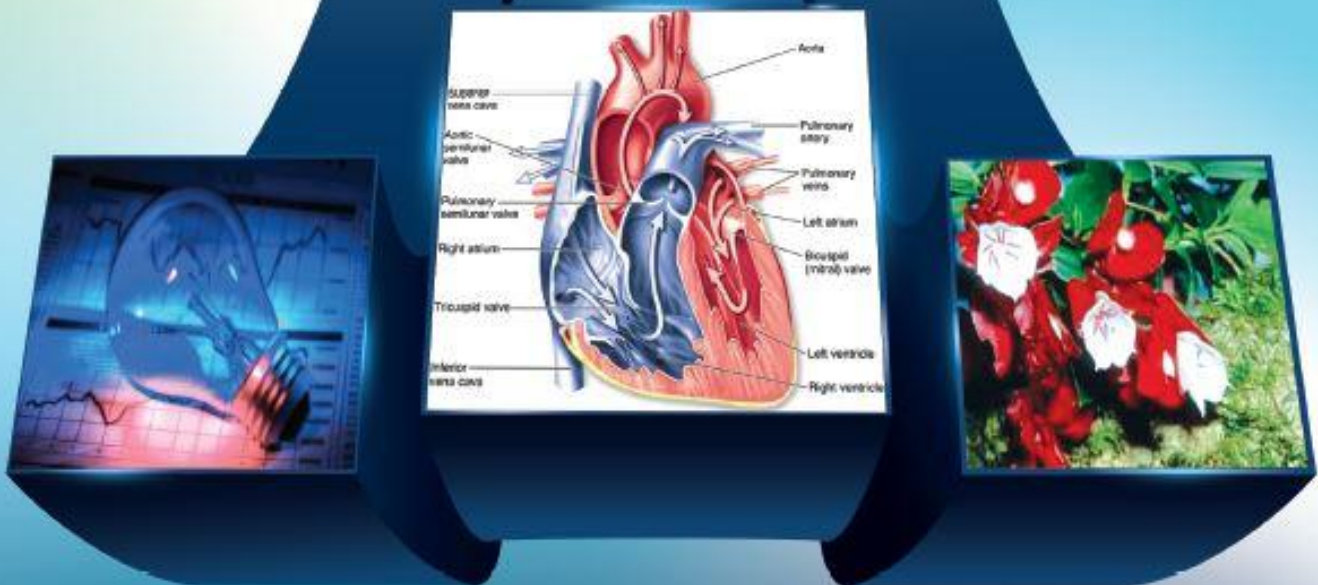




SCIENCE BOOK 2

LOWER SECONDARY



MINISTRY OF EDUCATION
CURRICULUM DEVELOPMENT UNIT



BASIC SCIENCE

SCIENCE BOOK 2

LOWER SECONDARY

**CURRICULUM DEVELOPMENT UNIT
MINISTRY OF EDUCATION
SUVA, FIJI 2014**



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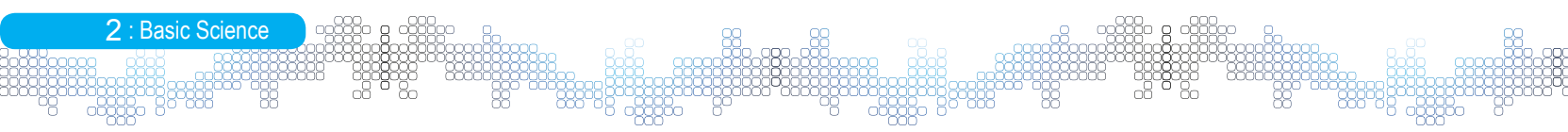




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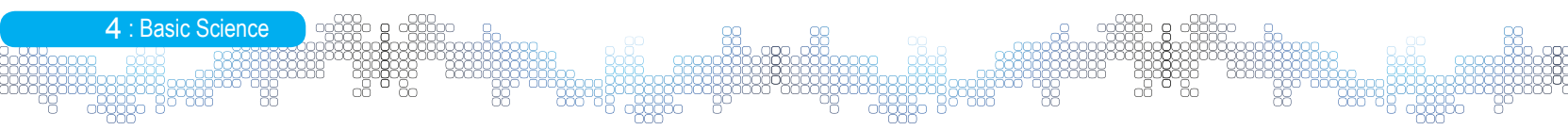


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CHAPTER 1: LIVING THINGS AND THE ENVIRONMENT

1. STRUCTURE AND LIFE PROCESSES
2. LIVING TOGETHER
3. BIODIVERSITY CHANGE AND SUSTAINABILITY

INTRODUCTION

The study of living things and the environment basically involves the study of the relationship between living things themselves and also with their environment. This is shown by how they interact, how they depend on one another for survival and how they influence one another.

Living things have various structures that enable them to survive: for example, transport structures in plants allow water and nutrients to move. Similarly there are digestive structures and respiratory structures in animals and reproductive structures in plants and animals that assist in organisms functioning within their environment. Each organism has particular forms of these structures that assist their survival. In all environments, organisms with similar needs may compete with one another for limited resources, including food, space, water, air and shelter.



UNIT 1: STRUCTURES AND LIFE PROCESSES

INTRODUCTION

This unit will help us examine the internal structures of animals and account for the structure and functions of parts of the human system that relate to life processes – digestion, blood circulation, respiration, excretion and reproduction.

1.1.1

ANATOMY OF A DIGESTIVE SYSTEM

We don't know how man first learned about the digestive systems in animals. It was probably an accident. As hunters cut open their prey, they probably noticed some long tubes and pouches inside the animals. Grazing animals probably had some grass in various states of 'decay' in the pouches. Predators may have had pouches containing the remains of their prey. There is no way of telling what early man thought of these observations. But cutting open an animal, he was beginning to learn something about the animal's internal anatomy (inside structures).

Your study of the use of food will begin in much the same way. First you will examine the anatomy of a digestive system. Then you will investigate in more detail how that systems works. An organ system is made from a group of different organs, which all work together to do a particular job.

A frog's digestive system is easy to observe. Much of what you learn of the frog's anatomy will be true for many other animals, including man.



Activity 1: Dissecting a Frog

Materials

- frog (unconscious frog using methylated spirit)
- safety goggles, gloves, and a lab apron
- dissecting forceps
- scalpel (sharp razor blade) /dissecting scissors
- dissecting pins (10- 20)
- dissecting tray and paper towels
- dissecting probe/ needle
- plastic storage bag

Did You Know?

Frogs don't drink water; they absorb water through their skin.





Method

1. Put on safety goggles, gloves, and a lab apron.
2. Place frog in tray. Rinse the frog with water then place it in the dissection pan. The frog should be lying on its back side with the belly facing up.
3. Pin the frog. Pin the frog for dissection by securing each of the four limbs to the pan. Place the pins through the hands and feet to secure them to the pan.
4. Once the legs of the frog are securely pinned to the dissection tray begin to cut the skin and use the forceps to lift the skin midway between the rear legs of the frog. Using the scalpel, make a cut along the centre, or midline, of the frog, bisecting it equally.
5. Continue cutting the skin by using the scissors all the way up the frog's body to the neck. Be very careful not to cut too deeply.
6. Still using the scissors, make horizontal cut just above the rear legs and between the front legs of the frog as shown in figure 1.A
7. Once you have finished the cutting between the front and rear legs of the frog you need to separate the skin flaps from the muscle below. To do this:
8. Pick up the flap of skin with the forceps, and use a scalpel to help separate the skin from the muscle below.
9. Once the skin flaps have been cut pin them to the dissection tray using several pins as shown in figure 1 B.

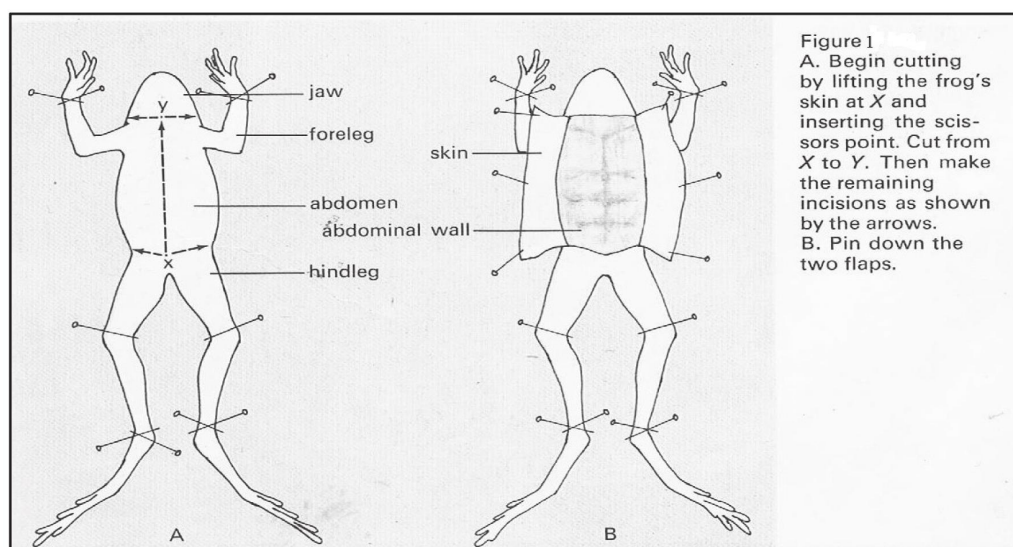
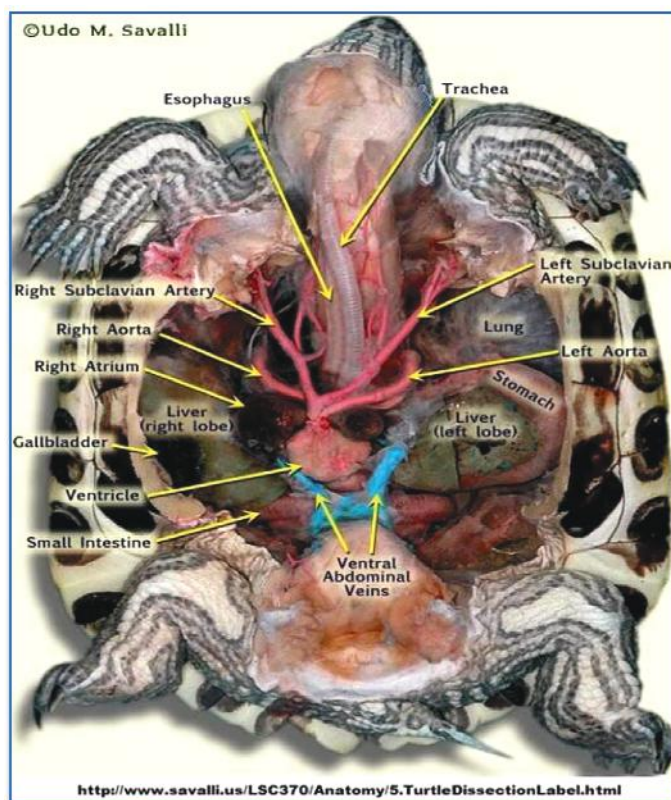


Figure 1
A. Begin cutting by lifting the frog's skin at X and inserting the scissors point. Cut from X to Y. Then make the remaining incisions as shown by the arrows.
B. Pin down the two flaps.

10. This section will describe the procedures for cutting through the frog's abdominal muscles.
11. Now that the skin has been removed, begin by cutting the abdominal muscle and using the forceps to lift the muscle midway between the rear legs of the frog. Next use the scalpel to start cutting in the direction of the chin.
12. Using the scissors, continue carefully to cut the midline of the frog, but **do not cut too deeply as to damage the organs.**
13. This is very important. When you reach a point just below the front legs, turn the scissors blades sideways to cut through the bones in the chest. This should prevent damage to the heart or other internal organs. When your scissors reach a point just below the frog's neck you have cut far enough.
14. Next, using the scissors, make horizontal incisions through the muscle between both the front legs and above the back legs.
15. To finish opening up the frog's body cavity therefore exposing the abdominal region, use the forceps to hold the muscle flaps while separating the muscle from the tissues below with a scalpel.
16. Once the muscle flaps have been separated from the underlying tissue, they must be pinned back. This will allow easy access to the frog's internal organs. If your frog is female, the body cavity maybe full of black eggs. You may have to remove one side in order to continue your dissection.
17. Open the mouth of the frog. Observe the tongue and the place where it is attached to the lower jaw. The two bumps on the roof of the mouth between the internal openings of the nostrils are the teeth. At the back of the mouth, find the openings of a tube. This tube leads to the stomach and is called the oesophagus. Use the dissecting probe to push organs aside without damaging them.
18. Identify the liver. It is large, dark structure found under the bone you cut. The lungs are the sac like structures at the back of the heart. The heart is a small triangular shaped between the





front legs and back to the liver. The gall bladder is a small, round sac attached to the middle part of the liver. Move aside the left part of the liver. At the end of the oesophagus is the J shaped stomach. At the bottom of the stomach, you should notice the beginning of a small tube, the small intestine. The pancreas is located near where the stomach and small intestine join. It is small, flat, light yellow body held in a thin membrane that is attached to both the stomach and the small intestine. You may also see a mass of yellow, finger like structures attached to the membranes near the intestine of your frog. These are fat bodies where the frog stores fats. The spleen is small, round reddish organ. Follow the small intestine until it joins a somewhat larger tube near the lower end of the abdomen. This is the large intestine. The large intestine leads to the outside of the frog.

19. Carefully remove the frog from the dissecting tray. Wrap some wet paper towel around the frog or place it the plastic storage bag and dispose it according to the direction from your teacher.

Result

Organ	Description	Function
1. Lungs	reddish pink, sponge like structures	site for oxygen and carbon dioxide exchange
2. Liver	dark maroon, lobe shape	makes bile (aids in digestion)
3. Pancreas	thin, yellowish ribbon like	makes insulin (aids in digestion)
4. Heart	reddish, triangular shape	pump blood to all parts of the body
5. Stomach	greyish white, J shaped	first site of chemical digestion, temporary stores food, breaks down food
6. Large intestine	greyish white, long tube like	collects waste, absorbs water
7. Oesophagus	greyish white, tube like	carries food to the stomach
8. Spleen	dark reddish brown, round and small sac	part of circulatory system, stores blood
9. Small intestine	greyish, long folded tube like	absorb nutrients from food
10. Gall bladder	greenish sac	stores bile
11. Fat bodies	bright yellow, finger like structure.	stores fats

Review Exercise

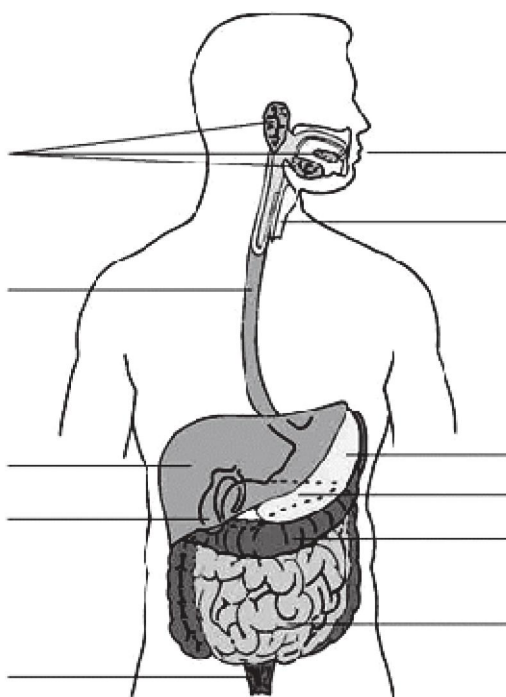


1. What is the purpose of your body's digestive system?
 - A. to help your blood move through the body
 - B. to help you breathe
 - C. to help your body make food
 - D. to help your body break down food

2. Place these events in the correct order. Number each sentence 1 - 5.
 - _____ Food ends up in the small intestine.
 - _____ Food is chewed up.
 - _____ Food is in the large intestine.
 - _____ Food travels through the oesophagus.
 - _____ Food waste leaves the body.

3. How would you determine what the frog has eaten?

4. Label the drawing of the digestive system with the following structures: **mouth, oesophagus, stomach, liver, small intestine, and large intestine, salivary gland, rectum, pharynx, pancreas, gall bladder.**



5. Why do foods have to be digested?

6. The physical breakdown of large pieces of food into smaller pieces is referred to as digestion.

7. The breakdown of large food molecules into smaller molecules that can be absorbed into the bloodstream is called digestion.



1.1.2

DIGESTIVE SYSTEM

Digestion and Absorption

Carbohydrates, proteins and fat are the main nutrients in our food. They are large molecules which the body cannot absorb directly. To be useful they must be broken down into simpler substances which the body can absorb.

<i>Nutrient</i>	<i>Absorbed as.....</i>
Carbohydrates/starch	Glucose
Protein	Amino acids
Fat	Fatty acids and glycerol

The chemical and mechanical processes of digestion convert these foods into absorbable substances in the intestine. Vitamin and minerals in food are absorbed unchanged during digestion.

The chemical processes of digestion depend on different **enzymes**. **Enzymes are catalysts that speed up the chemical reactions**. Without them nutrients in the food you eat would be broken down slowly that you would starve to death. The absence of even one enzyme can cause illness. The human gut is a tube. At one end food is put in the mouth – **ingested**. At the other end the undigested remains of the meal are removed through the anus – **egested**. In between mouth and anus the mechanical and chemical processes of digestion break down food into substances suitable for absorption

Different parts of the gut perform different tasks in processing food as it passes through. The human gut is 7-9m long. The longest part of it is composed of the **smallest intestine** and the **large intestine**. These lie folded and packed in the space of the abdominal cavity.

There are two **types of digestion**:

1. Chemical digestion

this occurs in the **mouth, stomach and intestines**, where there are **enzymes** to break down the food.

2. Mechanical digestion

this occurs in the **mouth**, where teeth grind and break up food, and in the **oesophagus, stomach and small intestine**, where a process called **peristalsis** (muscular contractions) pushes the food around causing it to break up further.

After we swallow, our food passes through these organs in turn:

- oesophagus or gullet
- stomach
- small intestine
- large intestine



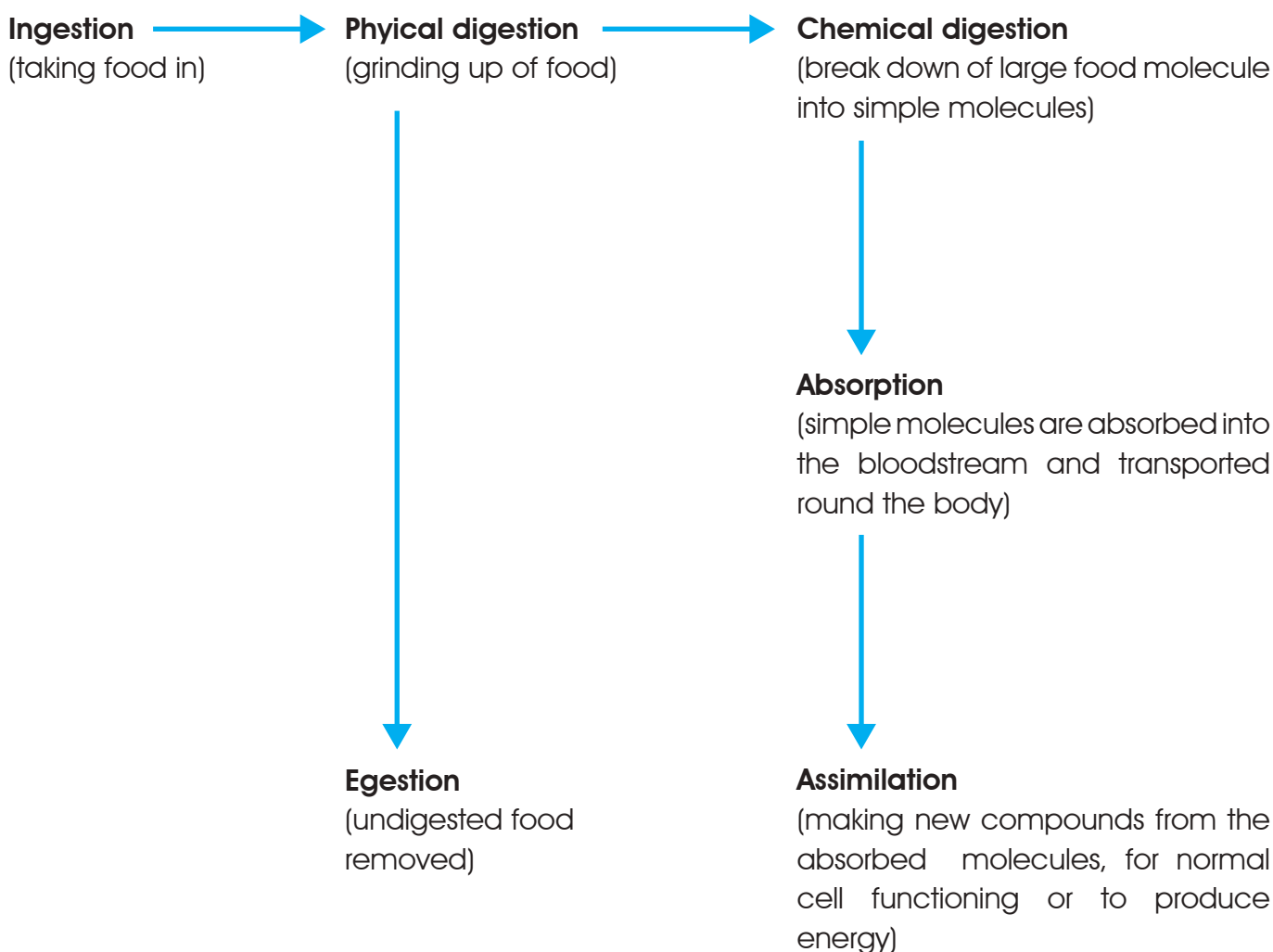
Stages of digestion

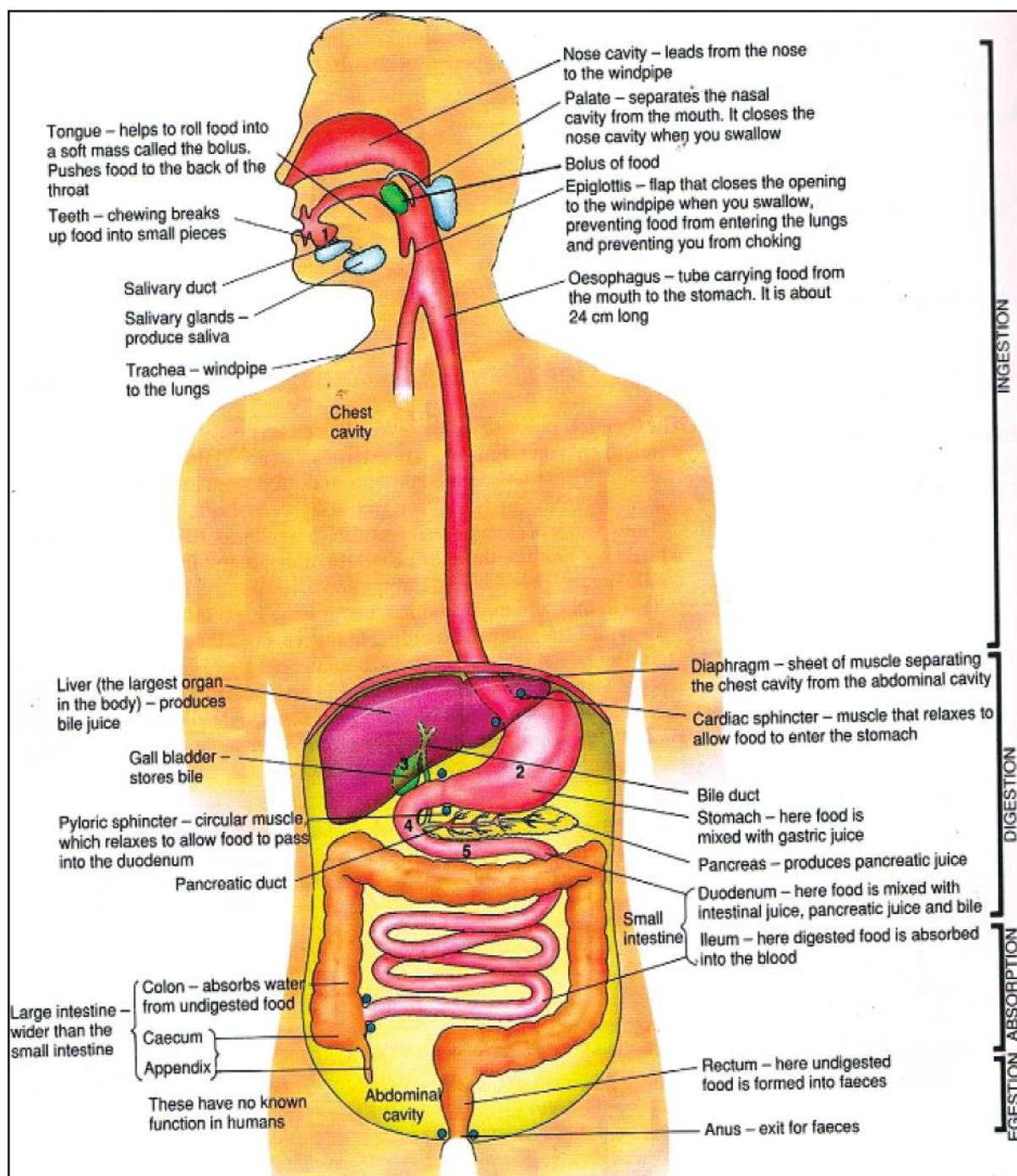
- Food is digested in the mouth, stomach and small intestine.
- Digested food is **absorbed** into the bloodstream in the small intestine.
- Excess water is absorbed back into the body in the large intestine.
- Any undigested food is stored in the rectum and passes out of the anus as **faeces** when we go to the toilet.

