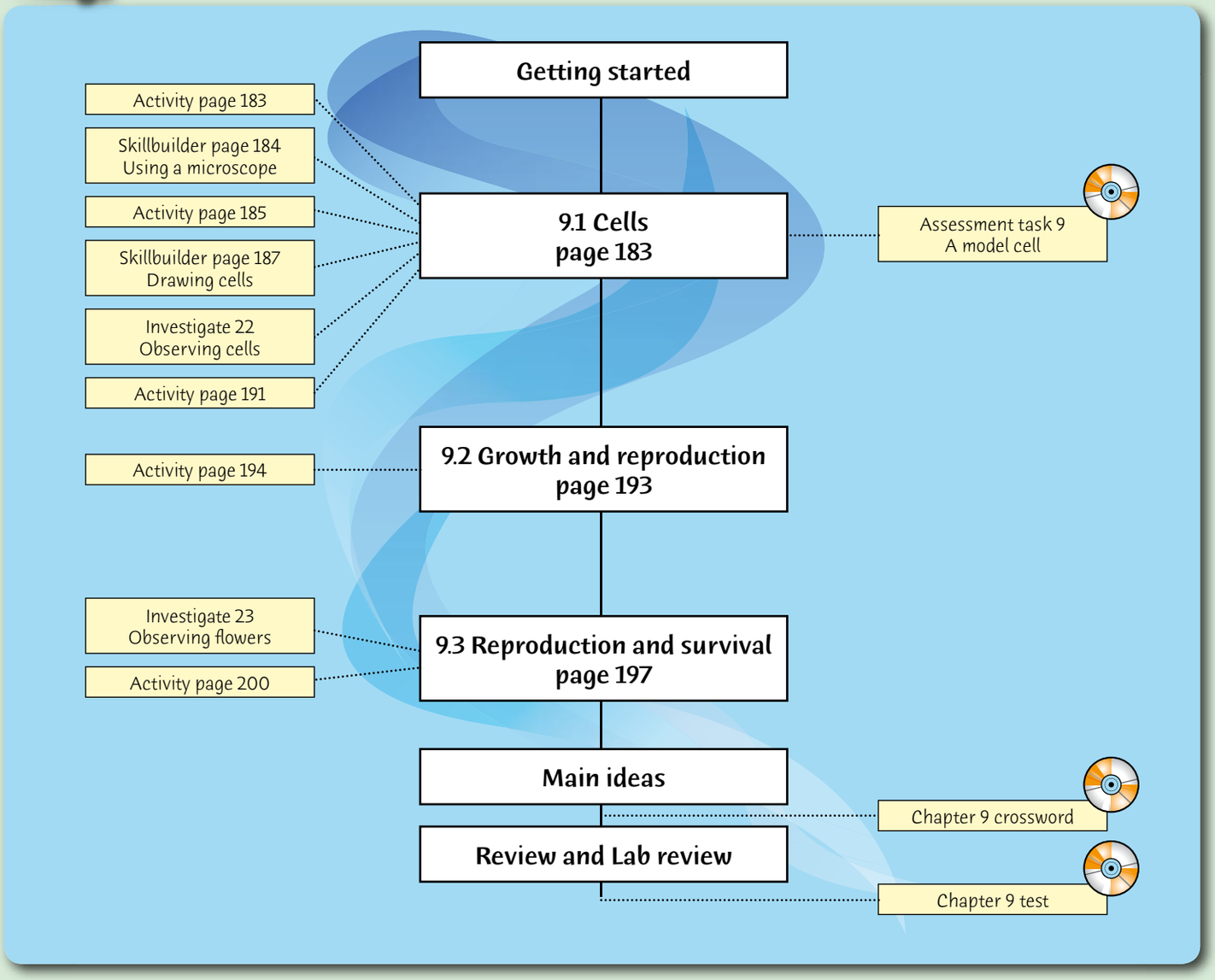
9 Building blocks of life

Planning page



Essential Learnings for Chapter 9

Essential Learnings	References		
	Student book (page number)	Workbook (page number)	Teacher Edition CD (Assessment task)
Knowledge and understanding *Life and living* Complex organisms depend on interacting body systems to meet their needs internally and with respect to their environment	pages 190–191 pages 193–194	pages 70–73	Assessment task 9 A model cell
Ways of working Select and use scientific equipment and technologies to enhance the reliability and accuracy of data collected in investigations	Skillbuilder pages 184–185		
Communicate scientific ideas, explanations, conclusions, decisions and data, using scientific argument and terminology, in appropriate formats	Skillbuilder page 187	page 69	

QSA *Science Essential Learnings by the end of Year 9*

Vocabulary

behaviour
chloroplast
connective
cytoplasm
dispersal
dissect
euglena
eyepiece
fertilisation
focus
magnify
multicellular
nucleus
ovary
parental
puberty
reproduction
specialised
survival
tissue
unicellular
vacuole
vegetative

Focus for learning

Investigate the use of magnifying glasses and microscopes to observe tiny organisms (page 182).

Equipment and chemicals (per group)

Skillbuilder page 184	microscope, prepared slide of stained cells
Activity page 185	microscope, microscope slide and cover-slip, small piece of newspaper
Skillbuilder page 187	HB pencil, eraser
Investigate 22 page 188	microscope, 2 microscope slides, cover-slips, piece of onion, methylene blue stain, leaf from a freshwater plant (eg elodea), small pieces of apple, mince meat, fresh chicken, moss, potato, spirogyra etc
Activity page 191	microscope, prepared slides of various types of tissues, nail polish or PVA woodworking glue
Activity page 194	fresh hen's egg, glass dish or petri dish, hand lens or stereomicroscope (optional)
Investigate 23 page 199	different types of flowers for dissection, petri dish, toothpick or small (fine) brush, stereomicroscope or hand lens, cavity microscope slide
Activity page 200	different types of fruit or seeds from fruit (cut small sections of branches to demonstrate the fruit on the plant)

9 Building blocks of life

Getting Started

- You are using a magnifying glass to look at a tiny insect on a stick (top photo). The magnifying glass has x2 on it. What does this mean?
- Another magnifying glass has x4 on it. How is this different from the first one? What will you see if you look at the insect with this magnifying glass?
- The organisms in this photo live in freshwater ponds and creeks. What does the x100 mean on the photo? Can you think of a way to find out how big these organisms are?

Starting point

This is a very interesting topic which will engage most students.

Microscopes are used in this chapter and it may be the first time students have used them. It is very important to allow adequate time for students to learn to recognise the parts of the microscope and to develop skills in using it. Try to ensure that all students get a turn.

It is also important to make sure that all microscopes are working and have had regular maintenance checks to ensure any problems are minimal.

Start the lesson with a slide show or picture show, showing the class what different things look like under the microscope. Discuss how complicated their structures look even though they are classified as simple organisms.

You might like to have a guessing game with the students and show photos of microscopic organisms or magnified views of pollen grains, blood cells, human hair or a flea. Images can be found on the internet and printed out or displayed in a PowerPoint presentation.

9.1 Cells

All organisms are made of small building blocks called *cells*. Your body contains over 3 billion of them. Most cells are very small and can be seen only with a microscope. However some cells, such as birds' eggs, are large enough to be seen with your eye. The emu egg is the largest single cell of all!

Some organisms are *unicellular*. These single cells are complete organisms. The photo below shows unicellular organisms called euglena (you-GLEEN-a), which live in fresh water and contain chlorophyll to make their own food by photosynthesis.

Fig 3 Euglena live in freshwater lakes and ponds. Long, whip-like 'hairs' called flagella at one end of the cell help it move through the water.

Multicellular organisms contain many different types of cells and each type of cell is specialised. This means that each type of cell has a different job to do in the organism. For example, in humans, red blood cells carry oxygen, muscle cells contract and relax to move bones and organs, nerve cells conduct nerve messages, and stomach lining cells make substances which help in the digestion of foods.

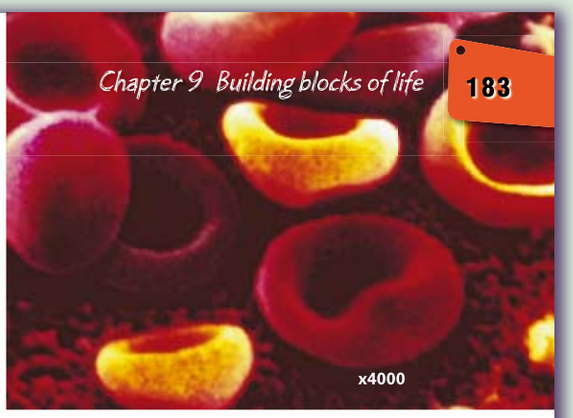


Fig 4 Red blood cells are specialised cells that carry oxygen around your body.

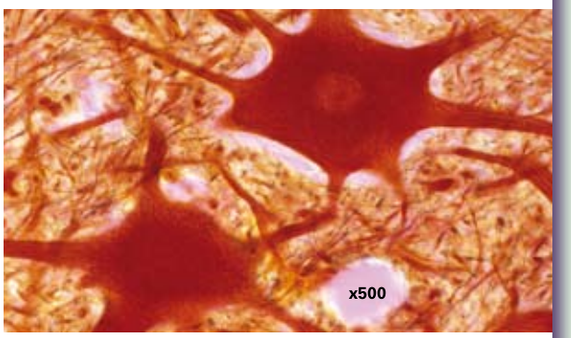


Fig 5 Nerve cells have an irregular shape. They carry nerve messages throughout your body.

Activity

The photos of the cells on this page are many times larger than the actual size of the cells. Each photo shows the number of times that the cell has been magnified. For example, the x200 on the euglena photo means that the cells have been magnified 200 times. You can use this information to find the actual sizes of the cells.

Measure an average-sized euglena cell with your ruler. Then divide this by 200 (the magnification) and give your answer in millimetres.

Use this method to find the sizes of the other cells in the photos.

Hints and tips

Have a set of calculators available for students, particularly those less mathematically able, to use when calculating the actual sizes of the magnified images.

