8.1 Life and Living

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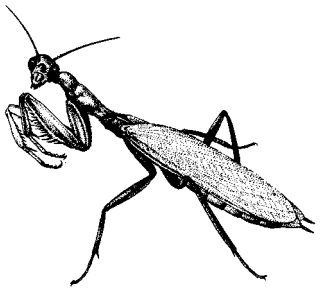
Australian Curriculum 2013 edition

CONTENTS

This course was developed at Rossmoyne Senior High School to provide opportunities for students to achieve in the 'Life and Living' and 'Investigating' Outcomes.



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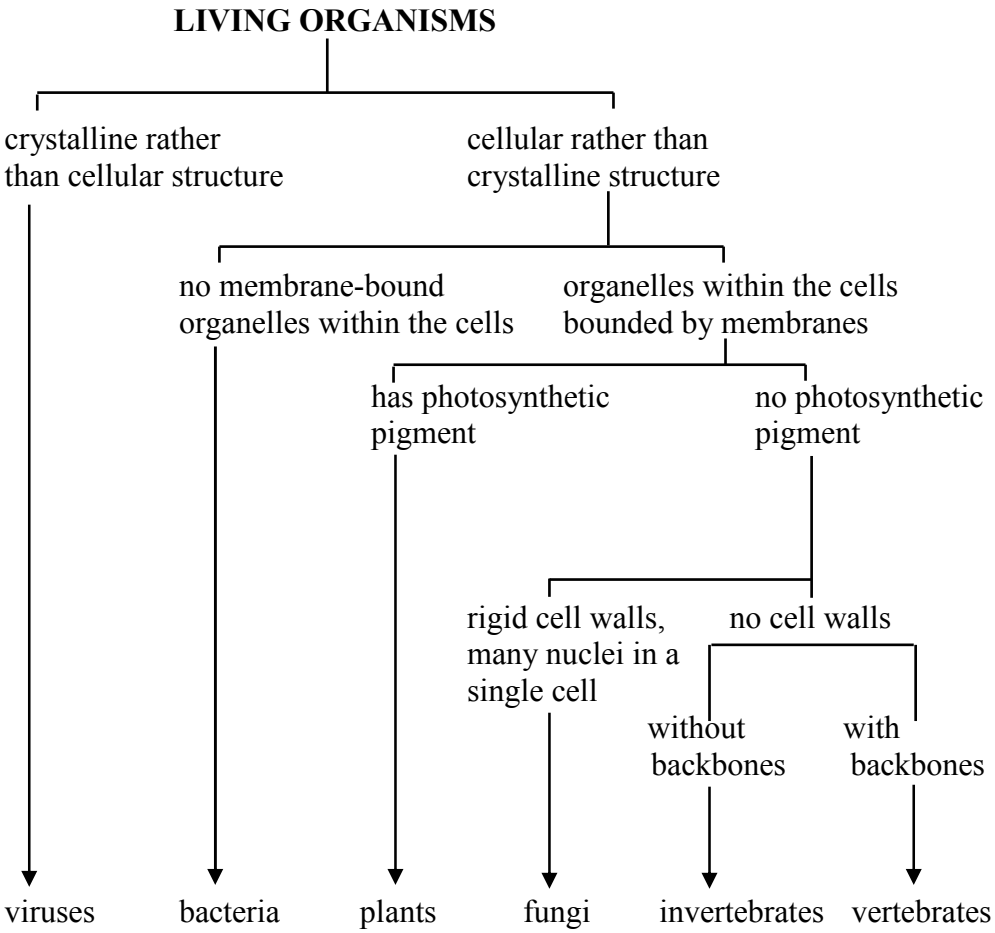
OBJECTIVES

By the end of this booklet you should be able to do the following:

1. Describe cells as the basic units of living things.
2. Know that cells have specialised structures and functions.
3. Examine a variety of cells using a light microscope, by digital technology or by viewing a simulation.
4. Distinguish plant cells from animal or fungal cells.
5. Identify structures within cells and describe their function.
6. Recognise that some organisms consist of a single cell.
7. Know that cells reproduce via cell division.
8. Describe mitosis as cell division for growth and repair.
9. Know that multi-cellular organisms contain **systems** of organs that carry out specialised functions that enable them to survive and reproduce:
10. Identify the organs and overall function of a system of a multicellular organism in supporting the life processes.
11. Describe the structure of each organ in a system and relate its function to the overall function of the system.
12. Describe the specialised cells and tissues involved in structure and function of particular organs.
13. Compare similar systems in different organisms such as digestive systems in herbivores and carnivores, respiratory systems in fish and mammals.
14. Distinguish between asexual and sexual reproduction by comparing reproductive systems of different organisms.

ACTIVITY 1: CLASSIFYING LIVING THINGS

One way of classifying living things is shown in the flow diagram shown below:



A classification of living organisms.

Use this classification chart to answer these questions:

1. What is the difference between plants and fungi?
2. What do plants and bacteria have in common?
3. What is the distinguishing feature between vertebrates and invertebrates?
4. What makes a fungus a fungus rather than anything else?
5. Why isn't a plant a fungus?
6. Many scientists do not regard viruses as living things.
   What is there about them, which makes us undecided?
7. Suggest a meaning for the word “organelle”.

Obtain and complete a copy of this worksheet with your teacher's assistance.

You might need a microscope to read this

WORKSHEET 1: THE INCLINED HEAD MICROSCOPE

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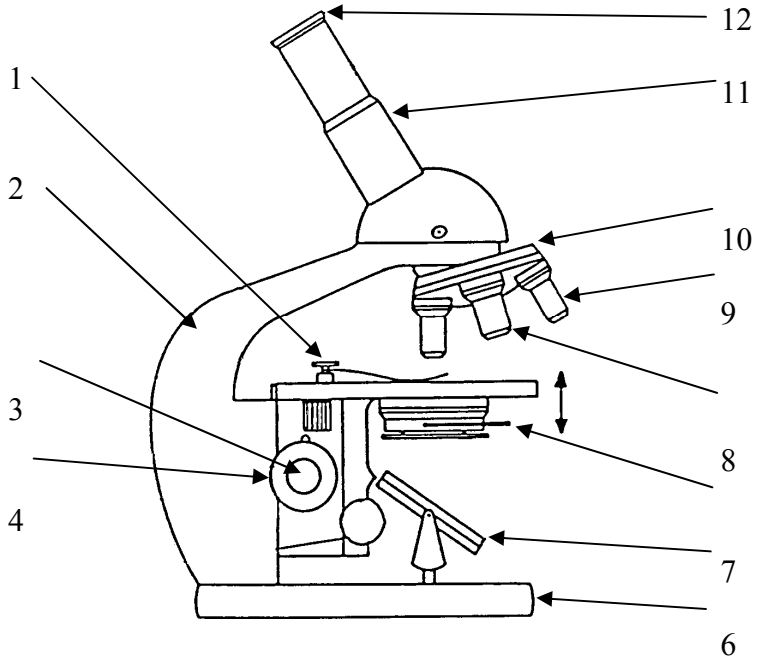
1. Label this diagram



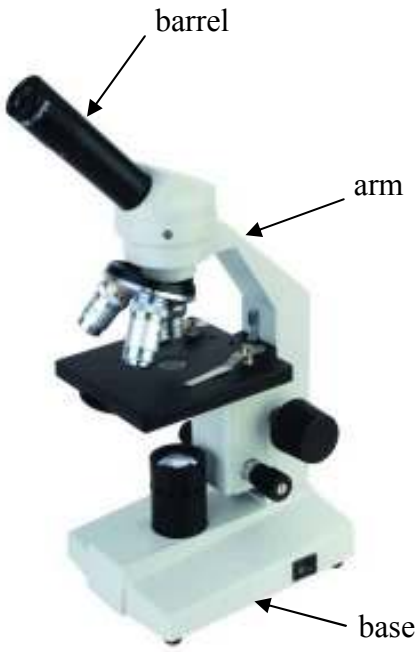
2. Give the functions of the following parts of the microscope:

- Ocular lens_____
- Revolving nosepiece_____
- Objective lens_____
- Mirror_____
- Stage_____
- Stage clips_____
- Coarse focus knob_____
- Fine focus knob_____
- Iris or wheel diaphragm_____

ACTIVITY 2: USING AN INCLINED HEAD MICROSCOPE

There are two kinds of light microscopes available at this school. The instructions which follow are for the newer inclined head microscopes. Some classes may have access to the upright microscopes. Separate instructions are available for these.
Discuss with your teacher how the microscope you have should be handled and how it can correctly be used to focus on a small object. Some hints follow:

1. ***Always carry a microscope upright, using two hands - one on the arm and one under the base.***



2. ***Place the microscope carefully on a flat surface.***

3. ***If they are dirty, clean the lenses with lens tissue. Do not touch them with fingers or allow them to get wet.***

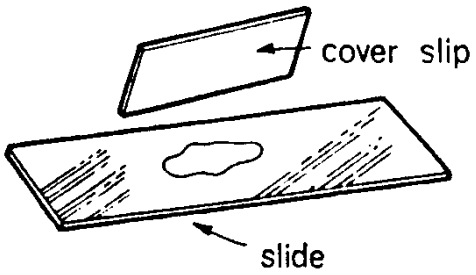
4. ***Keep the stage of the microscope dry and clean.***

5. ***Rotate the revolving nosepiece so that the low power objective is above the condenser lens in the centre of the stage.***

6. ***Turn on the power so that a strong beam of light comes up the barrel. (If your microscope has a diaphragm under the stage, this can be used to help regulate the amount of light passing through the object being viewed on the stage.***

7. ***Use one eye to look down the microscope's eyepiece, but try to keep both eyes open.***

8. ***Always place an object to be viewed on a slide in a drop of water and cover it with a cover slip before putting it on the microscope stage.***



9. ***As you place the slide on the stage, centre the object you want to examine over the centre of the condenser lens.***

10. ***To focus, while looking from the side and with the low power objective lens over the condenser lens, raise the stage as far as it will go using the coarse focus adjustment knob. Never use force – it will destroy the focussing mechanism of the microscope. Then look through the eyepiece.***

11. ***Focus an image by gently moving the stage downwards <u>away</u> from the objective lens.***

12. ***To increase the focussing power of the microscope, first position the object on the slide that you want to see over the middle of the condenser lens. Make sure you have focussed on low power, then, <u>without</u> touching the focus knobs, rotate the higher power objective so that it clicks into position over the centre of the condenser lens. Check the focus – the new focus should be obtained by using the fine focus adjustment knob.***

Be careful!!

ACTIVITY 3: MAGNIFICATION

How big you make your specimen appear is determined by two factors:

1. The power of the eyepiece lens (E)

2. The power of the objective lens (O)

MAGNIFICATION = E x O

What is the smallest magnification possible for your microscope?

What is the largest magnification possible for your microscope?