Liver and Pancreas

The liver and the pancreas play important part in digestion. The liver produces **bile**, which helps the digestion of fat. The pancreas produces chemicals called **digestive enzymes**.

Pathway of food through an animal





(adapted from text book)



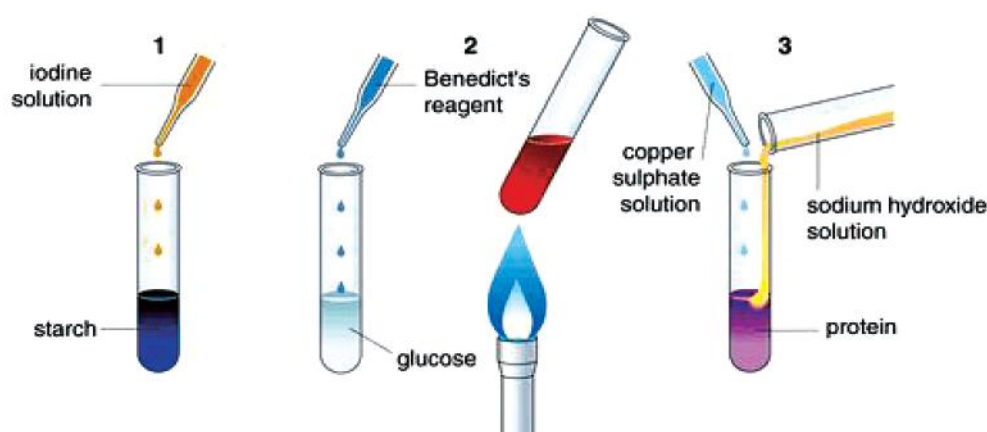
Activity 2: Breakdown of Starchy Foods by Saliva

- Take 3 small pieces of bread/cassava/roti/biscuit and place one piece on a watch glass.
- Add 2 drops of iodine solution on it. What do you observe? What does this test indicate?
- Place a second small piece of bread/cassava/roti/biscuit into your mouth and chew it for minutes but do not swallow it. Do you notice any change in the taste?
- Spit the chewed food material into a clean test tube and add distilled water to make up 10 mL.
- Put the third piece of bread/cassava/roti/biscuit into another test tube and add distilled water so that the volume adds up 10 mL. This act as a control. The control is a test of what happens when you do nothing. You need one for comparison.

- Filter the contents of both the test tubes and test the liquids that pass through glucose. Which test tube showed the presence of glucose? Explain what happens to starch when mixed with saliva?

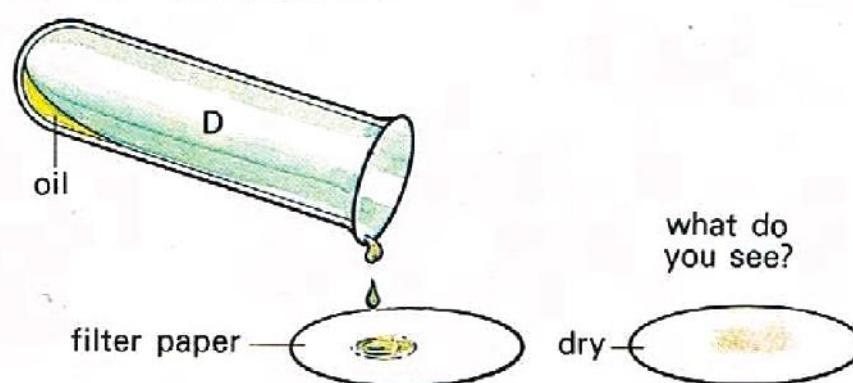
Food test – to find out what the food usually contains.

- Starch test** – add small drop of **iodine solution**. Starch present – **dark blue black or bluish black colour**.
- Simple sugars/glucose test** – add small amount of **Benedict's solution or Fehling's solution A and B** to the sample and heat gently in a water bath. Glucose present – **brick red or reddish orange colour** (depending on the concentration)



- Protein test** – add several drops of Biuret solution or Copper sulphate and Sodium hydroxide solution to the food solution. Protein present – **purple colour** will develop.
- Fats test** – rub the food sample on to a small area of brown paper or if liquid, a drop is placed on the brown paper and the test area is allowed to dry. Fat present – **greasy spot** will remain on the paper.

Fats – the filter paper test





Exercise

Model Gut Experiment

Visking tubing is a material with extremely small holes in it, too small for us to see. It **acts as a sieve**, and allows only very small molecules to pass through it. Glucose molecules were able to pass through these holes, but starch molecules were unable to do so. This suggests that glucose molecules are smaller than starch molecules.

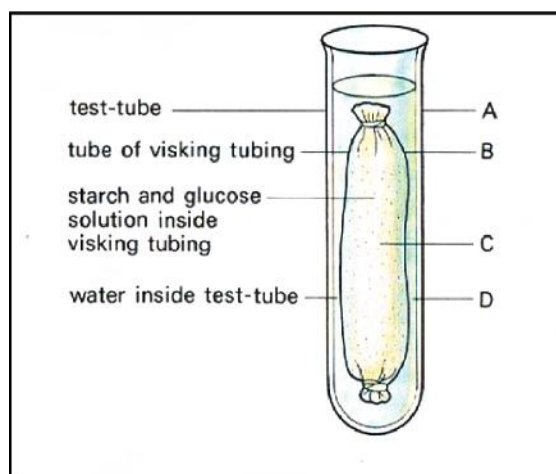
The walls of your alimentary canal behave like visking tubing, and only allow small molecules to pass through them. The food that you eat must pass through the walls of the intestine so that it can go into your blood stream. However, most of the food you eat contains large complex molecules such as starch. These molecules are too big to pass through the walls your intestine into your blood vessels. In the intestine these large complex molecules are broken down into molecules small enough to pass through the walls. This breaking down process is called **digestion**.

Materials

- Starch solution (cassava water or rice water)
- 30 cm visking tubing (cellophane)
- Cotton thread
- Glucose solution
- Test tube
- Iodine
- Fehlings / Benedicts solution

Method

1. Soak the visking tubing strip in water until it has softened.
2. Separate the sides of the tube by rubbing it between your fingers. It should form a tube.
3. Knot one end of the tube. Half fill the tube with the mixture of starch and glucose solution.
4. Knot the other end securely. Carefully rinse the outside of the tube with water. Put the tube in a test tube of water as shown in figure below.



5. Remove a sample of water from the test tube and test for the presence of glucose and starch.
6. Take samples of liquid from the test tube at 2 minute intervals until a further 5 samples have been removed. Each time test the liquid for the presence of glucose and starch.

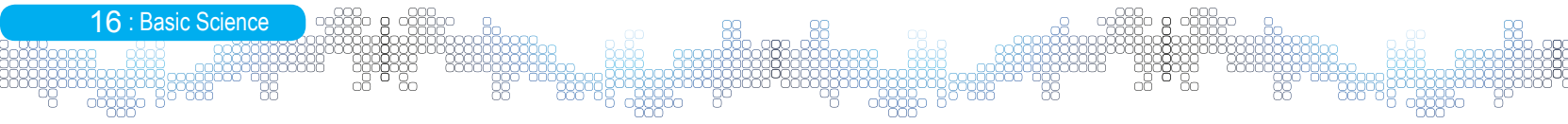


7. Enter your results in a table like the one below.

Time	Glucose	Starch
Start		
2 min		
4 min		
6 min		
8 min		
10 min		

Review Questions

- (a) Which substance, starch or glucose, passed through the tubing?
- (b) What does this suggest about the walls of the tubing?
- (c) Why are some molecules able to pass through and others not?
- (d) Which molecule do you think is larger – starch or glucose?
- (e) What is the visking tubing similar to in our body?

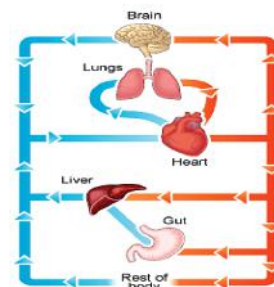




1.1.3

CIRCULATORY SYSTEM

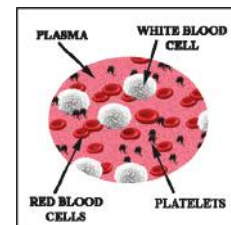
The components of the circulatory systems are: heart, blood vessels and blood. Blood carries digested food to the cells of the body. It also brings them other vital substances such as oxygen and water, and it carries away their waste materials.



Blood

Blood is a mixture of red blood cells, white blood cells and platelets all suspended in water liquid called **plasma**.

<http://carolgigliobbio2.wordpress.com/category/uncategorized/>



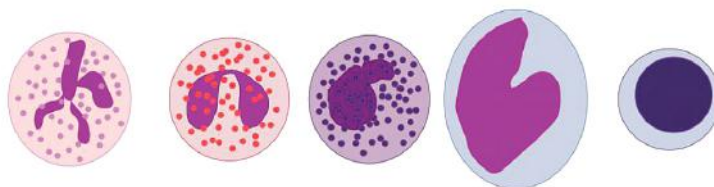
Red Blood Cells

These are **made in the red marrow inside the bones**. Red cells are partly made from a **protein** called **haemoglobin** which contains iron and gives blood its dark red colour. Haemoglobin is important because it can **attract and carry molecules of oxygen**. Blood which is carrying oxygen is **bright red** in colour.



White Blood Cells

White blood cells are an important component of the blood system. Although white blood cells account for only about 1 percent of the blood, their impact is significant. White blood cells, also called leukocytes, are essential for good health and protection against illness and disease.



neutrophil eosinophil basophil monocyte lymphocyte

They flow through your bloodstream to battle viruses, bacteria, and other foreign invaders that threaten your health. When the body is in distress and a particular area is under attack, white blood cells rush in to help destroy the harmful substance and prevent illness.

White blood cells are produced inside the bone marrow and stored in your blood and lymphatic tissues. Because some white blood cells have a short lifespan of one to three days, your bone marrow is constantly producing them.

Platelets

These are pieces of broken up blood cells which come from red bone marrow. They help the blood to clot when the skin is cut.



Plasma

Plasma is mainly water but contains many dissolved substances including digested food (glucose, amino acids, minerals and vitamins), hormones, antibodies and waste materials such as carbon dioxide and urea.

A bag of blood plasma



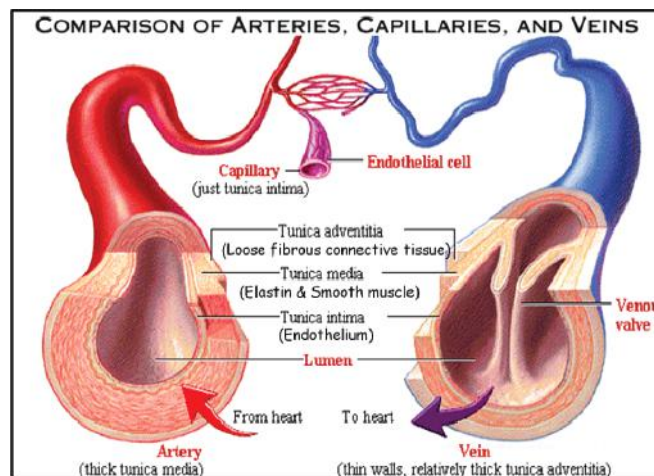
Circulation and the Blood

The heart pumps blood round the body through a system of tubes. Blood travels away from the heart to the organs through arteries, and returns through veins.



Arteries

- Carry blood away from the heart (always oxygenated apart from the pulmonary artery which goes to the lungs)
- Have thick muscular walls
- Have small passageways for blood (internal walls)
- Contain blood under high pressure



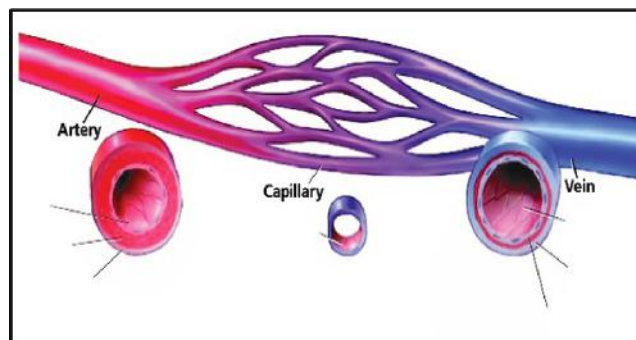
http://mstimmasbiology.blogspot.com/2013_01_01_archive.html

Veins

- Carry blood to the heart (always de-oxygenated apart from the pulmonary vein which goes from the lungs to the heart)
- Have thin walls
- Have larger internal walls
- Contain blood under low pressure
- Have valves to prevent blood flowing backwards

Capillaries

- Join arteries to vein
- Found in the muscles and lungs
- Microscopic – one cell thick
- Very low blood pressure
- Where gas exchange takes place. Oxygen passes through the capillary wall and into the tissues, carbon dioxide passes from the tissues into the blood



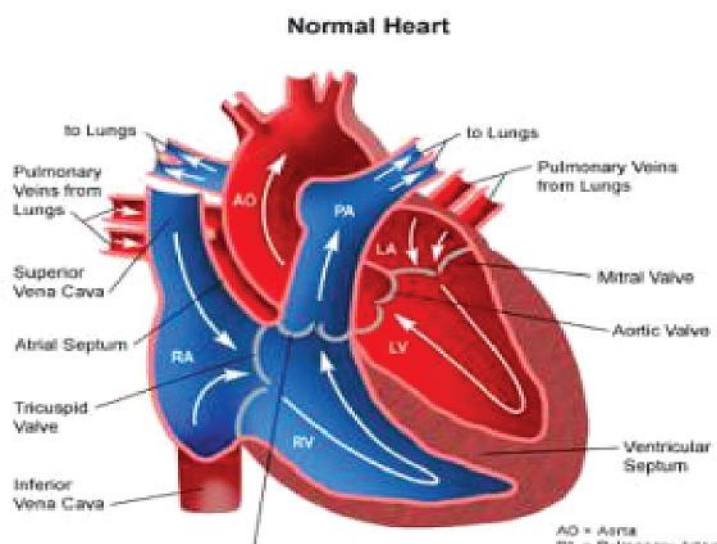
<http://www.examiner.com/slideshow/main-blood-components-and-vessels#slide=1>

The Heart

The circulatory system is powered by the body's hardest-working organ - the heart, which is only about the size of a closed fist. Even at rest, the average heart easily pumps over 5 litres of blood throughout the body every minute.

The heart pumps blood around the body. The wall of the heart contains muscle fibres.

The diagram below shows the structure of the heart.



<http://carolgiglioibbio2.files.wordpress.com/2012/11/bio-6-2-12.jpg>

Blood returns to the heart from the body in veins. It enters the right atrium, which contracts forcing the blood into the right ventricle.

When this contracts it forces blood out of the heart through the pulmonary artery to the lungs, where carbon dioxide is removed and oxygen is absorbed.

Blood from the lungs enters the left atrium of the heart and is forced into the left ventricle. This chamber has a very thick muscular wall to push blood out of the heart into the main artery, the aorta, and around the body.

There are valves in the heart to make sure that blood flows in the correct direction or it prevents the backflow of the blood.

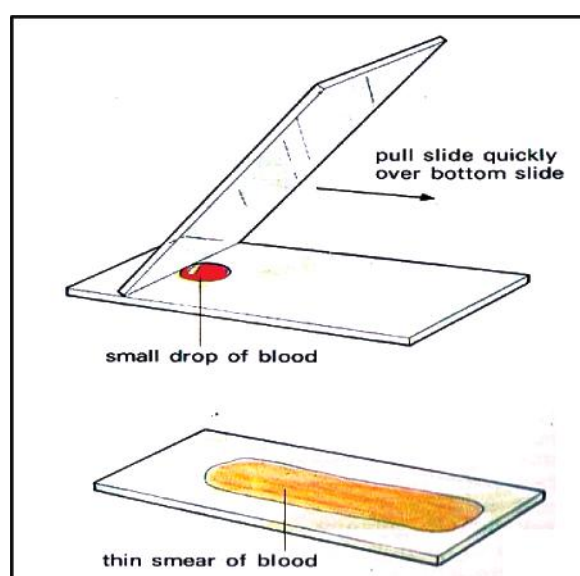


The heart is said to be a double pump, because the right side of the heart pumps blood to the lungs, and the left side pumps it around the body. This is called a double circulation.



Experiment: Blood

1. Take 3 clean glass slides. Put a very small drop of blood on two of them.
2. Using the other slide quickly spread or smear the blood over the slides as shown.
3. Examine the blood smear on one of the slides under the microscope using high power.
4. Draw what you saw.
5. Add a drop of Leishmann's stain to your blood smear and leave stain on the slide for about minutes.
6. Rinse the excess stain from the slide with water, and then examine the stained smear under the microscope.
7. Draw what you saw.



Poster – Construct an **information poster** on heart problems in Fiji. Include:

- What causes this disorder?
- How can it be prevented?
- What are the main symptoms to look out for?
- How can it be helped?

1. Name the blood vessel that supplies the heart with its own blood supply.
2. State how many blood groups are there?
3. Where are worn out red blood cells destroyed?



1.1.4

RESPIRATORY SYSTEM

In the lung, oxygen is added to the blood and carbondioxide is removed. It's all part of the process by which the body releases the energy in digested food.

Respiration

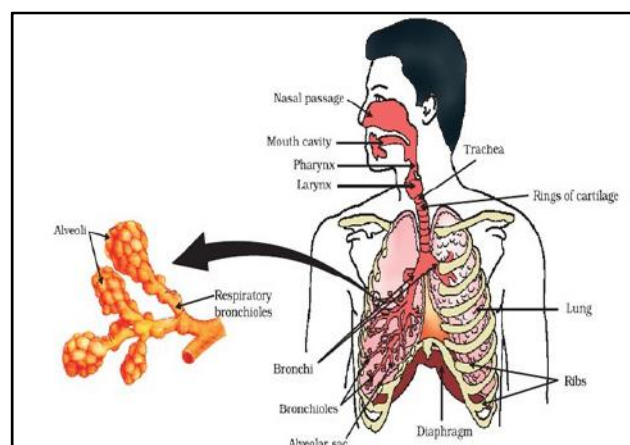
The cells (building blocks of all living things) of the body get their energy they need by combining digested food with oxygen brought to them by the blood. The process is called respiration – like burning of other fuels, it produces water and carbondioxide gas.

As blood passes through the lungs, it absorbs fresh supplies of oxygen, and releases the unwanted carbondioxide carried away from the cells.

The Lungs

The lungs are two spongy bags of tissue filled with millions of tiny air spaces called alveoli. These are very thin walls and each is surrounded by a dense network of capillaries. Oxygen from the air you breathe diffuses through the thin walls and into the blood at the same time; carbondioxide diffuses from blood out into the air spaces.

The tiny air spaces lie at ends of a series of branching air passage which connect with the windpipe. As you breathe, air moves in and out of the lungs throughout the windpipe and some of the old air in the air spaces is exchanged for new.



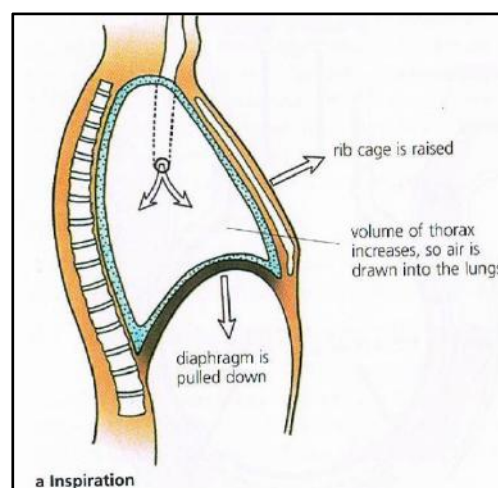
<http://www.kshitij-school.com/Study-Material/Class-10/Science/Life-processes/Respiration.aspx>

Breathing

The lungs hang in an air tight space called thorax. At the bottom of the thorax is a curved sheet of muscle called diaphragm. Around the sides of the thorax is the rib cage, with the sheets of muscles between the ribs – these are known as intercostal muscles. To make air move in and out of the lungs, you must keep changing the volume of your thorax. First you make it large so that air is sucked in. Then you make it smaller again so that air is sucked out. This is called breathing or ventilation.

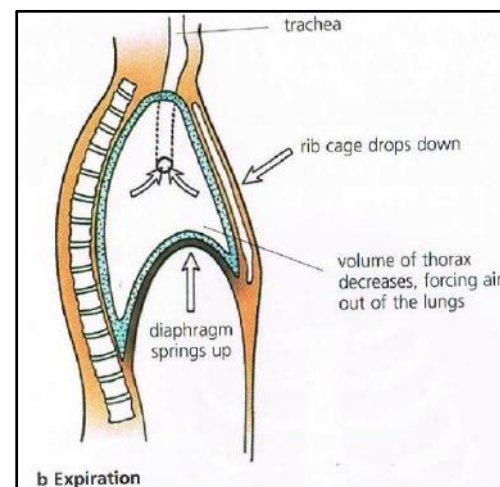
Breathing in (inhaling) – When you breathe in, 2 things happen at once:

- The diaphragm muscles pull the diaphragm downwards (contract), increasing the volume in the thorax.
- The external intercostal muscles contract, pulling the rib cage upwards and outwards.



Breathing out (exhaling) – When you breathe out, the diaphragm muscles and the muscles between the ribs relax, the thorax returns to its original size and air is pushed out of the lungs decreasing the volume.

During light breathing, the breathing action is mainly produced by movement of the diaphragm muscles. The muscles between the ribs are used when greater amounts of air are moved in and out of the lungs – during running for example. With more air flowing in and out of the lungs, the blood can absorb oxygen and release carbondioxide at faster rates.



Comparison of Inspired and Expired Air

	Inspired air	Expired air	Reason for differences
Oxygen	21 %	16 %	Oxygen is absorbed across gaseous exchange surface, then used by cells in respiration
Carbon dioxide	0.04 %	4 %	Carbon dioxide is made by cells as a waste product of respiration, and is released across the gaseous exchange surface
Argon and other inert gases	1 %	1 %	
Nitrogen	78 %	78 %	Nitrogen gas is not used by cells
Water content (humidity)	Variable	Always high	Gaseous exchange surfaces must be kept moist. Some of this moisture evaporates and is lost as air is breathed out
Temperature	Variable	Always high	Air is warmed as it passes through the respiratory passages

Experiment: Making a model lungs

What you will need

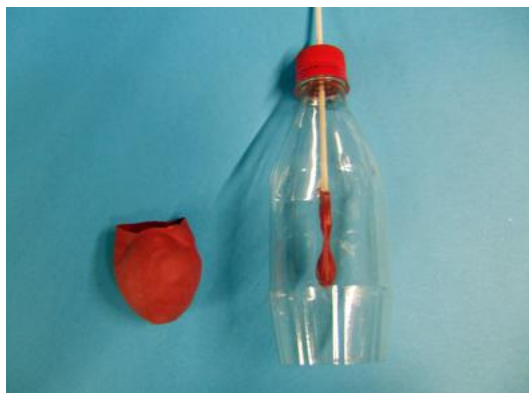
- A plastic bottle
- A straw
- An elastic band
- Scissors
- 2 balloons
- Playdough/plasticine





Method

1. Remove the bottom of your bottle.
2. Tie a knot in one end of a balloon and snip of the fat end
3. Stretch this end around the bottom of your plastic bottle
4. Put a straw in the neck of the other balloon and secure tightly with the elastic band but not so that you crush the straw. The air must flow through so test it with a little bow through the straw to see if the balloon inflates.



5. Put the straw and the balloon into the neck of the bottle and secure with the playdough making a seal around the bottle – make sure that again, you don't crush straw. Your lung model is finished and now for the action
6. To see your model lung work you need to pull down on the balloon at the bottom and if you watch the water balloon you can see it inflate. If you let go of the balloon or push it back in you can see it deflate.

Review Questions

1. From the model, what represents:
 - (i) Ribcage
 - (ii) Diaphragm
 - (iii) Lungs
2. In your lungs, what gas is removed from your blood? What simple test could you carry out to show that this gas is present in the air you breathe out?