Learning experience

Construct a table and ask students to list as many different sorts of multicellular and unicellular organisms that they can think of. Ask students to recall the differences between multicellular and unicellular organisms and possibly research some differences between them.

Have set up around the room some prepared slides under microscopes that have been pre-focused. Allow students to work their way around the room and view them. They could view things like blood cells, cheek cells, pollen grains, amoebas and paramecia. Ask your lab technician to suggest a variety of other examples for the class to look at.

At this stage, students have not been through the Skillbuilder on using a microscope so you will need to instruct students that they are not to lift or move the microscopes from the benches, as this will cause loss of focus. If they need to adjust the focus slightly for varying eye focus, they should use the fine focus knob located on the side of the microscope.

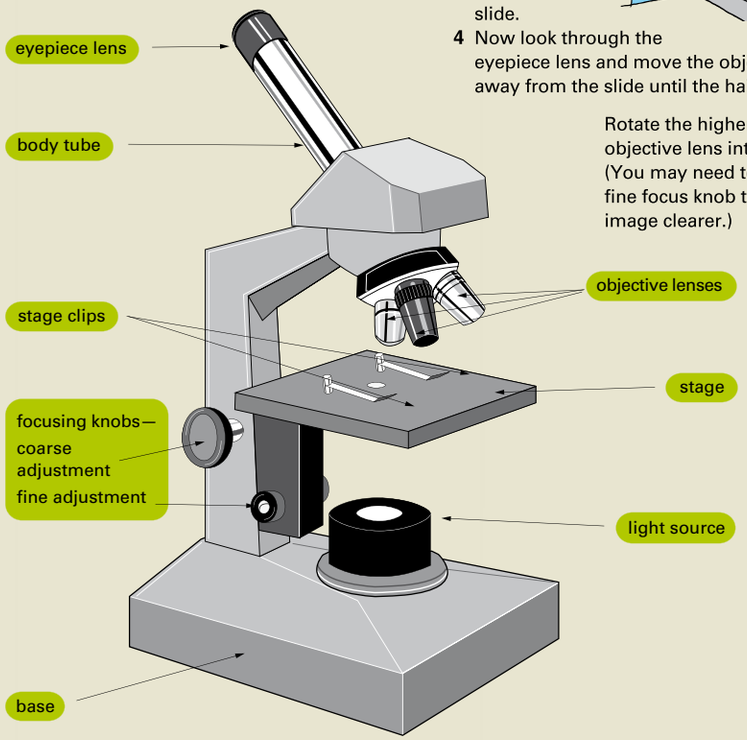
Skillbuilder

Using a microscope

In this chapter you will be using a microscope to view different types of cells

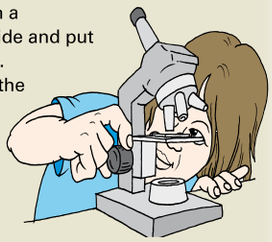
Parts of the microscope

Study the diagram below which shows the parts of a microscope. Your microscope may be slightly different from this one. However, the basic parts will be the same. If you are in doubt, ask your teacher for advice.



Setting up a microscope

1. Rotate the objective lenses until the low power lens clicks into position directly above the hole in the stage. (The low power objective lens is usually the shortest one, and has the lowest number stamped on it, eg ×4.)
2. Place a hair on a microscope slide and put it on the stage.
3. Looking from the side, turn the focusing knob to move the lens very close to the slide.



4. Now look through the eyepiece lens and move the objective lens away from the slide until the hair is in focus.

Rotate the higher power objective lens into place. (You may need to use the fine focus knob to make the image clearer.)

Skillbuilder notes

Microscopes are valuable and fragile. The following rules and procedures are good practice:

- Always carry the microscope with two hands and do not run or push against others.
- Always start on low power.
- Start with the objective lens near the slide and wind upwards.
- If the microscope has coarse and fine adjustment, use the coarse adjustment first, then the fine adjustment.

Hints and tips

When the students have mastered the skills of using a microscope, award them a 'Microscope Licence'.

Learning experience

It may be useful to place a microscope on the front bench or central desk and ask students to gather around it. Outline each of the parts of the microscope and explain what each part is used for.

Some microscopes have a mirror at the base which directs the light up through the stage. Remove the eyepiece and adjust the mirror so that maximum light passes up the body tube.

What x10 means

A microscope magnifies things. Each lens of a microscope has its magnifying power marked on it.

Look at the eyepiece lens. You may see the number ×10. This means that this lens magnifies things to 10 times their original size. The objective lenses are marked in the same way.

The total magnifying power of the microscope is found by multiplying the power of the eyepiece lens by the power of the objective lens. If the eyepiece is ×10 and the objective is ×10, then the microscope will magnify the object 100 times.

Observing prepared slides

Your teacher will give you a microscope slide containing some cells for you to practise your microscope technique.

Observe the shapes and features of the cells.

Questions

1 A microscope has a x4 eyepiece and a x10 objective. What is the total magnification of the microscope?
2 When focusing, why do you turn the focusing knob so that the objective lens moves away from the slide?
3 A hair is 0.005 mm wide. How wide would it be if you looked at it with the lenses in Question 1?

Activity

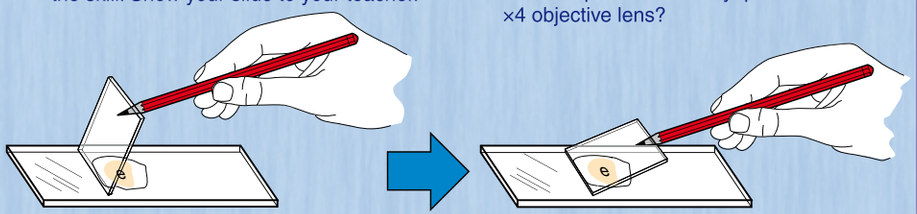
Making a wet-mount slide

1 Place a drop of water in the middle of a microscope slide.
2 Cut out a small lower case 'e' in the piece of newspaper and place it on the drop of water on the slide. Cover the 'e' with another drop of water.
3 Place the edge of the cover-slip on the edge of the drop of water, and lean it on a pencil, as shown.
4 Lower the pencil slowly and let the cover-slip fall flat on the slide. (This stops air bubbles forming under the cover-slip.) You should do this a few times to master the skill. Show your slide to your teacher.
5 Place the slide on the stage and observe the letter under low power.

Record your observations. Is the 'e' the right way up? Move the slide to the left. Which way does the 'e' move when viewed through the lens?

Questions

1 Suppose you place the number '5' under the microscope. Draw what you would expect to see through the lenses? Explain your drawing.
2 A cell is 0.01 mm long and 0.02 mm wide. How big would it be if you viewed it under a microscope with a ×10 eyepiece lens and ×4 objective lens?



Hints and tips

Prior to commencing the activity, go through what is required, and only proceed when all students have a clear understanding. When instructing students, ensure you use the correct terminology when referring to the microscope.

Activity notes

To avoid too many air bubbles, put a drop of water on the slide before the specimen is added and another drop on top. Then carefully lower the cover-slip.

Lens cleaning paper is expensive and should only be used for this purpose. Plain (unscented) facial tissues should be used for cleaning or drying slides, and hand towels for drying hands.

Make sure you examine the wet-mount slides that each student makes (step 4), and reject any that have air bubbles.

Research

Students could research the history and development of the light microscope and electron microscope and make a time line of events.

Cells in organisms

The cells of living things vary in shape and function, but they do have features in common.

All cells are surrounded by a thin covering called a **cell membrane**, which acts like a fence controlling the movement of substances into and out of the cell. The cell membrane also helps to hold the cell together and to give it shape.

The round, dark-coloured object in the cells in the photos below is the **nucleus** (NEW-klee-us). This controls all the cell's activities, and without it the cell eventually dies.

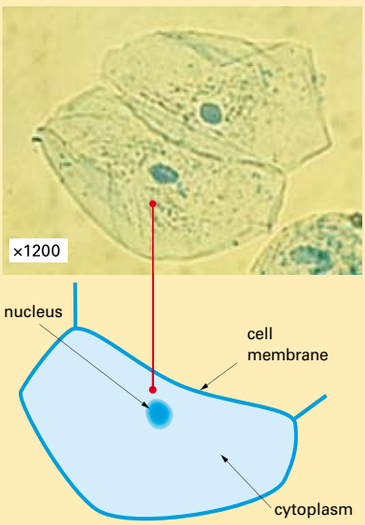
The inside of cells is filled with a jelly-like substance called **cytoplasm** (SIGH-toe-plaz-um). This is where many chemical reactions take place. The cytoplasm also contains many other small bodies and structures called **organelles** (OR-gan-els). These help to keep the cell functioning correctly.

How are plant cells different from animal cells? Plant cells have a **cell wall** on the outside of the cell membrane. This is a thick, tough layer that protects the softer parts inside the cell and also provides stiffness that helps support the plant.

Plant cells also contain large liquid-filled spaces called **vacuoles** (VAK-you-oles) where water and dissolved substances are stored. Some animal cells have small vacuoles, but most have none at all. Inside the cytoplasm of plant cells there are organelles called **chloroplasts**. These contain the green pigment chlorophyll, which is needed for photosynthesis. Photosynthesis occurs in the chloroplasts.

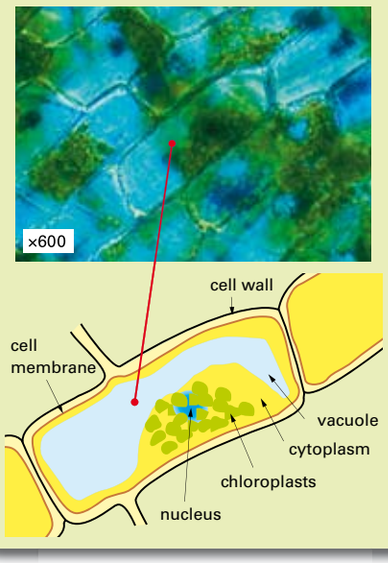
Animal cells

These cells are from the inside lining of a human cheek. The diagram below will help you interpret the photo.



Plant cells

These cells are from the leaf of a plant. The diagram below will help you interpret the photo.



