **Identify** the male reproductive part that has functions in both the reproductive and excretory systems
   - b **Describe** its role in each.

13 Figure 4.3.8 shows how the proportions of a human body change as they grow. N
   - a **Calculate** the fraction of a newborn body taken up by the head.
   - b **Calculate** the fraction of an adult body taken up by the head.

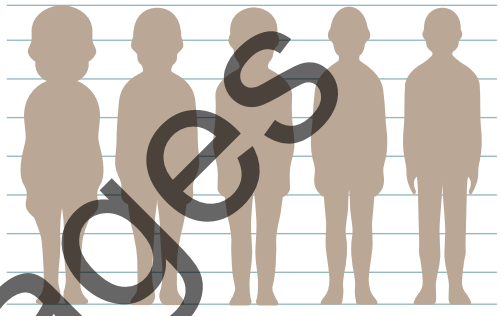


Figure 4.3.8

Analysing

14 **Compare** ova, ovulation and oviduct.

15 **Compare** ovaries and testes in:
   - a their position
   - b the number of gametes produced.

Evaluating CCT

16 Swelling of the prostate gland in a man often makes it difficult to urinate. **Propose** a reason why.

Creating CCT

17 **Construct** diagrams of the female and male reproductive systems from the front. Label each organ with its function.

Inquiring

Research how human twins are formed. Find:

- how fraternal twins differ from identical twins and conjoined twins
- how cell division influences the type of twins formed
- the percentages of fraternal twins, identical twins and conjoined twins born in Australia.

Present your research as a pamphlet to be distributed at family planning clinics.

4.3 Practical investigations

1 My changing body

Purpose

To identify the changes that occur during puberty.

Materials

- A3 sheet of paper or roll of butcher's paper
- coloured sticky note
- sticky tape, Blu-Tack or similar

Procedure

1. Choose a partner. Trace or draw an outline of your bodies on separate sheets of paper.
2. On your outline, add labels to each part of your body that changes as you go through puberty.
3. Describe the changes that occur to each body part as puberty proceeds.
4. At the bottom of your page, write down what causes these changes. Be as specific as possible, giving correct terms if possible.
5. Swap outlines with your partner and read their page. Identify any differences with yours. Discuss differences with your partner and combine the information onto one of the outlines and stick it up on the wall to create a gallery with the other students.
6. When all the outlines in the class are up, wander around the gallery. Read all the posters and then place a sticky note on the one you think best represents all the changes that occur during puberty.
7. Tally the scores and identify which poster won.

Practical review

1. **Evaluate** the poster that won and **identify** what made it particularly good at explaining the changes that happen during puberty.
2. **Evaluate** your poster and suggest improvements you could make to it.
3. **Summarise** in 25 words what causes the changes during puberty.

STUDENT DESIGN

2 Reproduction models

Purpose

To construct models of the male and female reproductive systems.

Materials

- As chosen by students

SAFETY

A risk assessment is required for this investigation.

Procedure

1. Construct a model of the male or female reproductive system. Your model should:
   - be 3D
   - have cutaway sections to show what the insides of different parts look like
   - clearly show its structure
   - be able to be suspended from string or cotton, or stood on a stand.
2. When all the models are complete, display them around the room.
3. Observe the other models and decide which ones you think are the best.

Practical review

1. **Explain** why you chose a particular model as the best.
2. **Evaluate** your model and suggest improvements.

4.4 Pregnancy

You are developing in the womb for close to 9 months, 40 weeks. There is a lot that happens during this time from copulation to birth.

Copulation

Copulation is the term for two individuals joining together for sexual reproduction. In humans it is also called **sexual intercourse**. In sexual intercourse, the penis becomes stiff and erect. It is then inserted into the vagina. Stimulation causes sperm to be squeezed out of the penis in a process called **ejaculation**.

Ejaculation deposits several hundred million sperm near the cervix. Sperm can swim, propelled by their tail. Their energy source is sugar in the semen. However, not all sperm are healthy. There are many different ways a sperm can be defective. Some are shown in Figure 4.4.1.

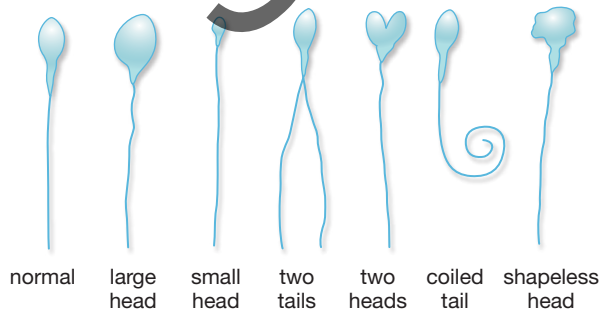


Figure 4.4.1 Sperm can swim, but defective sperm are poor swimmers.