<http://healthylogica.blogspot.com/2012/08/tips-to-clean-lungs-of-smokers.html>



Research: How does smoking damage the lungs?



3. Circle the letter of each sentence that is true about blood flow through the heart.
- a. Blood enters the heart through the right and left atria.
 - b. Blood enters the heart through the right and left ventricles.
 - c. Blood flows from the ventricles to the atria.
 - d. Blood flows out of the heart through the right and left atria.
4. Flaps of connective tissue called _____ prevent blood from flowing backward in the heart.
5. What does a sudden increase in the number of white cells tell a physician?
6. Match each structure of the respiratory system with its description.

Structure	Description
_____ (i) pharynx	a. Tiny air sacs where gas exchange occurs
_____ (ii) trachea	b. Tiny projections that sweep trapped particles and mucus away from the lungs
_____ (iii) cilia	c. Tube that serves as a passageway for both air and food
_____ (iv) larynx	d. Large passage ways in the chest that lead to the lungs

1.1.5

EXCRETORY SYSTEMS

As a result of all chemical processes which occur in the body, waste products are constantly being formed. If they are allowed to accumulate in cells and tissues they would slow down chemical processes and poison cells.

Excretion – the removal of waste products from the body.

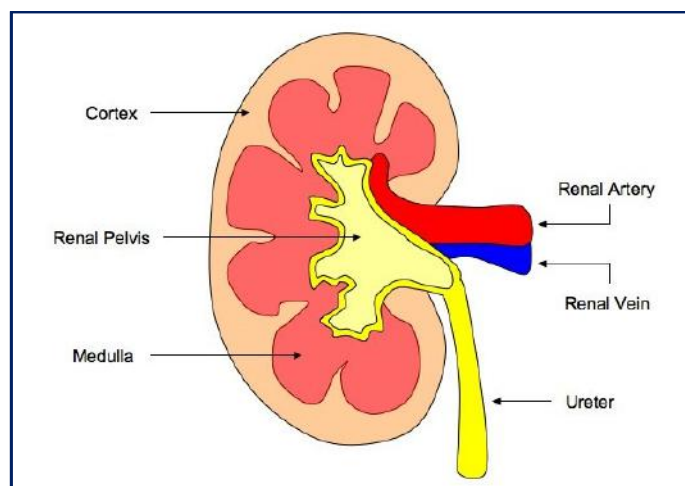
The lungs and the kidneys are organs for excretion – they remove from the body substances which it makes but does not need.

Lungs – remove carbondioxide from the blood. They also add oxygen to the blood.

Kidney – remove from the blood nitrogen rich compounds such as urea. They also remove excess salts and water which the body has no use for. Together, these substances form urine which is collected in the bladder and released when you urinate.

Structure of the Human Urinary System

Human kidneys are compact, bean shaped structures located in the area behind the back. They produce urine, a yellowish fluid composed of materials removed from the blood as it passes through them.

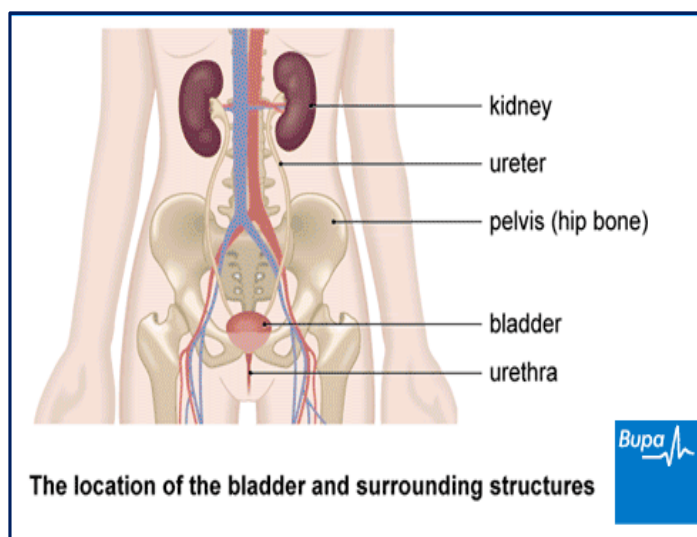


<http://www.ib.bioninja.com.au/higher-level/topic-11-human-health-and/113-the-kidney.html>

Urine leaves the kidneys via the ureters and is stored in a muscular bag, the bladder. The bladder expands as it fills and can hold about 400mL of urine.

Leading out of the bladder is a tube called the urethra. There is a sphincter muscle at the top of the urethra, which is usually tightly closed. When the bladder is full, the sphincter muscle opens, so that urine flows along the urethra and out of the body. Adult can consciously control this sphincter muscle whereas in babies, it opens automatically when the bladder is full.

Blood is brought to the kidneys in a branch of renal artery. The blood is filtered into tiny tubules called nephron inside the kidneys. All of the glucose and some of the salts, that have gone into the tubules are taken back, or reabsorbed, into the blood. The remaining fluid in the tubules is water with urea and some salts dissolved in it. The fluid is urine.



<http://www.bupa.co.uk/individuals/health-information/directory/k/kidney-stones>

Activity: How Does The Body Get Rid of Soluble Waste?

- Place a few small fish in a beaker of water.
- Add 2 drops of universal indicator to the water. Let this be Beaker A.
- Add the same amount of the indicator to another beaker which has water only. Let this be Beaker B. This is the control.
- Leave the beaker for about 30 minutes. Then see if there is any change in the colour.
- Is the change in colour noticeable in both beakers?
- What can you infer from the colour change?
- Add about 5 drops of ammonium hydroxide (NH_4OH) to the control beaker B. What happens?
- From your observation, what can you infer about excretion in a fish?

Review Questions



1. Dialysis is a procedure used on a person who has:
A. kidney stones B. overactive bladder
C. kidney failure D. low blood sugar
2. The primary function of the kidney is to
A. filter wastes from the blood B. remove excess water from the body
C. protect the body against infection D. maintain blood sugar levels
3. The filtering unit of the kidney is the:
A. neuron B. peptide C. nephron D. ureter

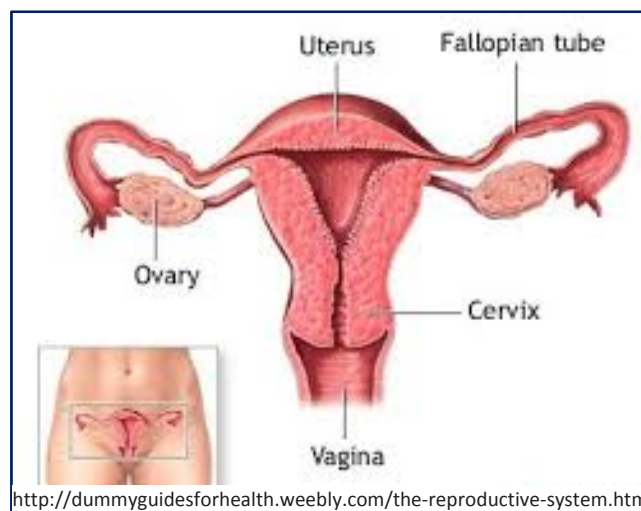
1.1.6

REPRODUCTIVE SYSTEM

One of the most important things that help us to tell something living from something non-living is that living things can reproduce themselves. Cats can have kittens, dogs can have puppies, sheep can have lambs, and humans can have babies, but your desk will never have a brood of little desks. You can see that without reproduction life would come to a stop.

The Female Reproductive System

The female gametes called eggs or ova are made in the two ovaries. Leading away from the ovaries are the oviduct or fallopian tubes. They do not connect directly to the ovaries, but have a funnel shaped opening just a short distance away. The oviducts lead to the womb or uterus. This has a very thick wall, made of muscle. It is quite small – only about the size of a clenched fist but it can stretch a great deal when a woman is pregnant. At the base of the uterus is a narrow opening guarded by muscles. This is the neck of the womb, or cervix. It leads to the vagina, which opens to the outside. The opening from the bladder, called urethra runs in front of the vagina, while the rectum is just behind it. The 3 tubes open quite separately to the outside.

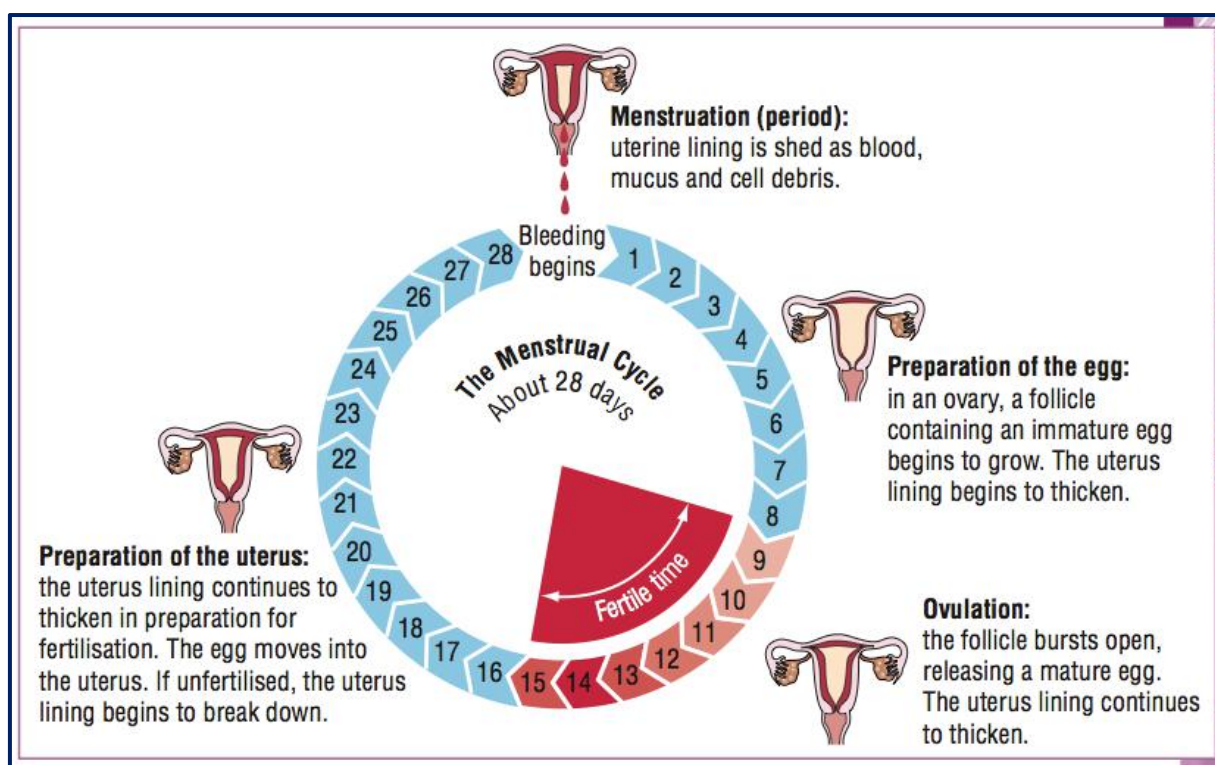


<http://dummyguidesforhealth.weebly.com/the-reproductive-system.html>

At birth, a girl has hundreds of thousands of partly developed eggs or ova in her ovaries. From the time she reaches puberty, she releases a mature egg from one of her ovaries about every 28 days. The egg is drawn down the oviduct and into the uterus. The release of an egg is called ovulation. Just before this happens, the ovaries put into the blood a hormone called oestrogen which sets off changes in the lining of the uterus – the lining thickens and a dense network of tiny blood tubes forms within it. The uterus is then ready to receive a fertilised egg and to nourish it as it develops into a baby.

Menstruation

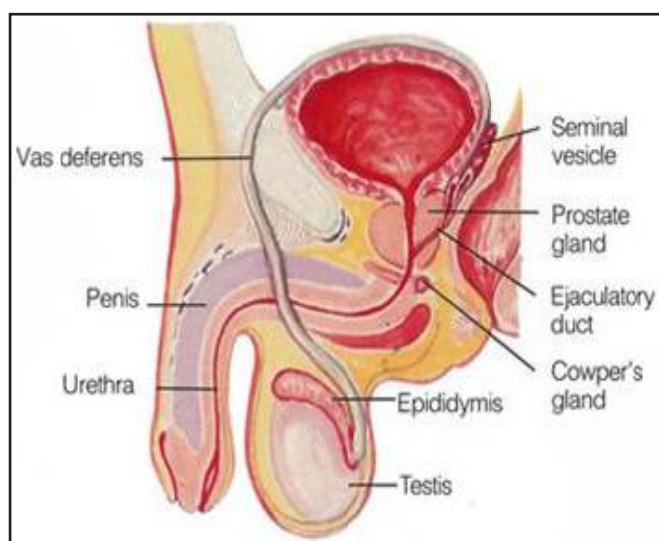
If the egg is not fertilised, it dies and the lining of the uterus begins to break up. Within two weeks, ovum lining and blood passes out through the vagina during a period – the process is called menstruation. Menstruation usually last about 5 days. The 28 day cycle of ovulation, uterus lining growth and menstruation is called the menstruation cycle.



<https://wikis.engrade.com/a96science/reproduction>

The Male Reproductive System

A man produces male gametes called sperm in his testes. The testes also produce the male sex hormone, testosterone. To leave his body, the sperm first travel through the sperm ducts where they mix with liquid produced in the seminal vesicles and prostate gland. The liquid and sperm are together known as semen. The liquid nourishes the sperm and sets off the swimming movements in their tails which helps them to travel up the oviduct of the woman. Like urine, semen leaves the body through the urethra, the tube that passes through the penis.

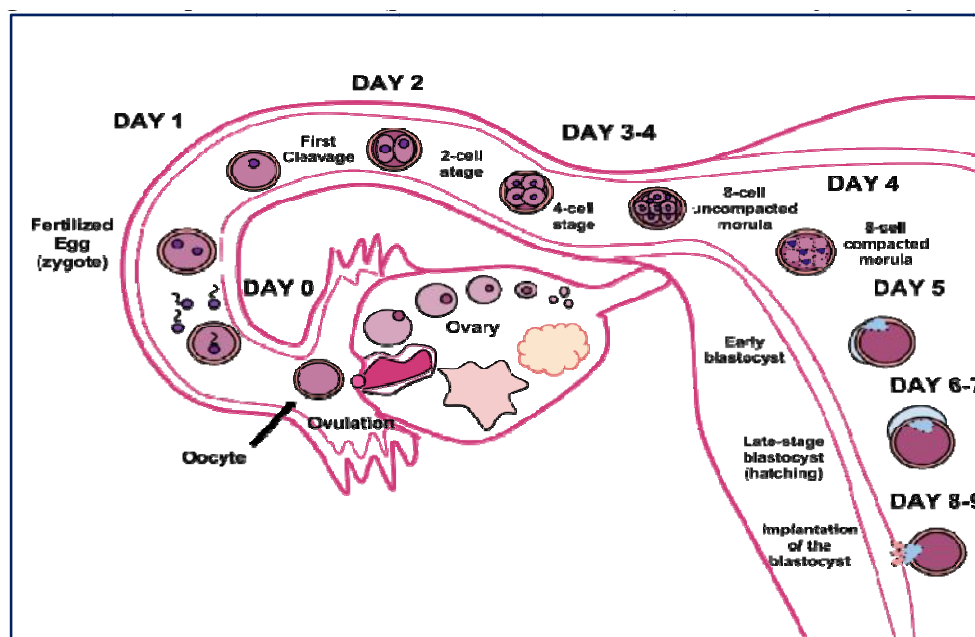


<http://www.bioartfertility.co.za/wp-content/uploads/2013/06/Male-Reproductive-System.jpg>

Fertilisation

During sexual intercourse the man's penis releases semen into the woman's vagina. Sperm cells travel in semen from the penis and into the top of the vagina. They enter the uterus through the cervix and travel to the oviduct. If a sperm cell meets with an egg cell there, fertilisation can happen. Fertilisation happens when an egg cell meets with a sperm cell and joins with it.

The fertilised egg divides to form a ball of cells called an embryo. This attaches to the lining of the uterus and begins to develop into a foetus (pronounced "fee-tuss") and finally a baby.



http://en.wikipedia.org/wiki/Human_fertilization#mediaviewer/File:Human_Fertilization.png

Development of the foetus

The foetus relies upon its mother as it develops. These are some of the things it needs:

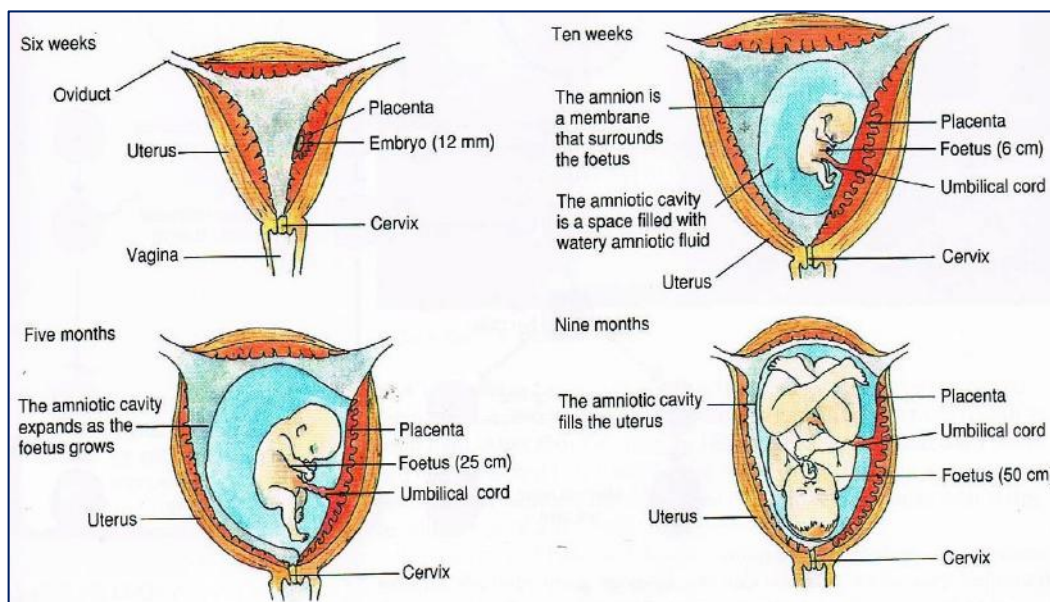
- protection
- oxygen
- nutrients (food and water).

The foetus is insulated and protected by the uterus and the amniotic fluid, a liquid contained in a bag called the amnion.

The placenta is responsible for providing oxygen and nutrients, and removing waste substances. It grows into the wall of the uterus and is joined to the foetus by the umbilical cord.

The mother's blood does not mix with the foetus's blood, but the placenta lets substances pass between the two blood supplies:

- oxygen and nutrients diffuse across the placenta from the mother to the foetus
- waste substances, such as carbon dioxide, diffuse across the placenta from the foetus to the mother.



Birth

After nine months the baby is ready to be born. The cervix relaxes and muscles in the wall of the uterus contract, pushing the baby out of the mother's body.

Puberty

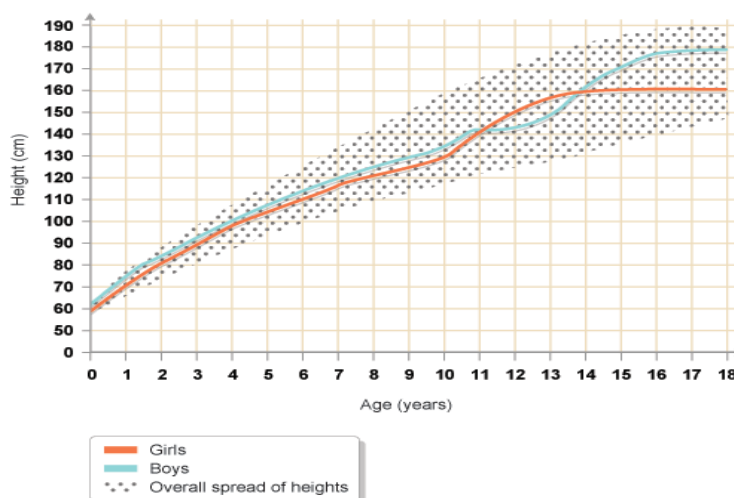
The reproductive system of a child is not mature and needs to change as a boy or girl develops into an adult, so that the system is fully working. These changes begin between the ages of ten and fifteen. The time when the changes happen is called puberty.

The changes happen because of sex hormones produced by the testes in boys and by the ovaries in girls. Some changes happen in boys and girls, while others just happen in boys or girls.

Here are some changes that happen to both boys and girls:

- underarm hair grows
- pubic hair grows
- body smell gets stronger.
- emotional changes
- growth rate increases

The time when the physical changes and emotional changes happen is called adolescence.



[http://www.bbc.co.uk/bitesize/ks3/science/organisms behaviour health/reproduction/revisi](http://www.bbc.co.uk/bitesize/ks3/science/organisms_behaviour_health/reproduction/revisi)

Boys

Here are some changes that happen only to boys:

- voice breaks (gets deeper)
- testes and penis get bigger
- testes start to produce sperm cells
- shoulders get wider
- hair grows on face and chest area



Girls

Here are some changes that happen only to girls:

- breasts develop
- ovaries start to release egg cells (periods start)
- hips get wider.
- menstrual cycle to begin.

Review Questions

Copy and complete using the words from the word list.



1. In the man the testes make the cells. The becomes erect during sexual intercourse. The sperms are carried through a long called the sperm duct to the top of the penis. Here glands produce fluids that help the sperms to The urethra is a tube that carries sperms and out of the body.

In the woman the ovaries make the One ovum is produced every The ovum is carried along the down towards the The uterus protects the developing baby. A special organ called the p.....grows in the uterus during pregnancy. This supplies the developing baby with and o.....

urine ova food month tube sperm swim oviduct placenta penis oxygen uterus

2. During puberty special chemicals are released into the bloodstream. These chemicals are called s..... h..... The hormone produced in the boy's testes is called t..... The hormone produced by the ovaries is called o.....

oestrogen hormones testosterone sex

3. (i) How does a developing foetus get the oxygen it needs?
(ii) Differentiate the function of placenta and umbilical cord.
(iii) What happens to the lining of the uterus just before ovulation takes place?
(v) How are identical twins produced?
4. The table below contains a list of changes during puberty. Tick the correct columns to show which changes happens to boys, girls or both.

Changes at Puberty	Boys	Girls
<i>Hips become wider</i>		
<i>Feeling of sexual attraction begins</i>		
<i>Sperm are produced</i>		
<i>The breast grows larger</i>		
<i>Voice breaks and becomes deeper</i>		
<i>Hair grows under the armpits</i>		
<i>The shoulder grows broader</i>		
<i>Ova(eggs) are produced</i>		



UNIT 2: LIVING TOGETHER

INTRODUCTION

In this unit, the growth and movement of organisms in response to their environment is investigated. The feeding relationship that exists between organisms within a community is described.

1.2.1

TAXIS AND KINESIS

Taxes and kinesis are examples of orientation behaviours. Such behaviours describe the way in which motile (moving) organisms or gametes position themselves and move in response to external stimuli.

Common stimuli are gravity, light, chemicals and temperature. Some animals and many protozoa e.g. paramecium respond to certain stimuli simply by changing the rate of movement or by randomly turning without actually orientating to the stimulus.

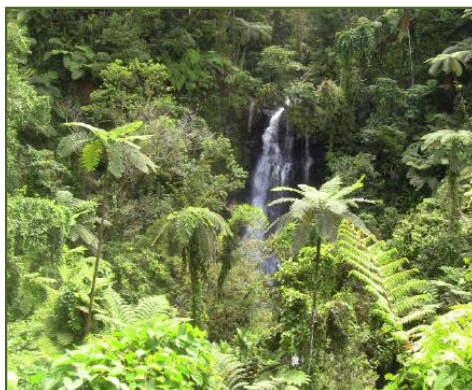
Undirected movement is called kinesis (sing.kinesis). Directed movement towards or away from stimulus is called taxes (sing.taxis)

Behaviour	Definition	Example
Taxis	• A response • Towards (positive) or Away from (negative) a stimuli. • The movement is direct and orientated with respect to the stimuli. e.g. Positive Photo-taxis : towards the direction from which light is coming. e.g. Positively chemo-taxis: towards the source of a diffusing chemical	 Planaria is a flatworm It will move towards food source Positively chemo-taxis The movement is direct and orientated with respect to the stimuli
		 • Euglena is a unicellular photosynthetic organism that moves in response towards light. • Positively photo-taxis: the movement is direct and orientated with respect to the stimuli
Kinesis	• A response to a stimuli • No particular direction of response • Increased or decreased level of activity • Until the organism ends up further or nearer to the stimuli	 Woodlouse

<http://click4biology.info/c4b/E/E3.htm>

Every organism needs food in order to live and has to get that food from somewhere. Every organism can be classified by where it fits into the food chain. Most broadly, all organisms fit into one of three camps: producers, consumers, and decomposers.