Hints and tips

Remind students what an organism is and how photosynthesis works (Chapter 7).

Assessment task

Students could attempt Assessment task 8: A model cell, found on the CD, after this page is discussed.

Learning experience

Compare and contrast plant and animal cells. Ask students to label things that they would see in a plant cell and not in an animal cell and vice versa. Then construct a table listing parts of the cells and their function.

Make a three-dimensional model of a cell using recycled material. Ensure that all parts of the cell are labelled.

Science in action

Shane is a baker. He makes different kinds of bread with the help of a unicellular organism called *yeast*.

When making bread, Shane adds the basic ingredients—flour, sugar, water and yeast—and mixes them together to form dough. The dough is then left for a while in a warm place. During this time, the yeast cells grow and multiply rapidly using the sugar as a food.

Yeast cells get the energy needed for growth and reproduction by breaking down the sugar. Carbon dioxide and alcohol are produced as waste products. This process is called *fermentation*.

glucose ⟶ carbon dioxide + alcohol

The carbon dioxide gas given off by the yeasts causes the bread to rise and makes the holes in the bread. When the bread is baked, the heat of the oven quickly evaporates the alcohol from the dough.

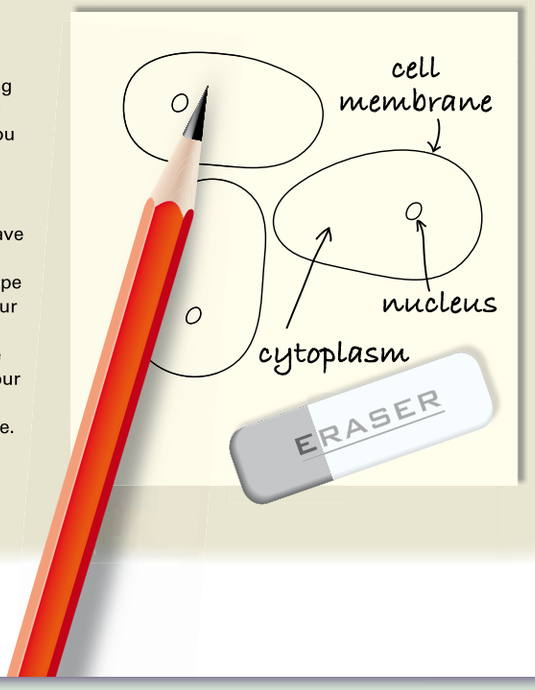
Skillbuilder

Drawing cells

In the next investigation you will be using the microscope to observe some animal and plant cells. In these observations, you should include drawings in your report.

How to draw cells

1. Always use a sharp HB pencil, and have a clean eraser handy.
2. The cells you see under the microscope are fairly complicated. Try to keep your drawings as simple as posssible.
3. Choose 2 or 3 cells to draw. Draw the lines and shapes. Don't shade or colour the drawing.
4. Make the drawing as large as possible. Include only the structures you can identify. Label these structures.



Hints and tips

Make some bread dough to show the students how the yeast cells grow and multiply. Do this at the start of the lesson and check it at the end. Make sure you leave the dough to rise in a warm position.

Learning experience

Students could view pond water or slime under the microscope and discover the life that exists beyond their vision. Have students draw and then research the small organisms that have been identified. Reinforce the rules for drawing scientific diagrams:

- Use a pencil.
- Keep the diagrams simple.
- Draw two or three cells only.
- Use clear single lines.
- Make the cells large and label them.

Lab notes

- It is good practice to number the microscopes and insist that students use the same one each time.
- Microscopy requires a number of skills, and if biology is not your strength it might be a good idea to invite a biology colleague to help, or swap classes for a lesson or two. Ask the lab technician to help during class, since many students may need help at the same time.
- Be careful with the methylene blue stain as it will stain books, skin, clothes etc.
- The onion epidermis is a single cell thick and looks like thin plastic wrap. Use a piece no bigger than a fingernail so that it will lie reasonably flat on the slide.
- Do not allow students to handle or view fresh human blood. Check to see whether your school has some prepared slides of blood.
- Review the Skillbuilder on page 187 on how to draw cells.

Investigate

22 OBSERVING CELLS

Aim

To use a microscope to observe plant and animal cells.

Materials

- microscope
- 2 microscope slides and cover-slips
- piece of onion
- methylene blue stain
- leaf from a freshwater plant (eg elodea)
- small pieces of apple, mince meat, fresh chicken, moss, potato, spirogyra etc

Planning and Safety Check

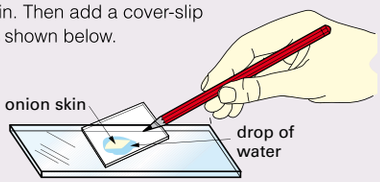
- Carefully read through Parts A, B and C, and make a list of the materials you will need for each part.
- Ask a partner to describe what they are going to do in Part A. Then you describe what you are going to do in Part B.

PART A
Onion skin cells

Method

1 Remove one layer from the onion. Then peel a small piece of the very thin skin from inside the layer.

2 Put a drop of water on a slide then place the piece of onion skin on the drop. Add another drop of water on top of the onion skin. Then add a cover-slip as shown below.



3 Repeat Steps 1 and 2 with a second slide, but instead of adding water, add one drop of methylene blue stain. Then place a cover-slip over the onion skin.

4 Observe both slides under low power, then under higher power.

Record the differences between the two slides. In which one are the cells more easily observed? Which parts of the cell can you easily see?

Draw two or three stained cells. Label the cell wall, the nucleus and the cytoplasm.

PART B
Looking at chloroplasts

Method

1 Tear a small leaf from the top of the freshwater plant.

2 Prepare a slide as you did for the onion skin, but this time use the leaf. (You can use a drop of water or the methylene blue stain if you wish.)

3 Observe the leaf under low power, then under higher power.

Use the photo of the plant cells on page 186 to help you identify the round chloroplasts, the cell wall, the nucleus and the cytoplasm.

Draw a labelled diagram of what you observe. How do these cells compare with the onion cells from Part A?

PART C
Other cells

Method

1 For this part you will look at cells in apple, mince meat, chicken, moss, potato, spirogyra, duckweed etc.

2 Place a small amount of material on the end of a toothpick. Scrape it onto a slide.

3 Add a drop of water and a cover-slip. You can add a drop of stain if you wish.

Observe the cells. Draw and label two or three of the cells.

Discussion

1 Why is a stain used when observing cells?

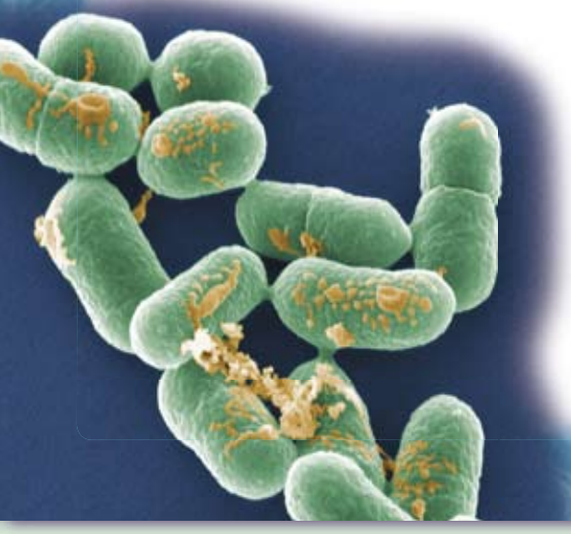
2 What general shape are the onion cells? Do other types of cells also have a regular shape? Do other cells have the same shape as onion cells?

Video microscope: Your teacher may connect a camera to a microscope to show you different types of cells.

science bits

Sizes of cells

You have seen that cells have a variety of shapes depending on their function. Most animal and plant cells are about 0.005 mm to 0.02 mm in diameter. The largest single cell is the ostrich egg, which is about 15 cm long. However, the longest cell is a type of nerve cell found in the giant squid and can be up to 7 metres in length.



Bacteria

Bacteria are unicellular organisms and have a much simpler cell structure than animal and plant cells. A bacteria cell is usually smaller than other cells, ranging in size from 0.0005 mm to 0.003 mm.

Bacteria are usually classified by their shape. There are rod-shaped ones (bacilli), spherical ones (cocci) and spirals (spirilli). Bacteria have a cell wall, but no nucleus. This is the major difference between a bacterial cell and a plant or animal cell.

Questions

1 What is the main difference betweeen an animal cell and a bacterial cell?

2 What is the average diameter of an animal or plant cell? What is the average diameter of a bacterial cell? How much larger is an average animal cell than an average bacterial cell?

WEBwatch

Go to www.scienceworld.net.au and follow the links to **Bacteria**.

Use the websites to find out about different types of bacteria: the ones that cause disease and the ones that are useful to us.

Hints and tips

Prepare some information sheets on various bacterial or fungal growth which is harmful to humans. Ask the students to form small groups and present to the class information on why it is harmful, how it is identified and how it can be treated. Possible organisms are: salmonella, meningococcal, staphylococcal or Escherichia coli (E. coli).

Learning experience

Research the differences between plant, animal, bacterial and fungal cells. Tabulate the information and draw simple diagrams of each.

Learning experience: observe bacterial and fungal growth

Observe microbial growth on agar when the plates are exposed to different places in the school. Ask your lab technician to prepare some agar plates and allocate one to each group. (Do not allow students to make agar plates.) As a class group, decide which sources the agar plates will be exposed to, eg dirty hands, bathroom sink, door handle etc. Use cotton buds to take swabs from the various sites and then rub the cotton buds over the agar. Tape the lids on with adhesive tape and do not remove them from now on. Turn the plates upside down and label them with a marker. Place them, lid side up, in an incubator (38°C) or in a warm, dark cupboard for a few days. Observe the plates and determine which area had the most microbes.

Cells, tissues and organs

Unicellular organisms such as euglena contain all the structures necessary to exist on their own and be independent from other cells. However, the cells in large, multicellular organisms are generally specialised, and therefore need to work together with other cells for the survival of the organism. For example, a single cheek cell cannot exist on its own for very long and will die after a short time outside the body.