EXAMINING A PREPARED SLIDE

MATERIALS:

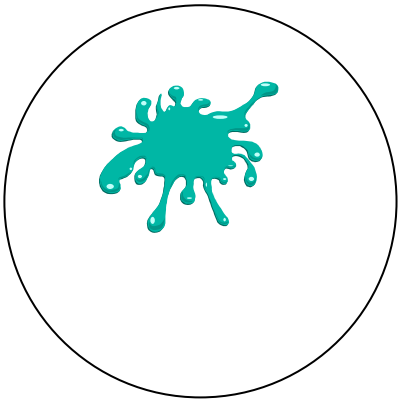
- clean microscope slides and cover slips
- prepared microscope slides
- dissecting scissors, forceps and dissecting needles
- newspaper
- plastic pipettes
- lens tissue
- plastic ruler
- Euglena culture

METHOD:

Set up the microscope according to the rules:

1. Set the low power objective (x10) in position.
    - ***Does turning the coarse focus knob towards you move the stage up or down?***
    - ***Does turning the coarse focus knob away from you move the stage up or down?***
2. Place the prepared slide on the stage.
3. Looking from the side of the microscope, gently raise the stage until it is as close to the objective as it will go. (do not force it)
4. Looking into the eyepiece move the stage **downwards** by slowly turning the coarse focus knob until the object on the slide comes into focus. At this point the objective should be about 10 mm from the slide.
6. Turn the fine focus knob to make the focusing sharper.

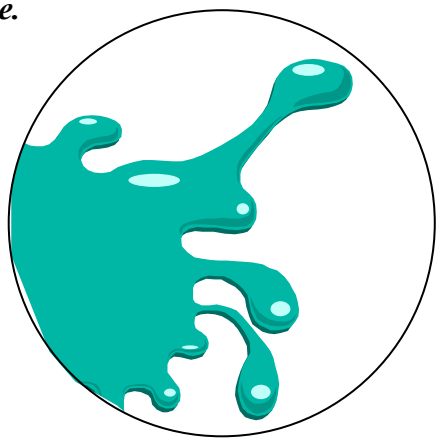
In a large circle drawn on a page in your notebook record what you see.



7. Swing the high power objective into position while looking from the side of the microscope. The high power objective should be about 2 mm from the slide.

8. Looking into the eyepiece move the stage **downwards** by turning the fine focus knob until the object on the slide comes into focus.

   - ***Record what you see.***



Answer the following questions related to the above activity:

1. Why is it important to look from the side of a microscope when raising the stage?
2. How did the image of the object change as you viewed it under high power?
3. The field of view is the circle of light seen through the microscope. Was the field of view brighter when using low or high power?
4. On a clean microscope slide place a drop of water and into this drop place a letter "e", "g" or "p" cut from a piece of newspaper. You might like to look at more than one of these. If so repeat the method.

   Write a few sentences explaining the differences you noticed when looking at the letters "e", "g" and "p" under the microscope.

   In your notebook under the heading "***Rules for Using a Microscope***", write down six rules to apply for the correct and safe use of a microscope.

5. Use your microscope to examine a

   - hair
   - piece of lens tissue
   - plastic ruler
   - wooden ruler

   In each case briefly describe what you saw.

ACTIVITY 4: WHAT'S IN POND WATER?

AIM: To observe organisms in pond water.

MATERIALS:

- microscope
- microscope lamp
- cavity microscope slide and cover slip
- 100 mL beaker of fresh pond water
- eyedropper
- paper towel
- Pond I, II and III Charts

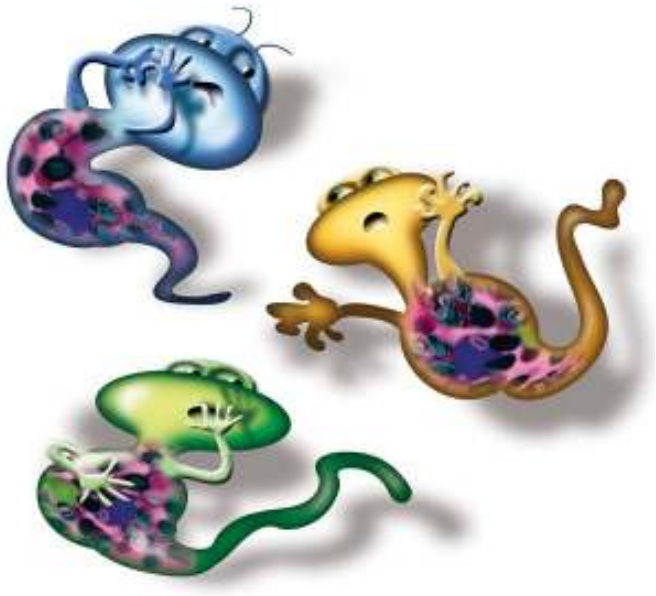
METHOD:

1. Using the eyedropper, transfer a drop of pond water to the cavity in the microscope slide and cover it with a cover slip.
2. Use the paper towel to remove excess water.
3. Set up the microscope using low power.
4. Examine the slide searching for any living thing.

RESULTS:

In your notebooks use a pencil to draw a neat diagram and give a description of any organisms observed in the pond water. Try to make your diagrams an accurate record of what you see.

Make sure you draw your diagram clear and LARGE.



ACTIVITY 5: PLANTS CELLS UNDER THE MICROSCOPE

AIM: To observe cells from the skin (epidermis) of an onion.

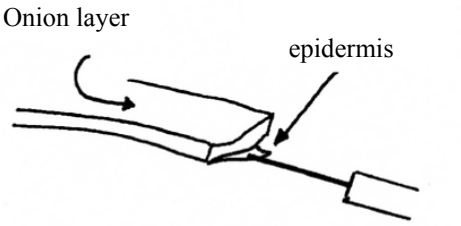
MATERIALS:

- microscope
- tooth pick
- dropper bottle of water/plastic pipettes
- paper towel
- microscope slides and cover slips
- gem blade
- forceps, dissecting needle
- slice of onion
- pond weed
- cutting board & knife

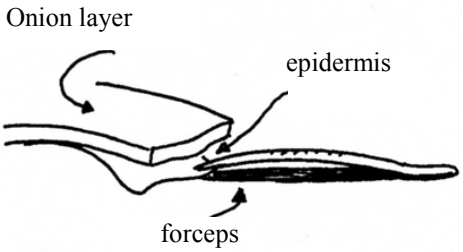
METHOD:

1. Cut a slice of onion, being careful to cut through only one of the onion layers.
2. The epidermis is the very thin membrane on the underside of each onion layer. Using the dissecting needle, tease the epidermis away from the onion layer and use the forceps to pull the epidermis away as shown in the diagrams opposite.
3. Very carefully place a piece of onion epidermis on a clean slide, making sure that it is flat. Add a drop of water and cover with a cover slip.
4. Set up the microscope and examine the onion epidermis as it appears on low power.
5. Examine some onion epidermis cells under high power. Draw one or two cells in detail.

Step 1



Step 2

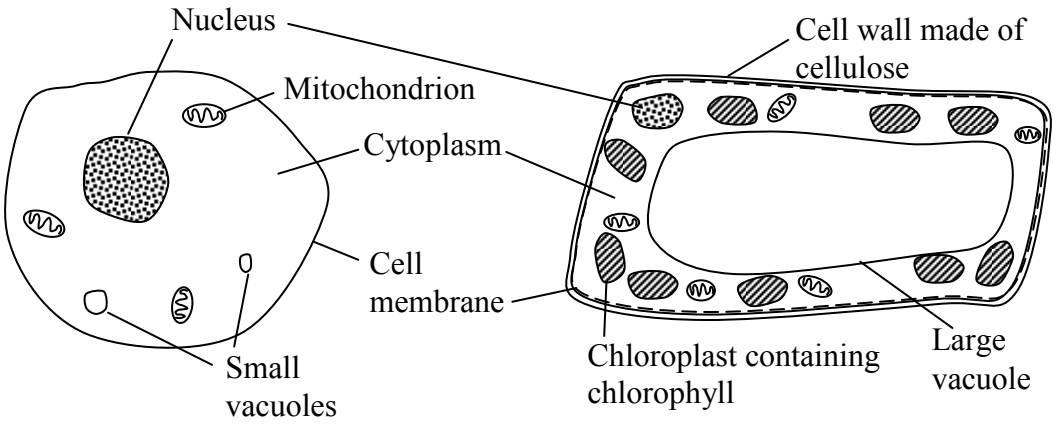


6. What are some of the structures you can see within the cell?
7. Tear off a piece of leaf from the pondweed and mount this on a microscope slide in a drop of water. Place a coverslip on top. Examine the cells of this leaf under low power.

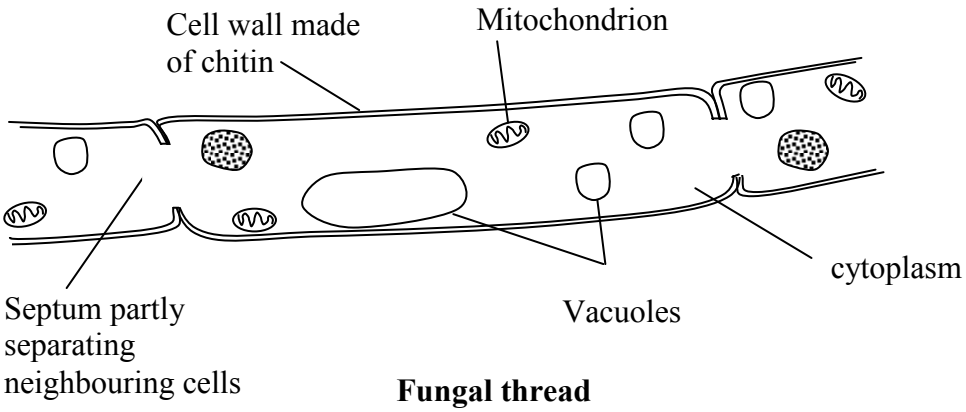
   - ***What new structures are visible within these plant cells?***
   - ***What use does the plant make of these?***

ACTIVITY 6: CELLS

All organisms are made of at least one cell. If they are made of one cell they are called 'unicellular' organisms. 'Multicellular' organisms consist of many cells. A human body is made up of billions of cells. Individual cells are usually very small. Your red blood cells for example have a diameter of $5/1000^{th}$ of a millimetre. Others special cells like nerve cells can be very long.
The cells of plants tend to be larger than animal cells and have some features that are not present in animal cells.



Animal cell **Plant cell**



Fungal thread

- Examine the diagrams drawn above showing a cell of an animal, a plant and a fungal thread.
- Tabulate the main differences shown between these types of cells.
- Refer back to the diagrams recorded for Activity 5. Identify these organisms as being unicellular or multicellular.

ACTIVITY 7: FOODS THAT CONTAIN STARCH

In this experiment you will use the iodine test for starch on a variety of food substances.

AIM: To test a variety of foods for the presence of starch.