- (i) Producers/Autotrophs – organisms which make their own food from simple substances such as carbon dioxide and water e.g. green plants



Primary Source

- (ii) Heterotrophs – organisms which cannot make their own food but rely on readily made food. Also known as consumers. The different types of consumers are:

- Primary Consumer/Herbivores are organisms that feed directly on green plants e.g. cows, horses, and goats.



<http://www.experienceproject.com/stories/Want-People-To-Share-My-Poetry/2641385>

- Secondary Consumers/Carnivores are organisms that eat herbivores e.g. birds, lizards.
- Tertiary Consumers/Carnivores are organisms that eat secondary carnivores eg.sharks, snakes.



http://www.bbc.co.uk/nature/life/Great_white_shark

- Omnivores are organisms that eat both plants and animals e.g. humans, chimpanzees



Primary Source

- Parasites are organisms that eat living organisms (without killing them) e.g. mosquitoes, fleas
- Scavengers are organisms that eat food scraps, waste products and dead bodies. e.g. seagull, crabs.
- Carrion feeders are organisms that feed on dead bodies e.g. hawk, vultures
- Decomposers are organisms that breakdown the complex compounds of dead and decaying plants and animals into simpler molecules that can be absorbed e.g. fungi, bacteria, earthworm.



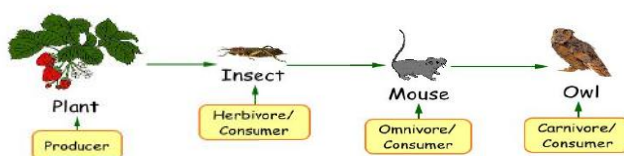
<http://webquest-foodchain.weebly.com/process.html>

Energy flows through an ecosystem in one direction from producers to various levels of consumer.

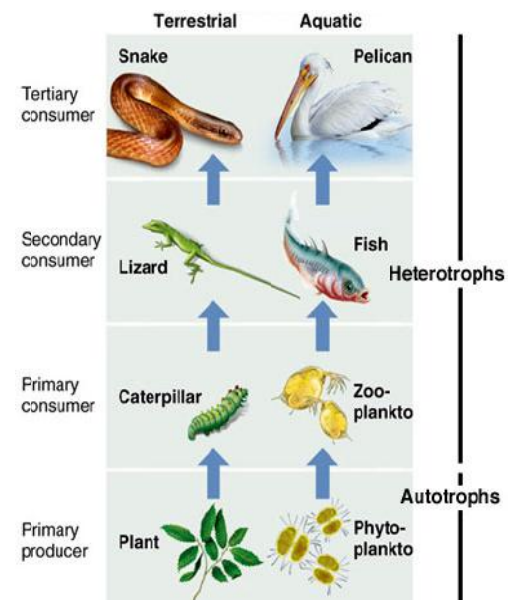
Food Chain – is a chain of organisms through which food and energy flows. It shows 'who is eating who'. The arrows between each item in the chain always point from the food to the feeder. This is the direction in which energy flows in the food chain.

As the energy is passed along the chain, each organism uses some of it. So the further along the chain you go, the less energy there is.

The Food Chain Of An Owl

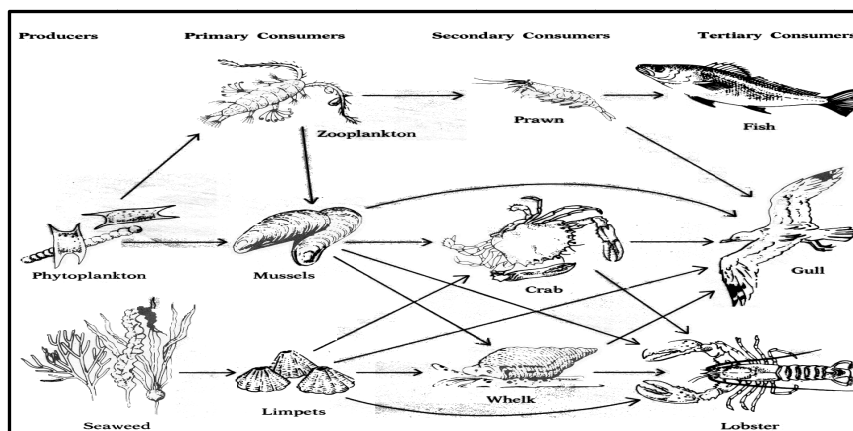


A food chain shows the path of energy from one living thing to another.



<http://heightstechnology.edublogs.org/tag/foodchain/>

Food Web shows all possible feeding relationships in a community. It represents a network of interconnected food chains.



Symbiotic Relationship – when two species live together

The distribution and abundance of living things are affected not only by physical factors but by other living things. When they are found together, organism may either increase or decrease each other's chances of survival. These interactions may be between members of the same kind or members of different kind.

Types of Symbiosis

These are relationships between living things that increase their chances of survival and reproduction. The organisms involved are likely to be found in the same area. Animals that live in groups improves the individual chances of finding a mate, avoid being eaten and getting enough food.

- (i) **Commensalism** – relationship that benefits one organism and do not harm the other. The organisms are not dependent on this type of relationship: they could survive without each other e.g. orchid on tree. Orchid gets support not nutrients and the tree is not affected.



<http://ecodan.files.wordpress.com/2010/04/orchid1.jpg>

- (ii) **Mutualism** – relationship where both organisms benefit from the association e.g. lichen; they are formed by algae and fungi living together. Algae can photosynthesise and make food, which is shared by the fungus. The fungus in turn shelters the algae from a harsh climate. Cleaner' fish - these feed off the dead skin and parasites of larger fish such as sharks This



http://en.wikipedia.org/wiki/Lichen#mediaviewer/File:Flavoparmelia_caperata_-_lichen_-_Caperatflechte.jpg



<http://www.sciencedirect.com/science/article/pii/S0960982208014978>



provides the cleaner fish with food and keeps the larger fish clean.

- (iii) **Predation** – is a feeding relationship where the predator (hunter) obtains its food by killing other animals (prey). The predator benefits by getting food and the prey is affected e.g. cat and rat.



<http://www.catster.com/the-scoop/unlikely-ally-cat-news-killer-cats-buzzfeed>

- (iv) **Parasitism** – one organism (parasite) generally lives on or in another organism (host). The parasite benefits usually by getting food and the host suffers e.g. ticks, ring worm, lice and intestine worms.



<http://yottatire.com/2014/06/large-number-of-lyme-parasites-to-appear-soon-in-new-england/>

- (v) **Competition** – an act of rivalry between organisms for resources that are in short supply. These may include food, space, light, water, mates and other things vital for life. Clearly only those individuals able to compete successfully will survive so competition decreases the number of individuals. Competition between individuals is of two types:

- **Intra specific competition** – competition between organisms of the same kind e.g. dog and dog, lizard and lizard.



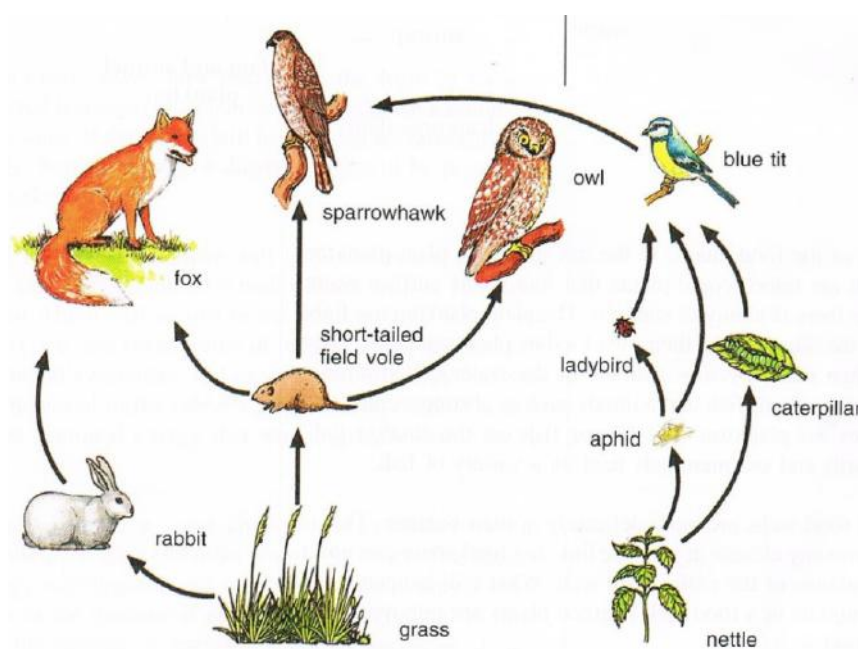
- **Inter specific competition** – competition between organisms of different kind e.g. frog and lizard.



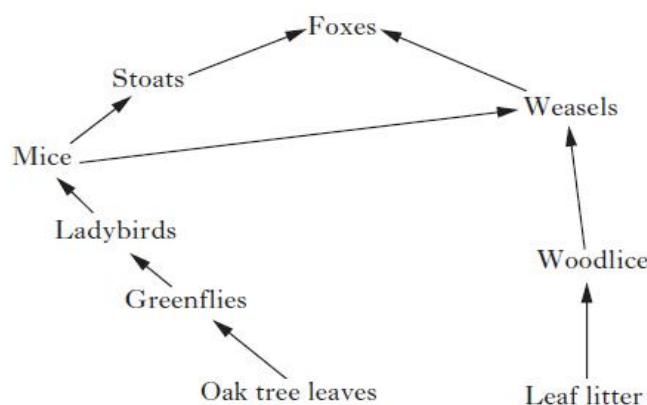
Review Questions



1. From the food web shown:



- Construct a food chain with (i) three links and (ii) four links.
 - Write down the name of the herbivores
 - Which one of the carnivores has the least varied diet?
- Which competition is more fierce, intra or inter competition? Give a reason.
 - Construct a food web from a coral reef environment or forest.
 - Suppose that the sun suddenly ceased to shine so that the world was plunged into permanent total darkness. Which kinds of organisms would you expect to die last – decomposers, producers, herbivores or carnivores?
 - Describe ways in which animals depend on plants, apart from for food.
 - The diagram below shows part of a woodland food web.



Use the words increase, decrease or stay the same to describe the effect on the populations of greenflies and stoats if all the mice were killed by a disease.



UNIT 3: BIODIVERSITY, CHANGE AND SUSTAINABILITY

INTRODUCTION

In this unit, the importance of the marine ecosystem will be discussed and how man's activities have influenced the resources of the different communities of this ecosystem. Conservation measures taken will be described.

1.3.1

MARINE ECOSYSTEM

Ecosystem is a system formed by living things interacting with each other and with their physical environment. Ecosystems vary in size – from the very small (such as the fish, snail, weeds, rocks and water of an aquarium) to very large (such as the tropical forest and ocean). Understanding the structure of ecosystems makes it possible to use resources more efficiently and to conserve resources. Marine ecosystems have distinct organisms and characteristics that result from the unique combination of physical factors that create them. Oceans cover almost three-fourths of Earth's surface. Scientists call the ecosystems in the ocean marine ecosystems.

Marine ecosystems, like all ecosystems, are affected by abiotic factors. Oceans play crucial roles in regulating the atmosphere and modulating weather, storing carbon, cycling nutrients, and providing other ecosystem services. Coastal areas provide essential resources, buffer land from storms, and provide living space for almost half of the global population.

- (i) **Temperature** - The water near the surface is much warmer than the rest of the ocean because it is heated by the sun. Deep ocean water is much colder. Water temperatures at the surface are also affected by latitude. Water near the equator is generally warmer than water closer to the poles. The water at the surface is also warmer in summer than winter. Temperature affects the animals in marine ecosystems. For example, fish that live near the poles have a chemical in their blood that keeps them from freezing. Most animals that live in coral reefs need warm water to live.
- (ii) **Water Depth and Sunlight** - The average depth of the oceans is 4,000 m, but sunlight does not reach deeper than 200 m. Producers that carry out photosynthesis, such as algae, can live only in water less than about 200 m deep. Planktons are tiny organisms that float near the surface of the ocean. Many kinds of plankton are producers. These phytoplankton uses photosynthesis to make their own food. They are the base of most ocean food chains. Large consumers, such as whales, feed on these tiny producers.

Ocean Zones is divided based on things such as water depth, the amount of sunlight and water temperature.

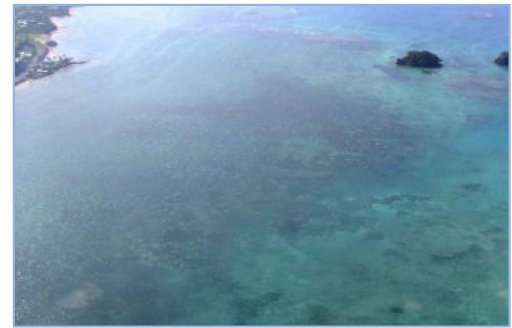
THE INTERTIDAL ZONE

The intertidal zone is where the ocean meets the shore. The organisms of the intertidal zone are covered with water at high tide and exposed to air at low tide. Rocky shores, mudflats and sandy beaches all fall within this area.



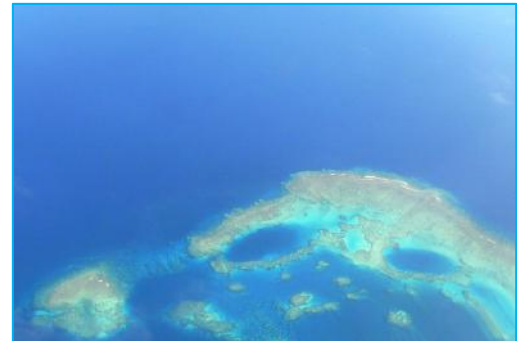
THE NERITIC ZONE

The neritic zone is further from shore. In this zone, the water becomes deeper as the ocean floor starts to slope downward. This water is warmer than deep ocean water and receives a lot of sunlight. Corals and producers thrive in this zone. Sea turtles, sea urchins, and fishes are some of the consumers of this zone.



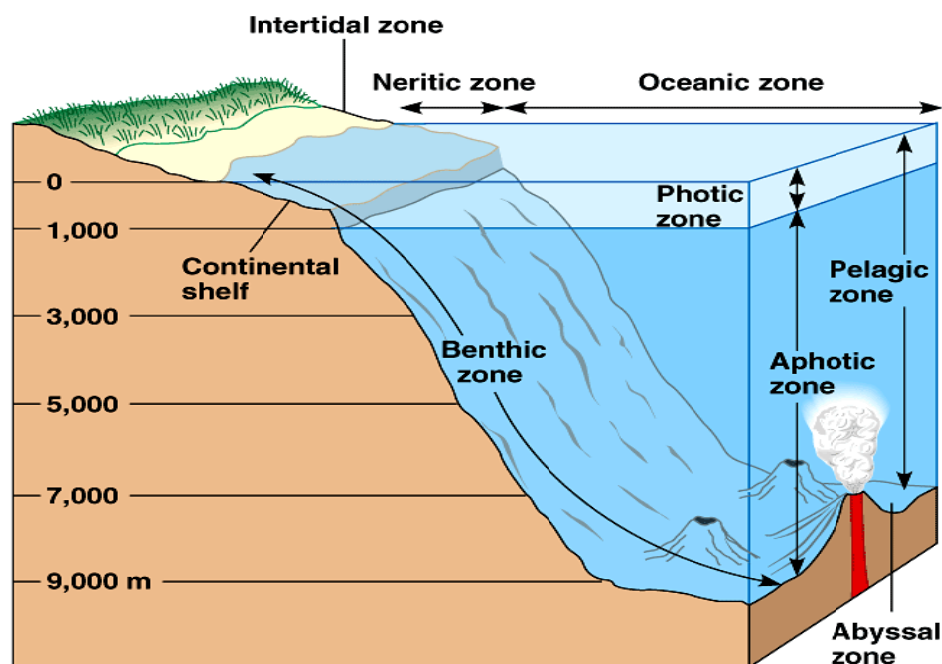
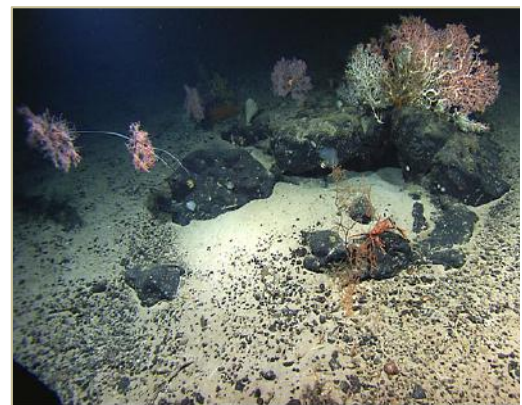
THE OCEANIC ZONE

In the oceanic zone, the sea floor drops off quickly. The oceanic zone extends from the surface to the deep water of the open ocean. Phytoplankton lives near the surface, where there is sunlight. Consumers such as fishes, whales, and sharks live in the oceanic zone. Some of the animals live in deep waters, where there is no sunlight. These animals feed on each other and on material that sinks from the surface waters.



THE BENTHIC ZONE

The benthic zone is the ocean floor. It does not get any sunlight and is very cold. Fishes, worms, and crabs have special features to live in this zone. Many of them feed on material that sinks from above. Some organisms, such as angler fish, eat smaller fish. Other organisms, such as bacteria, are decomposers and help break down dead organisms.



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Tropical Shoreline: A shoreline is formed when the water merges with the land. Land is often submerged in water and gets exposed when the water pulls back. This part of the land and water is a habitat to many living organisms and aquatic animals. As known to many of us, water is a source of life and as it makes its way to the land it also brings along different life forms with it. Even the shallow portion of the shore is home to many different, unique and interesting animals and plants. Shores are not only shelter to numerous life forms but also a source of food to humans and birds like seagulls. There are different types of shores all over the world. Some are rocky while some are sandy shores and life forms are different on these two types of shores. Shoreline area that falls between the high tide and low tide mark. Animals in this area are able to adapt to being both underwater and in open air. Common life forms include: crabs, urchins, starfish, clams, snails, seaweeds and mussels.



Coral Reefs Coral reefs are a precious resource in the ocean because of their beauty and biodiversity. Coral reefs provide shelter for a wide variety of marine life, they provide humans with recreation, they are a valuable source of organisms for potential medicines, and they create sand for beaches, and serve as a buffer for shorelines. Coral reefs are built by millions of coral polyps, small colonial animals resembling overturned jellyfish that use excess carbon dioxide in the water from the atmosphere and turn it into limestone. Corals are in fact animals. They are relatives of jellyfish and anemones.



Corals can exist as individual polyps, or in colonies and communities that contain hundreds to hundreds of thousands of polyps. Corals can be divided into two groups: hard coral and soft coral. Hard corals, also known as stony coral, produce a rigid skeleton made of calcium carbonate (CaCO_3) important for reef-building. Alternatively, soft corals, including sea fans, do not produce a rigid calcium carbonate skeleton and do not form reefs, though they may be



present in a reef ecosystem. Most reef-building corals have a mutually beneficial relationship with microscopic unicellular algae called zooxanthellae that live within the cells of the coral.

As much as 90% of the organic material the algae manufacture photosynthetically is transferred to the host coral tissue. In addition to the symbiotic relationship with algae, most corals capture and consume live prey ranging from microscopic zooplankton to small fish, depending on coral size. Using its tentacles that extend outside its body, the coral uses its nematocysts, or stinging cells, to stun and kill its prey before passing it to its mouth. Once the food has been digested, the waste is expelled from the same opening. Corals are unique in that they are capable of reproducing both sexually and asexually.

Coral reefs can be found in both shallow and deep waters and are classified into 2 general categories:

- (i) **Hard Corals** (stony corals) - Hard corals, also called reef-building corals, produce a rock-like skeleton made of the same material as classroom chalk (calcium carbonate). These skeletons and the various shapes of different colonies form the familiar structure of the reef. Hard corals rely on symbiotic algae (zooxanthellae) living within their tissues for nutrition and energy to build their skeleton. They must therefore live in shallow clear water to allow sunlight to reach the algae.



- (ii) **Soft Corals** - Soft corals look like colourful plants or graceful trees and are not reef-building since they do not produce the hard calcified skeleton of many reef-building corals. However, soft corals do produce smaller amounts of calcium carbonate that help them keep their shape. Soft corals can be distinguished from hard corals by the fact that soft coral polyps always have eight tentacles, while hard coral polyps have multiples of six tentacles.





Coral reefs are under threat from overexploitation especially destructive fishing, mining of corals and sands. Activities on land pose the greatest threat, with increasing rate of sediment and nutrient pollution caused by growing populations in coastal areas.

Now an increasing range of global threats are driven by climate change. Increased sea surface temperatures are stressing and killing corals through bleaching. This occurs when corals lose their symbiotic algae – zooxanthellae that provide them with most of their energy, resistance to UV radiation and their colour.

Carbondioxide concentration in seawater also increases, making it more acidic and reduces the calcium in corals. To make matters worse, an increase incidence in coral diseases and plagues of coral predators such as crown of thorns starfish.

Blue Planet

Students to work in small groups to identify basic information about coral polyps and coral reefs, coral reef habitats, and natural threats to coral reefs; create a poster related to one of these topics; and explain the topic to the class via a presentation.

1.3.2

MARINE RESOURCES

1. Mangroves

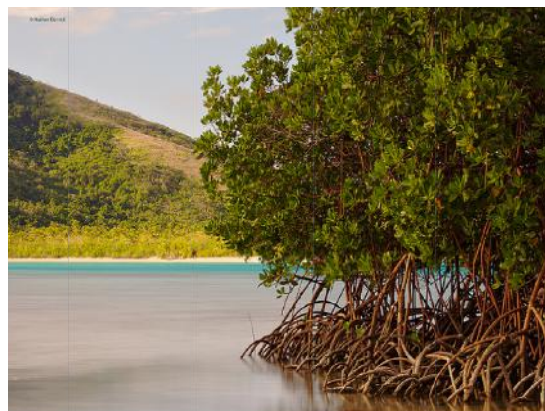
Mangroves are trees that grow in intertidal salty environments because they can't tolerate frequent flooding and are able to obtain fresh water from salt water. Mangroves secrete excess salt through their leaves and block absorption of salt at their roots some more than others.

Mangroves are an important habitat, providing food, shelter and nursery areas for fish, birds, crustaceans and other marine life. They also provide a source of livelihood for many humans around the world, including wood for fuel, charcoal and timber and areas for fishing. Mangroves also form a buffer that defends coastlines from flooding and erosion, land stabilization, nutrient cycling, processing pollutants (including absorption of heavy metals).

Many types of marine and terrestrial life utilize mangroves. Animals inhabit the mangrove's leafy canopy and waters underneath the mangrove's root system, and live in nearby tidal waters and mudflats.

Types of Mangroves

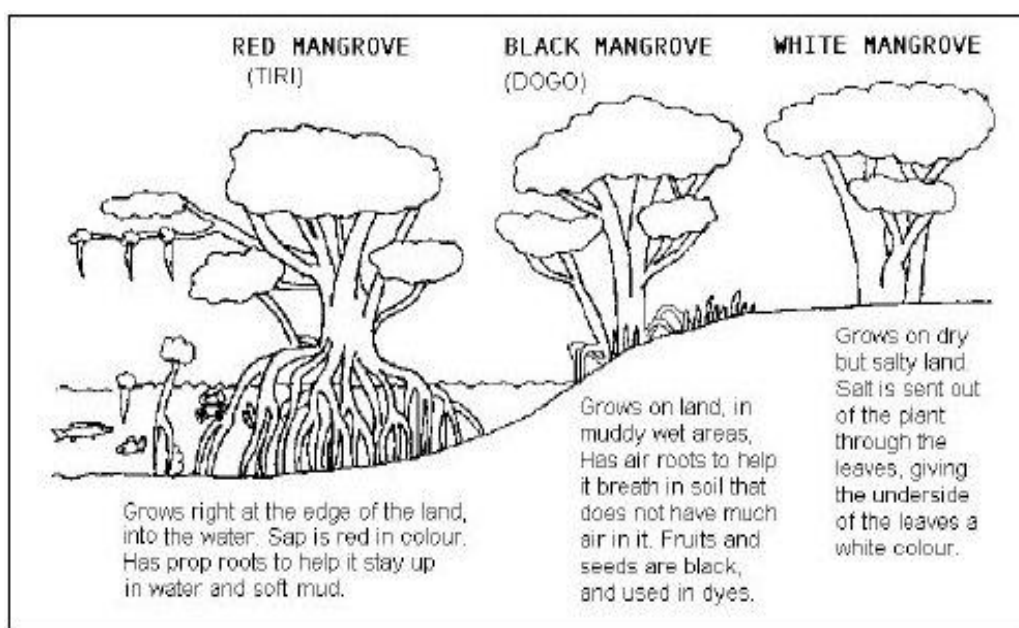
Red Mangroves ("Tiri") grow at the water's edge, with "prop" roots that stabilize trees in soft mud and wave zones. The sap is red in colour. Have stilt roots which grow like arches from high up in the tree.





Black Mangroves ("Dogo") are usually found behind Red Mangroves, in muddy areas that flood at high tide. They may have "prop", or "elbow" roots that stick up out of the mud, sometimes both. The fruits and seeds are black and used in dyes.