Cells of the same type are generally found together in tissues. A **tissue** is a group of similar cells organised to do a particular job. For example, the muscle tissue in the wall of your stomach and gut is made from muscle cells. The nerve tissue in your brain and spinal cord is made from nerve cells.

In multicellular organisms, various tissues are arranged into a structure called an **organ**. An organ is a collection of specialised tissues that has a particular function. For example, a leaf whose main function is to make food, contains food-making tissue, transport tissue, support tissue and lining tissue.

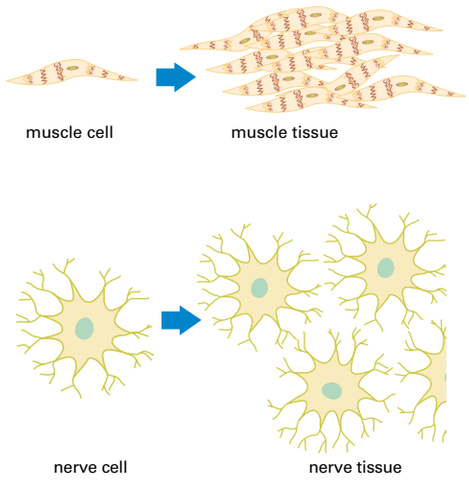
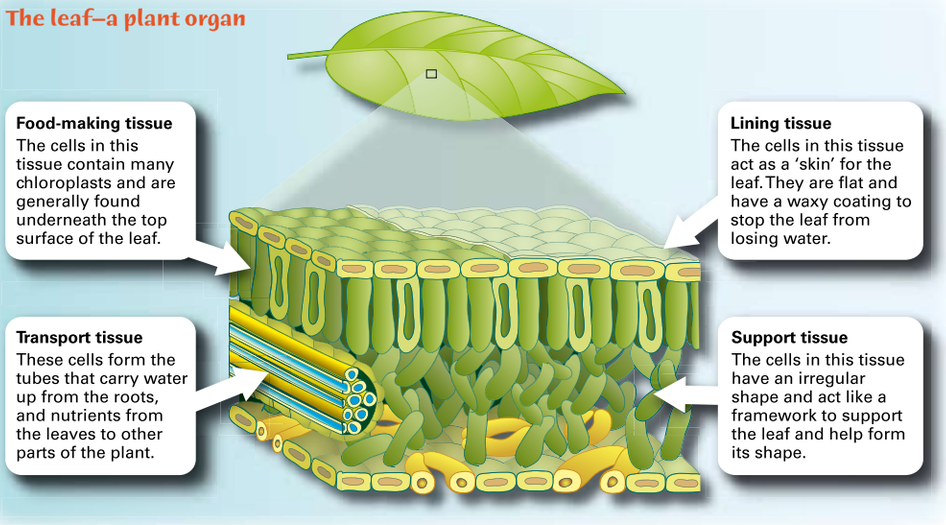


Fig 17 Many cells of the same kind combine to form tissues in the body.



Research

Ask students to research the many different types of cells that are found in leaves, humans and other animals.

Research

Ask students to research one of the systems in the human body. They should draw diagrams of the types of cells that are involved in this system and explain their primary function.

Issues

'Stem cell research is considered unethical.' Ask students to investigate this statement and come up with two arguments—one for and one against stem cell research. You might like to have a class debate to explore the social, ethical and scientific implications of the research. (Essential Learnings: students know and understand that values and ethics influence the ways that science is applied.)

Activity

You will need a microscope and slide, some prepared slides of various tissues, some clear nail polish and a leaf.

A Looking at tissues
Set up a microscope and ask your teacher for a prepared slide of a tissue.

Draw a sketch of the cells in a small section of the tissue (about six to ten cells).

Write down the name of the tissue (this will be written on the slide).

B Observing the cells on a leaf's surface
Brush some nail polish on the *underside* of a leaf, so that it covers an area about the size of a 20 cent piece. Let it dry for a few minutes.

Peel the dried nail polish from the leaf and look at it under a microscope. You will see a copy of the surface cells on the leaf.

You will also see cells that form holes or pores in the surface of the leaf. Find out from the library what these pores are called. What is their function?

The stomach is an organ whose function is to break down (digest) food. It contains glandular tissue which produces substances that chemically break down foods, muscle tissue which churns the food, and connective tissue which holds the other tissues together.

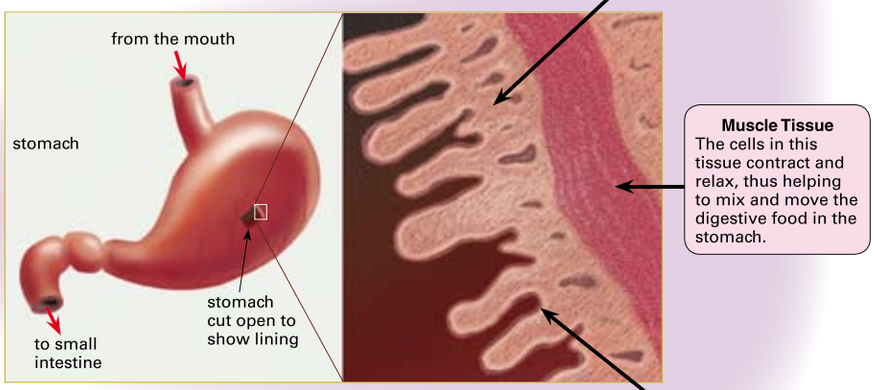


Fig 20 The tissues in the stomach have a number of functions. Cells in the gland tissue make chemicals that help digest foods, and muscle tissue moves the stomach to help mix the food.

Activity notes

Part B

As an alternative to nail polish, woodworking glue (PVA glue) can be used. Dab a 20-cent-sized spot of the white glue on the underside of a leaf and leave it to dry overnight. Next day, peel the clear, dried glue from the leaf and observe it under a microscope.

Make a leaf section

If your students are skillful enough, you might like to let them prepare a thin section of a leaf to observe under a microscope.

The cells in most leaves are not rigid enough to withstand the crushing force of a blade slicing through them. To prepare a section of a leaf, first slice a large raw carrot in half lengthwise, then sandwich the leaf between the two halves. Tie the carrot halves together with thread, than use a sharp single-sided razor blade to cut very thin sections. Use forceps to place the leaf section on a microscope slide and prepare a wet-mount as previously.

Alternatively, the leaf can be snap frozen using carbon dioxide from a cylinder and cut thinly without using a carrot.

Research

Students might like to find out what a stomach ulcer is, how it affects a person and how it can be cured.

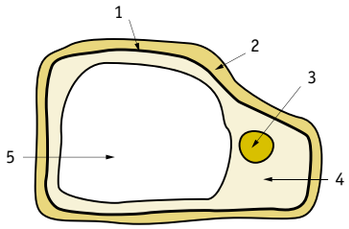
Check!

1 Draw up a table similar to the one below and list the features of plant and animal cells so you can compare them. One feature has been done for you.

Plant cells	Animal cells
Have a nucleus	Have a nucleus

2 A microscope lens has ×10 marked on it. What does this mean?

3 Copy the drawing of a cell below into your notebooks. Use the information in the table above to determine whether it is a plant cell or an animal cell, then label the cell.



4 Describe the function of each of the five parts of the cell in Question 3.

5 Copy the following sentences into your notebook, then complete them using the words you have learnt in this section.
- **a** Organisms are made of building blocks called _____.
- **b** Cells in large organisms are called _____ cells, because they perform a particular function.
- **c** The lens that you look through at the top of a microscope is called the _____.
- **d** Organelles are found in the _____ of a cell.
- **e** Chloroplasts are organelles that contain _____.

6 Explain the difference between a tissue and an organ. Give an example and use the words *cells* and *function* in your answer.

7 On page 183, the word *multicellular* was used. Explain what this word means.

8 Look at the diagram of the leaf on page 190. Make an inference for each of the following observations.
- **a** The lining cells are very flat and fit together like tiles.
- **b** There are many chloroplasts in the food-making cells.
- **c** There are holes or pores in the underside of the leaf.
- **d** The cells in the support tissue fit together like trusses in a house frame.

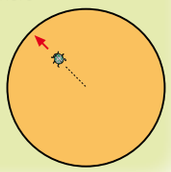
9 You are an illustrator for a Year 8 science textbook. Try to explain, using labelled drawings, how to make a wet-mount slide.

challenge

1 A microscope has two eyepiece lenses, ×4 and ×10, and three objective lenses, ×4, ×10 and ×40.
- **a** What combination of lenses gives a ×160 magnifying power?
- **b** What are the lowest and highest magnifying powers of the microscope?
- **c** A specimen was photographed using the ×10 and ×10 lenses. On the photo the specimen measured 55 mm in diameter. What is the actual size of the specimen?

2 **a** What does the letter 'F' look like through a microscope?

b Under a microscope you observe a tiny insect moving diagonally across a slide, as shown in the diagram. Where should you place your finger to prevent it from escaping from the slide?



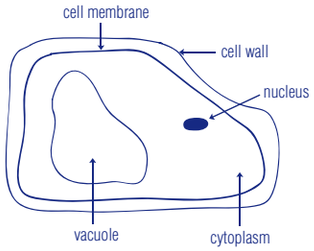
Check! solutions

1

Plant cells	Animal cells
Have a nucleus	Have a nucleus
Have a membrane	Have a membrane
Have cytoplasm	Have cytoplasm
Have a cell wall	Do not have a cell wall
Often have chloroplasts	Never have chloroplasts
Often have large vacuoles	Sometimes have small vacuoles

2 This means that the lens magnifies things 10 times, just like a hand lens or magnifying glass.

3 This is a plant cell because it has a cell wall and a large vacuole.



4 1 The cell membrane is a very thin structure which controls the movement of materials into and out of the cell.
2 The cell wall is only present in plant cells and provides strength and shape for the cell.
3 The nucleus contains important structures and information that help the cell grow and divide.
4 The cytoplasm is a jelly-like substance in which reactions take place and through which materials move.
5 The vacuole stores water and dissolved substances and also helps to maintain cell shape.