MATERIALS:

- water in a dropper bottle
- iodine solution in a dropper bottle
- depression tile
- starch solution
- 5 food samples

METHOD:

1. Collect a dropper bottle of water and iodine.
2. Add a drop of iodine to water on a depression tile.
3. Add a drop of iodine to a drop of starch in a second cavity on the depression tile.

How would you know if starch were present in a substance?

Iodine, which causes the colour change you have seen is known as an ***indicator***

4. Copy a table similar to the one below into your notebook.

FOOD TESTED	COLOUR WITH IODINE	WAS STARCH PRESENT?

5. Put a drop of a test food in a new cavity on the depression tile.
6. Add a drop of iodine.
7. Note the change of colour in the drop.

Complete the following questions in your notebooks.

1. Name the foods tested that contain starch.
2. Do these foods come from plants or animals?
3. Explain why foods containing large amounts of starch are important to us.

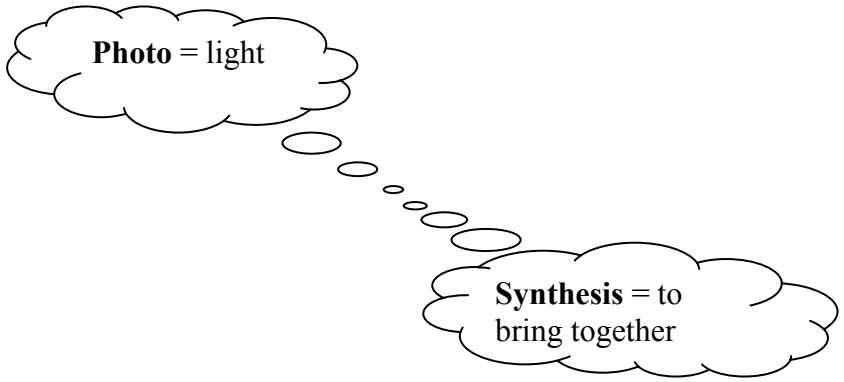
STORING FOOD IN LEAVES

BACKGROUND:

You may have noticed that plants and many of their cells are green in colour. This is due to the presence of a substance known as **CHLOROPHYLL** found within them. This pigment is found in cell structures called **CHLOROPLASTS**

Chlorophyll allows plants to make their own food in the chemical process called **PHOTOSYNTHESIS**, which uses the energy from sunlight.

In carrying out photosynthesis, plants use water and the gas carbon dioxide. The food the plant makes is a sugar called **GLUCOSE**.



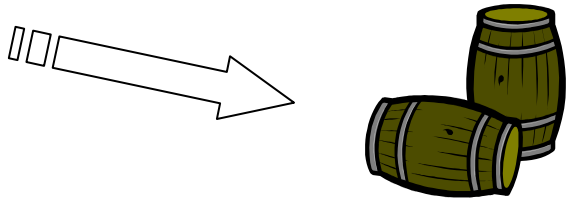
The plant cells trap light energy to join together carbon dioxide from the air with water from the soil.

carbon dioxide + water ⟶ sugar + oxygen

Later, the cells of the plant change the sugar to starch, which is stored until it is needed.

If we find that a leaf contains starch, this shows that the plant has been making food during the last 24 hours. Plants do not actually make starch directly; they first make a simple sugar called glucose, but then rapidly convert this to starch to be stored in the leaf and other parts of the plant.

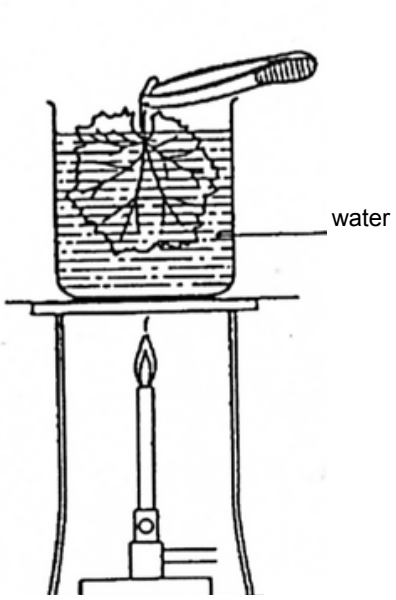
Glucose made in the leaves



Storage as starch in the leaves, stems and roots of the plant

ACTIVITY 8: STARCH IN LEAVES

AIM: To test a leaf to see if starch is present.



MATERIALS:

- geranium leaf
- 250 mL beaker half full of water
- Bunsen burner
- tripod & gauze mat
- forceps
- test tube half full of methylated spirit
- white tile
- iodine solution in a dropper bottle
- matches
- eye protection

METHOD:

1. Get ready about 100mL of boiling water in the beaker.

2. Using forceps, dip the geranium leaf into the boiling water for about 5 minutes. This will kill the leaf and soften it.

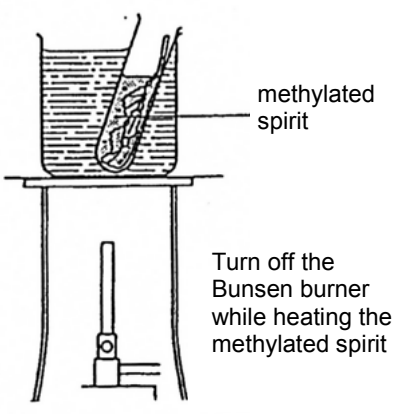
NOW TURN OFF THE BUNSEN BURNER!!

Do not continue to boil the water. Turn off the Bunsen burner, as methylated spirit is **very** flammable.

3. Put the leaf into the test tube containing methylated spirit.

4. Stand the test tube in the beaker of hot water. The methylated spirit will boil in the test tube and remove the green chlorophyll from the leaf. The leaf will also become very brittle.

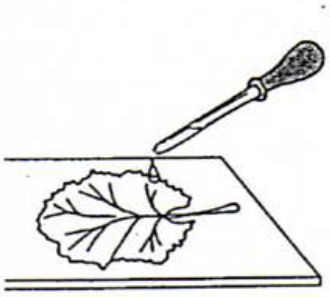
   Leave it in the methylated spirit for about 10 minutes.



5. Using forceps, remove the leaf from the methylated spirit and wash it in the hot water to make it softer.

6. Carefully spread the leaf out on the white tile and then cover it with the iodine solution.

7. If the leaf turns a blue/black colour this shows that starch is present in the leaf.



QUESTIONS

1. Record what happens to the leaf when iodine is added.
2. Is there any starch in your leaf?
3. Which parts of a plant would you expect to contain starch?
4. Which vegetables that you eat contain a large amount of starch? Which parts of the plant are eaten?

INVESTIGATION:

Some plants like geraniums have variegated leaves. Explain how you could use plants with variegated leaves to demonstrate that plants need chlorophyll in order to make starch.

Carry out your experiment under the direction of your teacher.

ACTIVITY 9: CO_2 AND PHOTOSYNTHESIS

AIM: To test whether a plant uses carbon dioxide during photosynthesis.

MATERIALS:

- carbon dioxide gas generator [hydrochloric acid, marble chips ($CaCO_3$), test tubes, delivery tube]
- test tube
- aquatic plant in a beaker e.g. Spirogyra or Centella
- bromothymol blue solution
- large test tube and stopper x 2
- drinking straw
- labels

METHOD:

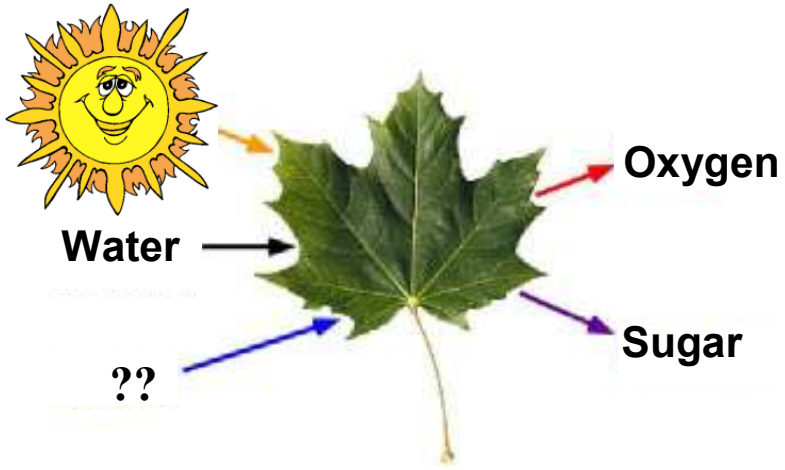
1. Make some CO_2 gas in the gas generator by mixing a small amount of HCl with marble chips ($CaCO_3$).
2. Bubble this gas through a test tube containing a solution of bromothymol blue solution. Record any change.
3. Place some of the aquatic plant into the two test tubes of water containing bromothymol blue solution that has had a tiny amount of CO_2 gas bubbled through it, enough to **just** change its colour.
4. Place one beaker in strong light, the other in a dark cupboard.
5. After 20 minutes, record your observations of each beaker.

RESULTS:

1. What happened to the bromothymol blue solution when CO_2 gas was bubbled through it?
2. Describe what happened in each of the two beakers.

CONCLUSION:

What have you learned from this activity?



ACTIVITY 10: CHEMICAL REACTIONS IN CELLS

We have seen that photosynthesis occurs in the chloroplasts of plants to produce food. We can indirectly observe another chemical reaction, which occur in the bodies of plant, animal and fungal cells.

AIM: To show that chemical reactions take place in animals.

MATERIALS:

- conical flask containing 100 mL of limewater.
- drinking straw.
- bicycle pump.

PROCEDURE AND RESULTS:

1. Bubble ordinary air through the limewater for two minutes using the bicycle pump. Describe your observations.

2. Using the straw, **BLOW** air from your lungs into the limewater. Record what happens?

   WARNING: Blow ….don't suck

Answer these questions in your notebook……..

CONCLUSIONS:

1. What inference (deduction or explanation) can you make from these results?

2. What evidence is there that a chemical reaction has taken place inside your body?

3. Which gas has caused the limewater to change its appearance?

4. What name would you give to substances like limewater that change their colour in a special way when certain chemicals are present?

ENERGY AND RESPIRATION

You have discovered that plants can produce their own food in the process of photosynthesis.

You may know that animals are incapable of carrying out photosynthesis, yet they still need food. It is obvious that animals eat food to gain their nutrient requirements.

Why do plants and animals need food?

Both plants and animals need food to provide them with **energy** so they can carry out all their activities.

Both plants and animals obtain this energy by breaking down their food in the presence of oxygen in a chemical reaction known as **RESPIRATION**.

> ***Respiration occurs in all cells of living things, all the time.***

EXTENSION:

A leafy potted plant and a mouse with food and water can live together sealed inside an air-tight container for many hours, provided there is enough light. But the same mouse in the same airtight container without a plant will die quickly, even if there is plenty of food and water.
Write a paragraph explaining these observations.

RESPIRATION

In the next two activities you will look at the process of respiration in living organisms.

Respiration occurs in all living cells. The energy is released from glucose that has been made during photosynthesis or taken in as food. It releases the energy, which all living things need to carry out their life processes.