White Mangroves ("Sagali", "Kedravivinayalewakalou", "Sinu gaga", "Dabi") are often not recognized by the layman as part of the mangrove community. They are very salt-tolerant trees that grow on dry land immediately behind the wet mangrove areas, and can survive occasional salt-water flooding, and salty soil. Salt is sent out through the leaves, giving the underside of the leaves a white colour. Have pencil like roots growing up from the ground.



2. Fishes

Fish are aquatic animals. Most have streamlined bodies for fast swimming, are covered with scales with two sets of paired fins, have gills throughout their lives (to extract oxygen from water), several unpaired fins and lay eggs. Most fish are "cold-blooded" - adjust body temperature to environment. Fish range in size. Coastal communities are the first to benefit from the different fish species that forage for food in estuaries, marshes, wetlands, mangroves and bay areas.





However, human beings found more uses for marine life aside from their function in the food chain. The demand for fish supply became greater than before. Many fishers are aware of the threats of overfishing to the seas and their businesses. Some are moving towards sustainable management of fish resources. This recognises that there is also a responsibility to look after the marine environment, and ensure that fishing practices are in balance with the local ecology.



A polluted section of the sea (e.g. from an oil spill) might blockout sunlight which kills the phytoplankton, which are tiny aquatic plants at the bottom of the food chain. This means there are fewer plants for shrimp and small fish to feed on, so some starve. Larger fish have fewer shrimp or small fish to feed on and so they may starve too, or move to another feeding ground. This increases the pressure on other species trying to share the same food source. Growing human populations are demanding more food, and this puts pressure on many food chains. In some areas, fishers may catch too many fish. In some parts of the world many of the big fish have been caught so fishers are now catching smaller, younger fish before they reach their full size. These younger fish may not have had a chance to produce their own young. Overfishing means that some types of fish have been fished so much, they cannot maintain their population, so there are fewer fish year after year.

3. Turtles

Sea turtles are one of the Earth's most ancient creatures. The seven species that can be found today have been around for million years, since the time of the dinosaurs. The sea turtle's shell or "carapace" is streamlined for swimming through the water. Unlike other turtles, sea turtles cannot retract their legs and head into their shells. Their colour varies between yellow, greenish and black depending on the species. Turtles eat jellyfish, seaweed, crabs, shrimp, sponges, snails, algae and molluscs. Sea turtles are found in all warm and temperate waters throughout the world and migrate hundreds of miles between nesting and feeding grounds. Most sea turtles undergo long migrations, some as far as 1400 miles, between their feeding grounds and the beaches where they nest. Sea turtles spend most of their lives in the water and will return to the same nesting grounds at which they were born. When females come to the shore they dig out a nest in the ground with their back flippers, bury their clutch of eggs and return to the ocean. After hatching, the young may take as long as a week to dig themselves out of the nest. They emerge at night, move toward the ocean and remain there, solitary, until it is time to mate.

Did You Know?

Sea turtles cry salty tears to get rid of the extra salt they drink from the sea.

Types of Turtles

(i) **Green Turtle** (*Chelonia mydas*) – largest and best known turtles in Fiji and is an excellent source of food. It is greenish brown in colour with darker markings. They are called Green Turtles, but when you look at them they aren't really green. Green is the colour of the fat inside their bodies. Green turtles have always been popular as food. Maybe their name came from what they look like on the inside.





The green turtles' numbers have dropped since they and their eggs were captured by people. Green turtles are herbivores although the young can be carnivores eating animal food such as crabs and jelly fish. Found in shallow water where they find plenty of turtle grass and sea weed their main food. They usually lay their eggs in their eight years and continue for up to 60 years laying about 900 averages every 3 years. Green turtle is listed as an endangered organism.



(ii) **Loggerhead Turtle** (Vonu damu) –is the most common of the turtles in Fiji. It is brown in colour and about a metre long when fully grown. They move freely in the open sea and may be found in deep water. They are carnivorous, feeding on fish, crabs and other marine animals. The meat is not often eaten but their eggs which are faintly pinkish in colour were valued as food in the past. Loggerhead turtle is listed as an endangered organism.



(iii) **Hawksbill Turtle** (Taku) – is the smaller species and has a distinctive and very beautiful shell made up of brown and yellow overlapping plates. They are omnivores, feeding on both plant and animal. They eat seagrass, seaweed, shellfish, fish, jelly fish and other marine animals. Hawksbill turtle have hooked jaws to enable them to get crabs out of crevices or to pull molluscs off the rocks. They live near the shore and lay about 100 to 140 eggs at a time. Hawksbill turtles are listed as an endangered organism.



(iv) **Leathery Turtle** (lkadina) – is the largest and most distinctive of the sea turtles. The length of this turtle may exceed 2 metres and is sometimes mistaken for an upturned boat. It has a relatively smooth leathery skin, which is spotted with white. It lives in the deep sea and travels widely over the ocean.





1.3.3

IMPORTANCE OF MARINE ECOSYSTEM

Habitats

- The edges of the sea are the hatcheries and nurseries of many important organisms of marine life.
- Coastal wetlands and estuaries (areas where rivers enter the ocean) also serve as nesting, feeding and resting spots for migratory waterfowl and they reduce erosion and flooding inland.
- Along the intertidal zones, the area between the high and low tide marks many kinds of plants and animals thrive.
- Mudflats occur where the water moves slowly enough to deposit sediment of small particles. Algae cover the particles and provide food for many burrowing molluscs, worms and crustaceans.
- Sandy beaches are less stable than mudflats for sand shifts constantly and dry out faster than mud when the tide is out. Most of the tiny protists, worms and crustaceans that live between the sand grains eat marine plankton stranded when the tide goes out, or algae attached to the sand grains. A wide variety of shore birds feed on these organisms.
- Rocky shores support a wider variety of organisms as they hide themselves in crevices, anchor themselves firmly to rocks or seaweeds. Birds feed on these organisms during low tide.
- Beaches provide feeding grounds for migratory birds, provide nesting habitat
- Seagrass provides a range of ecosystem services including habitat and food services for coral reef fish and invertebrates
- Mangroves are an important habitat, providing food, shelter and nursery areas for fish, birds, crustaceans and other marine life.





Tourist Attractions

- Island nations often have few natural resources and coral reef is an important tourist attraction.
- Large number of tourist travel across the Pacific to dive and see the coral reefs
- Tourism is the largest business sector as it provides foreign exchange for the country.
- Healthy coral reef ecosystems and other marine habitats directly support the tourism industry by providing attractions for beachgoers, divers, snorkelers, and the recreational fishing sector, among other interested public.
- It generates income both on nationally and privately
- The tourism industry encompasses many different areas, so it also creates jobs in many different areas. With tourism comes hotels, restaurants, car rental agencies, tour companies, service stations, souvenir shops, sports equipment rentals, and much more. All of this creates many different levels of employment for people in a given community.
- In many places the introduction and development of tourism allows local people an opportunity for economic and educational growth that would not otherwise be available. In addition, it allows both the tourist and the local community a chance to experience other cultures, which broadens understanding.
- If properly used, tourism generated income can be tremendously beneficial to the host country and its local communities. Tourism generated income can be used on a national and local level to better education, improve infrastructure, to fund conservation efforts, and to promote more responsible tourism.



Source of Income

- Marine ecosystem provides many services to humans which has generated billions of dollars to the country.
- Employment services in the fishing industries, tourism sector, timber industry, seaweed farming, pearl farming and aquaculture.
- It provides income for local fisherman selling along the road or in the market place.
- Pharmaceutical compounds derived from marine





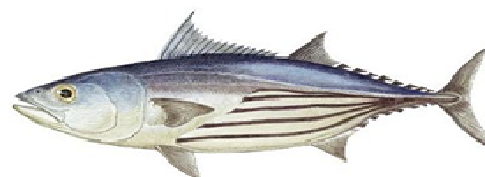
algae and invertebrates (organisms without backbones)

- Landowners benefit from leasing out their island or land for tourism
- Development of the fisheries sector include export of an expanded variety of fresh fish, cultured seaweed and other marine products such as giant clams, cultured black pearls and tuna.
- Locals selling souvenirs and handcrafts for tourists.
- Generate foreign currency for the nation through tourism and fishing industries.
- It is mined for minerals (salt, sand, gravel, and some manganese, copper, nickel, iron, and cobalt can be found in the deep sea) and drilled for crude oil.



Source of Food

- The ocean covers approximately 70% of Earth's surface, which means it is the largest environment for living things on Earth. There are five major ocean habitats: tropical or reef habitat, temperate waters, Open Ocean, the deep sea, and Polar Regions. Most sea life lives in the top 150 meters (500 feet) of the ocean. From the warm, sunlit waters of coral reefs to the dark, cold waters of the deep sea, the ocean teems with life.
- The ocean is an important source of food and other resources. Since well before recorded history, humans have used the sea as a source of food. While only 5% of the protein consumed by world populations comes from the sea, it is still an important contribution to the diet of millions of the world's inhabitants
- Fisheries of today provide about 16% of the total world's protein with higher percentages occurring in developing nations. Fisheries are still enormously important to the economy and wellbeing of communities.
- It provides food in the form of fish, shellfish (clams, oysters, and bivalves), beach der mer, molluscs, lobsters, crabs, seaweed and octopus.
- It also provides food for other marine organisms and birds.





1.3.4

Human Impact on Marine Environment

Today, the oceans of the world are under threat from many different sources, not just direct pollution by sewage, rubbish and radioactive waste but from indirect changes. For example, atmospheric pollution is causing global warming and raises ocean temperatures. On top of this, marine life has to cope with natural changes, such as El Nino effects that produce an unusually high sea surface temperature over the eastern tropical and equatorial Pacific Ocean. Many coral reefs are threatened by the dumping of wastes from nearby tourist areas and by drilling for underlying oil deposits.



It is easy to dump something in the water, for tides and currents quickly wash it out of sight. For many years, coastal towns and cities have used the oceans as convenient place to dispose of sewage and general rubbish.



As human population grows, so has the pollution in the seas. Most shallow coastal waters. Such water is thoroughly mixed by the currents and winds so the pollution affects all marine life. More than half of the world's sewage ends up in the ocean. Raw sewage of course carries bacteria that contaminate the water, making shellfish unfit to eat and cause illness in swimmers. Sewage whether treated or untreated are rich in nutrients especially nitrates and phosphates.

Some come from organic matter, the rest from soap powders and detergents. When nutrients enter the water, they cause nutrient enrichment or eutrophication. This, in turn causes the rapid growth of algae, creating algal blooms over the surface of the water, which affect marine food web.



As algae die, they are decomposed by millions of bacteria that rob the water of its oxygen. Algal blooms are common in shallow waters or lagoons in which there is no or little current to spread the pollution. This causes shellfish poisoning in humans and high death rate of clams. Slash and burn agriculture causes soil erosion, as heavy rainfall washes excessive amount of soil into rivers and out to sea. This reduces sunlight and chokes coral polyps.

Fertilisers used by farmers also contribute to the problem. These fertilisers are soluble in water, so they drain from the fields and into the rivers, eventually washing into the sea.

Pesticides that are sprayed onto crops and the pest animals





that they kill also end up in the sea becoming incorporated into the food chain. Levels of pesticide in the water may be very low, but they are taken up into the bodies of planktons which are eaten by fish and other herbivores.



Carnivores then eat the herbivores. Each time the pesticide becomes more concentrated in the animal's tissues. The animals that are worst affected are the top predators – sharks, whales, tuna, sea gull and many others have died from pesticide poisoning.

A vast amount of rubbish still ends up in the ocean particularly plastics. Most marine animals often die from either becoming entangled in the plastic or from eating it.



Oil spills covers the ocean surface and when washed up onto shorelines coating the sand and rocks. This kills the animals straight away as they cannot breathe. Birds are unable to fly as oil clog their feathers and when they try to clean their feathers they swallow the oil and die. Sea seals lose their protective insulation and freeze to death. Coral reefs are being damaged by tourists diving, snorkelling and anchoring of boats. Apart from these, litters and sewage all contribute to the loss of diversity on the reefs.

The primary threats to all mangrove species are habitat destruction and removal of mangrove areas for conversion to aquaculture, agriculture, freshwater diversion, forest use urban and coastal development, and overexploitation.



Of these, clear-felling, aquaculture and over-exploitation of fisheries in Mangroves are expected to be the greatest threats to mangrove species over the next 10–15 years.

Causes of degradation of coastal habitats include inappropriate agricultural activities, mining, sewage pollution, inappropriate solid waste disposal, fishing activities, use of destructive fishing practices, beach sand mining, building of jetties and, commercial harvesting of coral, soil erosion and siltation, improper disposal of industrial waste, and natural hazards such as climate change and sea level rise and hurricanes.



Review Exercise

What can I do?



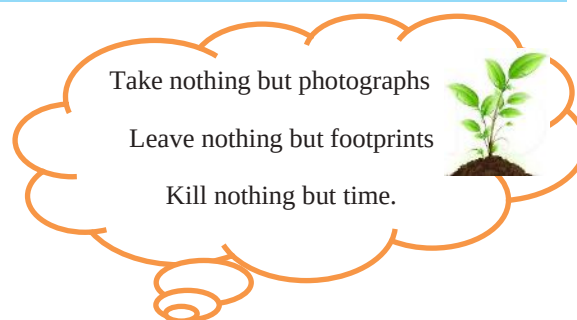
Mangroves reforestation can be an interesting and very exciting activity. There are several ways to get involved and to help protect the mangroves. Find the pairs that belong together!

- | | |
|----------------------------|---|
| 1. Keep the water clean | Confront them with the benefits of mangroves |
| 2. Look for planting sites | Don't dump your waste into the sea |
| 3. Watch the mangroves | Help planting and maintaining mangroves |
| 4. Talk to people | Keep them clean and protect them from animals |
| 5. Get involved | Monitor their growth and survival |

1.3.5

What is Conservation?

Habitat destruction and exploitation have meant that thousands of species of plants and animals have been brought to the verge of extinction. In the face of economic development, the growth of human population and the increase in agriculture to feed them, habitats are vanishing quickly and their species with them.



The destruction of tropical rain forest means that 500 -1000 species of plants are becoming extinct every year. They are disappearing even before they are discovered by man and their potential value, for instance in providing new medicines, is wasted. Animal species are now disappearing at the rate of one species per day.

Humans, through greed and ignorance, are cutting down forests that not only harbour a huge diversity of species but provide the oxygen we breathe and uses up carbondioxide. We can benefit future generations by preserving our environment. We have a duty of care to manage wild species which can be direct use to us in terms of food and other materials.

We must realise that over exploitation of non-renewable resources will leave us poorer in the future. It is also in our interests to safeguard the existence of species that are part of the delicate balance of nature in our world. There are many animals that we shall never see. The destruction of habitats to enable agriculture to feed ever more mouths is one cause. The over exploitation of species for commercial use is another.

Conservation means protecting our environment so that animals and plants can maintain their numbers.



Conservation aims to make our total surrounding better by sustained utilization of the resources in the environment. It aims to plan development so as to retain as much natural beauty as possible – to keep Fiji green, the sea unpolluted and the air fresh and to use our natural resources scientifically so that they are not exhausted.

To support conservation is not opposed to development and changes but to be prepared to consider fully the cost of development, including the effect on the natural environment – a cost which must be minimised if our world to survive. Conservationists want development that works with nature.

Conservation Practice

- **Fisheries**

They must be managed on a sustainable level as they can be easily reduced but not so easily increased. Fisheries can only be protected if harvests are kept below the level at which fish are taken faster than they can be replaced. Overfishing affects other marine life. Fish are a critical part of the food chain and overfishing means other animals go hungry.

The use of drift nets which hang in the water for many kilometres are not selective in the animals it trap. Quiet often the nets are abandoned and left to float free in the ocean becoming death trap for even more animals. It is impossible to estimate how many dolphins, sharks, turtles and other animals have died in these nets.

Sustainable fishing guarantees there will be populations of ocean and freshwater wildlife for the future. Aquatic environments are home to countless species of fish and invertebrates, most of which are consumed as food. (Others are harvested for economic reasons, such as oysters that produce pearls used in jewellery.) Seafood is respected all over the world, in many diverse cultures, as an important source of protein and healthy fats. For thousands of years, people have fished to feed families and local communities.

Demand for seafood and advances in technology have led to fishing practices that are depleting fish and shellfish populations around the world. Fishers remove more than 77 billion kilograms (170 billion pounds) of wildlife from the sea each year. Scientists fear that continuing to fish at this rate may soon result in a collapse of the world's fisheries. In order to continue relying on the ocean as an important food source, economists and conservationists say we will need to employ sustainable fishing practices.





Consider the example of the bluefin tuna. This fish is one of the largest and fastest on Earth. It is known for its delicious meat, which is often enjoyed raw, as sushi. Demand for this particular fish has resulted in very high prices (\$2000 - \$20 000 depending on size) at markets and has threatened its population. Today's spawning population of bluefin tuna is estimated at 21 to 29% of its population in 1970.

Since about that time, commercial fishers have caught bluefin tuna using purse seining and longlining. Purse seine fishing uses a net to herd fish together and then envelop them by pulling the net's drawstring. The net can scoop up many fish at a time, and is typically used to catch schooling fish or those that come together to spawn.

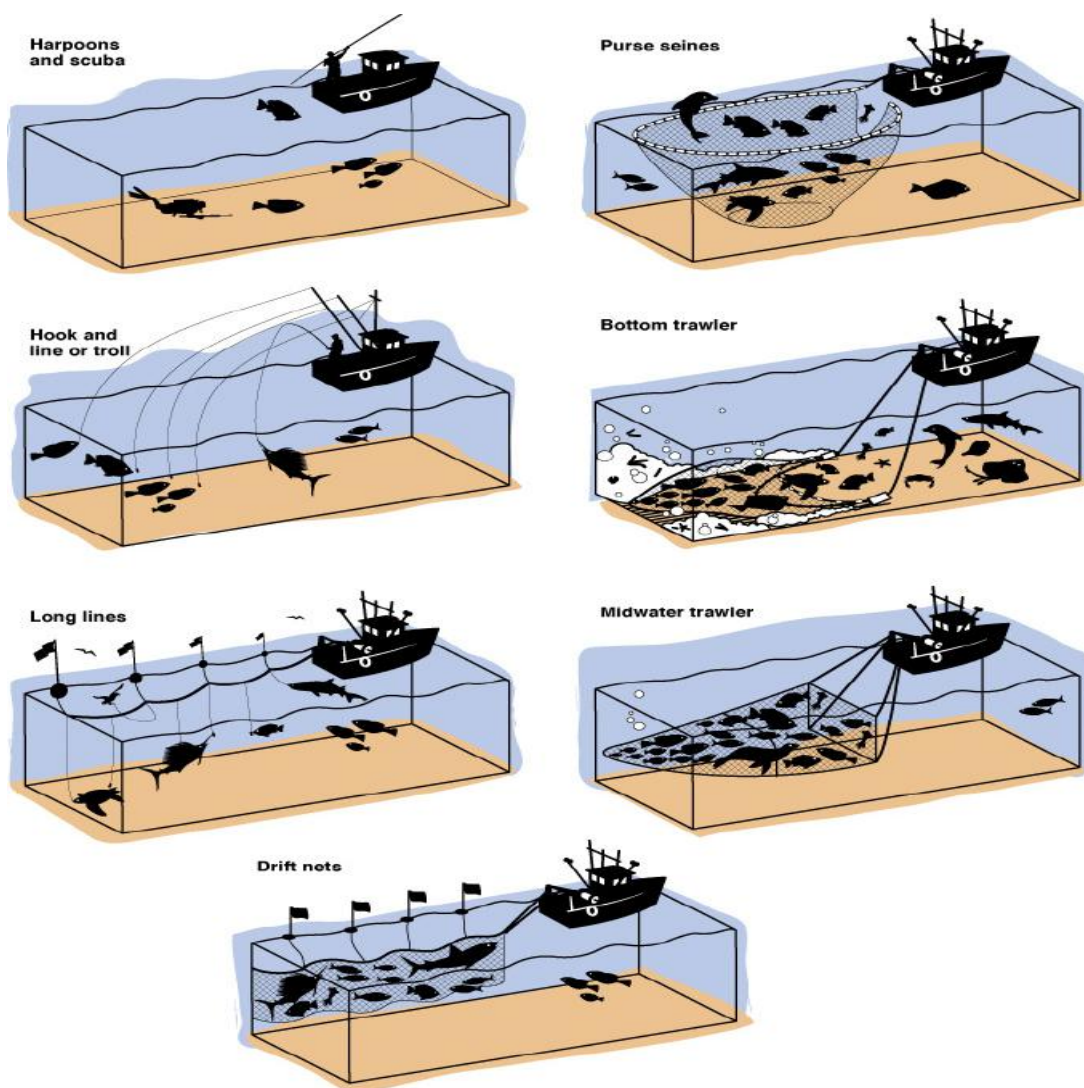


Longlining is a type of fishing in which a very long line - up to 100 kilometres (62 miles) - is set and dragged behind a boat. These lines have thousands of baited hooks attached to smaller lines stretching downward. Both purse seining and longlining are efficient fishing methods but are not sustainable. These techniques can catch hundreds or thousands of fish at a time.

Catching so many fish at a time can result in an immediate payoff for fishers. Fishing this way consistently, however, leaves few fish of a species left in the ocean. If a fish population is small, it cannot easily replenish itself through reproduction. Taking wildlife from the sea faster than populations can reproduce is known as overfishing.



Purse seining, longlining and many other types of fishing can also result in a lot of by catch, the capture of unintended species. Longlines intended to catch bluefin tuna, for instance, can ensnare birds, sea turtles, and other fish such as swordfish.



Traditional Fijian cultures have relied on the ocean's resources. Their most common historical fishing practices were hook and line, spearfishing, and cast nets. Hooks constructed of bone, shell, or stone were designed to catch specific species. Fishers would also craft 2-meter (6-foot) spears. They would dive underwater or spear fish from above, again targeting specific animals. Cast nets were used by fishers working individually or in groups. The nets could be cast from shore or canoes, catching groups of fish. All of these methods targeted fish needed for fishers' families and local communities.





Our lack of concern for the value of marine organisms is clearly seen in the killing of sharks. Shark dorsal fins are used to make simple bowl of soup but no other part of the shark is used. Many sharks are highly vulnerable to overfishing because they grow slowly, mature late and produce a small number of young. Sharks are now listed as an endangered species in Fiji.



- **Corals** - there is an urgent need to conserve coral reefs to safeguard their valuable resources. Action is needed to put large areas of reefs aside under full protection where fishing and damaging activities are prohibited, but non-damaging activities such as sustainable (or environmentally sensitive) tourism are encouraged to provide alternative incomes.



Ways of protection can be:

- the promotion of non-damaging activities on coral reefs such as environmental tourism
- the prevention of dynamite and cyanide fishing for live fish trade
- the control of pollution and deforestation in tropical catchment areas near coral reefs
- the reduction of greenhouse gases that are driving climate change
- aid from donor countries to be used in the protection of coral reefs.

- **Mangroves** – Mangroves are highly biodiverse habitats that host a large variety of unique organisms from barnacles and oysters to fiddler crabs, mudskippers. Nutrients and carbon from mangrove forests provide essential support to other near shore marine ecosystems such as coral reefs and seagrass areas, and enrich coastal food webs and fishery production. The physical presence of Mangroves along the coastlines and rivers also provide the first line of defence against cyclones, high winds and storm surges. It is estimated that globally, mangroves provide at least \$1.6 billion per square kilometres in ecosystem services annually.



Such services include protecting foreshores, fisheries production and supply of building materials but also tourism, recreation and improving water quality. Mangrove ecosystems are also one of the best, and largely overlooked Carbon sinks. In essence, Mangroves provide natural adaptation to the effects of climate change, serve as natural insurance against climate change, and contribute towards the global reduction of greenhouse gas emissions. They are thus nature's answer to the effects of Global Warming.

As a consequence, conservation of mangroves and associated ecosystems has been identified as a key natural adaptation strategy and action for reducing the severity and serious measure to

climate change. Protecting these vital ecosystems also safeguards and enhances the livelihoods of coastal communities.

More to Know

To protect our flora and fauna and their habitats, protected areas called sanctuaries, national parks and biosphere reserves have been earmarked. Plantation, cultivation, grazing, felling trees, hunting and poaching are prohibited there.

Sanctuary: Areas where animals are protected from any disturbance to them and their habitat.

National Park: Areas reserved for wild life where they can freely use the habitats and natural resources.

Biosphere Reserve: Large areas of protected land for conservation of wild life, plant and animal resources and traditional life of the tribals living in the area.

Conservation farming is any system or practice which aims to conserve soil and water by using surface cover (mulch) to minimise runoff and erosion and improve the conditions for plant establishment and growth. It involves planting crops and pastures directly into land which is protected by mulch using minimum or no-tillage techniques.