Sperm enter the uterus (womb) through the cervix. They swim through the uterus and into the fallopian tube. Most sperm die along the way, leaving a few hundred healthy sperm to make it to the upper fallopian tube to meet the egg. When they encounter the egg, the sperm swarm over its surface. You can see this happening in Figure 4.4.2. One sperm manages to bury its head into the egg, and the tail breaks off. The egg surface changes as soon as one sperm head makes it through to ensure that no more sperm can enter the egg. The egg is now fertilised.

Figure 4.4.2 Sperm swarm around an egg, trying to penetrate its surface.

Implantation

The first cell of the new individual is called a zygote. The zygote begins to divide as it travels down the oviduct. You can see this in Figure 4.4.3. The zygote keeps dividing until it forms a hollow ball of cells called a **blastocyst**. About five days after fertilisation, the blastocyst reaches the uterus. Then the blastocyst burrows into the wall in a process called **implantation**. The woman is now pregnant.

Embryonic development

A baby takes about 38 weeks to develop from fertilisation to birth. For the first 8 weeks the developing baby is referred to as an **embryo**. During this time, all the different types of cells, such as nerve, muscle and bone, are developing. These are being built into the different organs and systems of the body. In this critical period of development, the baby can be severely affected by many things. This means that smoking, alcohol and some drugs (legal and illegal) have the potential to cause damage. This is because any chemical that can affect cells could damage the embryo. So, too, do some illnesses, such as rubella. These can cause deformities such as missing limbs and can also cause brain damage. In Figure 4.4.4 you can see an embryo.

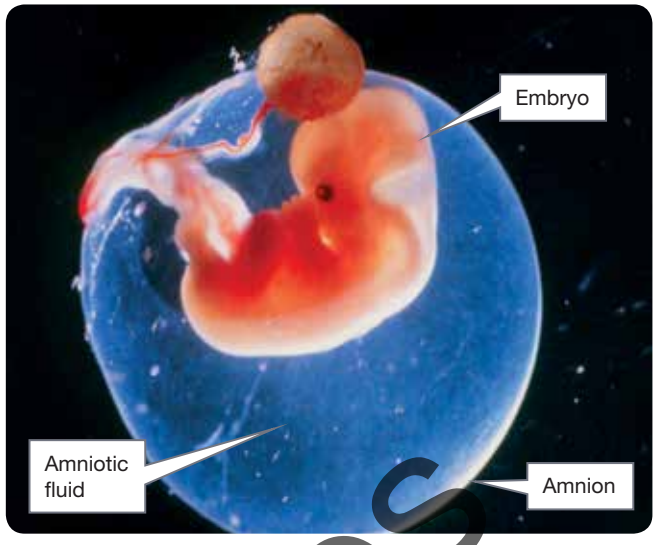


Figure 4.4.4 Major tissues, organs and systems form during the early development of the embryo.

SciFile

A fast but brief life

The fastest sperm take about 15 minutes to make their journey to the fallopian tube. Sperm can live for up to 2 days and fertilisation is possible if the egg encounters the sperm in this time. This means that intercourse up to two days before ovulation can result in pregnancy.