There are two ways this can occur. The first happens when there is no oxygen available. Your own muscles can use this process when you require them to do fast repetitive exercise that uses up oxygen faster than your blood can supply it. Lactic acid is formed as a waste and a small amount of energy is released.

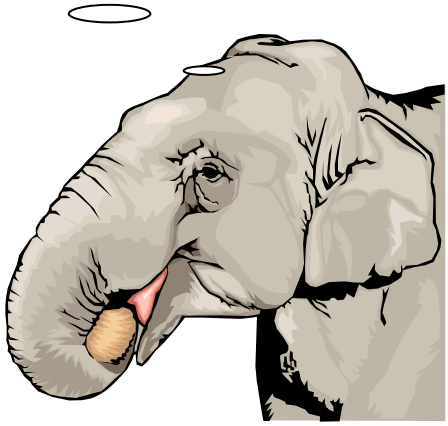
If oxygen is available the respiration of the glucose is completed in tiny organelles called mitochondria. A cell may have many mitochondria – the more energy they need the more mitochondria the cell will have. Liver cells and muscle cells may contain thousands of mitochondria.

The energy in this sugar is released by breaking down the glucose using oxygen.

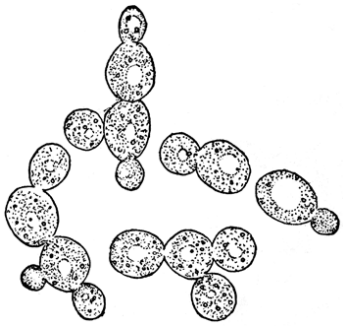
The equation for respiration that you <u>must</u> remember……...

GLUCOSE + OXYGEN ⟶ ENERGY + CARBON DIOXIDE + WATER

Do not forget this -
your life depends on it!



ACTIVITY 11: RESPIRATION BY YEAST



Yeast cells budding

BACKGROUND:

Yeast is a type of fungus which respires sugar to release energy. When little oxygen is present, alcohol and carbon dioxide gas are released as wastes as well as a small amount of energy needed for cell growth and survival.

INVESTIGATION:

Design an experiment to test the hypothesis that 'sugar is needed for yeast to form carbon dioxide'.

MATERIALS:

- for class: sugar solution
- for class: yeast suspension
- two 250 mL conical flasks
- two balloons
- limewater
- thermometer
- kettle

METHOD:

Using only the materials listed above; design an experiment to test the hypothesis.

1. ***Make sure your experiment has a control set up.***
2. ***What other variables will you need to control so that your testing is fair?***
3. ***How will you test to show that carbon dioxide gas is being formed?***

RESULTS:

What happened in your experiment?

CONCLUSION:

What do your results tell you about yeast and sugar?

ACTIVITY 12: GAS EXCHANGE IN PLANTS

In terrestrial (land) plants, air is taken through holes called STOMATA, which are usually found on the underside of their leaves or in the skin (epidermis) of their green stems. Plants that float on water have stomata only on the upper side of their leaves and those that are submerged have none at all because they exchange gases directly through the outer layer of their leaves - the epidermis.

AIM: To examine the breathing pores (stomata) of leaves.

MATERIALS:

- colourless nail varnish
- fresh leaves from different plant species (leaves of the flame tree work well)
- a microscope, microscope slides, cover slips
- a paint brush

METHOD:

1. Gently paint the nail varnish on the underside of two different types of leaves. Wait until it has dried.
2. Peel off the nail varnish layer carefully and examine it under the microscope on low power.

OBSERVATIONS:

1 Record what you see in a diagram. Remember to label the diagram with the magnification that you used when viewing the specimen.

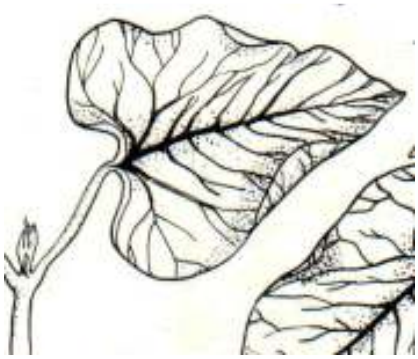
2 You should be able to identify stomata as openings. Are there any differences in the size or numbers of stomata in the two different types of leaves?

CONCLUSIONS:

1. What are stomata?
2. What passes IN and OUT of stomata?

3 Why are stomata important to plants?

4 What is the difference between 'gas exchange' and 'cell respiration'?



Collect and complete Worksheet 3: Energy & Respiration

WORKSHEET 2: ENERGY AND RESPIRATION

Collect a copy of this worksheet from your teacher then complete it:

1. Both plants and animals need _____as a source of energy for all their cell processes.
2. Green plants make their own food using the process of _____. Animals have to eat ready-made _____.
3. Both plants and animals release the energy in this food by breaking down the food in the presence of_____. This chemical reaction is called _____.
4. This reaction occurs in every living _____of all living things, all the time.
5. Write a word equation for respiration:

6. How do the reactants and products in this equation compare to those of photosynthesis?

> *You must **LEARN** and understand the equations for **RESPIRATION** and **PHOTOSYNTHESIS**.*

Write them both here……

	RESPIRATION	PHOTOSYNTHESIS
RAW MATERIALS NEEDED		
SOURCE OF THE ENERGY		
USEFUL PRODUCTS		
BY- PRODUCTS		
WHERE IT OCCURS		
WHEN IT OCCURS		
IS ENERGY TAKEN IN OR GIVEN OUT?		

ACTIVITY 13: BREADMAKING

Some organisms like yeast are able to live where there is little oxygen. They get their energy by partly breaking down glucose to form carbon dioxide and alcohol. This process is called **fermentation**. We make use of the fermentation action of yeast on sugar to make bread. In this process the bread dough traps the carbon dioxide gas as tiny bubbles. These expand as the dough is left to rise and are set into the bread as it is baked.

AIM: To make and bake some bread.

MATERIALS:

- pre-weighed bread mix (110g) in clean food container
- pre-weighed yeast (1.5 g)
- 0.25 teaspoon of salt
- 0.5 teaspoon of sugar
- disposable cups
- sesame seeds, 60 mL of warm water (not boiling)
- measuring jug
- food container and mixing spoon
- foil covered bench mat
- butter & honey
- Recipe cards
- kettle

METHOD:

1. Measure 60 mL of warm water (37°C) into a clean disposable cup.
2. Add 1.5 g of yeast.
3. Add 0.5 teaspoon of sugar.
4. Allow to stand for 15 minutes.

In a mixing bowl:

1. Add 100 g bread mix and mix in 1/4 teaspoon of salt.
   Add the liquid to the dry ingredients and stir the mixture with the mixing spoon.
2. Add more warm water (37°C) if needed to make a soft dough. Dust your hands with plain flour to stop the dough sticking to your hands.
3. Knead well on a sheet of alfoil wrapped around a bench mat.
4. Shape your dough, brush with milk and sprinkle with sesame seeds.
5. Set aside to prove for 1 hour in a warm place.
6. Bake in a preheated oven 200°C gas or 220°C until brown for 25 – 30 minutes, or until golden brown.
7. Butter the roll, spread with honey and share it with your teacher!

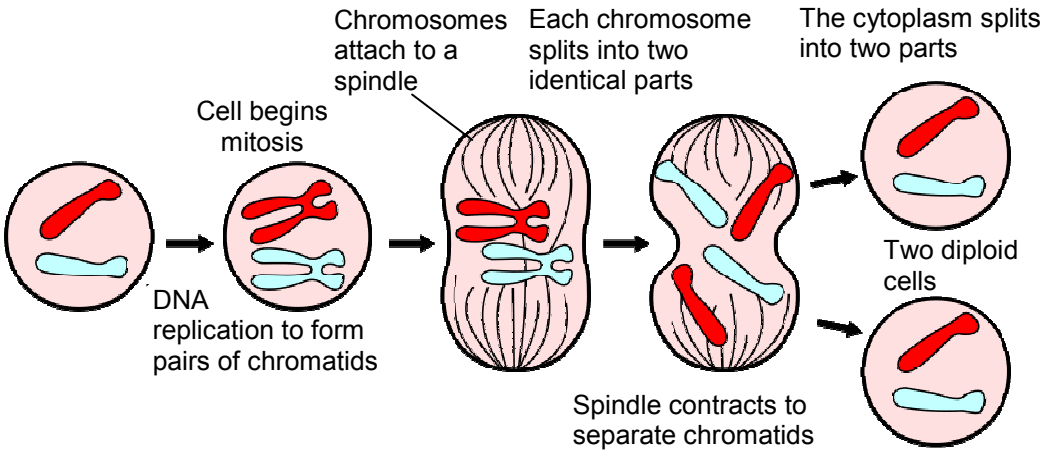
ACTIVITY 14: REPRODUCTION OF CELLS

You began life from a single cell formed when a sperm cell fertilized an egg cell. This cell then began dividing to form two cells, then each cell divided again to form four cells, eventually through this cell division process forming the billions of cells that you now have.

Cells do not last forever; they have a lifetime that may be quite short, e.g., red blood cells live for about 120 days. Most of your heart muscle cells will live as long as you do. Skin cells are being formed continuously, ageing then dying to eventually fall off your body.

The process which forms new cells for growth as well as repair is called MITOSIS.

The following diagram shows a cell undergoing mitosis:



Mitosis: Two cells have formed. Each cell has the same genetic information

In this process each chromosome in the nucleus of the cell divides into two identical parts. These separate to opposite ends of the cell. The cell membrane then separates the cytoplasm into two new cells, each having identical chromosomes that carry all the genes of a cell. Each new cell is therefore identical genetically.

AIM: to observe mitosis in onion root cells.

MATERIALS:

- prepared slides of onion root cells in mitosis
- microscope and lens tissue

METHOD:

- Set up your microscope, then place the microscope slide showing onion mitosis occurring in some cells in position on the stage.
- Locate cells undergoing mitosis.
- Use a pencil to draw large diagrams of individual cells at different stages of mitosis similar to those shown in the diagrams above.

Collect a copy of the worksheet "A Muddle of Mitosis" from your teacher. Individually, or as a small group, cut out the images of the cells shown in various stages of mitosis and arrange and then paste them into your notebook in a correct sequence.

THE IMPORTANCE OF MITOSIS

While the process of mitosis results in cells having identical genetic instructions; as cells mature they respond to different stimuli in their immediate surroundings to become different in structure and function. During your early development some cells became **specialised** to form body linings like the skin, others became parts of muscles, nerves, as well as blood, bones and ligaments that help to connect parts of our bodies together.

Cells having a similar structure and function are called tissues. Muscle is a **tissue**, so are the skin and nerves.