Conservation farming - This is a combination of methods which aim to conserve water, soil quality, moisture, fertility and seed production, as well as the farmer's energy, time and money. Some of the key aspects and benefits include:



- **Planting in basins** Farmers create basins in the soil in which seeds can be planted. When the rains come the water is trapped in the basins, allowing roots to develop and stopping the top soil and fertiliser being washed away.
- **Leaving crop residue for the next harvest** Farmers are encouraged to leave the residues rather than burning them. This reduces soil and water loss, improves infiltration, reduces surface temperatures and in time improves soil fertility. Because seeds are planted in the same basin each year, the fertiliser left from the previous crop can be absorbed by the new crop.
- **Nitrogen-fixing crop rotations** Farmers are encouraged to grow legumes (beans, peanuts) and other nitrogen-fixing crops in rotation to increase the natural soil nutrients. This will reduce the need for artificial fertiliser and enable them to diversify their crops.
- **Early planting during the first rains** This means that farmers need to prepare land as soon as they have harvested the previous crop. Planting during the first rains enables the seeds to benefit from the nitrogen that the rains flush through the soil.
- **Planting dense rows of trees** as wind-breaks along the borders of the land, especially on the sides that are exposed to stiff winds. Their roots stabilize the soil and prevent it from being shifted away by the wind.



- **Planting crops in rotation.** Alternating crops helps avoid depleting the soil nutrients too fast.
- **Planting cover crops.** These stabilize the soil and reduce the effects of soil erosion. They also discourage the spread of weeds and help the soil retain its moisture in the summers.
- **Ploughing along the contour of the land.**
- **Planting crops parallel to the slope of the land.**
- **Going for strip cropping.** This involves planting grasses or pulses between regular crops like corn. The corn crop is not particularly effective in preventing soil erosion, but the grasses keep erosion in check.
- **Adding mulch to the soil surface.** This prevents erosion by acting as a barrier and catching run-off water.
- **Adding coir logs** (durable biodegradable erosion prevention log) as barriers. These are very useful in areas where too much erosion has taken place and act as erosion preventing barriers and a support for new developing vegetation. Aside from coir barriers, sand bag and gravel bag barriers are also used.
- **Growing grass on slopes and in waterways.** Grassed waterways prevent too much soil from being washed away.
- **Terrace cropping** slows down the flow of rain down a hillside, terrace gives the water time to soak in and nourish the crop.



Public Awareness

Public awareness is the public's level of understanding about the importance and implications of conservation. Raising public awareness is not the same as telling the public what to do – it is explaining issues and disseminating knowledge to people so that they can make their own decisions. There are various organisations and schemes that seek to inform the public of important and topical issue. Greater awareness empowers the public and enables informed debate on environmental issues affecting society. Here are some examples of such public awareness activities. Ways of raising public awareness:

- Seminars
- Workshops/conferences
- Awareness materials (brochures, posters, videos, stickers etc.)
- Exhibitions
- Public awareness events
- Visitors' days
- Field days
- Media (newspapers, radio, TV)
- Websites and other internet based tools



Review Exercise

1. Discuss the **effects of development** (hotel development, building of jetties, and building of industrial areas, constructing roads) on marine environment.
2. Write a paragraph on how you conserve the resources you use at home.
3. Create a poster(using pictures or drawings) to educate the community on conservation of any one of the following:
 - Tropical forest
 - Mangroves
 - Corals
 - Turtles
 - Marine areas
 - Crested Iguana
 - Sharks
 - Wetlands
 - Whales
4. Explain the meaning of endangered, extinct, endemic, over exploitation and non-renewable
5. What will happen if :
 - we go on cutting trees.
 - the habitat of an animal is disturbed.
 - the top layer of soil is exposed.
6. Discuss what a Carbon sink is.
7. **IUCN Red List** of Threatened Species is a complete list of conservation information of plants and animals around the world. List down all the IUCN Red List species of Fiji.



CHAPTER 2: MATTER

1. INVESTIGATING MATTER
2. MATERIALS
3. REACTIONS

INTRODUCTION

All that can be observed around us, using our senses, is either matter or energy. Matter is the stuff around us and of what we are made. The building blocks of matter are very small particles.

Everything around us is made of very tiny pieces, or particles. Your body is made of particles. So are your desk, your chair, and this book. These particles are so tiny that it is impossible to pick up just one of them, and look at it. However, there is a machine that is powerful enough to take pictures of groups of particles. It is called scanning electron microscope. The microscope is very powerful, but still not powerful enough to show just one particle.

Matter, we can say is made of particles. This way thinking about matter is called model. A model is a way of explaining what something is and how it works. The model that we use to explain matter is called particle model. According to the particle model, all matter is made up of tiny particles called atoms. Everything is made of atoms.



Primary Source

UNIT 1: INVESTIGATING MATTER

INTRODUCTION

This unit will be investigating the structure of an atom and explain the properties of common elements in relation to their position on the periodic table.

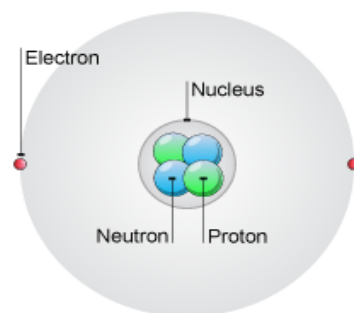
2.1.1

STRUCTURE AND CONSTITUENTS OF AN ATOM

Chemists are people who study types of matter and the changes matter goes through. They are vitally interested in the fundamental question what is matter made of? Nowadays, scientists and non-scientists alike accept that matter is made of tiny particles. These tiny particles are atoms. The word 'atom' comes from the Greek word atomos meaning indivisible or unable to be broken down any further.

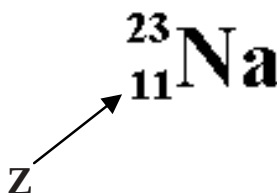
Atoms are made from 3 kinds of sub atomic particles (particles smaller than an atom) – protons, neutrons and electrons. These are building blocks of atoms.

1. **Protons** – are positively (+) charged particles which are tightly packed together in the nucleus of the atom.
2. **Neutrons** – are neutral particles which have no charge and are found in the nucleus.
3. **Electrons** – are negatively (-) charged particles which move around the nucleus in shells or orbits.



Protons and neutrons are heavier than electrons. The negative charge of electrons balances the positive charge of protons, thus the number of protons is equal to the number of electrons.

Atomic Number (Z) – is the number of protons (p) in any atom. It determines the element of the atom, e.g. any atom with 6 protons is carbon, regardless of the number of neutrons and electrons.

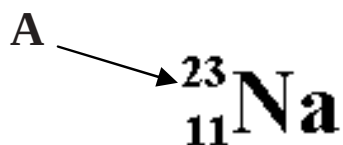


The elements are arranged in the Periodic Table in ascending order of atomic number so it's easy to find the name or symbol for an atom if you know the atomic number.

11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
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Mass Number (A) – the total number of protons (p) and neutrons (n) in an atom. The mass number is usually about twice the atomic number.



Isotopes – occurs when two atoms of the same element have different numbers of neutrons. They will have the same atomic number but a different mass number. Compare these two atoms – chlorine.



They're both chlorine – they both have the same atomic number - but they have different mass numbers – they're **isotopes** of chlorine.

Both isotopes have 17 protons. The isotope with mass number 35 has 18 neutrons. The isotope with mass 37 has 20 neutrons.

Review Exercise:

1. State how many protons and electrons the following atoms would have:

Atom	Number of protons	Number of electrons
Lithium	3	_____
Sodium	_____	11
Fluorine	_____	_____
Magnesium	_____	_____



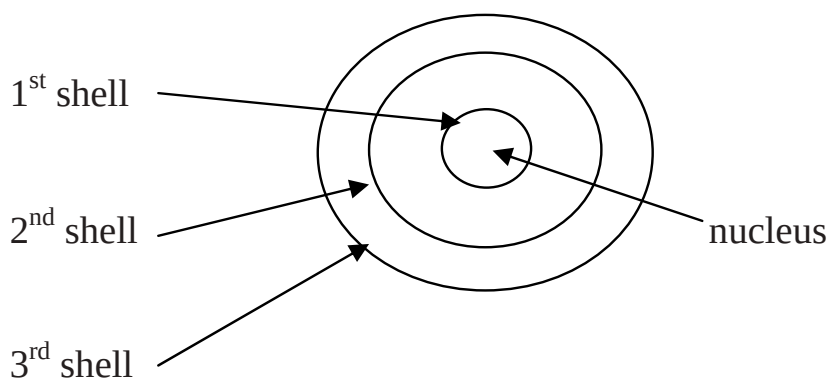
TASK

Complete the table below. The first one has been done for you.

Symbol	Element	Number of protons	Number of electrons	Number of neutrons
${}^1_1\text{H}$	Hydrogen	1	1	0
${}^2_1\text{H}$			1	
	Lithium	3		4
${}^{12}_6\text{C}$			6	
		6		7
	Oxygen			10
			12	12
${}^{238}_{92}\text{U}$	Uranium			
	Nitrogen			7
${}^{35}_{17}\text{Cl}$				
	Chlorine			20

Electron shells/Energy levels - a region of space in which electrons move around the nucleus of an atom.

- The 1st shell is close to the nucleus and has room for only 2 electrons.
- The 2nd and 3rd shell can contain up to 8 electrons in each shell
- The 4th shell can hold 18. (This will be discussed later in higher Form)
- There can be as many as 7 occupied shells of electrons
- The shell nearest to the nucleus fills up first.



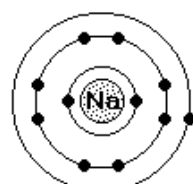
Outer shell/ valence shell – the last electron shell in which there are electrons. The way an element behaves largely depends upon the electrons in the outermost shell. These outer electrons are the ones most commonly involved when atoms joined up with each other. Metals generally have 1 or 2 electrons in their outer shells, whereas non-metals have 3 or more electrons.

Octet – a group of 8 electrons in a single electron shell. Atoms with an octet for the outer shell are very stable and unreactive. Other atoms can achieve stable octet either by sharing electrons with other atoms or by gaining or losing electrons.

Electron configuration – a group of numbers which shows the arrangement of the electrons in an atom.

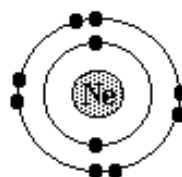
Example: For the element **sodium (Na)** and nitrogen (N). Find the number of energy shells and electrons in each shell. Write the electron configuration.

Sodium (Na) Protons (atomic number) = 11 Electrons = 11
 1st shell = 2 electrons, 2nd shell = 8 electrons, 3rd shell = 1 electron (Total electrons = 11)
Electron configuration: Na (2, 8, 1)

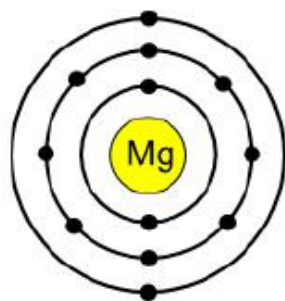


Na (11) 2,8,1

Neon (Ne) Protons = 10 Electrons = 10
 1st shell = 2 electrons, 2nd shell = 8 electrons (Total electrons = 10)
Electron configuration: N (2, 8)



neon (10) 2,8



The **electron configuration** for magnesium can be written as **2, 8, 2**



Review Exercise:

1. In the periodic table, each row is called a _____.
2. The elements in each _____ have the same number of _____.
3. Each column in the periodic table is called a _____.
4. Each of the elements in the same _____ have the same number of _____ in their outer shells.
5. The electrons in the outer shell are called _____ electrons.
6. The _____ number equals the _____ of _____ electrons.

Symbol	Element	Period	# of Shells	Group #	# Valence electrons
C					
Na					
Ne					
H					
Be					
S					
K					
He					

7. Draw the electron structure diagram for:

(i) Oxygen

(ii) Sulphur

(iii) Aluminium



have similar chemical properties. Groups with alternative names:

Group I – Alkali metals

Group II – Alkaline earth metals

Group VII – Halogens

Group VIII – Noble gases/Inert gases

Mnemonics for Elements



*Hi He Lies Because Boys Can Not Operate Fireplaces New Nations Might
Also Sign Peace Security Clause A King Can.*

H, He, Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca.



Review Exercise:

Complete the table below for elements with the given atomic number.

Atomic Number	Electron Configuration	Symbol of Element	Group of Periodic Table
3			
12			
10			
1			
17			
19			

2.1.3

PHYSICAL & CHEMICAL PROPERTIES

- A **physical property** is a characteristic of a substance that can be observed or measured without changing the chemical nature of the substance.
- Common physical properties and their characteristics are:
 - Physical state – solid, liquid or gas at room temperature
 - Colour – related to the ability of a substance to reflect visible light.
 - Density – is the concentration of matter in a substance. Is the mass per unit of volume in g mL^{-1}
 - Melting – temperature at which a substance changes state from solid to liquid
 - Boiling point - temperature at which a substance changes state from liquid to solid
 - Lustre – describes how well the substance shines
 - Electrical conductivity – the ability of a substance to allow an electric current to pass through it.
 - Thermal conductivity – the ability of a substance to allow heat to pass through it.
 - Malleability – the ability of a substance to be beaten into a sheet
 - Ductility – the ability of a substance to be drawn into wires.
 - Tensile strength – ability to support pressure or load
- Chemical properties are those that alter the chemical nature of the substance and enable the product to be recognized as a separate substance.
- More than three quarter of the 109 elements are metals.
- About 19 elements are non-metals and about 7 more are semi metals or metalloids, elements having both metal and non-metal properties.
- The properties of elements are repeating themselves. The pattern of repeating properties matches the pattern of electrons in their outer (last) shells. Those elements with the same number of electrons in their outer shell have similar properties.
- Groups of elements with similar properties are called blocks. The elements in a group resemble each other. Sometimes they look alike, and usually they behave in the same way.
- Reactivity – is a measure of how actively a substance or chemical reacts with another substance or chemical. In chemistry, the substances that react are called metals. The most reactive metals are the alkali metals, while the noble gases don't react at all.
- There tends to be gradual changes in physical and chemical properties down a group.
- Down Group 1 (Alkali Metals) – lithium, sodium and potassium.



Physical properties - All are metals, so light they float in water, are silvery and shiny when freshly cut (but quickly tarnish) and have low melting and boiling points compared with other metals.



Chemical properties – lithium is the least reactive because it reacts the most slowly. Potassium is the most reactive of the three.

Why they have similar properties? Because in the elements of Group 1, all atoms have 1 electron in their outer shell.

- Down Group 7 (Halogens) – chlorine, bromine and iodine.



Physical properties – are non-metals, are coloured (chlorine – green gas, bromine- red liquid, iodine – black solid), are poisonous

Chemical properties – chlorine is the most reactive, it reacts most easily with iron. Iodine is the least reactive of the three.

Why they have similar properties? Because the atoms have 7 electrons in their outer shell.

- Down Group 8 (Noble gases) – helium, neon and argon

Physical properties – are non-metals, are gases (they are all found in air), are colourless.

Chemical properties – unreactive

Why they have similar properties? Because the atoms all have a full outer shell of electrons, that is why they are unreactive.



Neon signs



Helium balloons

The reactivity series is a list of metals arranged in the order of their decreasing activities.

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	
Fe	Iron	Reactivity decreases
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive



UNIT 2: MATERIALS

INTRODUCTION

This unit will investigate the differences in the properties and uses of metals and non-metals. The change in properties of metals when heated or cooled or when doing work on them will be described

2.2.1

PROPERTIES OF METALS AND NON METALS

Metals – are on the left of a periodic table. Properties of metals are:

- Most are solid, except for mercury (the only liquid metal used in thermometer)
- Usually high melting and boiling point.
- Very good conductors of heat and electricity
- Shiny appearance (silvery except for copper and gold)
- Quiet strong material
- Malleable – easily beaten into thin sheet (e.g. foil)
- Ductile – can be pulled to make wires (e.g. electrical wirings)
- High density – feel heavy
- Sonorous – they make ringing noise when you strike them
- React with oxygen to form basic oxide



Metals get more reactive as you move to the left of the periodic table so Group 1 metals are the most reactive

Non-metals – are on the right of the periodic table. Properties of non- metals are:

- Gases, liquids or solids at room temperatures
- Usually have low melting and boiling points
- Have dull surfaces when solid
- Non- malleable when solid
- Brittle – breaks easily
- Poor conductors of heat and electricity
- Low density
- React with oxygen to form acidic oxide





2.2.2

USES OF METALS AND NON METALS

We use different metals for different jobs as they have different properties: it's important to choose the right metal for the job.

Metals	Properties	Uses
Aluminium 	low density, does not corrode conductor of heat and non-toxic malleable and strong	suitable for the bodies of planes for making saucepans for cooking foil and milk tops
Copper 	good conductor of electricity, does not react with water Ringing sound, sonorous	electrical wires as it is a good conductor water pipes due to its low reactivity for bell making
Gold 	very good conductor of electricity, unreactive does not rust and shiny	electrical connections on circuit boards - due to its conductivity jewellery - due to its lack of reactivity
Steel 	cheap and strong	suitable for building material, car parts, kitchen sinks, cutlery
Lead 	malleable, can be stretch without breaking, heavy and cheap. Resist corrosion (rust)	suitable for fishing line sinkers and roof sealing automobile industry - batteries

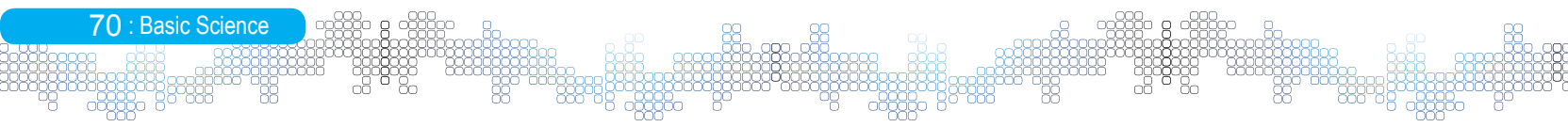


Sometimes a metal is most useful when it is pure. For example, copper is not nearly a good conductor, when it contains impurities. But many metals are more useful when they are not pure. Iron is the most widely used metal of all, and it is almost never used pure. Pure iron is no good for building thing, because it is too soft and stretches easily. Besides, it rusts easily too. But when a little carbon (0.5%) is mixed with it, it becomes much harder and stronger – called steel and is used for building, bridges, ships and car bodies.

You can see that the properties of the iron have been changed by mixing other substances with it. The mixtures are called alloys. The properties of any metal can be changed, by mixing other substances with it. The mixtures are called alloys

The added substances are usually metals, but sometimes non metals like carbon or silicon. An alloy is usually made by melting the main metal and then dissolving the other substances in it.

Non metals	Properties	Uses
Carbon (graphite) 	Soft and smooth	Lead of pencil Electrodes in electrolysis and dry cells
Carbon (diamond) 	Hard Colourless and transparent	Drill bits for cutting stones Jewellery
Neon gas 	Poor conductor	Lights used for billboards
Chlorine 	Acidic, soluble in water	Kills germs in drinking water, used for making plastics, bleaching powder and liquid.
Phosphorus 	Reacts easily with oxygen	Making matches

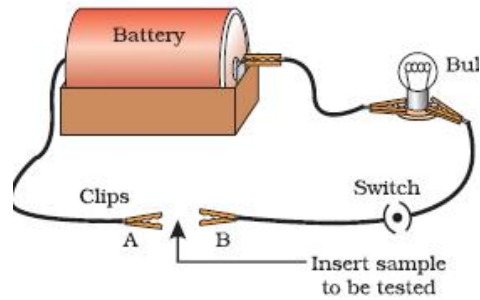




Activity 1

The easiest way to start grouping substances is by comparing their physical properties. Let us study this with the help of the following activities. Collect the samples of following elements – iron (steel wool), copper, aluminium, magnesium, sulphur (lump), lead, carbon (black electrodes inside batteries), sand paper and conductivity tester (electric circuit).

- Rub each of the elements with sand paper or steel wool and observe whether they are shiny or dull.
- Try to bend the sample. Is it bendy (easy to bend) or brittle (breaks easily)
- Set up an electric circuit as shown in diagram.
- Place the metal to be tested in the circuit between terminals A and B as shown.
- Does the bulb glow? What does this indicate?



Elements	Shiny or dull	Bendy or brittle	Electrical conductor (Good/bad)

2.2.3

EFFECT OF HEATING AND COOLING OF METALS

Over 75% of all elements are metals. Manufacturers want metals to be malleable and ductile so that they can be shaped easily. But they also want them to be hard and strong, so that they are useful.

Annealing is a heat process whereby a metal is heated to a specific temperature /colour and then allowed to cool slowly. This softens the metal which means it can be cut and shaped more easily. Mild steel is heated to a red heat and allowed to cool slowly.

Physical property. Annealed metals are relatively soft and flexible. It can be cut and shaped more easily. They bend easily when pressure is applied. As a rule they are heated and allowed to cool slowly.

Activity 2

- Take a piece of springy steel wire or hair pins.
- Straighten one end of the steel and hold one end with tongs
- Heat the center of the other half in the flame until it is red hot.
- Shift it slowly higher in the flame and hold it for a while.
- Finally remove it and let it cool on a tile.
- When it is cool, pick it up and try to bend it in your fingers.
- Try to bend both halves with your fingers. How do the 2 halves compare (bendability)?
- How has the springy steel change its property after being heated and slowly cooled?
- What process have you carried out on the steel wire?
- What does the process do to the springiness of the steel?



Quenching is a heat process whereby a metal is heated to a specific temperature /colour and then allowed to cool rapidly by dipping the heated metal in water.

Physical property: Quenches metals are hard and brittle. Hardened metals are difficult to cut and shape. They are very difficult if not impossible to bend. As a rule they are heated and cooled very quickly by quenching in clean, cold water.

Activity 3

- Straighten another piece of steel and hold one end with tongs.
- Heat the center of the other half in flame until it is red hot.
- While it is still red hot, quickly remove it from the flame and plunge it into a beaker of cool tap water.
- Try bending both halves of the piece of steel with your finger. How do the 2 halves compare (bendability)?
- How has the springy steel changed its property after being heated and cooled quickly?
- What process have you carried out on the wire?
- What does the process do to the springiness of the steel?



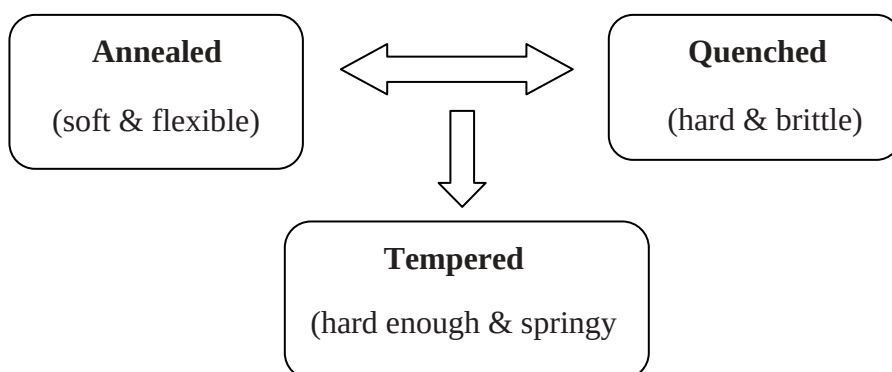


Tempering is a heat process whereby a metal is gently heated to bluish purple colour and then allowed to cool.

Physical property: Tempered metals are often hard enough and springy enough.

Activity 4

- Take a quenched steel from activity 3 and hold one end with tongs.
- Slowly heat the center of the other half in a small flame until it changes colour to dark blue or purple.
- Immediately remove it and cool it.
- How does tempering change the properties of a brittle piece of steel?
- Which type of steel (annealed, quenched or tempered) would you want to use for winding round a box? Why?



Changing the Shapes of Metals

Most metals we use in our daily lives have had their shape changed during manufacturing. Very few were 'cast' or poured when molten and allowed to solidify into their present shapes. Work is when we use force and when we make something move.

Methods of Changing Metal Shapes

1. **Hammering** – metals are beaten into shapes
2. **Rolling** – the large blocks of metals are rolled back and forth between heavy rollers, and the block gradually becomes longer and thinner, e.g. making flat sheet of iron.
3. **Pressing** – a sheet of metal is pressed down, using enormous pressure until it takes up a new shape, e.g. the shape of motor car bodies
4. **Pulling** – the long piece of metal is pulled out through a hole that is smaller than the thickness of the metal, the metal becomes longer and thinner, e.g. making wires and nails.
5. **Spinning** – a flat piece of metal is held at its center and spun around while being pushed from one side until it takes a hollow shape, e.g. saucepans and cooking pots.
6. **Twisting** – heating a metal bar until red hot and twist the heated part with wrench. Then heat it again and slowly cool it.

Generally during these processes the metal becomes 'work hardened' which means hard and brittle. Remember that these shape changing processes are carried out on solid metal. Sometimes the metal is hot but at other times it may be heated and cooled after each time its shape has been changed a little.

Magnetic Metals

Magnetic metals are those that can be attracted by a magnet and can also form a magnet when magnetized.