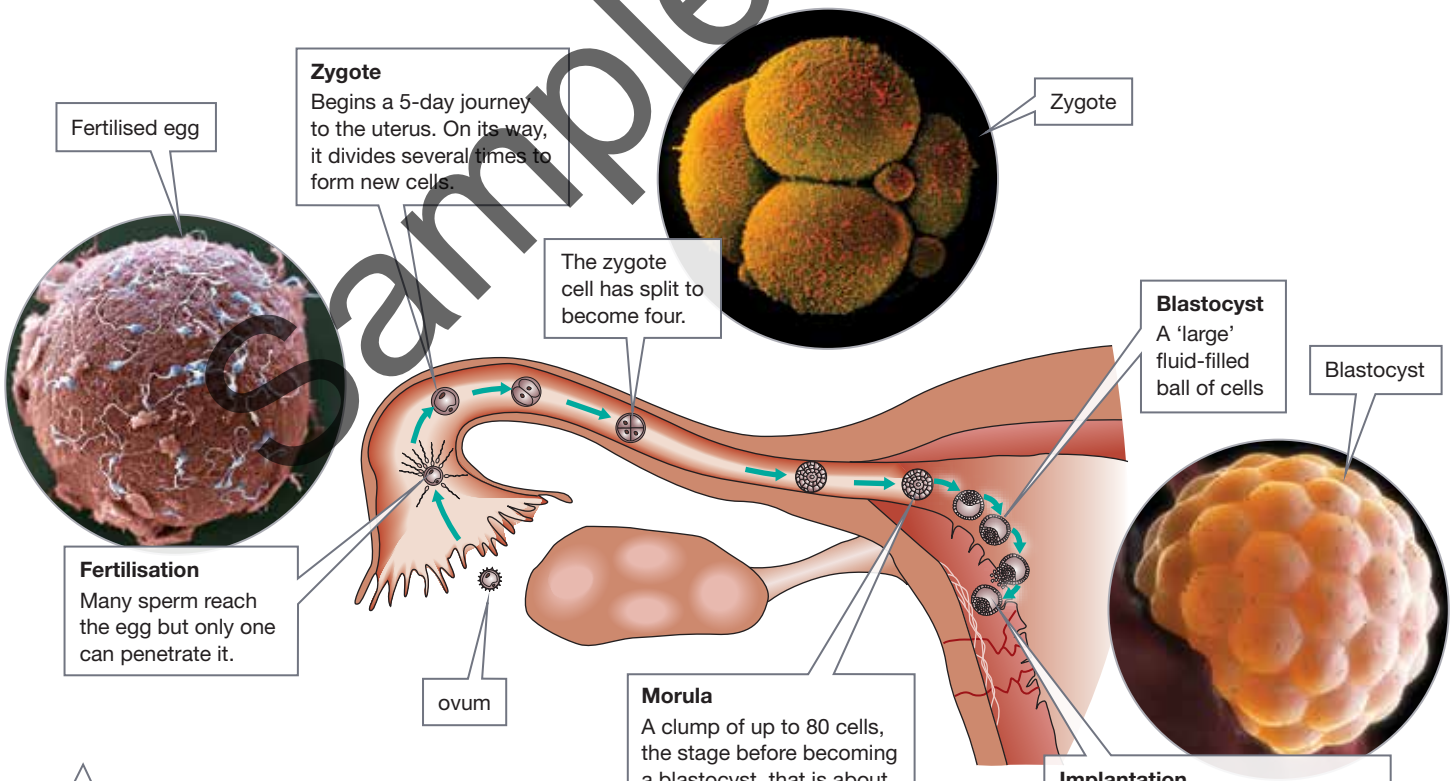


Figure 4.4.3 The sequence of steps from ovulation to implantation takes about 5 days.

Amniotic fluid

The embryo floats in a fluid enclosed in a 'balloon' or membrane (thin layer of living tissue) called the amnion. The **amniotic fluid** acts as a shock absorber, protecting the embryo from bumps. It also helps keep the embryo's temperature constant.

The placenta

In its early development, the embryo is fed from the yolk sac and secretions (fluids) from the lining of the uterus. The yolk sac is similar to the yolk in a chicken egg. Later, the placenta develops from branching structures called villi, which are on the outside of the blastocyst. You can see these in Figure 4.4.5. The **placenta** is a highly folded series of membranes and blood vessels. It allows nutrients and oxygen from the mother to enter the baby. It also allows the embryo's waste materials such as carbon dioxide to enter the mother's blood so her body can remove it.

Belly buttons

SciFile

The umbilical cord joins the embryo in its abdomen. Your 'belly button' is where your umbilical cord joined you to your mother in the womb.

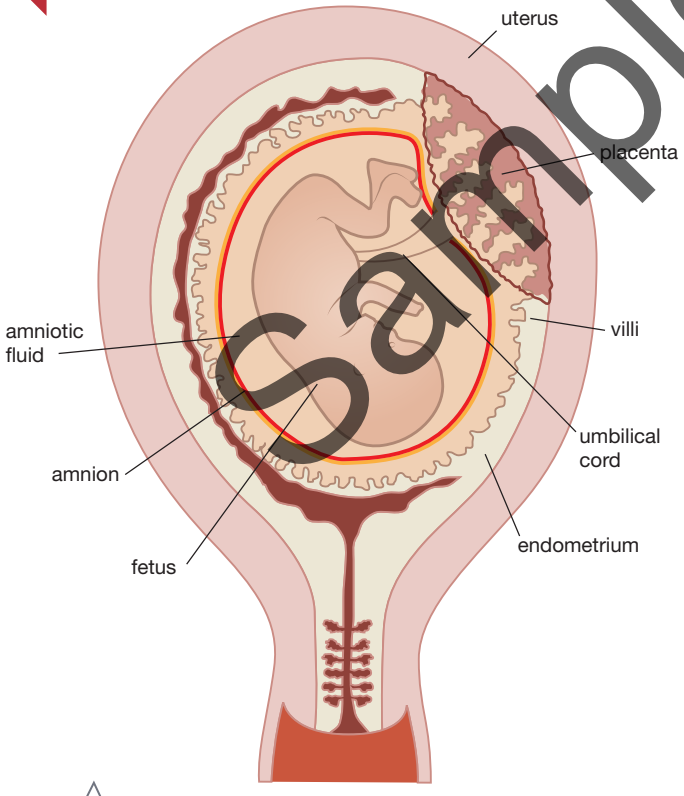


Figure 4.4.5 The umbilical cord connects the baby to the placenta.

Figure 4.4.6 shows how the placenta is connected to the embryo by the umbilical cord. This contains blood vessels from the embryo. The blood supplies of the mother and embryo do not mix together. They are kept apart by a membrane. The materials to be exchanged between the mother and embryo pass across this membrane.