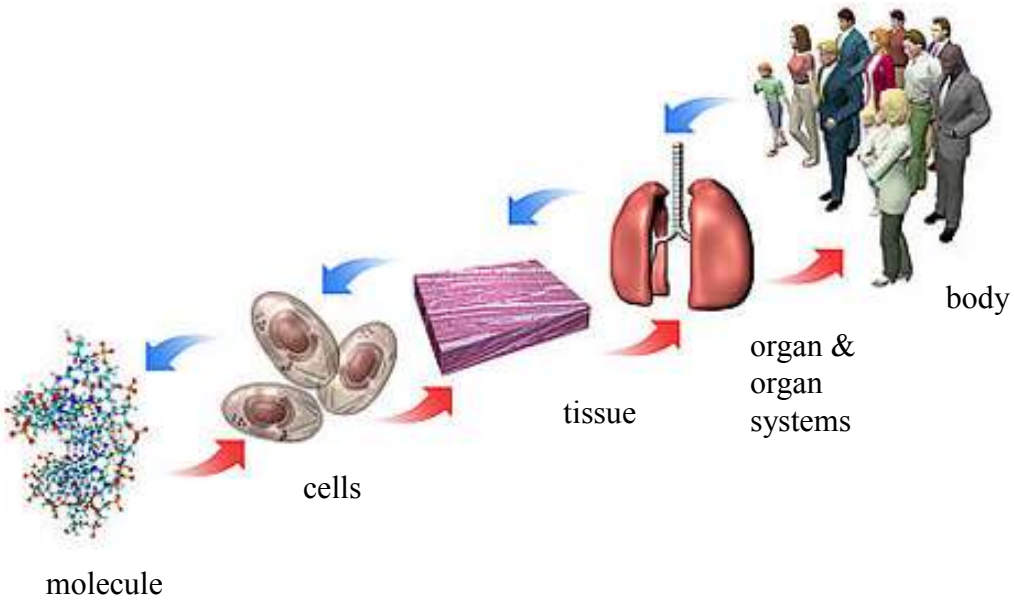
The four tissue types are called

- Lining tissue (epithelial tissue)
- Muscle tissue
- Nerve tissue
- Connective tissue

These tissues have formed into functioning organs that are essential to your life. The heart is an **organ**, made of muscle, nerves, linings and works to pump blood around your body.

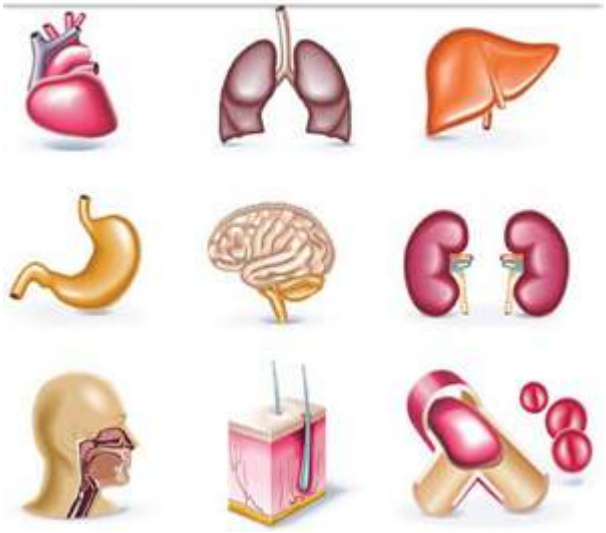
QUESTIONS:

1. Define these terms in your own words: cell, tissue, organ.
2. List the names of as many of your body organs as you can.



ACTIVITY 15: FUNCTIONS OF ORGANS

An organ is a structure made of different tissues that has a special function in the body.



1. In your notebook draw a table to record the name and function of the body organs shown above.

2. Are there any other organs that you can think of that are not pictured here? If so add them to your list.

ORGAN SYSTEMS

Any organ cannot function alone. Each organ requires the assistance of other organs in order for it to carry out its work. A heart can be taken out of a brain-dead person's body and continue to beat for some time. But without the connections to other organs provided by arteries, veins and tiny capillaries, its beating cannot pump blood around the person's body to keep it functioning. The heart is only one part of the whole circulatory system.

QUESTIONS:

1. Name three other body systems.
2. Name some of the other organs associated with one of these organ systems.
3. What is the main role of this organ system?

ACTIVITY 16: A CLOSER LOOK AT A BODY SYSTEM

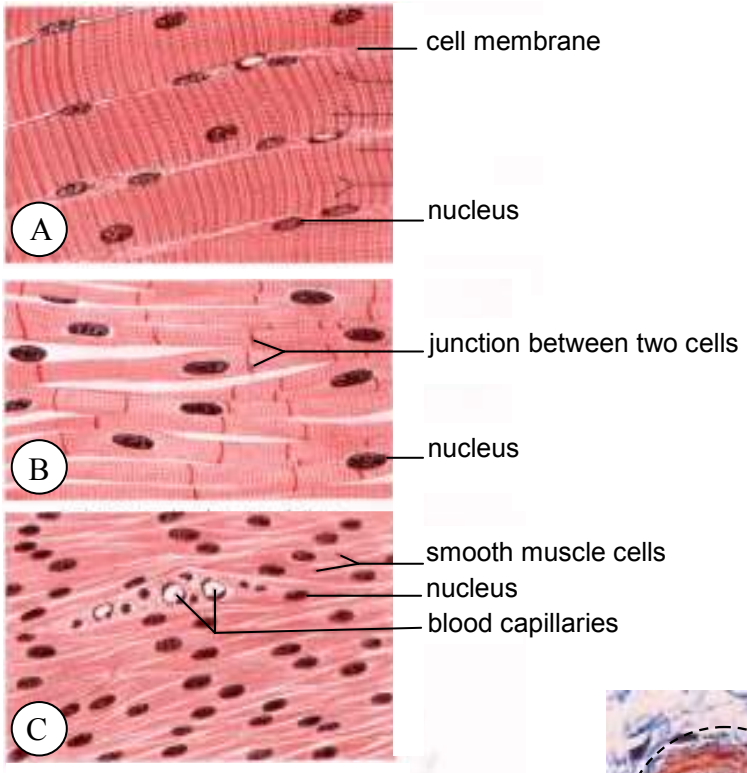
In this activity we will examine some of the structures that link together to form the circulatory system.

MATERIALS:

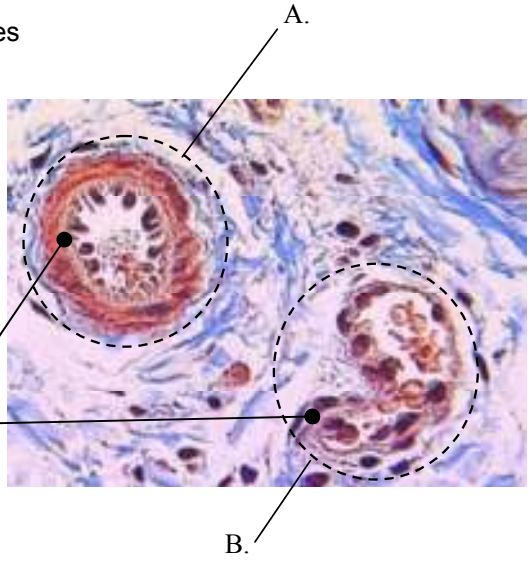
- Monocular microscope
- Prepared microscope slides of
  - heart muscle
  - XS artery
  - XS vein

METHOD:

1. Focus on heart muscle tissue. The structures stained blue are nuclei.
   Below are three diagrams, each showing a different kind of muscle tissue. Which one best matches what you are seeing?



2. Examine the slide showing a cross section of an artery. Then examine a cross section of a vein. The images to the right are of two different blood vessels. Which one is an artery and which one is a vein? Justify your answer.



3. Briefly describe the role of heart muscle, arteries and veins in the circulatory system.

NUTRITION

All living things require some form of nutrition, i.e., they need food. This food may be used as a supply of **energy** for such things as movement, to provide the building blocks to extend the body during **growth** and to **repair** any body parts that may have been worn out or damaged.

Green plants make their own food using energy from sunlight in the process of photosynthesis. Since plants are able to produce their own food, they are called **producers.** Animals, on the other hand must take in ready-made food. They must consume their food and therefore are called **consumers.**

ACTIVITY 17: TYPES OF CONSUMERS

There are three main types of consumers, those that eat mainly meat (carnivores), e.g., a dog, those that eat mainly plants (herbivores) e.g., a horse, and those that eat both plants and animals (omnivores), e.g., a human.

AIM: To study the digestive systems of a meat eater and compare it with the digestive system of a plant eater.

MATERIALS:

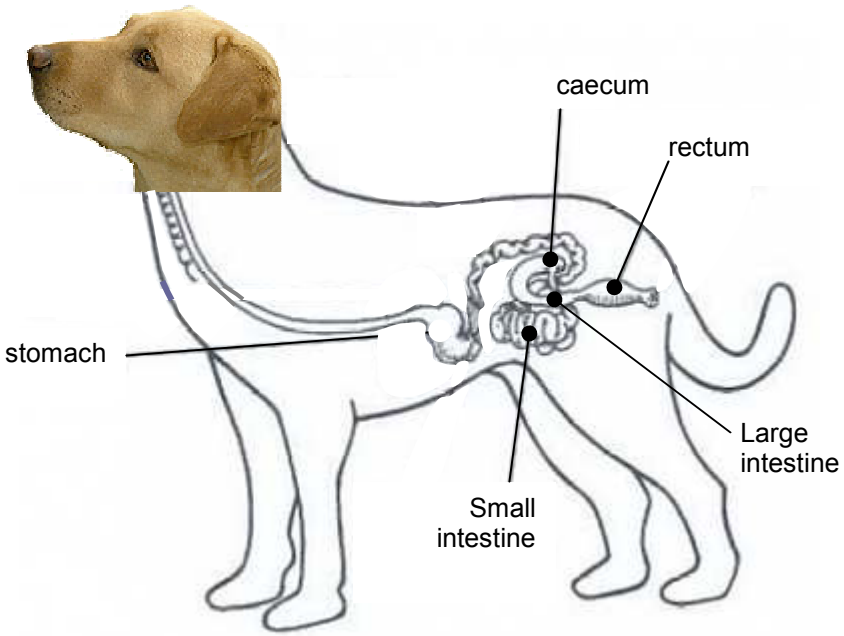
- jaw bone of a dog
- human jawbone/skeleton
- jaw bone of a cow, horse or sheep
- diagrams showing the gut of a herbivore e.g., sheep and carnivore e.g., dog