The only magnetic metal is iron and if a metal has iron in it, e.g. steel

Magnetic and Non Magnetic Metals

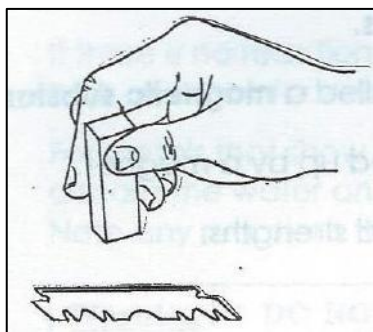
- A **magnet** is a metal that can attract other metals.
- Only certain materials can become magnets
- A material that can become a magnet is called a magnetic substance.
- A magnetic substance can be also picked up by a magnet
- Magnets are made in many sizes, shapes and strengths.
- Magnets have many uses.



Activity 5

Obtain a strong magnet from the teacher.

Break a razor blade into two long pieces and rub one end of the magnet along the blade in one direction. Then take the other end of the magnet and rub it several times in the opposite direction.

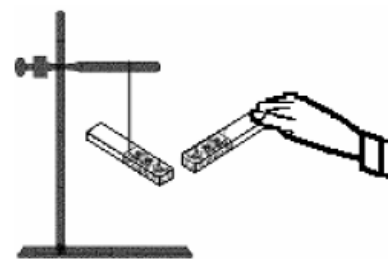


The half blade should now be magnetic



Review Exercise

1. The diagram shows the north pole of one magnet being brought up to the north pole of a freely suspended magnet.
What would you expect to happen to the freely suspended magnet?
2. What does this tell us about like poles?





UNIT 3: REACTIONS

INTRODUCTION

In this unit, the different types of chemical reactions and factors that affect the rate of reactions will be investigated. The various chemical reactions that are encountered daily will be appreciated.

2.3.1

CHEMICAL REACTIONS

Consider the following situations of daily life and think what happens when –

- milk is left at room temperature during a hot day.
- an iron nail is left exposed to humid atmosphere.
- pineapple becomes rotten.
- food is cooked.
- food gets digested in our body.
- we respire.

In all the above situations, the nature and the identity of the initial substance have somewhat changed. We have already learnt about physical and chemical changes of matter in our previous lessons. Whenever a chemical change occurs, we can say that a chemical reaction has taken place.

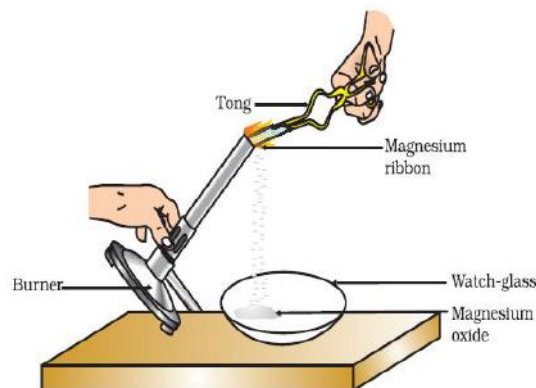
You may perhaps be wondering as to what is actually meant by a chemical reaction. How do we come to know that a chemical reaction has taken place? Let us perform some activities to find the answer to these questions.

Activity 1

Using a tongs, hold a 3cm strip of magnesium ribbon over a blue Bunsen burner flame. Collect the ash in a watch glass. Shield your eyes so that you are not looking directly at the reaction. Record your observations.

What the substance look like at the start?

Any changes that occur during the experiment as well as the final outcome.

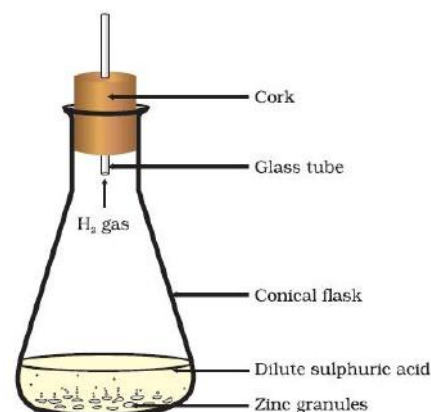


Activity 2

Take a few zinc granules in a conical flask or a test tube. Add dilute hydrochloric acid or sulphuric acid to this.

CAUTION: Handle the acid with care

Do you observe anything happening around the zinc granules? Touch the conical flask or test tube. Is there any change in its temperature?





From the above three activities, we can say that any of the following observations helps us to determine whether a chemical reaction has taken place –

- change in state (forming of precipitate)
- change in colour
- release of a gas
- change in temperature.

As we observe the changes around us, we can see that there is a large variety of chemical reactions taking place around us.

Chemical reaction - is when a new substance is formed with a new characteristics and composition, also known as chemical change. Examples are fireworks exploding to produce spectacular colour, coke producing gas bubbles, making cake, nail turning rusty.

During chemical reaction products are formed from reactants.

Reactants $\longrightarrow$ Products



Reactants – substance present at the beginning of a chemical reaction.

Products – substance formed in a chemical reaction.

Properties of Chemical Reaction

- One or more new chemical substances are formed
- Heat is often released
- Change is usually difficult to reverse (to change back to its original substance)

Chemical Equations

- Represents a chemical reaction by briefly summarizing what has happened.
- It shows the substances that are reacting- reactants and the substances that are formed- product.
- Symbols and formulae are used.
- An arrow in the equation represents the change that takes place in the reaction, from the reactants to the products.
- Chemical equations can be written into 2 ways: word equation and chemical equation. For example, the word equation for Activity 1 would be:



- Chemical equations can be made more meaningful and useful if we use chemical formulae instead of words. A chemical equation represents a chemical reaction. If you recall formulae of magnesium, oxygen and magnesium oxide, the above word-equation can be written as –



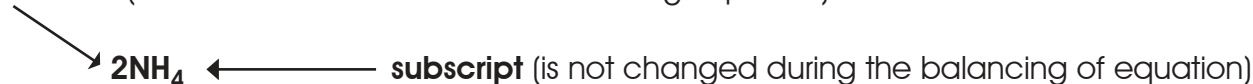
- Count and compare the number of atoms of each element on the LHS and RHS of the arrow. Is the number of atoms of each element the same on both the sides? If not, then the equation is unbalanced because the mass is not the same on both sides of the equation. Such a chemical equation is a skeletal chemical equation for a reaction. Equation (1.2) is a skeletal chemical equation for the burning of magnesium in air.

Balancing Chemical Equations

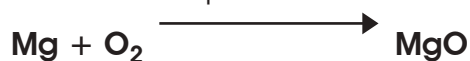
One of the most important rules of chemistry is that matter is not created or destroyed in a chemical reaction. It only changed into a new form. This is the Law of Conservation of Mass which states that in a chemical reaction, the mass of the product is equal to the mass of the reactants.

- Balanced chemical equation has the same number of atoms of each element on each side.
- To balance the equation, we place coefficients in front of each chemical.

coefficient (is added to the formulae in balancing equation)



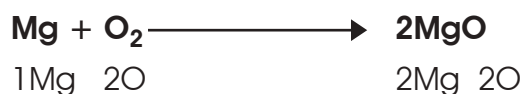
- Consider the skeletal equation for the above reaction



- Count the atoms on each side.



2. Balance the oxygen atoms



3. Balance the magnesium atom



(The number of atoms on the LHS is equal to the number of atoms on the RHS)



Review Exercise

1. Write the names of the reactants and products in the following equations:

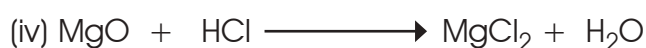
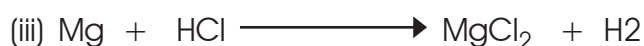
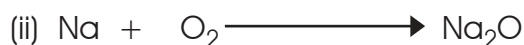
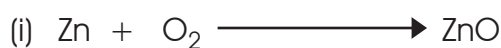


2. What is a balanced chemical equation? Why should chemical equations be balanced?

3. Meera told Gopi that a soluble aspirin tablet fizzing in water is a chemical reaction, but the water, in a kettle turns to steam is not. Do you agree? Give a reason.

4. Two colourless liquids were mixed. No observable change occurred to the solutions, however, the test tube in which they were mixed got hotter. Did a chemical reaction occur? Explain.

5. Balance the following skeletal chemical equation:



2.3.3

TYPES OF CHEMICAL REACTIONS

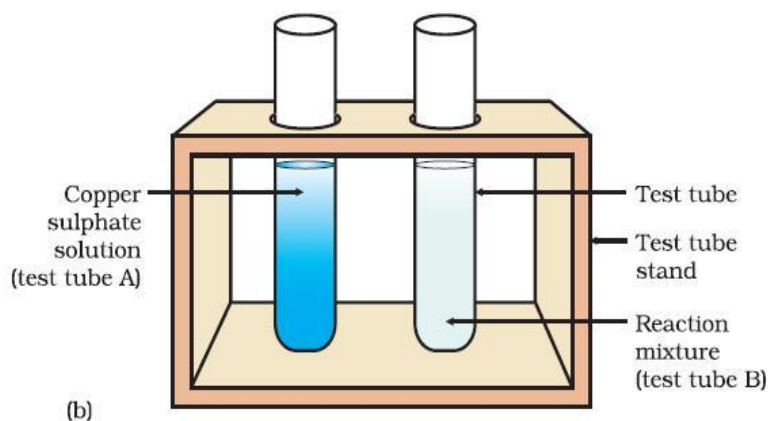
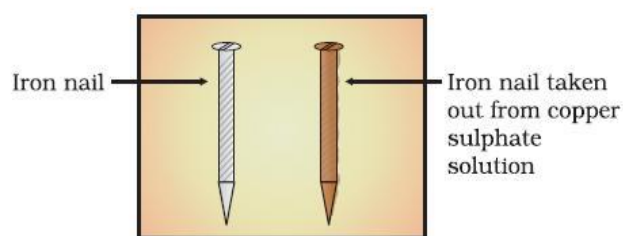
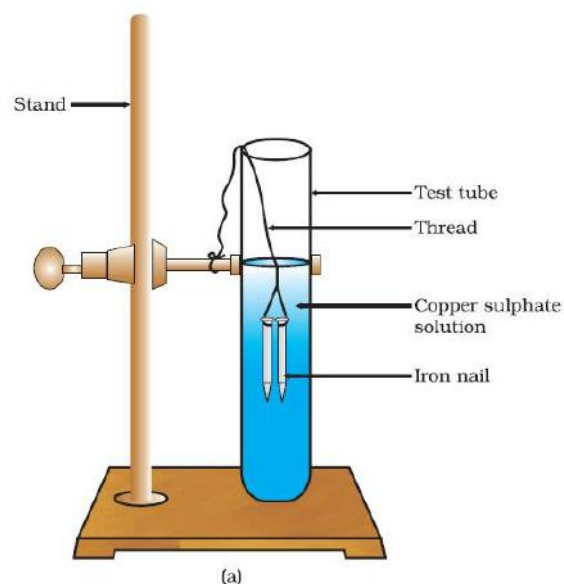
During a chemical reaction atoms of one element do not change into those of another element. Nor do atoms disappear from the mixture or appear from elsewhere. Actually, chemical reactions involve the breaking and making of bonds between atoms to produce new substances.

1. Displacement Reaction (also known as single replacement)

A displacement reaction is where a more reactive metal displaces a less reactive metal from a compound. In other words a metal higher up in the reactivity series will 'push out' a metal lower in the series.

Activity 3

- Take three iron nails and clean them by rubbing with sand paper.
- Take two test tubes marked as (A) and (B). In each test tube, fill about 10 mL copper sulphate solution.
- Tie two iron nails with a thread and immerse them carefully in the copper sulphate solution in test tube B for about 20 minutes. Keep one iron nail aside for comparison.
- After 20 minutes, take out the iron nails from the copper sulphate solution.
- Compare the intensity of the blue colour of copper sulphate solutions in test tubes (A) and (B).
- Also, compare the colour of the iron nails dipped in the copper sulphate solution with the one kept aside.



Why does the iron nail become brownish in colour and the blue colour of copper sulphate solution fade? The reason why this happened is because iron is higher in the reactivity series so it 'takes' the sulphate from the copper to form iron sulphate... and copper.



In this reaction, iron has displaced or removed another element, copper, from copper sulphate solution. This reaction is known as displacement reaction.



Basically, the rule is: If the pure metal is higher in the reactivity series than the metal in the compound, then displacement will happen

2. Precipitation (also known as double replacement)

Is a reaction in which the elements in two compounds are exchanged and form different compounds. When some solutions are mixed, an insoluble solid forms as one of the products. The insoluble solid is called precipitate. Any reaction that produces a precipitate can be called a precipitation reaction.

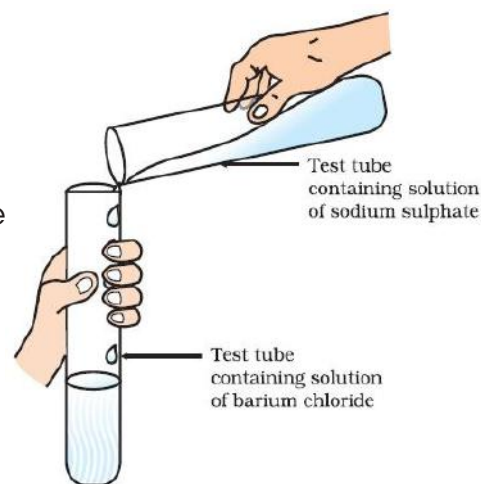
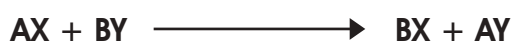
Activity 4

Take about 3 mL of sodium sulphate solution in a test tube.

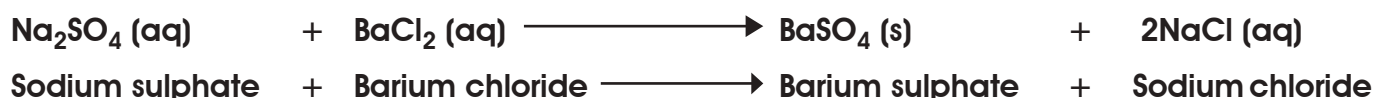
In another test tube, take about 3 mL of barium chloride solution. Mix the two solutions.

What do you observe?

Which compound was responsible for the reaction?



As an analogy, imagine that AX and BY are two couples. A and B switch boyfriends, so B is now going out with X and A is now going out with Y.



3. Synthesis (also known as combination reaction)

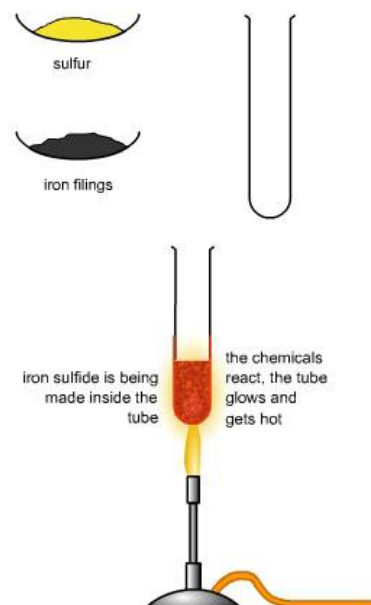
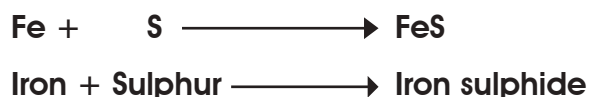
A synthesis reaction is one where two substances combine to make a new substance. It can be shown in an equation such that:



The properties of the reactants are different from the properties of the compound formed.

Activity 5

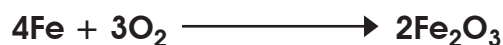
- Place 2g of iron filings in a test tube.
- Place 2g of sulphur in the same test tube.
- Mix the iron and sulphur.
- Heat the test tube over Bunsen burner and stop once the reaction begins.
- What was the colour of iron filings and sulphur before and after heating?
- Name the new substance that was formed from the reaction.



4. Oxidation and Reduction

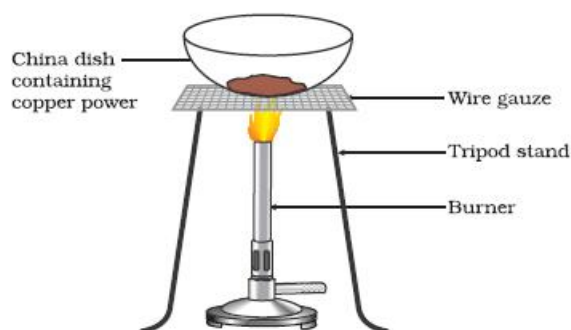
Oxidation is a reaction where an element gains oxygen. It is the loss of electrons from an atom or ion. Reduction is a reaction where an element loses oxygen. It is the gain of electron from an atom or ion. Examples of oxidation are combustion (burning), respiration and rusting.

Rusting: iron gains oxygen to form iron oxide.

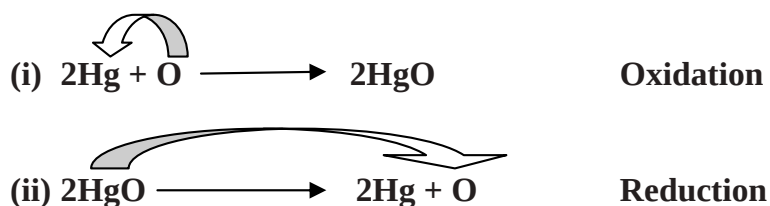


Activity 6

- Heat a china dish containing about 1 g copper powder.
- What do you observe?
- What do you think has happened to copper powder?

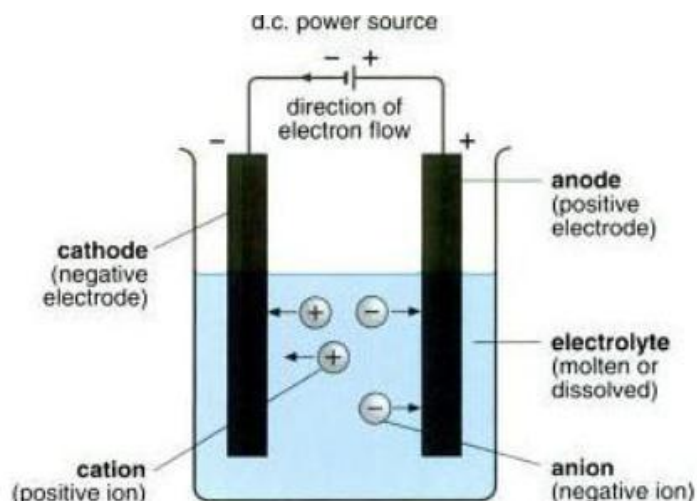


An example of reduction is the decomposition of mercury oxide (HgO). When it is heated, mercury oxide decompose (break down) to form mercury and oxygen. Because mercury loses oxygen in this reaction, we say that it is reduced.



5. Electrolysis – Electroplating

Electrolysis is the decomposition of compound using electricity.



Electrolyte – is the compound which conducts electric current in molten or when dissolved in water (aqueous solution).

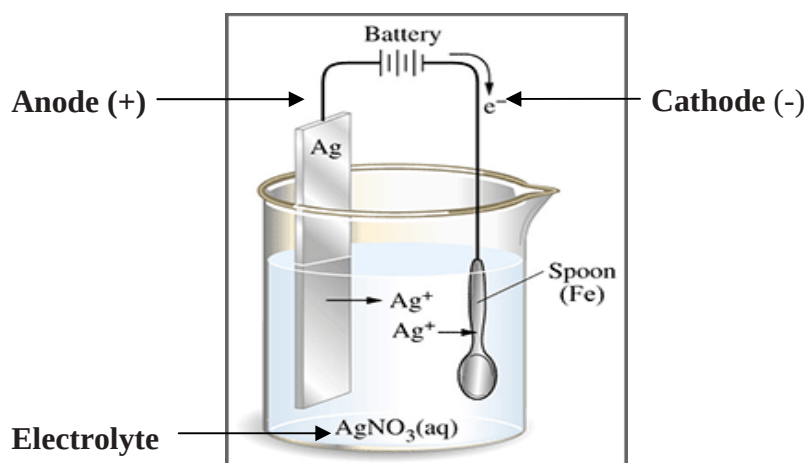
Electrode – is a rod or plate where electric current enters or leaves electrolyte during electrolysis. Reaction occurs at electrodes.

Anode – is the positive electrode; anion – is negative ion (attracted to anode)

Cathode – is the negative electrode; cation – is positive ion (attracted to cathode)

Electroplating - the process of coating a metal object with a thin layer of another metal by means of electrolysis. Example, chromium, zinc, nickel, gold over cheap metal like iron, copper, brass using electrolysis process.

To coat the spoon with silver metal (Ag), the spoon is used as the cathode (-) and silver metal is used as the anode (+). Silver from the anode is oxidized to silver ions (Ag^+), which dissolves in the electrolyte. The ions are attracted to the cathode where they are reduced to silver metal, which forms a coating on the spoon.



The liquid electrolyte always contains a compound of the metal to be plated e.g. silver nitrate (AgNO_3). The plating metal (anode) gradually dissolves and eventually gets deposited on the object to be plated (cathode).



Electroplating is very **useful** because of the following reasons:

- Surface protection (prevent the metal from rusting) e.g. nickels plating of iron to prevent corrosion, bumper parts and door handles are often made from steel or brass plated with chromium.
- Makes the article attractive e.g., electroplating of silver or gold on brass etc.
- Repair of finer machine parts.



2.3.4

FACTORS AFFECTING REACTION RATE

Explosions are chemical reactions that take place very quickly. Explosions also produce a lot of heat, light and sound. In less than 10 milliseconds, a dynamite blast in a large mine can produce 5 billion litres of gas and release 20 billion joules of energy- enough energy to tear any rock apart. In contrast, the chemical reactions that cause concrete set are very slow. It can take several days for the concrete to set hard. Rusting is another example of a slow chemical reaction.



The rate of a chemical reaction is a measure of how fast the reactants are being used up and how fast the products are being made. Particles must collide for a chemical reaction to happen. The rate of a reaction depends on the frequency and energy of collisions between particles.

Chemical reactions proceed at different rates. The factors that affect reaction rates are:

1. **Temperature**

If the temperature is increased, the rate of reaction will increase; low temperature, reaction rate will be slow.

Activity 1

- Bunsen burner
- Matches
- Test tube, test tube rack & test tuber holder
- Solid calcium carbonate or coral
- Dilute Hydrochloric acid (HCl)



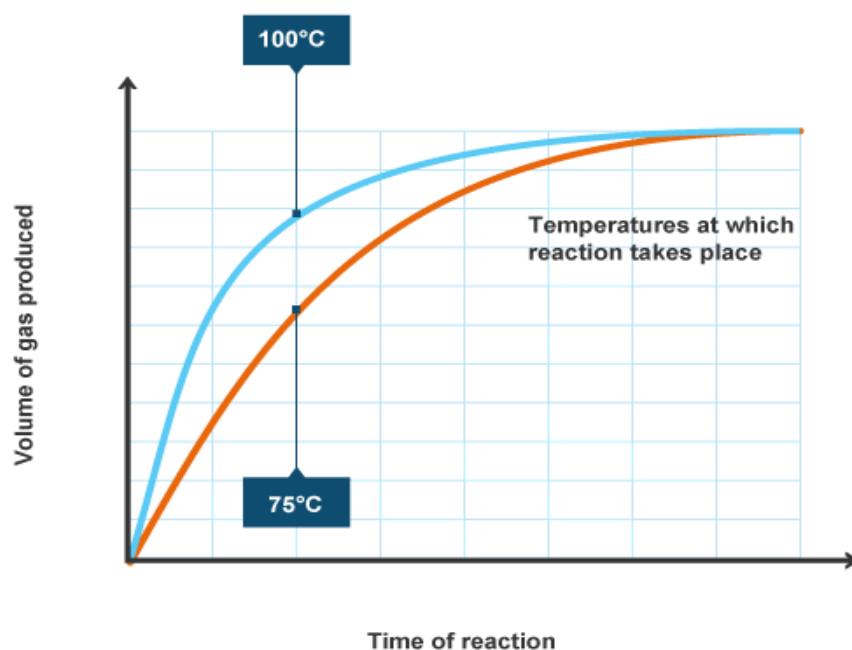


Place 2-3 pieces of calcium carbonate inside the test tube and add hydrochloric acid to half fill the test tube. Observe the reaction. Then gently heat the test tube and observe the reaction.

1. While adding HCl to the test tube containing calcium carbonate, did any reaction occur?
2. What happened when the test tube was heated?
3. In this reaction the calcium carbonate reacted with HCl to form calcium chloride, water and carbon dioxide gas. Write the word equation for this chemical reaction.

If the temperature is increased, the particles have more energy and so move quicker. Increasing the temperature increases the rate of reaction because the particles collide more often and with more energy.

Look at the graph of the reaction between hydrochloric acid and calcium carbonate. Notice how an increase in temperature leads to an increase in the speed of release of carbon dioxide, but not the total volume.



2. Concentration

Increasing concentration increases the rate of reaction. Dilute solution react slowly and concentrated solution react quickly.