5 **a** Organisms are made of building blocks called **cells**.
b Cells in large organisms are called **specialised** cells, because they perform a particular function.
c The lens that you look through at the top of a microscope is called the **eyepiece**.
d Organelles are found in the **cytoplasm** of a cell.
e Chloroplasts are organelles that contain **chlorophyll**.

6 A tissue is a collection of *cells* of the same type (eg muscle tissue). When this tissue works together with other tissues, it forms an organ which has a particular *function* (eg the heart).

7 The word 'multicellular' means many cells. An organism which is multicellular consists of many, sometimes billions, of cells which are usually specialised to perform different roles.

8 Likely inferences are:
- **a** The function of these cells is to protect the leaf and reduce water loss.
- **b** The function of chloroplasts is to use light to make food for the plant.
- **c** The function of these pores is to control the loss of water vapour and movement of other gases into and out of the leaf.
- **d** The function of these cells is to provide support and shape to the leaf.

9 Students should check their instructions and drawings with those on page 185.

Challenge solutions

1 **a** Eyepiece 34 and objective 340
b Lowest power: 316 (34 and 34)
Highest power: 3400 (310 and 340)
c This combination of lenses gives 3100 magnification, so the specimen is actually 0.55 mm (or 550 µm).

2 Under a microscope the image is both back to front and upside down.
a The letter F will look like ∃.
b The insect looks as though it is going towards the upper left, but is actually going towards the lower right, which is where you should put your hand.

9.2 Growth and reproduction

When a bean seed is planted in moist soil, the roots begin to grow and become larger and longer. This growth occurs because certain cells in the roots multiply and make more cells by a process called **cell division**.

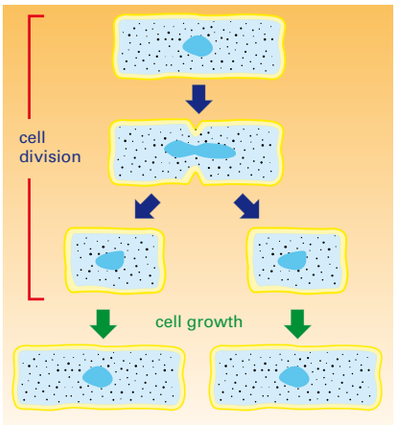


Fig 23 All living things grow when cells divide to make new cells. Each of these new cells then grows in size and becomes a mature cell.

All living things grow by making new cells. Your body grows rapidly in stages up to the age of about 15. During this time your bones grow thicker and longer. For example, your thigh bone (*femur*) grows to about three times the length it was when you were born. Bone cells in the enlarged rounded ends of the femur divide to make new cells.

Your skin grows in much the same way. Certain cells below the surface of the skin divide to make new cells. So, as the bones and other parts of your body grow larger, your skin also grows. However, unlike bones, which stop growing at adulthood, cell division continues in your skin until death. The skin continually loses cells from its surface and replaces them with new ones.

Producing new life

All organisms reproduce to make more of their own kind. Unicellular organisms do this by cell division. They simply split in two to produce offspring that are identical to the original organism. This is called *asexual reproduction*.

Fig 24 Microscopic organisms, like these paramecia, reproduce by splitting in two.

Larger organisms reproduce sexually. To do this, the two parents (one male and the other female) produce **sex cells**. These cells are different from other cells. They can combine to make a cell that eventually becomes a new and independent organism.

The female sex cell is called an **ovum** or *egg cell*. Ova (plural of ovum) are made in organs called **ovaries** (OH-var-ees). The male sex cell is called a **sperm cell** and is much smaller than ova. Sperm are made in organs called **testes** (TES-teez).

When a sperm and ovum meet, the nuclei of the two cells join together, and a new living thing is formed. This process is called **fertilisation** (FUR-til-eyes-AY-shun).

Fertilisation can occur externally or internally. For example, in humans internal fertilisation occurs. The male deposits the sperm inside the female's body. They then swim towards the ovum, where fertilisation occurs. Female frogs, on the other hand, release their eggs in the water, and sperm released by the male swim to the eggs.

Hints and tips

- There are many commercial videos available that show animations of asexual reproduction. Take the time to view these with your students.
- Ask students to explore the human aging process in the context of cell growth. You may like to get them to investigate degenerative diseases of the human body, or what happens when cell growth goes wrong.

Learning experience

Research the many different methods of asexual reproduction, eg binary fission, budding, regeneration and vegetative reproduction.

Separate the class into small groups and ask them to research how these methods occur, and present their findings to the class.

Fig 25 Human sperm cells (×2500) look like miniature tadpoles. They use their tail to swim through liquid. The head of the sperm contains the nucleus and a small amount of cytoplasm.

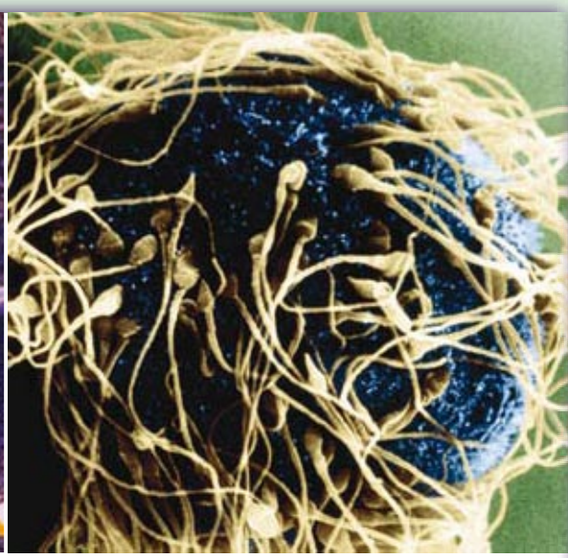


Fig 26 A human ovum (×1000) with sperm cells on its surface. The ovum is much larger than a sperm cell, because it has much more cytoplasm. The cytoplasm contains food for the fertilised egg during the first few days of cell division and growth.

The sex cells of organisms are not all the same size and shape. Fig 27 shows the actual sizes of ova from five different animals.

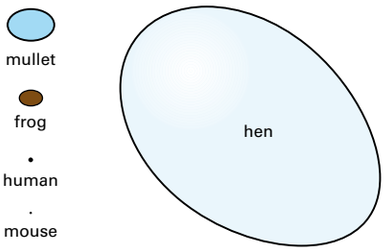


Fig 27 The sizes and shapes of five different ova

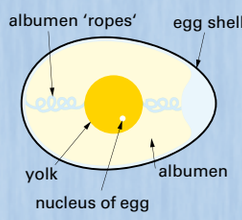
The eggs of mammals are small compared with the eggs of birds, reptiles, amphibians and fish. They have only a small quantity of cytoplasm, because the eggs develop internally and receive nourishment from the mother within a few days of fertilisation. In birds and many other animals, the fertilised egg develops outside the mother's body and must contain enough food for the whole period of growth.

Activity

Break open a hen's egg in a flat glass dish or petri dish. Notice the yellow yolk and clear albumen (the 'white'). These make up the cytoplasm of the cell.

Look at the yolk carefully and you should see a tiny white patch. This is the nucleus of the egg. It is this part of the egg that develops into a young chicken.

Observe the 'ropes' in the albumen. These keep the young chicken in place in the egg and stop it from rolling over.



Learning experience

Get students to make a set of flash cards on this chapter which can be used throughout the topic and as a revision tool.

Learning experience

You may want to talk further about sexual reproduction, particularly in humans.

Have students prepare mind maps of the cells and organs that are involved in this process. Then use these mind maps to construct a table and enter all relevant information.

Students may be very sensitive when talking about sexual reproduction. Allocate at least one lesson to answer the questions that students want to ask. Some questions may seem ridiculous, but usually they are very genuine. Once you have had this discussion, you will find that the students will stay on task.

science bits

Eggs and life cycles

Humans

In humans, a baby girl at birth has ovaries that each contain about 200 000 eggs. These eggs do not begin to mature until certain changes take place in a young girl's body. These changes occur during a stage called **puberty** (PEW-ber-tee). In girls, this occurs somewhere between the ages 10 and 14.

From the onset of puberty, a woman's ovaries will produce usually one egg a month for about the next 40 years. At about age 50, the ovaries stop producing eggs. This is called **menopause**.

Dogs

The ovaries in a female dog contain thousands of immature eggs when it is born. At about 6 months old, the female dog starts producing mature eggs. This is the period the female is said to be 'on heat', and it is a sign that she is ready to mate with a male dog. Unlike in humans, the ovaries in dogs can release many eggs during this period, and the female can give birth to as many as 15 puppies.

Female dogs go 'on heat' about every 6 months, so it is possible for dogs to have two litters of puppies in a year. The pregnancy lasts just over two months.

Chickens

Like humans and dogs, hens are born with many thousands of immature eggs in their ovaries. At 3 months of age, hens start laying eggs. They have been bred to lay up to 200 eggs a year. However, these eggs are usually used for food and not for producing more chickens. The eggs you buy at the supermarket have not been fertilised by a rooster and therefore cannot develop into chickens.

The ancestor of the modern hen was the red jungle fowl, found in South-East Asia. It is believed that this bird was domesticated about 4000 years ago. The present-day jungle fowl lays between 3 and 12 eggs a year, which is similar to the number of eggs laid by other birds.

Hints and tips

Present to the class some interesting facts about eggs and life cycles. One of Australia's most common marsupials, the brown antechinus, is fascinating; so too are many insects.

Research

Research the life cycle of an organism that reproduces sexually. Make sure animals and plants are represented evenly. Students should draw a simple diagram of the organism's life cycle, label the various stages and briefly explain what happens in each stage. Some organisms have incredible rituals that they perform during mating or elsewhere in their life cycles. For example, frogs undergo metamorphosis, some female spiders kill the male after mating etc. Ask students to include this fascinating information.

Check!

1 Copy and complete the following sentences.
- **a** _____ _____ is a process in which cells split into two.
- **b** In organisms that reproduce sexually, the male produces _____ and the female produces _____.
- **c** Fertilisation occurs when the _____ of sex cells combine.
- **d** In males the _____ produce sperm, and in females the _____ produce eggs.