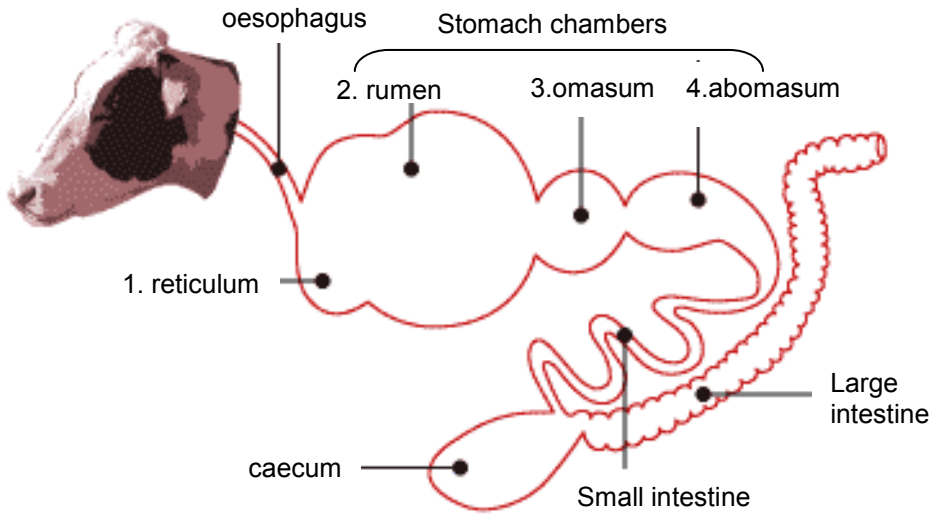
PROCEDURE:

1. Examine the jaw bones of both animals then in your notebooks complete a table like the one below:

	Carnivore	Omnivore	Herbivore
Number of teeth in jaw			
Number of different kinds of teeth in jaw			
Drawing of a front tooth			
Usefulness of this kind of tooth			
Drawing of a rear tooth			
Usefulness of this kind of tooth			

2. Examine the diagrams of the digestive systems of the two animals shown below:





N.B. Liver not shown

QUESTIONS:

a. Which food, meat or grass would be the harder to digest?

b. Which animal has the more complex stomach?

c. Why do you think this complexity is needed?

d. A cow is said to 'chew its cud". Find out what this means and why the cow does it.

e. A cow is known as a 'ruminant', as is a sheep and a goat. What does this word mean?

ACTIVITY 18: GAS EXCHANGE

Much earlier in this booklet we looked at the importance of respiration to release energy from food so the cells of organisms could function. For this to happen there must be a way for the organism to get enough oxygen into its body and release the waste carbon dioxide to the environment.

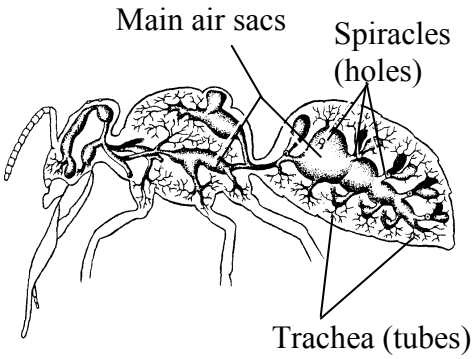
In animals, the respiratory or gas exchange surfaces are different from one group of animals to the next, depending on the animal's level of activity, body temperature, environment and size.

Some animals exchange gases directly through their skin, which must be kept moist.

Can you think of any?

Some aquatic animals like fish, marine worms, starfish, mussels, and tadpoles breathe through gills.

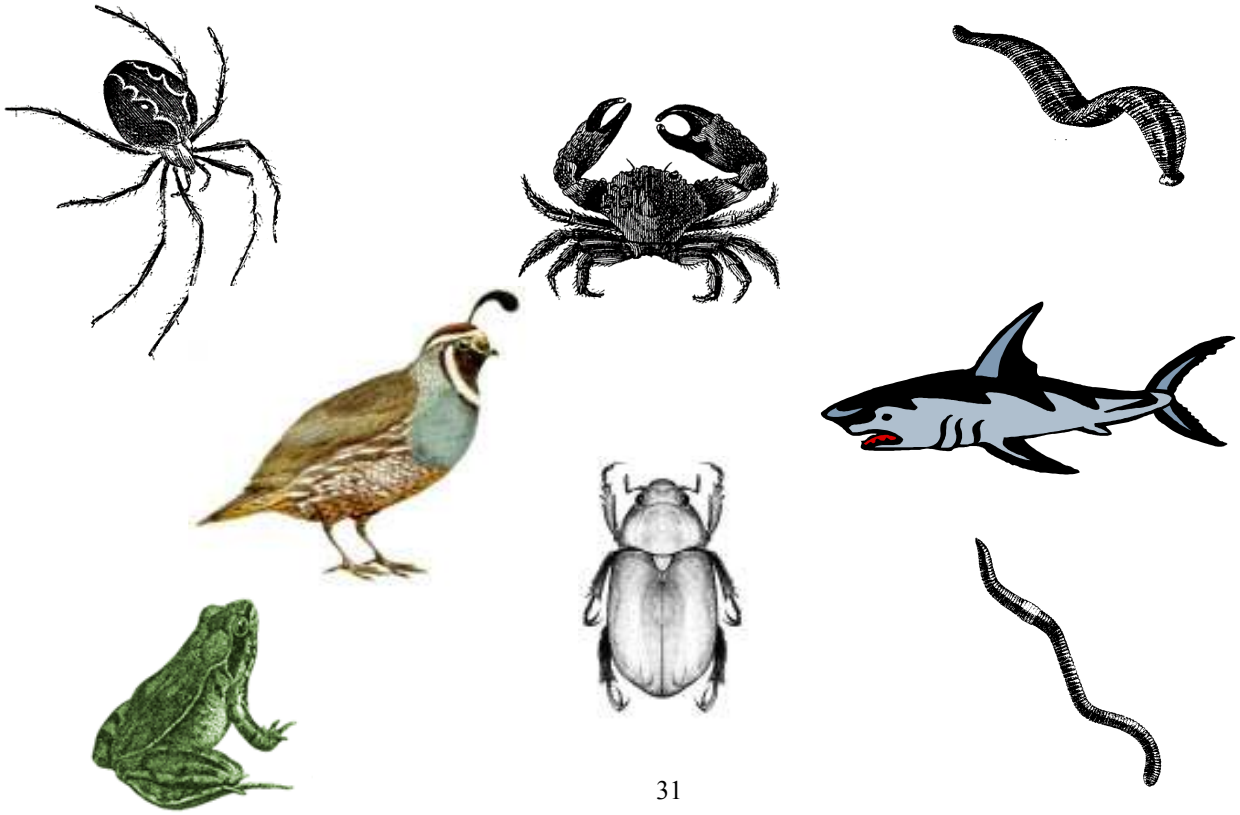
Other animals like Insects exchange gases through a system of air filled tubes called trachea. The air enters the trachea through openings on the body called spiracles.



Insect tracheal system

More complex animals exchange gases via their lungs and the gases are transported to the cells via a circulatory system of blood vessels.

Construct a table to list how each of the animals pictured below is able to breathe.

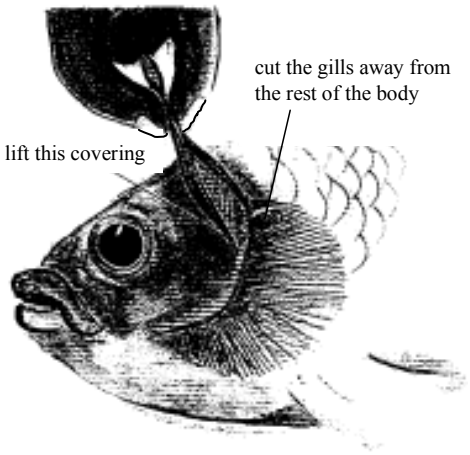


ACTIVITY 19: BREATHING

AIM: To examine the gaseous exchange surfaces of a fish.

MATERIALS:

- the head of a fresh fish
- sharp scissors
- forceps
- hand lens
- cutting board
- gloves
- newspaper
- cotton wool

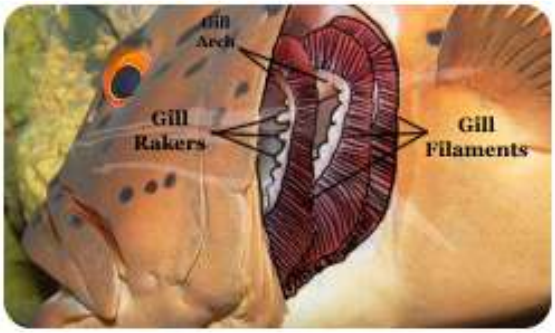


METHOD:

1. Examine the fish head.
2. Locate the opening of the gill slits.
3. Lift the flap that covers the gills. Examine the gills carefully. How are they attached to the fish?
4. Use your hand lens to look carefully at the gills. Describe what you see.
5. Run your index finger over the gills. What do they feel like?
6. What colour are the gills? Why do you think that they are this colour?
7. Carefully cut out one of the gills and look at it closely.

QUESTIONS

1. How many gills does this fish have?
2. Draw accurate diagrams of the gills still attached, and of the one that you have removed. Describe the gill.
3. How would its design help in exchanging gases with the water?
4. Use your observations to help you explain how a fish obtains oxygen from water.
5. Explain why fish die soon after they are taken out of water. (Hint: watch what happens as you take the gills out of the water. Use a piece of cotton wool – hold it in water, then take it out of the water – what happens?)



ACTIVITY 20: REPRODUCTION

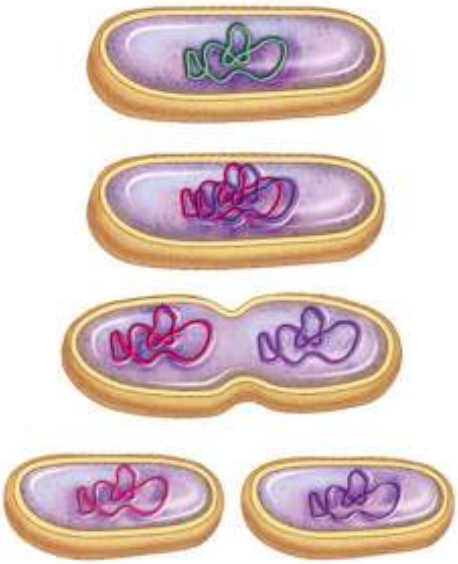
No organism lasts forever. Each has a lifetime that can be calculated in hours, days or years depending on the type of organism. For its kind (species) to continue to inhabit the Earth, reproduction must take place. If reproduction does not take place fast enough to replace those that are dying, that kind of organism will become extinct.

Reproduction is of two main kinds. The first is called **ASEXUAL** reproduction because it does not involve the fusing of two cells. **SEXUAL** reproduction does.

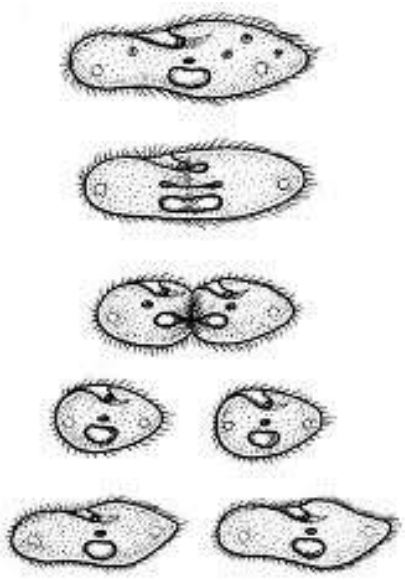
Asexual reproduction can allow rapid reproduction of the organism involved. Each new individual will be the same as its parent. In effect they are clones.