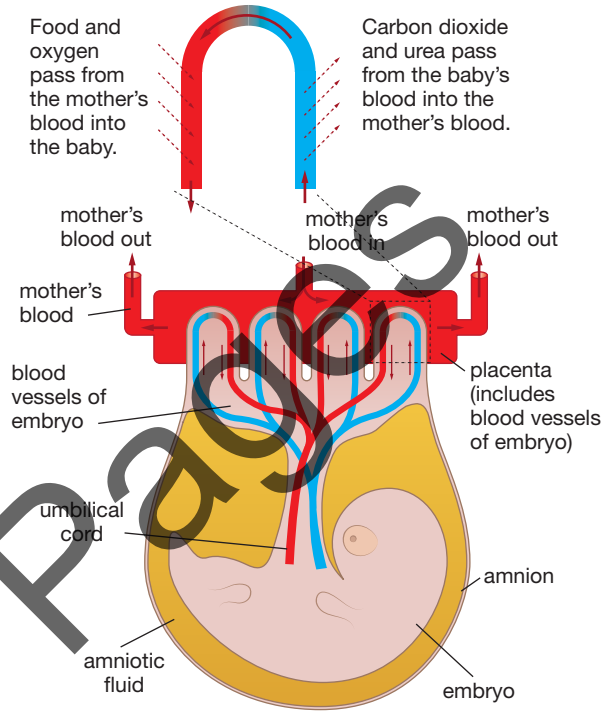


Figure 4.4.6 The placenta allows exchange of materials between the mother and the developing baby.

SKILL BUILDER

Weeks pregnant

The period during which the baby develops in the uterus is known as the **gestation** period.

A baby develops for about 266 days (38 weeks) from fertilisation to birth. However, because menstrual cycles vary in length, doctors can't be sure when ovulation actually occurred. So, they usually talk about 'weeks pregnant'. These are counted from the start of the last menstrual cycle. Since this is about 14 days before fertilisation, birth is at '40 weeks', or 280 days, from the last menstruation. So a doctor talking about 'weeks pregnant' is referring to the weeks since the last menstrual period.

4.7

Fetal development

Most of the major organs and systems have been formed when the embryo is about 9 weeks old. Its external appearance looks more human-like. It increases in size and the organs mature so they can function at birth. The developing baby is now classified as a **fetus** (also spelled foetus.)

Birth

Birth is part of the process called **labour**, which can last for a few hours to a day or more. The first sign of labour is pain in the abdomen. This is due to the uterus contracting and relaxing. The pains come and go. These gradually get stronger and more painful and come closer together. When the pains are regularly a few minutes apart, birth is not far away. The cervix relaxes and widens. This process is called dilation. The amniotic sac usually bursts, and then the baby's head begins to pass through the cervix. Usually the head goes through first, as you can see in Figure 4.4.7. Then the baby is born. This may take from 10 minutes to a few hours. The umbilical cord is cut and tied. A short time after the baby is born, the placenta is expelled from the mother. This is called the **afterbirth**.

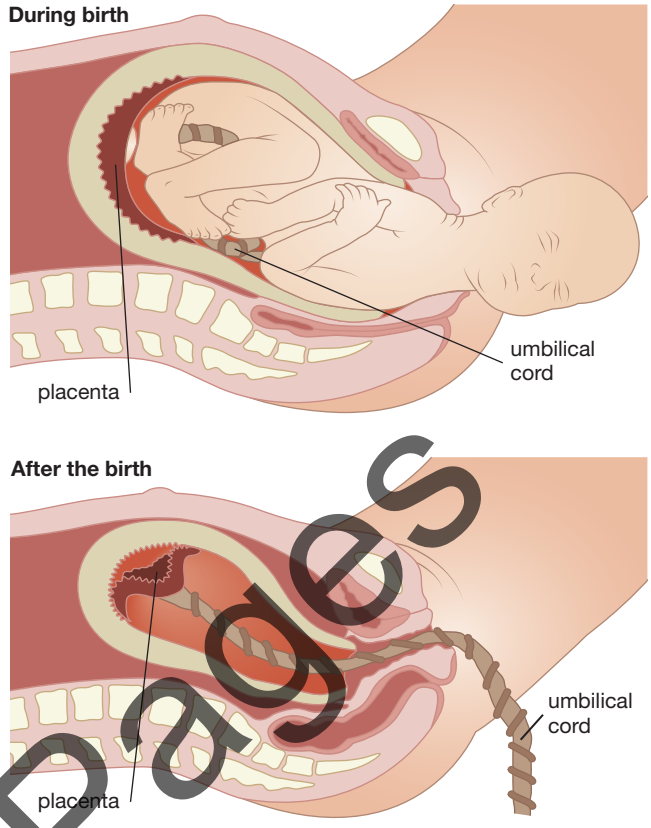


Figure 4.4.7 Labour involves birth of the baby and expulsion of the afterbirth.