2 Name two places in the body of a 1-year-old child where cell division occurs. Would this be the same for a 50-year-old person. Give a reason for your answer.

3 Look at the Term and Meaning lists top right. Match the terms in the left-hand column with the meanings in the right-hand column. To do this, draw up a table like the one below.

Term	Meaning

Term	Meaning
ovary	where sperm are made
semen	when the nuclei of a sperm and ovum join
fertilisation	a liquid containing sperm
ova	the organ that produces eggs
testes	female sex cells

4 Look at Figs 25 and 26 on page 194. Use a ruler and the information given in the captions to calculate the sizes of a sperm cell and an ovum.

5 Why do sperm cells have tails while eggs do not?

6 External fertilisation occurs in frogs and mullet. Suggest why these animals produce many more eggs than humans or mice do.

7 A male usually releases millions of sperm when it is mating with a female.
- **a** How many of these sperm do you think usually fertilise the female's ovum? Suggest a reason for your answer.
- **b** Suggest why the male makes and releases so many sperm.

challenge

1 Cell division in microscopic organisms can occur rapidly if the conditions are suitable. For example, bacteria can divide every 20 minutes. Assuming one bacterium divides every 20 minutes, and none die, how many bacteria would there be after six hours?

2 Women usually give birth to one child at a time, but multiple births do occur. Identical twins occur when the egg splits into two just after fertilisation and each develops separately. Fraternal twins occur when two eggs are released from the ovary and each is fertilised by a different sperm.

Use the information above to answer the following questions.
- **a** Identical twins are always the same sex and look almost exactly alike. Why?
- **b** Why is it possible to have fraternal twins with quite different features?
- **c** Suggest why twin births are much less common than single births.

Check! solutions

1 **a** **Cell division** is a process in which cells split into two.
b In organisms that reproduce sexually, the male produces **sperm** and the female produces **eggs**.
c Fertilisation occurs when the **nuclei** of sex cells combine.
d In males the **testes** produce sperm, and in females the **ovaries** produce eggs.

2 In a 1-year-old child there is a lot of cell division especially in bones and muscles. In a 50-year-old there would be less cell division because the person is no longer growing, but some division would still occur to replace aging or damaged cells.

3

Term	*Meaning*
ovary	the organ which produces eggs
semen	a liquid containing sperm
fertilisation	when the nuclei of a sperm and ovum join
ova	female sex cells
testes	where sperm are made

4 In Fig 25 the sperm heads are about 21 mm long after being magnified 2500 times. Therefore they are actually 21 ÷ 1500 mm, or about 1.4 µm. In Fig 26 the egg is about 10 mm after being magnified 1000 times so it will actually be 10 ÷ 500 mm or about 20 µm.

5 Sperm cells have tails to help them swim towards the egg cells.

6 These animals produce many more eggs than humans or mice because they are released and fertilised outside the body. As a result, many are not fertilised or the fertilised eggs may be eaten by other animals.

7 **a** In humans only one sperm will fertilise one egg. This occurs because when they fuse together one normal cell is formed.
b The male makes and releases so many sperm because they have a long way to swim and many will die on the way.

Challenge solutions

1 After 6 hours the number of bacteria will be 218 or 262 144. In fact, this rarely occurs because factors such as food supply will be limited.

2 **a** Identical twins come from same egg and sperm cell. They have exactly the same genes. The only differences will be those caused by the environment.

b Fraternal twins can have quite different features because there are two eggs and two sperms involved. They are just like normal siblings but born on the same day.

c Twins are less common because it is rare for a fertilised egg to split and also rare for two eggs to be fertilised at the same time.

9.3 Reproduction and survival

All organisms reproduce, but not all organisms do this in the same way. In animals, sperm can fertilise eggs inside the female's body (*internal fertilisation*) or outside the female's body after she has laid her eggs (*external fertilisation*). In mammals, birds and reptiles fertilisation takes place internally, while in most other animals the eggs are fertilised externally.

Fig 32 Fertilisation occurs externally in frogs. However, in some types of frogs, to make fertilisation more effective, the male clasps the female's back and produces sperm while she lays her eggs.

Caring for offspring

The young animals that hatch from eggs which are laid and fertilised externally are completely independent of each other and of their parents. For example, when a frog's eggs hatch, the tadpoles swim away from the leftover egg mass and have to find their own food and protect themselves from enemies.

The eggs of reptiles are fertilised internally, but most reptiles do not care for their young after the eggs hatch. For example, sea turtles lay their eggs in the sand on the beach. The eggs are covered up and left to incubate. When the young turtles hatch, they dig their way to the surface and then scramble down the beach to the water. On their journey to the water, many of the young turtles are eaten by birds and other animals.

Fig 33 Newly hatched turtles scramble towards the water. Many of the hatchlings die because there is no parental care and therefore no protection from enemies.

Birds and mammals produce considerably fewer eggs than reptiles, frogs and other animals. Young birds and mammals are generally dependent on their parents for food, warmth and protection from enemies. This increases the chances of survival of the young. For example, newly hatched birds cannot fly and cannot feed themselves and would certainly die without the protection of one or both parents.

The table at the top of the next page compares the method of reproduction and the parental care of four different types of animals.

Fig 34 These newly hatched birds are completely dependent on their parents for food, warmth and protection from enemies.

Hints and tips

Ask the librarian to source DVDs or videos on parental care of offspring, and use them to find interesting information about the parenting habits and behaviour of animals.

Here are some interesting animal parenting patterns you could talk about with students:

- The male emu looks after and raises its chicks.
- Some fish keep their babies safe in their mouths.
- The temperature of a crocodile's or scrub turkey's nest determines the sex of the offspring.
- Juvenile magpies often stay with their parents for a couple of years and help look after their younger siblings.

	Bream (fish)	Green tree frog	Magpie (bird)	Common wombat (mammal)
Number of eggs produced each year	about 5 million	up to 2000	three or four	one
How eggs are fertilised	externally in water (sea)	externally in water (ponds and creeks)	internally	internally
Parental care	None—the eggs are left in the water, the young hatch and have to find food and protection.	None—the eggs are protected by a mass of jelly, but after hatching the tadpoles have to find food and protection.	The female sits on the eggs until they hatch, then feeds and protects the young until they can fly.	A bean-sized baby is born, which develops inside the mother's pouch for up to 10 months. It is then protected by the mother for another 10 months.

Parental care in seahorses

Many animals have peculiar reproductive behaviours—the seahorse is one such animal.

The seahorse is a bony fish (as distinct from non-bony fish such as sharks and rays), and in most bony fish fertilisation occurs externally.

The female seahorse has a long, hollow appendage called an ovipositor. In some types of seahorses, she uses this to place her eggs in the male's front belly pouch. Here he fertilises the eggs and protects them until they hatch (note the belly pouches on the two male seahorses in the photo).

WEBwatch

Go to www.scienceworld.net.au and follow the links to **Wildlife Africa**.

This is a commercial website, but it has interesting information on the habits and behaviour of many African animals.

Reproduction and survival in flowering plants

Trees, shrubs, bushes, palms and grasses are examples of flowering plants. All these plants reproduce sexually. Flowers contain the reproductive organs that make the sex cells.

Pollen contains sperm cells and is made in the anthers. The ova, or eggs, are made in the ovaries. Pollen lands on the stigma of the flower (part of the female reproductive organs). The pollen tubes carrying the sperm then grow down the style and the sperm eventually fertilise the ova in the ovary.

Asexual reproduction

Some flowering plants are able to reproduce asexually as well as sexually. For example, a strawberry plant has flowers and produces fruit (strawberries) containing seeds. The plant can also send out runners from which new strawberry plants grow. This form of asexual reproduction produces new plants with features identical to the original plant.

Learning experience

View pollen cells under the microscope. The best results are seen in the morning. Shake the pollen of some flowering plants onto a piece of paper. Gently place some of the pollen onto a glass slide and observe under the microscope.

Show students how pollen tubes grow. To the slide that has the pollen grains on it, add a drop of strong glucose solution and allow the slide to sit on the microscope stage for approximately 5–10 minutes. During this time pollen tubes will grow and extend from the individual pollen grains. This can be viewed as a demonstration by using a video camera attached to a microscope (videomicroscope).

The glucose triggers the process, just as it would in nature when the pollen lands on the stigma of the flower, which also contains a sugary solution. The pollen tubes grow only on the side that has made contact with the stigma, however on the slides it grows in all directions as a result of it being totally covered in glucose.

Investigate

23 OBSERVING FLOWERS

Aim

To dissect a flower and identify its parts.

Materials

- a few different types of flowers, eg hibiscus
- petri dish
- small brush or toothpick
- microscope and microscope slide
- cavity microscope slide
- single-edged razor blade
- stereomicroscope or hand lens

Planning and Safety Check

Carefully read through Parts A and B, and make a list of the materials you will need for each part.

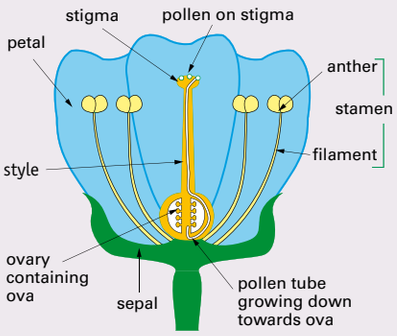
Make a list of the safety precautions you will need to take in this experiment.

PART A
Observing flowers

Method

1 Use the diagram of a flower below to identify the following parts of one of your flowers—petal, sepal, stigma, anther, filament and ovary.

2 Repeat for other flowers.



PART B
Dissecting a flower

Method

1 Touch the end of the stigma with your finger or a pencil. Notice that it is sticky.

2 Use forceps to gently hold a flower while you cut it in half by cutting down the stem.

3 Look at the ovary. It contains a number of rounded objects called *ovules*. Each ovule contains an egg (*ovum*).

4 Use a stereomicroscope or hand lens to observe the ovary and ovules.

Record your observations. Draw the arrangement of the ovules in the ovary.