Bacteria can reproduce this way. Under ideal conditions some bacteria can divide every 15 minutes. This process is known as binary fission. Were these conditions to continue, an enormous number of bacteria could be formed in a short time.

Other simple organisms like the one-celled Paramecium can also reproduce in this way. Division begins with the nucleus dividing into two, and then the cytoplasm of the cell cleaves forming two cells.



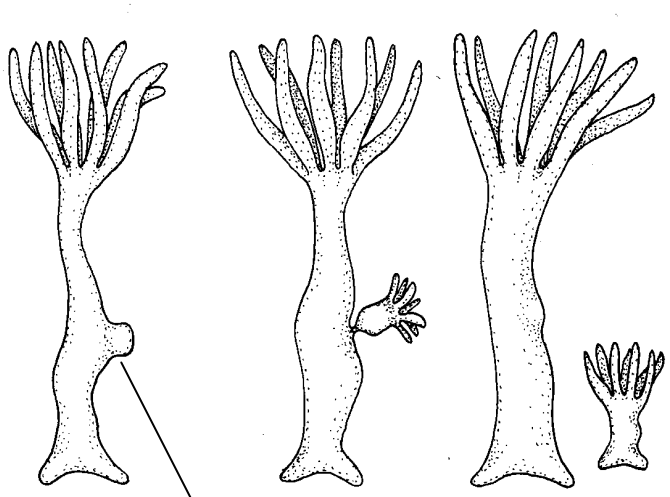
Binary fission in bacteria



Binary fission in Paramecium – an example of mitosis in action

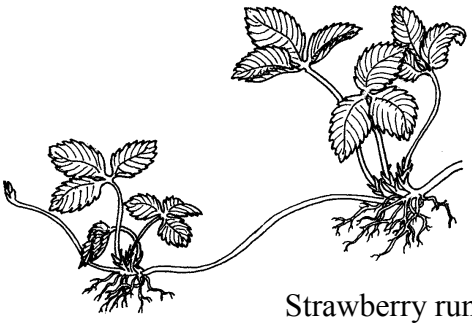
Some small animals can split into fragments and each fragment can then grow to form a new animal. Jellyfish can do this.

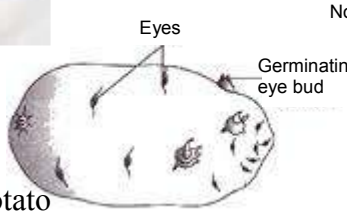
Hydra is a freshwater animal related to jellyfish that can form buds. The bud eventually drops off and becomes a separate animal.



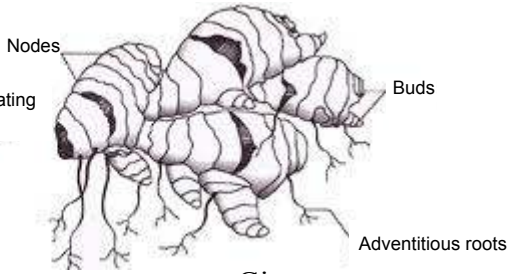
Many plants show asexual methods of reproduction. A whole lawn can be established from one runner of grass – but it might take a long time!

We are able to take cuttings of plants and 'strike' them by potting them in a coarse soil mix. If they are kept moist new roots will form and many new plants can be formed this way.


Strawberry runner



Potato



Ginger

QUESTION:

In your notebooks explain how each is an example of asexual reproduction.


Tree of Life

ACTIVITY 21: PLANT REPRODUCTION (MOSSES)

All living things must be able to reproduce so that their kind will continue through time. The plant groups show a number of different ways of reproducing. In this activity you will examine some of these ways.

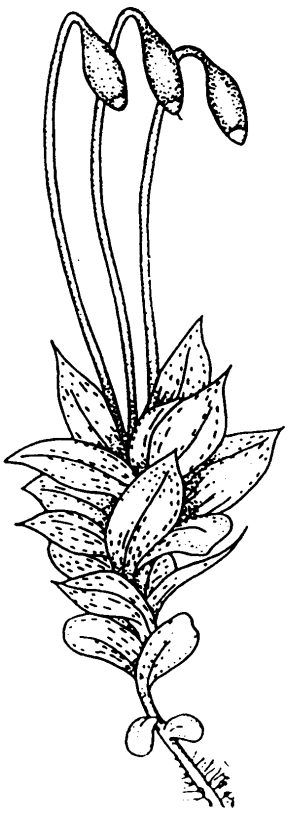
MOSSES

Mosses and liverworts are a very ancient group of plants.
They are the smallest of all green land plants and live in damp places. They do not have true roots, stems or leaves.

AIM: To find out how mosses and liverworts reproduce.

MATERIALS:

- moss plants
- mounted needle
- hand lens
- reference book



METHOD:

A. Using a mounted needle, carefully separate out one of the moss plants.

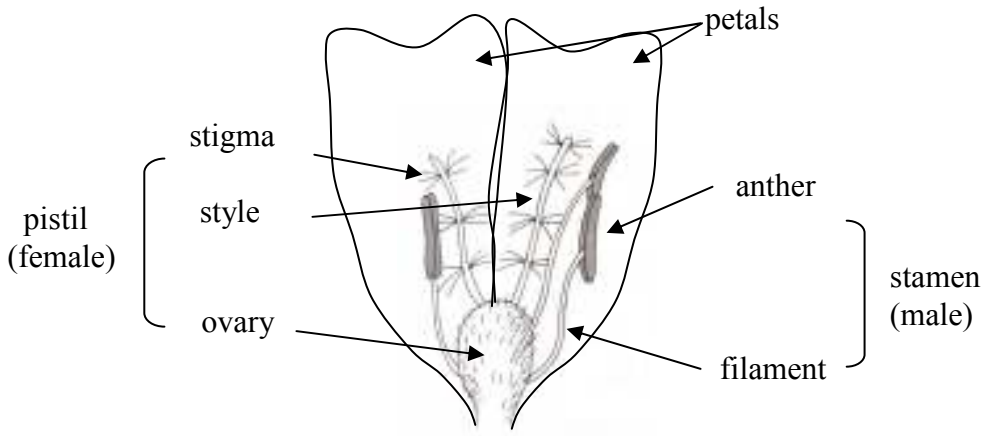
   - Carefully draw your moss plant and label the following parts:-rhizoids, leaf-like structures, spore capsule (if present).

B. By referring to your specimens and your textbook, reference book or the Internet answer the following questions:

1. The moss plant shown has two main parts, a green leafy part and a stalked spore capsule growing on it. What grows from a spore?
2. What two kinds of cells does the green leafy part form?
3. How do these two cells come together?
4. What forms as a result? What does it grow into?
5. What is a sporophyte moss plant?
6. What is a gametophyte moss plant?

ACTIVITY 22: PLANT REPRODUCTION: (FLOWERING PLANTS)

AIM: To locate the male and female parts of a number of flowers.



MATERIALS:

Flowers of:

- bottlebrush
- hibiscus
- grevillea
- flame tree
- Gem blade, hand lens and mounted needle

METHOD:

- Identify the stamens and pistil in the flowers provided.
- Record in a table similar to this one the number of each part present.
- Draw an accurate diagram showing the structure of the pistil in each case.

NAME OF PLANT	NUMBER OF STAMENS	DIAGRAM OF PISTIL

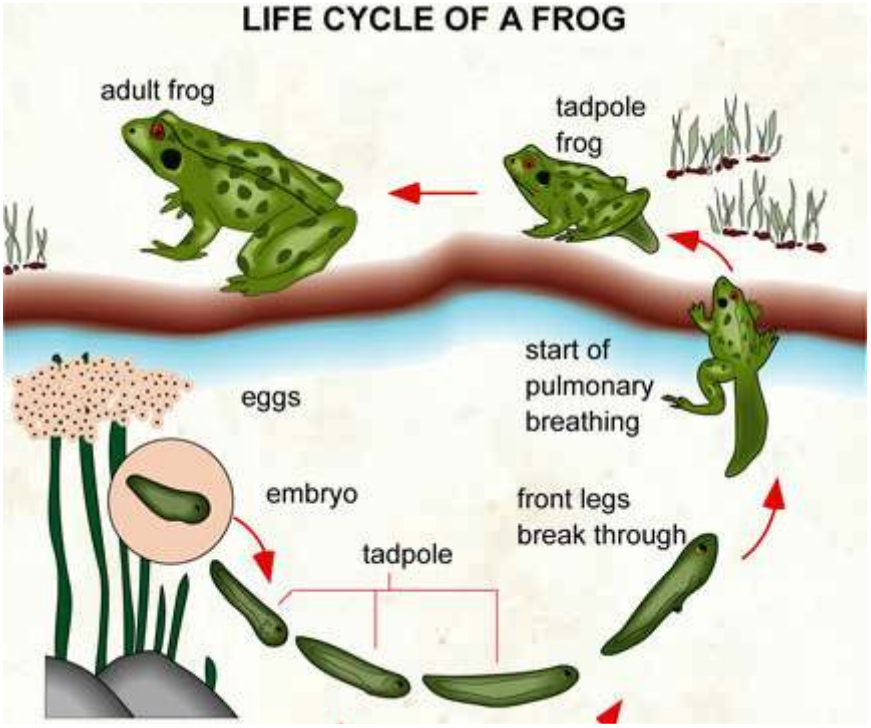
QUESTION:

Why is the arrangement of the flower parts different for different flowers?

ACTIVITY 23: REPRODUCTION IN ANIMALS
External Fertilisation

Sexual reproduction in animals always involves the fusion of a male cell called a sperm and a female cell called an egg cell. Sperm cells are produced in enormous numbers and must swim in fluid to reach an egg to fertilise it.

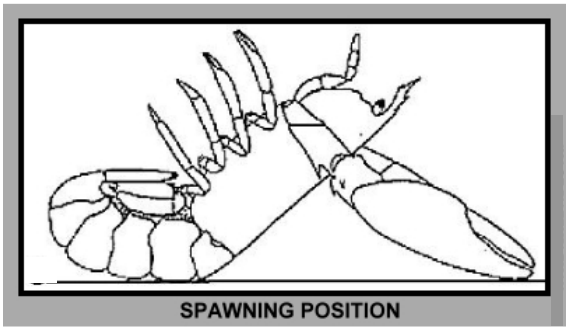
In some animals huge numbers of both sperm and eggs are released into a watery environment and fertilisation takes place externally. Frogs, most fish, crabs and rock lobsters reproduce this way. In most cases the young then develop without any care from their parents. The life cycles of a frog and rock lobster are shown below.



The frog's life cycle passes between two distinct stages, the aquatic tadpole and the terrestrial frog. To do this it needs to have two different means of exchanging gases: gills while a tadpole and lungs as an adult.