4.8

Pregnancy tests

The blastocyst produces a hormone known as HCG. This keeps the lining of the uterus thick to support the blastocyst. HCG is detected in pregnancy tests of the mother's urine.

SciFile

Big baby

The largest baby on record was born to Anna Bates, in Canada in 1879. The baby boy had a mass of 10.77 kg, about three times as heavy as the average baby born in Australia. He survived for only about 9 hours. Both his parents were over 2.2 metres tall.

SciFile

LEARNING ACROSS THE CURRICULUM

ETHICAL UNDERSTANDING

DRUGS AND PREGNANCY

Research over the past fifty years has shown that some drugs and chemicals can damage the developing baby during pregnancy.

Figure 4.4.8 Alcohol and smoking can do great harm to a developing fetus.

THALIDOMIDE

In the 1960s Australian scientist Dr William McBride noticed that a large number of children were being born with birth defects such as missing or shortened limbs, like those of the girl shown in Figure 4.4.9. When Dr McBride investigated the medical histories of the mothers, he found that they had been taking a pharmaceutical drug called thalidomide. The drug was prescribed by doctors to help relieve nausea and vomiting during pregnancy, symptoms called morning sickness. Further research by Dr McBride showed that thalidomide crossed the placenta and entered the embryo as it developed. It affected cell division, resulting in missing or deformed limbs. Thalidomide was then banned for use by pregnant mothers.

Under certain circumstances, thalidomide is still an effective drug. It has been shown to:

- slow cell division in cancer cells, preventing their spread
- help cure multiple myeloma, a cancer of the white blood cells
- ease the pain and halt the progression of leprosy, a bacterial disease that damages nerves, causing weakness and inability to use arms and legs.

Figure 4.4.9 Deformed and shortened arms and legs are typical symptoms of thalidomide taken by the mother during pregnancy.

In most of these cases, thalidomide is prescribed by specialist doctors to ensure that it is not taken by pregnant women.

Despite this, it is estimated that there have been over 7000 cases of thalidomide-affected babies born in Brazil in the past twenty years. Some of these cases are because doctors have prescribed thalidomide to pregnant women who have leprosy. Brazil is the world's largest user of thalidomide, with over 300 000 leprosy patients in that country.

ALCOHOL

Drinking while pregnant can have consequences for the baby. Research has shown that alcohol crosses the placenta and that high alcohol intake can cause a condition known as fetal alcohol syndrome (FAS). Babies born with FAS can have low birth weight, a smaller head, small eyes, flattened face and nose, and heart defects.

Children with FAS are affected for life and cannot be cured. FAS can result in serious problems such as:

- low intelligence, poor memory and learning difficulties (due to damage to the growing brain)
- behavioural problems such as attention deficit hyperactivity disorder (ADHD). However, not all ADHD is due to FAS
- increased risk of mental illness.

SMOKING

Research has shown that smoking damages both the mother and her unborn baby, because many chemicals from cigarettes can cross the placenta (Figure 4.4.10). Smoking can cause:

- death of the fetus in the womb
- miscarriage (expulsion of the fetus from the womb)
- premature birth
- slower growth and development
- increased risk of cleft lip and cleft palate
- lower birth weight
- twice the risk of sudden infant death syndrome (SIDS).

OTHER DRUGS

Many other legal and illegal drugs and chemicals have been shown to damage an unborn baby. These include:

- cocaine
- high doses of vitamin A
- some antibiotics.

Legal drugs such as antibiotics have warnings printed on their labels indicating whether there is a risk of damage to the unborn child if taken during pregnancy.

REVIEW

1 **Explain** how thalidomide causes birth defects.

2 **Propose** why a specialist doctor might give a patient thalidomide.

3 **Explain** how a fetus could be affected when a pregnant woman drinks a lot of alcohol.

4 **List** four permanent effects of fetal alcohol syndrome on children.

5 **Recommend** to pregnant women the approach they should take to smoking, alcohol and other drugs.

6 **Use** the information presented here to **demonstrate** how people can have different opinions on using a particular treatment to solve a health problem. CCT DD PSC EU

Prac 1 p169

Figure 4.4.10 Nicotine, alcohol and legal and illegal drugs can pass through the placenta and umbilical cord, passing them on from mother to baby.

4.4 Unit review

Remembering

1 **Name** the following.
   - a the cell formed by fertilisation
   - b both terms for the place where fertilisation occurs
   - c the site of implantation
   - d the fluid that surrounds the embryo
   - e the connection between the embryo and the placenta
   - f the time period from fertilisation to birth

2 **List** the major events from fertilisation to implantation.

3 **List** the signs that labour is occurring.

4 **List** some events in childbirth after dilation of the cervix.

Understanding

5 **Explain** the function of the amniotic fluid.

6 **Explain** the function of the placenta.