5 Cut an anther in half and observe the pollen grains with the stereomicroscope. Repeat this for other flowers.

Record your observations.

Discussion

1 Why is the stigma sticky?

2 Different types of flowers have different shapes and sizes of pollen. Suggest a reason for this.

3 Infer the functions of the sepals.

4 The petals on most flowers are brightly coloured. Suggest a reason for this.

5 What is meant by the word 'pollination'. How is it different from 'fertilisation'?

Lab notes

- Make sure students read the Planning and Safety Check thoroughly before starting.
- Other flowers that are good to dissect are geraniums, petunias, fuschias and fruit blossoms, eg peach.
- Beware of roses and orchids, which have unusual structures.
- Daisies and similar flowers have composite heads and need to be dissected with a needle under a videomicroscope.
- For safety, count the razor blades out and back in. Do not leave blades in moist places or they will rust.
- Cut only on a cutting board, not the bench, and use forceps as shown rather than fingers.

Hints and tips

At the start of the lesson ask a set of 'Quick Questions' to gauge what students have learnt so far. Revise any areas that are not properly answered. There are many new words for them to learn in this chapter and it is important to keep reinforcing their meanings.

Seeds and dispersal

After the ova have been fertilised and the seeds develop, the petals, sepals and stamens of the flower wither and fall off. The ovary becomes a fruit with the seeds inside it (or sometimes on the outside of it, eg a strawberry). In some fruits, such as apples, the wall of the ovary thickens to form an edible fruit. In others, such as eucalypts, it is hard and woody.

Seeds must be spread away from the adult plant to give the plants that grow a better chance of survival. This is called dispersal. There are four main methods by which fruit disperse their seeds.

1. The seeds fall out of the fruit and are carried away by the wind.
2. Animals eat the fruit, and the indigestible seeds pass out of the animal in its droppings. In this way the seeds can be spread many kilometres away from the adult plant.
3. Some seeds are sticky or have hooks or spikes which get caught in the fur or hair of animals. These seeds may be carried a long way before they fall off or are rubbed off.
4. Some fruit explode, throwing out the seeds.

Activity

1. Collect about 10 different types of fruit or the seeds from the fruit.
2. Draw up a data table and classify the seeds into groups, depending on the way you infer they are dispersed. Include a brief description of the way each group of seeds is dispersed in your data table.
3. Find more fruits or seeds, classify them and add them to your table.
4. Take digital photos of the seeds or fruit and present your report in a *PowerPoint* presentation. Or design a poster to record and display your results and talk about your findings to the class.

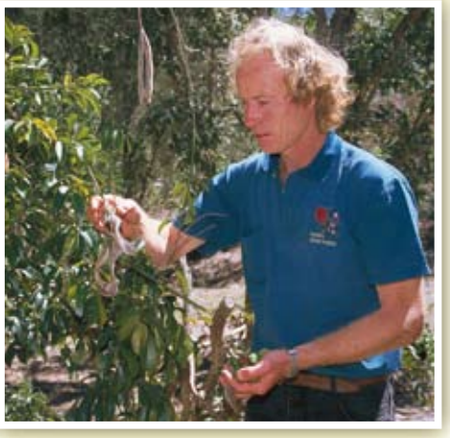
Science in action

Nick Hansa operates a large native plant nursery. For many years he has studied plants, and their methods of reproduction and seed dispersal.

He often goes looking for the seeds of rare or endangered native plants. To do this, he needs to know the type of seeds the plants produce.

For plants whose seeds are very small and are normally dispersed by wind, he covers the seed pods with special bags before the seeds mature. When the seed pods open, the seeds fall into the bag and are collected.

Larger seeds are collected on the ground after they have fallen from the plants.



WEBwatch

Go to www.scienceworld.net.au and follow the links to the websites below.

Fruit and seed dispersal
Has great photos and interesting descriptions.

Seed dispersal
Contains video clips showing types of seed dispersal.

Learning experience

Students could investigate the importance of declaring animal or plant life to customs or border securities when entering another country or different parts (states) of a country. Why is quarantine necessary?

Learning experience: germinating seeds

Germinate various seeds in the classroom, for example beans, carrots, tomatoes, mung beans. Place seeds on cotton wool, add a little water and place them in a well-lit place in the room. Water sparingly until the seeds have germinated. Once this occurs, plant the seeds in small pots containing vermiculite or seed-raising potting mix. Students should take care of their seedlings and keep a daily diary of events.

The germinated seeds can be pulled out of the vermiculite, the roots washed gently and observed using a hand lens or stereo microscope. The root hairs can easily be seen.

science bits

Growing plants from cuttings

Many plants, including flowering plants, are able to reproduce from parts of the adult plant. This is a form of asexual reproduction called *vegetative reproduction*.

Strawberry plants send out runners which produce new strawberry plants with leaves and roots. Potatoes are actually underground stems called *tubers*. The buds ('*eyes*') that develop on a potato can grow into new potato plants.

The advantages of vegetative reproduction are that a plant can multiply quickly in a place which suits it, and that it stops other plants from growing near it.

You can try growing plants from cuttings using the instructions opposite and the hints below.

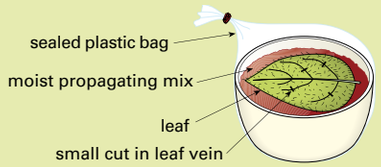
Helpful hints

1. Plants that are suitable for leaf cuttings are the ones which have soft, furry or velvety leaves: for example, African violet and coleus. You could also try begonia and snowflake (*Euphorbia leucocephala*).
2. Many types of shrub or small tree are ideal for growing plants from stem cuttings.
3. Daisies, fuchsias and native correas propagate easily from cuttings. For best results use a good quality propagating mix.
4. When growing plants from stem cuttings, dip the stem into some plant cutting powder (root growth powder). This will promote root growth on the cutting.
5. Do not over-water the propagating mix. It is best to add a little water often.
6. The plastic bag stops the plants from drying out and dying from water loss. You can also buy mini-hothouse trays at plant nurseries to grow your plant cuttings in.

Leaf cutting

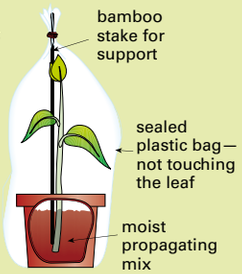
1 Place the cut end of the leaf stalk in a pot of moist propagating mix. Then tie a large clear plastic bag over the pot. Make sure the bag does not touch the cutting.

2 If the leaf has large veins, use a sharp knife to cut three or four of them as shown. Lay the leaf flat on a pot of moist propagating mix.



Stem cutting

Cut a stem about 10 cm long and remove all but 2 or 3 of the leaves at the top of the stem. Dip the cut end of the stem in plant cutting powder. Then tie a large clear plastic bag over the pot. Make sure the bag does not touch the leaves.



Learning experience

Visit a local nursery or ask them to come to the school to talk about the different processes and techniques used in this industry.

Start a vegetable or herb garden. Sell the produce at local markets or to staff, or alternatively let students take a basket of goodies home.

Do some gardening or clean up a garden around the school as a class project. This will instil class pride and ownership. Let the groups determine what can be planted in particular areas and even practise the vegetative methods on this page.

Learning experience

Potatoes are very easy to grow. If you have access to a small plot of soil, get the students to plant some. Cover them with a thick layer of pea straw or sugar cane mulch and water well. They need very little care and if kept moist should produce about four to five potatoes per tuber. Alternatively, grow them in a large pot with layers of soil and mulch.

Check!

1 Some of the following statements are false. Choose the false ones and rewrite them to make them correct.
   - **a** Pollen contains the male sex cells and is produced in the ovary.
   - **b** Fertilisation in most reptiles occurs externally.
   - **c** Young reptiles are dependent upon their parents for food and protection.
   - **d** All flowering plants reproduce sexually.

2 Describe the degree of care given to their young by most:
   - **a** fish
   - **b** frogs
   - **c** birds
   - **d** mammals

3 Suggest why the number of eggs produced per year by different types of animal decreases as the degree of parental care increases.

4 About 3 in every 100 000 eggs laid by a bream grow to be adult fish.
   - **a** Suggest why the survival rate of the eggs is so low.
   - **b** Use the table on page 198 to work out how many adult bream would be produced from the eggs laid by a bream in a year.

5 Use your own words to describe what the word 'disperse' means on page 200.

6 Suppose a particular type of plant can reproduce sexually (by seeds) as well as asexually (by sending out runners). List the advantages and disadvantages of each type of reproduction for the plant.

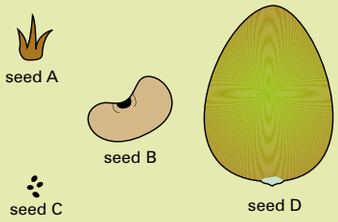
7 The coconut is a fruit with a very hard covering. It is hollow and does not sink in water. Suggest how coconut seeds are dispersed.

8 The photo shows a close-up of the seeds of the plant called cobblers pegs. Suggest how these seeds are dispersed.

challenge

1 Suggest why plants with bright flowers are mainly insect-pollinated, while grass flowers are usually wind-pollinated.

2 The seeds below are drawn at their actual size.
   - **a** Which one(s) do you think would be dispersed by the wind? Give a reason for your answer.
   - **b** Which one(s) might be caught on the fur of animals. Give a reason.



3 In most types of frogs, the eggs are laid in the water together in a mass of foul-tasting jelly, whereas fish lay their eggs individually in the water. Suggest how these two reproductive behaviours help in the survival of each type of animal.

4 Many types of animals show *courtship behaviour* before they mate and produce offspring. Use the internet and other library resources to find out what courtship behaviour means. Write a report of what you find out, giving examples. How does courtship help in the survival of each animal?

5 The 'most devoted parent' award for caring for offspring should go to the male emperor penguin. Use library books or the internet to find out why the emperor penguin would win this award.

Check! solutions

1 a False. Pollen contains the male sex cell and is produced in the **anther**.
   b False. Fertilisation in most reptiles occurs **internally**.
   c False. Young reptiles are **not** dependent on their parents for food and protection.
   d True. (The flower is a sex organ.)