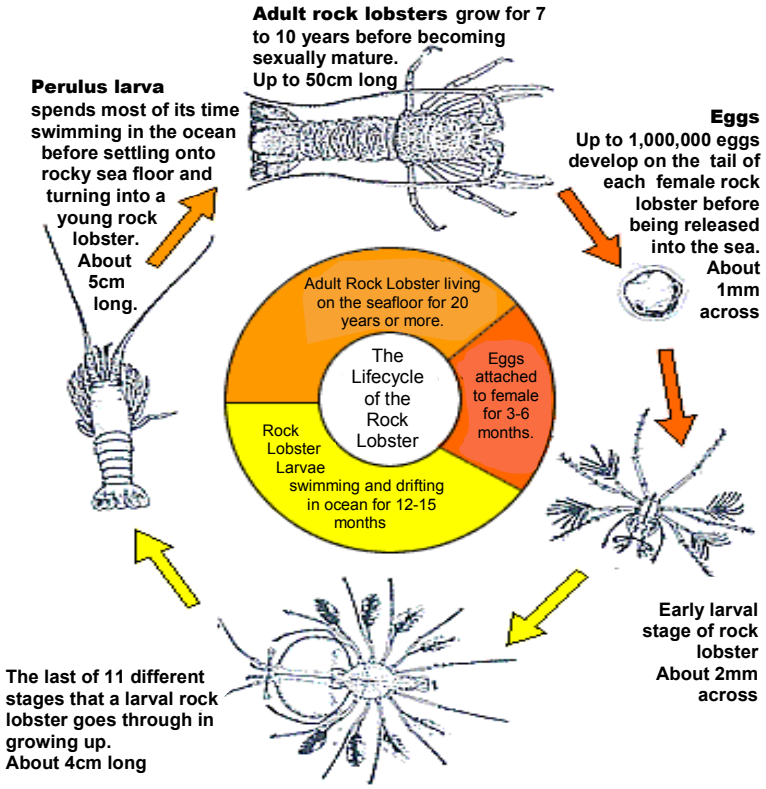
Since for most frog species there is no care of the young, very few of the hundreds of tadpoles become adult frogs capable of reproducing. Most will be eaten at the egg or tadpole stage.

The Western Rock Lobster also has external fertilisation, but the mating process is quite different. The male lobster passes a packet of sperm known as a 'tar spot' to the female during mating. During spawning the female lays on


SPAWNING POSITION

its back and the many eggs are passed down towards its tail. As they pass a special opening the sperm cells are released from the sperm packet and fertilization occurs. The fertilised eggs collect on the underside of the tail in a brood chamber.

Its whole life cycle is shown in this diagram:



During their development the larvae of the rock lobster travel great distances on ocean currents. As they do so they become part of the millions of tiny animals forming plankton, food for many marine animals. Very few survive to become adult breeding animals.

QUESTIONS:

1. Do the parents of either the frog or rock lobster take care of the young at anytime?
2. Very few young survive to reproduce more of their kind in both of these animals. Why is this?
3. Give a reason why these animals must produce so many eggs to be fertilised.

ACTIVITY 24: REPRODUCTION IN ANIMALS

Internal Fertilisation

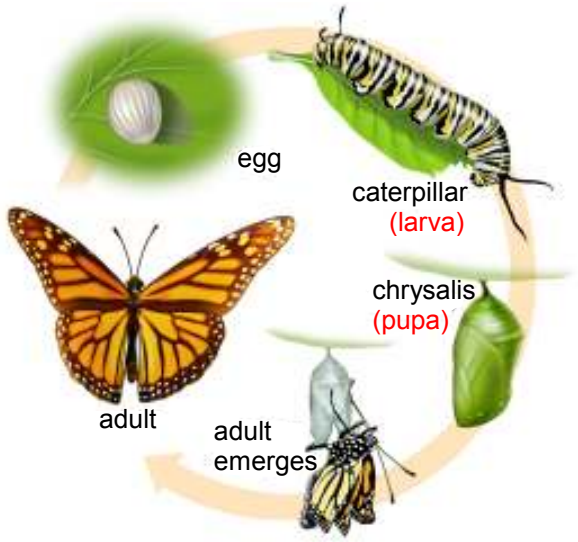
Many species of animals living on land rely upon internal fertilisation. This requires the male and female to come together so that the male can release sperm cells into the female's body. The sperm cells then swim to the egg cells and fertilisation takes place. The eggs may then be laid, as in snails, reptiles (like turtles and snakes and two mammals) and birds, or the young born alive as in some fish and most mammals.

This needs the male and female to show their readiness to mate by displaying special behaviour called COURTSHIP. This is especially important in some animals where coming together is decidedly risky. For spiders and scorpions, for example, there is very real danger, often fatal in the case of spiders. This involves 'dancing', signalling and stroking behaviour.

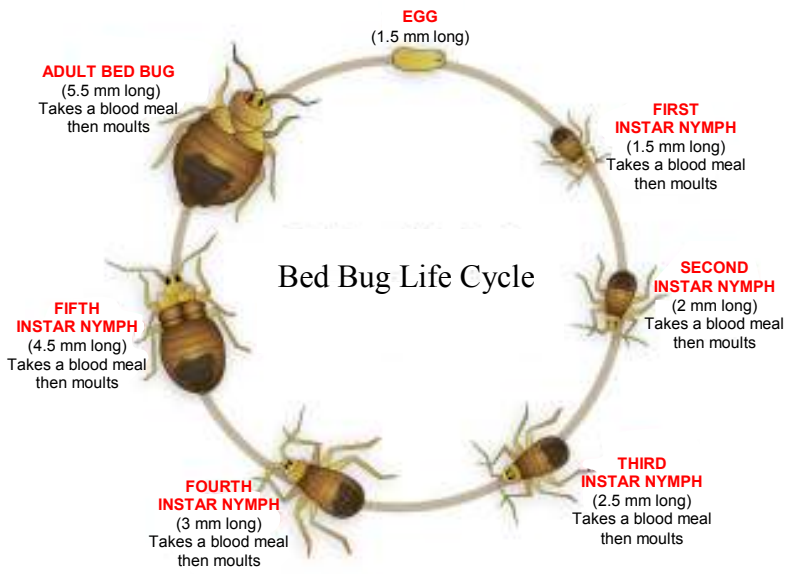
Some insects can even mate on the wing. The insects shown below are hover flies.

After an insect egg has been fertilised there are two main ways in which it may develop. The first is known as a **COMPLETE METAMORPHOSIS**. The egg hatches into a larva, which in turn becomes a pupa which in time is transformed into an adult.

A butterfly is a good example of such and insect.



The second way is called an **INCOMPLETE METAMORPHOSIS.** In this case, the egg hatches to produce an immature adult known as a **NYMPH** that gradually changes through a series of moults into the adult.
The following life cycle is for a bed bug, a creature that hopefully you have never met in your bed!



QUESTIONS:

1. Why might internal fertilisation be used by land animals rather than external fertilisation?
2. Use text resources or the Internet to find out two other examples of insects showing a complete metamorphosis and two showing an incomplete metamorphosis.

ACTIVITY 25: REPRODUCTION IN ANIMALS

Monotremes & Marsupials

All species of mammals rely upon internal fertilisation. The sperm from the male are released inside the female's reproductive tract during **copulation**. The sperm then swim to an egg that has been released into an oviduct where fertilisation occurs. The egg may then be laid, as in some primitive mammals like the platypus and echidna belonging to the group of mammals known as **MONOTREMES.**

After mating with a male, a female echidna digs a burrow, curls up her body, and lays one egg directly into her pouch. The egg does not have a hard shell like a bird's egg, but a rather leathery skin instead. The egg hatches in about 10 days. Inside the pouch, the jellybean-sized baby echidna licks milk that oozes from its mother's body. When its spines start to grow, the baby is moved into a burrow by its mother. A baby echidna is called a puggle. One born at Perth Zoo in 2012 and named Babbin weighed less than a gram at birth.

The female feeds the puggle until it is about 6 or 7 months old, after which time the young echidna fends for itself.

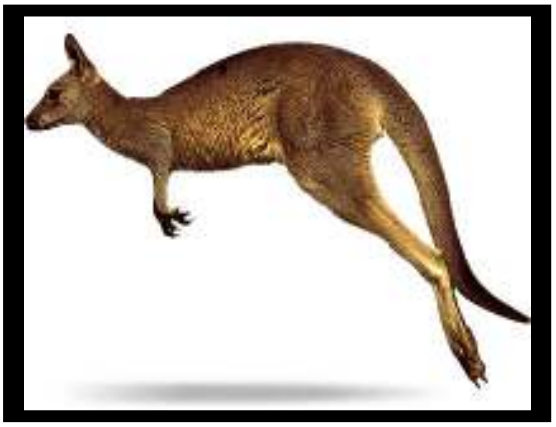
In the wild, an echidna can live for up to 16 years.

Sydenham, S. & Thomas, R. *Echidna* [Online] www.kidcyber.com.au(2006).

More advanced than the Monotremes are the **MARSUPIALS**. Mating between kangaroos takes place after displays of strength and fighting between males competing for the honour to mate with a female. The dominant male then copulates with the female, placing his penis inside the female's vagina. Sperm are released which then swim up the female's reproductive tract (vagina, uterus and oviducts) to fertilise an egg cell.
If the female has no joey that she is suckling then the fertilised egg will begin to develop and be born after a very short pregnancy. The newborn joey then makes its way through its mother's fur until it reached her pouch. There it attaches to one of her teats. Here it will stay until it reaches an age of being able to leave the pouch for short periods. Gradually it becomes more and more independent of its mother. During this time the mother takes a very active role in teaching survival skills to the joey.

QUESTIONS:

1. In both echidna the kangaroo fertilisation is internal. What might be the advantage of this to these animals?
2. Both animals have very few young by comparison with the frog and rock lobster. Yet all of these species have survived. Can you explain why this is so?
3. What is the importance of the mating behaviour (courtship) displayed by the male kangaroos?
4. Kangaroos and other mammals like the koala, bandicoot and numbat belong to the Marsupials. What characteristic do they have in common?



ACTIVITY 26: REPRODUCTION IN ANIMALS

Placental mammals

Mammals like ourselves are known as PLACENTAL mammals because we begin our lives attached by our umbilical cord to a structure called a placenta. This in turn attaches to the lining of the uterus or womb of our mother. For the first nine months of our life we develop inside the uterus, totally dependent on the placenta to gain nutrients and oxygen from our mother's bloodstream, while losing wastes to her bloodstream for her body organs to take care of. Many other mammals like mice, tigers and elephants develop in a similar way, although the length of pregnancy differs widely. A female mouse has a pregnancy lasting about 21 days, a tiger about 100 days while an expectant elephant must endure a gestation period up to 23 months long.

This is a very long time indeed.

- *Why is this type of reproduction so commonly found amongst the mammals?*
- *What possible advantages could there be in developing this way?*

Form into small groups to consider an answer to both of these questions, then report your group's ideas to the whole class.