7 **Define** the following terms.
   - a copulation
   - b ejaculation
   - c implantation
   - d blastocyst
   - e placenta
   - f labour

8 **Explain** what prevents mixing of the blood supply of the mother and the fetus.

Applying

9 If a woman last had a period on 1 January, and is clearly pregnant, **calculate** the date when her baby should be born. N

10 If a zygote was definitely formed on 1 January, **calculate** the date when the baby should be born. N

Analysing

11 **Compare** the major features of an embryo and a fetus.

12 **Distinguish** between the placenta and the umbilical cord.

13 **Compare** the meaning of labour and birth.

14 **Distinguish** between fertilisation, implantation and pregnancy.

Evaluating CCT

15 A pregnant woman complains that she is feeling sick every morning. She wants to use a natural remedy that a friend suggested. What would you **recommend** she do, and why?

16 A baby's skull bones do not lock together to make the skull rigid until well after birth. **Propose** why this is an advantage in childbirth.

17 To induce labour (to make it happen), a chemical called oxytocin can be injected into the mother. **Propose** what effect the chemical would have on the uterus.

Creating CCT

18 **Construct** a diagram of a developing fetus and the uterus. Label each part on the diagram with its function in reproduction.

Inquiring

1 Research how new biological knowledge and new technology have helped improve the health of pregnant mothers and babies. In particular, find the:
- benefits of ultrasound and amniocentesis
- use of fetal transfusions
- problems that high blood pressure during pregnancy can bring
- methods used to control high blood pressure during pregnancy
- effect of nicotine in pregnant mothers and development of asthma in their children.

Present your findings as a digital slide show to run on the TV in a doctor's waiting room. ICT EU

2 Research warning labels for pregnant women on any five common drugs (pharmaceuticals) that may be in your medicine cabinet at home. Some typical drugs are aspirin, Panadeine®, Panadol®, ibuprofen (Nurofen®), Zyrtec® (or other allergy relievers). In particular:
- take digital photos of the warnings (if you have a digital camera)
- research the internet to find out why each warning is on the packet
- explain why pregnant women should always read warning labels on packets.

Present your research in digital form. ICT

4.4 Practical investigations

STUDENT DESIGN

1 Interview a mother

Purpose

To interview a mother about her experiences of pregnancy and the advice she received.

Materials

- paper and pen or recording device such as the video function on a mobile phone

Procedure

1. Design an interview with a woman who has been a mother—either your own mother, or someone you know. Scientists must always be ethical and so it is important that the woman agrees to participate freely. You need to find out what advice they received about pregnancy and birth before they occurred, and what they think of their experiences.
2. After compiling your list of questions, discuss them with another student to get their opinion on them. Check with your teacher that your questions are good ones.
3. Show the questions to the mother and ask her if she could help you. Tell her that her name will not appear in the report and that her answers will not be shown to anyone else other than your teacher. It would be best if you could actually talk to her and write out or record what she says. If she doesn't want to talk about it, but would be happy to write out some answers, then accept the offer. Don't hassle her to tell you things. Some things may be personal.
4. Obtain the answers to your questions by interview or in writing from the person. Make sure that you keep your promises about her privacy.

Hints

The first step is to think about the questions you should ask them, and write these down. Some examples are:

- What changes did you think having a baby would make to your life?
- What changes did you find you had to make to your life after having a baby?
- What advice were you given about diet during pregnancy?
- What did you know about the possible effects of alcohol and smoking?
- What advice were you given about exercise?
- What care did you take during the pregnancy?

Practical review

Assess what you have learnt in this activity, including any lessons that could help if you become a parent in the future.

4 Chapter review

Remembering

1 **Name** the following.
- a the process of producing new cells during growth
- b changes in body form and shape in an organism's life
- c sex cells that must join together in sexual reproduction
- d the human organ that produces male gametes
- e the human organ that produces female gametes

2 **State** the following times.
- a the length of human gestation in weeks and days
- b the average age for the start of puberty in girls and boys
- c how long a sperm can live in the oviduct
- d when ovulation occurs in a typical 28-day menstrual cycle

3 **List** five different methods of asexual reproduction and for each name an organism reproducing that way.

Understanding

4 **Discuss** the advantages of:
- a sexual reproduction
- b asexual reproduction.

5 **Explain** the important role of the lining of the uterus in human reproduction.

6 a **Define** the term *repair*.
- b **Explain** how it relates to body tissues.

7 **Outline** the role of cell division in growth and repair.

8 **Outline** the role of cell division in sexual and asexual reproduction.

Applying

9 **Identify** the following:
- a a structure in a pregnant woman that allows the embryo's carbon dioxide to enter the mother's circulation
- b a drug that can affect the fetus and cause brain damage, behavioural problems, reduced brain size, and learning difficulties for life

10 Animals such as humans, dogs, sheep and horses are classified into a group called placental mammals. The echidna and platypus are classified into a different mammal group called monotremes because they lay eggs. **Identify** the key difference between these two mammal groups.