2 a In most fish, sperm and eggs fertilise externally and when the young hatch they need to find their own food and protection.
   b In frogs, although fertilisation is external, the eggs and young tadpoles have some protection and nutrients in the egg mass as they fully develop and become completely independent.
   c In birds, mating occurs and fertilisation is internal to form eggs which are laid by the female. The eggs are usually incubated until they hatch, then food is provided to the young as they develop and until they are able to find their own food and defend themselves against predators.
   d Most mammals mate and give birth to live young which are then suckled by the mother. The milk from the female provides the nutrients necessary for the young to grow and until it is able to find its own food and become independent.

3 Generally animals who do not take much care of their young have evolved so as to produce larger numbers of eggs to ensure that at least some survive and continue the species. If not, the species will become extinct.

4 a The survival rate of eggs is so low because of many living and non-living factors. These will include other animals which will eat them and currents which could carry them into unsuitable conditions (eg too cold) where they would die.
   b If only 3 out of 100 000 survive then in 5 million there will only be $3 \times 5\,000\,000 \div 100\,000 = 150$.

5 The word 'disperse' means to spread around or scatter to different areas.

6 The main advantage of sexual reproduction is that all of the offspring are slightly different, which means that even if the environment changes at least some of the species will survive. A disadvantage of sexual reproduction is that it is relatively slow. The main advantages of asexual reproduction are that it only involves one parent plant and will also occur fairly quickly when conditions are favourable and will quickly increase the numbers of the species. A disadvantage of asexual reproduction is that all of the offspring are the same and could all die at the same time.

7 The fact that the coconut fruit has a very hard coat and floats suggests that the seeds disperse by floating in rivers or the sea. When the coconut is washed ashore, the shell rots and the seeds germinate.

8 These seeds have projections with tiny spikes on their ends which can become attached to the fur or feathers of animals and dispersed in this way.

Challenge solutions

1 Bright flowers and sweet nectar attract insects which also 'accidentally' spread pollen from one flower to another. Some colours and patterns on flowers are only visible with ultraviolet light and can be seen by insects. However grasses have small flowers which are difficult to see because the pollen is spread by the wind.

2 a Seeds A and C are possibly dispersed by the wind because they are small and light.
   b Seed A is most likely to be caught in the fur of animals because it has

MAIN IDEAS

Copy and complete these statements to make a summary of this chapter. The missing words are on the right.

cell division
cell wall
cells
disperse
fertilisation
function
mammals
microscope
organs
reptiles
sperm
tissues

1 All organisms are made of _____. There are many different types of cells, with different shapes and different functions.

2 A _____ can be used to identify the various parts of a cell: the nucleus, cell membrane, cytoplasm and organelles. A _____, chloroplasts and vacuoles can be observed in plant cells.

3 Cells of the same type are generally found together in _____. Each type of tissue has a particular _____ in an organism.

4 Tissues are arranged in structures called _____ in multicellular organisms. Each tissue has a specific function in an organ.

5 An organism grows in size by making new cells in a process called _____.

6 In sexual reproduction, _____ occurs when the nucleus of a _____ cell joins with the nucleus of an ovum.

7 Organisms that care for their young (birds and _____) generally produce fewer eggs than those whose young are independent (fish, _____ and frogs).

8 Flowering plants show a variety of methods to _____ their seeds away from the adult plant.

Try doing the Chapter 9 crossword on the CD. Working with technology

REVIEW

1 A cell is observed under a microscope to have a nucleus, cytoplasm and organelles. The cell is:
A definitely an animal cell.
B definitely a plant cell.
C either a plant cell or an animal cell.

2 Which one of the following statements about cells is *false*?
A Plant cells have large vacuoles.
B A nerve cell is an example of a specialised cell.
C All cells are rectangular or brick-shaped.
D Plant cells have cell walls.

3 Match the cell part in the list with the correct description below.

cell membrane	cytoplasm	vacuoles
chloroplast	nucleus	cell wall

a an organelle that is involved in the process of photosynthesis
b the jelly-like material that fills a cell
c the part of the cell that controls its activities and keeps it alive
d a covering that controls the movement of materials into and out of a cell
e a thick, tough layer that helps support and protect the cell
f liquid-filled spaces found in some cells.

Main ideas solutions

1 cells
2 microscope, cell wall
3 tissues, function
4 organs
5 cell division
6 fertilisation, sperm
7 mammals, reptiles
8 disperse

Review solutions

1 **C**—All cells have a nucleus, cytoplasm and organelles.

2 **C**—Cells have many and varied shapes.

3 **a** chloroplast
b cytoplasm
c nucleus
d cell membrane
e cell wall
f vacuoles

sharp spikes rather than being smooth like the other seeds shown.

3 All adaptations assist the survival of an organism and species in some way. Frogs produce their eggs in foul-tasting jelly to discourage predators from eating them and fish lay eggs individually so that they can only be found and eaten one at a time by a predator.

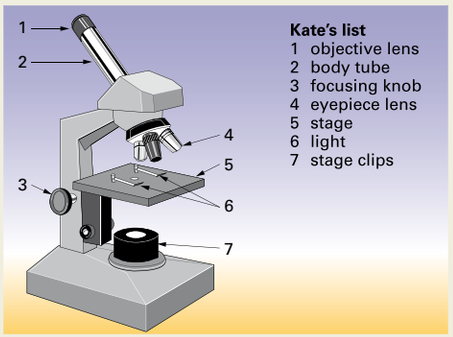
4 Courtship includes a variety of behaviours such as fighting or aggressive posturing among males, strutting around with elaborate displays of feathers and nest-building. These behaviours will vary depending on specific species and have evolved to ensure successful mating and reproduction.

5 The male Emperor penguin has the task of incubating the egg on his feet and covering it by a fold of skin until it hatches. He does so for 2 months during the coldest part of the year during which time he does not eat at all. After the chick hatches he then cares for it by keeping it warm and providing food for it through his throat from his crop. After this it is the female's turn and he goes off for a few weeks to feed on fish.

REVIEW

4 A microscope has a ×10 objective lens and a ×4 eyepiece lens. How big would an object 0.05 mm in diameter appear through the microscope?

5 Kate labelled a drawing of a microscope, but she made some mistakes. In your book write the correct names of parts 1 to 7.



Kate's list
1 objective lens
2 body tube
3 focusing knob
4 eyepiece lens
5 stage
6 light
7 stage clips

6 **a** A male fish *externally* fertilises the eggs laid by a female fish. Give two reasons why many of the eggs are never fertilised.

b Less than 0.5% of eggs laid by a frog reach adulthood, but over 60% of eggs laid by birds reach adulthood. Suggest reasons for this.

7 Explain how a unicellular organism is different from a multicellular organism.

8 Why is your stomach called an organ? Use the words *cells* and *tissues* in your answer.

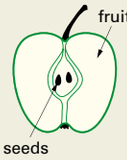
9 The two cells in the drawing below are found in different tissues in your body. The cell from tissue A is box-like and makes a watery substance called mucus. The cell from tissue B is very flat. Infer the function of each tissue and where it might be found in your body.


cell from tissue A


cell from tissue B

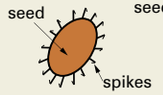
10 The fruits and seeds from various plants are shown in the diagrams below. Infer how the seeds are dispersed by each type of plant.

a pine

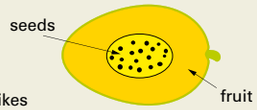


b apple

c eucalypt



d burr



e paw paw

Microscope licence test

LAB REVIEW

You will be working in pairs and assessing each other's work in this practical test of microscope skills.

You will be given—a microscope, microscope slide and cover-slip and a small piece of newspaper which contains a few letters. Your teacher will also give you an assessment grid to help you assess your partner's task.

Your task—to make a wet-mount slide of some letters on a small piece of newspaper without any air bubbles or excess water, and then draw it under the microscope.

The test—your teacher and the class will discuss what you have to do to pass the licence test. Your partner will then assess the quality of your wet-mount slide and drawing and record your results on the assessment grid. Remember, you can only pass or fail this test. If you fail you must repeat the test until you pass.

Your teacher may issue you with a microscope operator's licence when you pass the test.

Check your answers on pages 303–304.

4 A ×10 objective and a ×4 eyepiece lens give a total magnifying power of × 40. An object 0.05 mm in diameter would appear to be 40 × 0.05 = 2 mm in diameter.

5 Kate's list should be:

1	eyepiece lens	5	stage
2	body tube	6	stage clips
3	focusing knob	7	light
4	objective lens		

6 **a** Firstly, the eggs may be eaten by other animals, and secondly, sperm from the male may not reach the eggs to fertilise them.

b Fewer frogs' eggs reach adulthood than birds because: (1) the frogs' eggs are fertilised externally, which means that many eggs may not be fertilised; and (2) the young tadpoles are not cared for by the adult frog, so many young may be eaten by other animals.

7 A unicellular organism consists of a single cell which contains all the structures necessary to live an independent life. On the other hand, a multicellular organism contains many different types of cells which work together for the survival of the organism.

8 The stomach is an organ because it is made up of many different types of *tissues*, eg gland tissue, muscle tissue and connective tissue. These tissues contain specialised *cells* which work together to digest food.

9 Tissue A could be found in the lining of the gut where its function would be to produce mucus that is slippery and allows the food to move smoothly through the gut.

The cells of tissue B could form a flat surface like paving stones, and this tissue could be found in the skin.

10 **a** The pine seed has a wing that allows it to be carried in the wind.

b The apple has a sweet, edible fruit that is eaten by animals. The seeds pass through the gut of the animal and out in its droppings, and are spread this way.

c The eucalypt has very small, light seeds which fall out of the 'gumnut' and are carried away by the wind.

d The burr seed has spikes which stick to the fur, hair or feathers of animals. The animal may pick off the burr some distance from the plant.

e The paw paw has edible flesh around its seeds. The seeds are spread in animal droppings in the same way as apple seeds.

Microscope licence test

1 Making a wet-mount slide—see the Activity on page 185.

2 Setting up a microscope—see the Skillbuilder on page 184.