Analysing

11 **Compare** the processes of sexual reproduction in plants and animals.

12 **Compare** the structures involved in sexual reproduction in plants and animals.

13 **Contrast** sexual and asexual reproduction.

14 **Compare** cross-fertilisation and self-fertilisation.

15 **Compare** the effects of alcohol and smoking on the developing fetus.

16 **Compare** the changes in male and female bodies during puberty.

17 **Compare** cell division in sexual and asexual reproduction.

Evaluating CCT

18 **Justify** the argument that illegal drugs should not be taken during pregnancy.

19 a **Determine** whether you can or cannot answer the questions on page 137 at the start of this chapter.
- b **Assess** how well you understand the material presented in this chapter.

Creating CCT

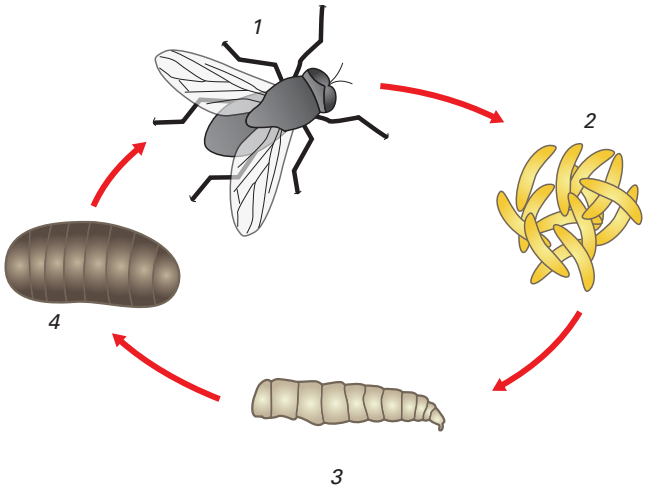
20 **Construct** flash cards about the male and female reproductive systems. Each card can be either a word or a diagram. Do some as words and some as diagrams. Write the answer on the back without your partner seeing it. Use the flash cards to test a partner. If you flash a word, they must tell you the function or meaning. If you flash a diagram, they must tell you the name. Take turns testing each other with your flash cards.

21 **Use** the following key terms to **construct** a visual summary of the information presented in this chapter.

life cycle	growth
sexual reproduction	asexual reproduction
flower	cell division
reproductive system	repair
fertilisation	placenta
pregnacy	

Thinking scientifically

Questions 1 and 2 refer to the following diagram of the life cycle of a housefly.



Q1 Between which two stages does fertilisation occur? CCT

A 1 and 2 **B** 2 and 3
C 3 and 4 **D** 4 and 1

Q2 Between which two stages is this cycle most similar to the stage in the life cycle of a flowering plant when the seed germinates (the plant breaks out of the seed)? CCT

A 1 and 2 **B** 2 and 3
C 3 and 4 **D** 4 and 1

Q3 Bats are like humans in that they are placental mammals. Which of the following should occur in the life cycle of a bat? CCT

A Bats would lay eggs in nests, like birds.
B Bats would give birth to live young and carry them in a pouch like marsupials.
C Bats would give birth to babies that go through a metamorphosis like butterflies.
D Bats would develop in a uterus with the fetus connected to the mother by an umbilical cord.

Questions 4 and 5 refer to the following table listing some reproductive structures in a human and a flowering plant.

Pair number	Human part	Flowering plant part
1	testis	stigma
2	uterus	seed
3	sperm	pollen
4	egg	anther
5	fetus	ovule
6	fallopian tube	fruit

Q4 Which of the following pairs in the table names parts that have the same role in human reproduction as they do in plant reproduction? CCT

A pair 1 **B** pair 2
C pair 3 **D** pair 6

Q5 Which of the following pairs in the table names parts found in the female human and the female part of the flower? CCT

A pair 1 **B** pair 3
C pair 4 **D** pair 5

Q6 The tables below show the names of four processes (numbered 1 to 4) that occur in humans, and a description of events (numbered i to iv). CCT

Process number	Name of process
1	Growth
2	Reproduction
3	Repair
4	Fertilisation

Event	Description of event
i	Sex cells join
ii	New cells form
iii	New individul forms
iv	New cells replace those that die

Identify which of the following correctly matches the name of a process with the event it describes.

A 1 – i **B** 2 – iv
C 3 – iii **D** 4 – i

Glossary

Unit 4.1 L

Cell division: process of a cell dividing to form new cells

Development: changes in body form and shape in an organism's life

Growth: an increase in body size

Life cycle: the changes that happen to an individual from its formation until it has produced offspring

Mitosis: the process of the cell nucleus dividing into two new nuclei

Repair: the process of fixing damaged body tissues

Reproduction: the process of parents producing new individuals, or offspring

Mitosis

Unit 4.2 L

Anther: the part of the flower that produces pollen

Asexual reproduction: a new individual growing from part of its parent's body with no joining of gametes

Copulation: two individuals joining to allow gametes to become fertilised

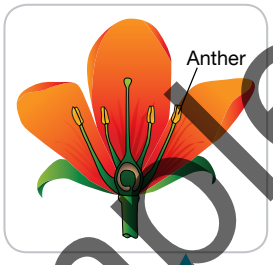
Development: the process by which the cell formed by fertilisation divides and develops to begin to look like an adult

Embryo: a developing offspring at a very early stage of development

Fertilisation: the joining of gametes

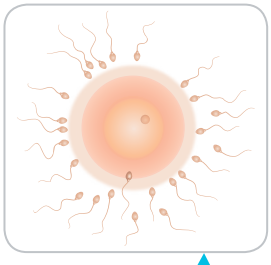
Flower: the reproductive structure in plants that makes male sex cells and female sex cells

Fruit: the structure that the ovary of a flowering plant turns into as the seeds ripen



Anther

Asexual reproduction



Fertilisation

Gametes: reproductive cells; sperm in males and eggs in females

Germination: when the young growing plant sprouts out of the seed

Hermaphrodite: an individual with both male and female sex organs

Meiosis: process that forms sex cells by division of a cell nucleus into four nuclei

Parthenogenesis: where offspring develop from eggs that have not been fertilised by a male gamete. A form of asexual reproduction

Pollination: transfer of pollen from the anther to the stigma

Sexual reproduction: the process of a sperm and an egg joining together and then growing into a new individual

Stigma: the flower part that receives the pollen

Style: connects the stigma to the ovary

Zygote: the first cell of the new individual after fertilisation

Unit 4.3 L

Cervix: part of the uterus that keeps it closed while the baby is developing

Fallopian tubes (oviducts): tubes down which the egg passes and where fertilisation occurs

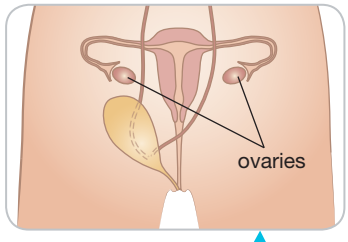
Hormones: chemicals made in the body to control reproduction and physical characteristics

Menstrual cycle: regular monthly changes in the hormones and reproductive organs of adult females

Ovaries: organs that produce the eggs or ova

Ovulation: the egg bursting out of the follicle

Period (menstruation): shedding of blood and dead tissue from the the lining of the uterus



Ovaries

Puberty: the time in life when physical changes bring sexual maturity

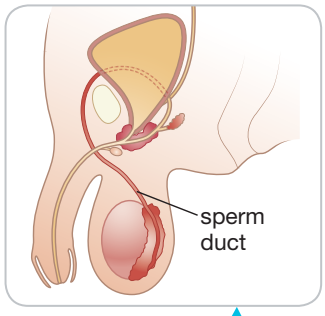
Semen: a mixture of sperm and other fluid released from the penis

Sperm duct (vas deferens): tube carrying sperm from the testes to the urethra

Testes: male organs that produce sperm

Uterus (womb): organ in which the fetus grows and develops

Vagina: organ that allows the male penis to be inserted to deposit the sperm; also acts as the birth canal down which the baby passes



Sperm duct

Unit 4.4 L

Afterbirth: placenta expelled from the mother after birth

Amniotic fluid: fluid surrounding the embryo that acts as a shock absorber and helps to maintain a constant temperature

Blastocyst: a hollow ball of cells that becomes an embryo

Copulation: two individuals joining together for sexual reproduction

Ejaculation: process of sperm being squeezed out of the penis

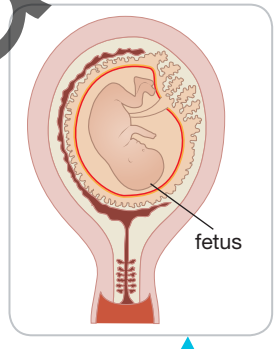
Embryo: early stages of development before the major organ systems are formed

Fetus: stage of development when most of the major organs and systems are present

Gestation: the time period from fertilisation to birth

Implantation: process of the blastocyst burrowing into the lining of the uterus


Blastocyst

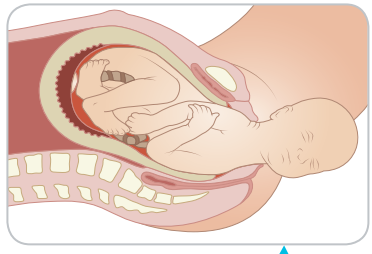


Fetus

Labour: process leading to birth, from first contractions of the uterus to expulsion of the afterbirth

Placenta: membranes of the fetus and mother that allow nutrients and oxygen to be exchanged and waste to be removed

Sexual intercourse: a male and female copulating


Labour