Activity 2

- Dilute & Concentrated Hydrochloric acid (HCl)
- Magnesium ribbon
- 2 test tubes & test tube rack

Place 2 pieces of magnesium ribbon of the same length in separate test tubes and add about 2mL of dilute HCl in one test tube. In another test tube add another 2mL of concentrated HCl. Observe the reaction rate of the two test tubes.



1. In which test tube is the reaction the fastest? Suggest a reason for this.
2. How can you measure the rate of this reaction?
3. What is the gas given off?
4. Why was it important that the same length of magnesium ribbon was used for each reaction?

If the concentration of reactants is increased, there are more reactant particles moving together. There will be more collisions and so the reaction rate is increased. The higher the concentration of reactants, the faster the rate of a reaction will be.

3. Surface Area

Increasing the surface area increases the rate of reaction.

Activity 3

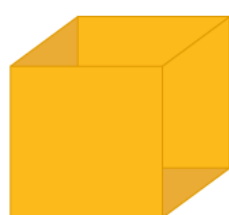
- 2g solid & 2g powdered calcium carbonate (or coral)
- Hydrochloric acid
- Beaker & 2 test tubes

Prepare a solution of hydrochloric acid in the beaker by adding 2 mL of the concentrated solution to 20 mL of water. Place the marble chips and powdered marble into separate test tubes. Add 10 mL of the dilute hydrochloric acid to each of the test tubes and observe the rate at which carbon dioxide gas is produced.

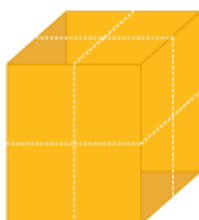
1. Which reaction proceeds the fastest?
2. Can you explain the reason for this reaction?
3. Complete the chemical equation for this reaction:



By decreasing the particle size of a reactant, we are increasing the surface area. The greater the surface area, the higher the chance of collisions occurring is, thus the faster the rate of reaction. The smaller the particle sizes the faster the reaction. Smaller particles have a larger surface area.



surface area 6 sides



surface area $6 \times 8 = 48\text{cm}^2$



4. Catalysts

A catalyst speeds up the rate of a reaction but it is not used up in the reaction. If a catalyst is present, the reacting particles can collide more successfully with less energy and so the reaction can take place at a lower temperature.

Activity 4



- Graduated cylinder
- Hydrogen peroxide (3%)
- Yeast
- Spatula
- Detergent solution
- Dropper



Add 10 mL of hydrogen peroxide to a graduated cylinder. Add 1 drop of detergent solution. Swirl gently and watch the solution for any bubbling. Use the spatula to add a small amount of yeast to the hydrogen peroxide in the graduated cylinder and swirl. Place the graduated cylinder on the table and watch for any bubbling. Hold the graduated cylinder to see if there seems to be any change in temperature.

1. What evidence did you have that a chemical reaction occurred in this activity?
2. What is the catalyst in this activity?
3. What evidence do you have that hydrogen peroxide decomposed faster when you added yeast?
4. When writing the chemical equation for this reaction, should yeast be included on the product side of the chemical equation?

Condition	Effect on rate	Explanation
Temperature	increasing the temperature increases the rate of a reaction	Two reasons: 1. There are more particles with sufficient energy to react (most important) - more successful collisions 2. There are more collisions
Concentration	Increasing the concentration of a reactant increases the rate of the reaction (usually)	There are more collisions as there are more particles in closer proximity
Particle size	The smaller the particles the faster the reaction. (note: the solute particles in solutions have the smallest particle size possible, and so solutions react fastest)	Collisions occur at the surface of particles. The larger the particle size the smaller the surface area and the fewer collisions can occur.
Catalysts	The presence of a catalyst increases the rate of a reaction	Catalysts provide an alternative mechanism with a lower activation energy



CHAPTER 3: ENERGY

- 1. ENERGY SOURCE AND TRANSFER
- 2. ENERGY TRANSFORMATION, USE AND CONSERVATION
- 3. FORCES

UNIT 1: ENERGY SOURCE AND TRANSFER

3.1.1 BEHAVIOR OF LIGHT ON LENSES AND PRISMS

Behaviour of light

- Light enables us to see things. It is a form of energy that we can detect with our eyes.
- Light comes to us mainly from the sun.
- This light that reaches the earth is only a small part of the various forms of energy given out by the sun.

Lenses

Lens is a transparent optical device used to converge or diverge transmitted light and to form images. Many materials contain lenses and a few examples are shown below.

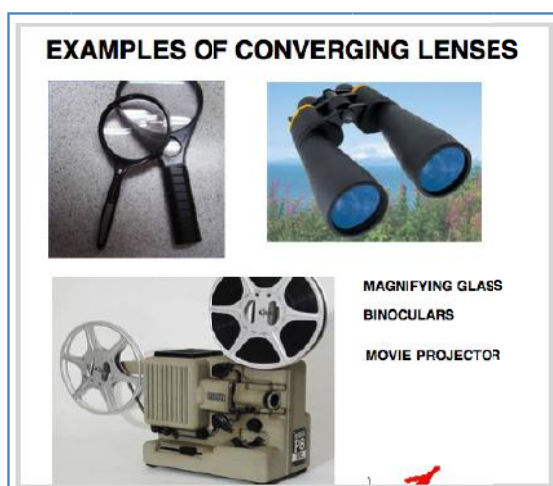
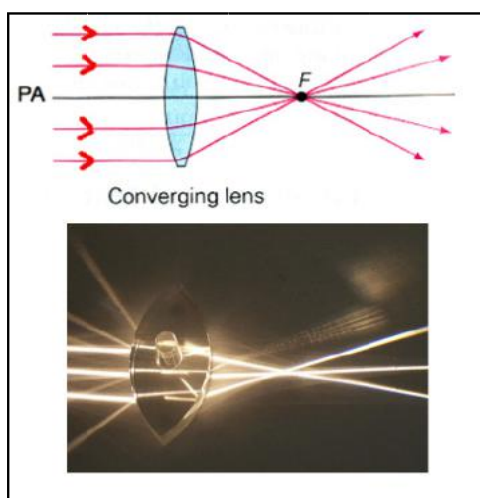
Object	Image	Object	Image
Eyes		Eye glasses	
Telescopes		Hand lens	
Microscope		Binocular	
Camera		Overhead Projectors	

What do lenses do to light rays?

A lens can either be a converging lens (convex lens) or a diverging lens (concave lens).

Converging lens

Lens bends light rays so that they meet at one point. This point is called the focus of the lens. Since the lens bends the light rays to a point, it is said to be a converging lens or a convex lens. Converging lenses can have different shapes. Some can be much curved while others can be nearly flat. The more curved the lens, the more it bends the light. A convex lens acts like a concave mirror. Converging lenses are thicker in the middle than on the outside.



Source: <https://www.google.com/search?q=convex+lens+ray+diagram>

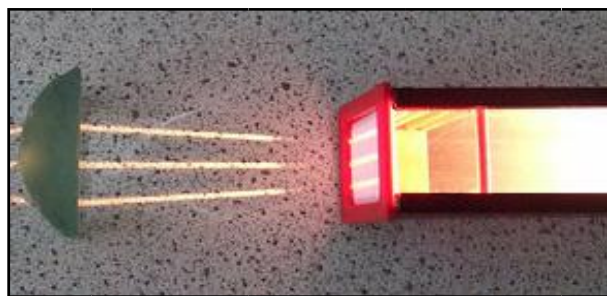
Activity: Lenses and Light

Aim: To investigate the way lenses bend light.

Materials: light kit (ray box), 12 volt power pack, a ruler

Method:

1. Place the light box at the edge of a clean page in your notebook. Shine three or four parallel light rays across the paper.
2. Place a thin converging lens about 5cm in front of the light box.
3. With a pencil, trace around the lens and mark the rays of light so that you have a permanent record of the path of the light rays.

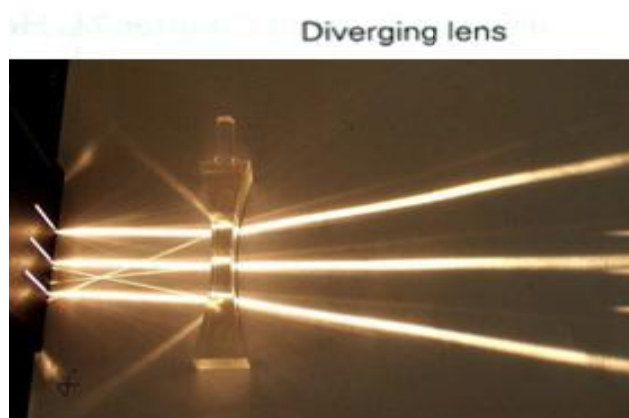


4. Record what you see happening to the light rays.
5. Repeat the above steps with a diverging lens.

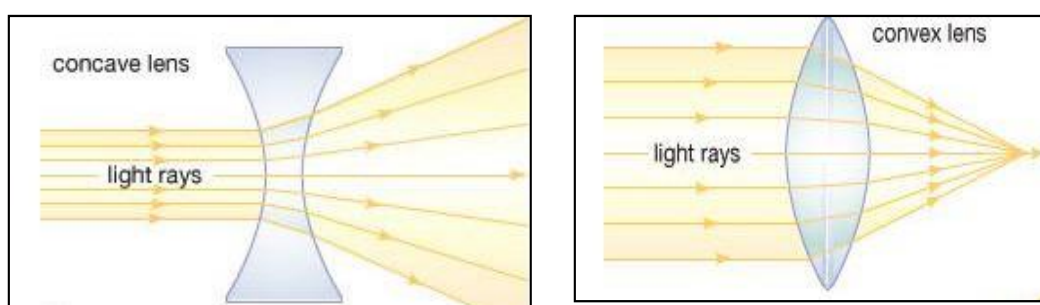
Results: (sentences and diagram of light rays)

Diverging lens

These lenses are thinner in the middle and they also bend light. However, the light rays are bent outwards and are said to diverge or spread out. These are diverging or concave lenses and they behave like convex mirrors.



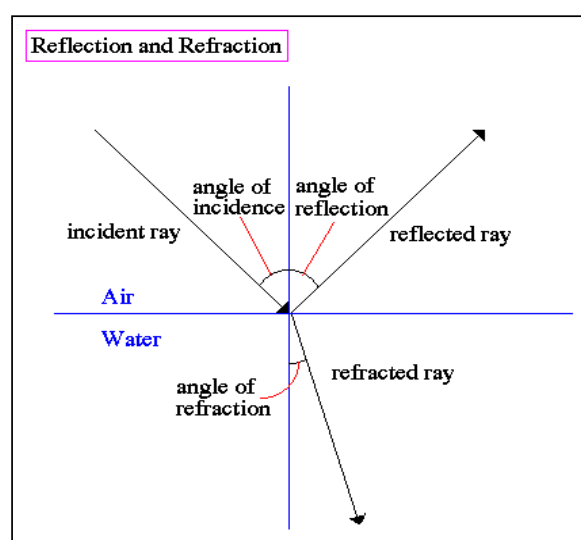
Ray diagrams



Refraction

Refraction is the bending of light when it enters a medium where its speed is different. The refraction of light when it passes from a fast medium to a slow medium bends the light ray toward the normal to the boundary between the two media. The amount of bending depends on the indices of refraction of the two media.

Refraction is responsible for image formation by lenses and the eye.





Example

When a ray of light enters a glass block, it bends towards the normal [fast medium to slow medium] and as it leaves the glass block, it bends away from the normal [slow medium to fast medium].

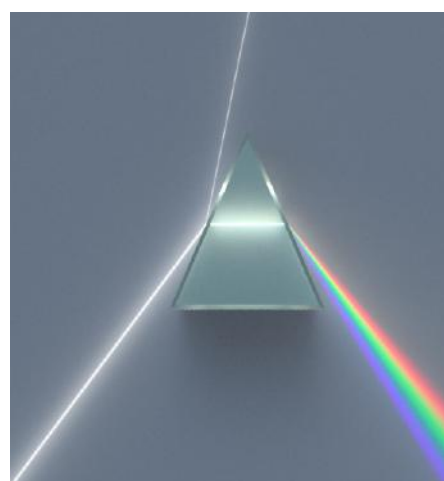
The bending of light can also give you a false impression about depth.



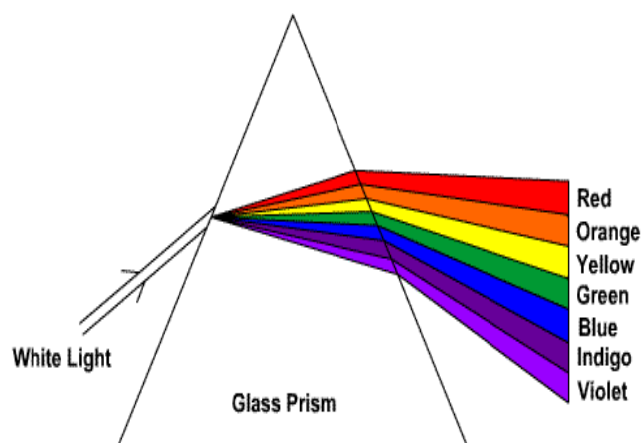
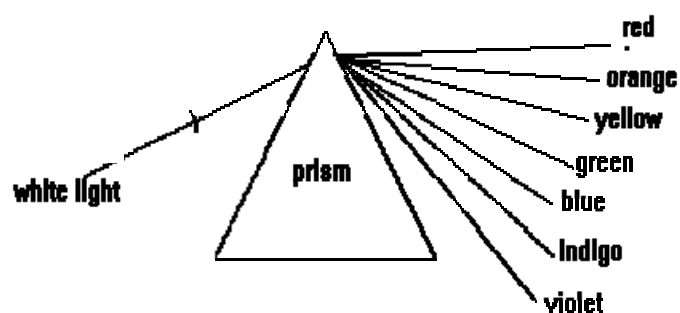
Dispersion of Light

The light rays from the sun consist of seven different colors – red, orange, yellow, green, blue, indigo and violet (ROYGBIV). We see seven different colors when these rays are passed through a glass prism.

If a ray of light passes through a prism as in the diagram, the light splits into a range of colours. The effect is called dispersion and the colour range is known as a spectrum.



Ray diagram through a prism



- Which colour does a prism refract (bend) the most?
- Which colour does a prism refract the least?

The most familiar example of dispersion is a rainbow which is seen when the sun appears in the sky after the rains. The moisture in the atmosphere behaves like tiny prisms, dispersing the sun's rays into seven colors.



Source: <http://www.educationalelectronicsusa.com/p/images>

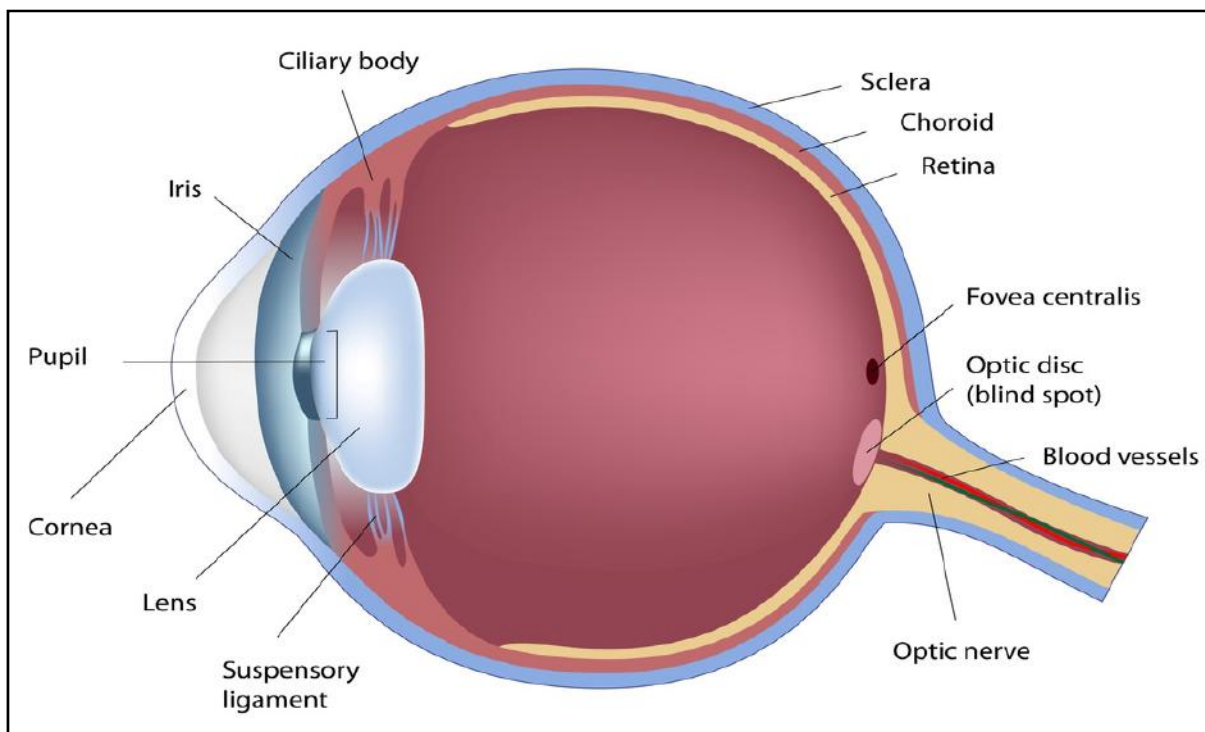
This shows that white light is not one colour but a mixture of colours. It also shows that rays of different colours are refracted (bent) by different amounts.



3.1.2

LONG-SIGHTEDNESS AND SHORT-SIGHTEDNESS

The Human Eye



Source: <http://www.wisegeek.com/what-are-the-most-common-eye-defects.htm>

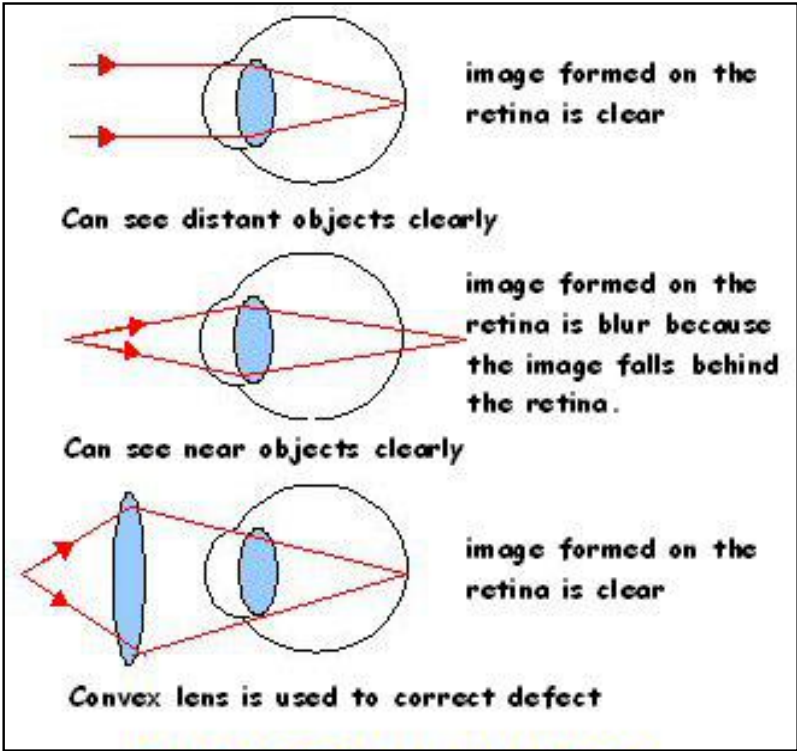
Eyes are different in the colour of the iris, the size and the shape of the eyeball, and how well the lens and cornea can focus the light. Some people have to wear spectacles to see clearly. As people get older, their eyesight generally becomes poorer. They find it difficult to focus on close objects. This is caused by the eye muscles around the lens becoming weaker with age. The lens also becomes harder, and cannot change shape so easily. People with this problem are said to be long-sighted (or far-sighted). They cannot see close objects clearly. The eye-ball is too short for the lens system.



They can only focus on far objects but near objects look blurry.

Source: <http://www.surgery-laser-eye.com/long-sight.htm>

Long-sighted people cannot focus the image on the retina. It focuses behind the retina. The image appears all 'fuzzy' or 'blurry' because it is not in focus.



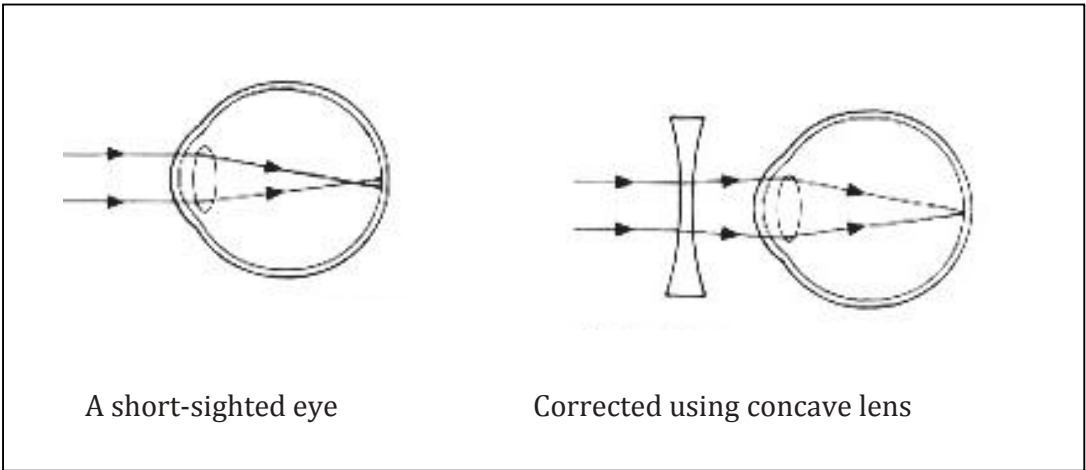
In this case, spectacles or glasses are worn. The lenses in the spectacles need to be converging lenses. These bend the light rays inwards and make the image form on the retina. Some eyes focus on the image in front of the retina. People with this fault are said to be short-sighted. They cannot see distant objects clearly and the eye-ball is too long for the lens system.



They can focus on close objects, but are unable to focus on distant objects.

Source: <http://www.surgery-laser-eye.com/long-sight.htm>

To correct the fault, spectacles using diverging lenses (concave lens) are worn.



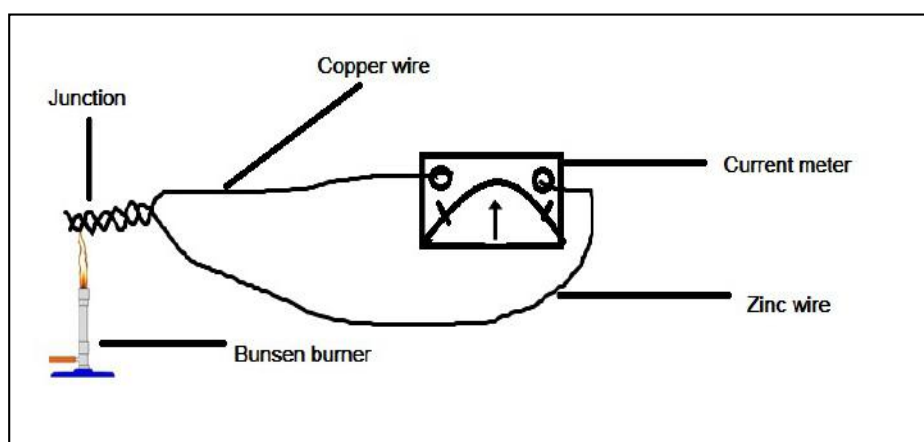
UNIT 2: ENERGY TRANSFORMATION, USE AND CONSERVATION

3.2.1

ELECTRICITY

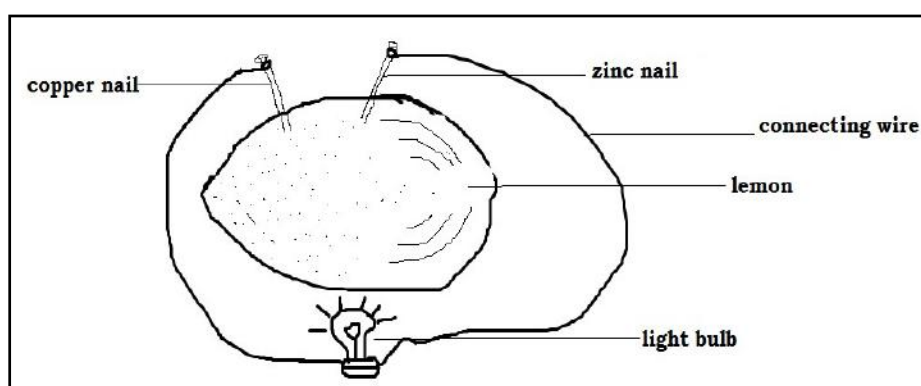
How is electricity produced?

1. Using Heat - Thermocouple



In this set up, two wires of different metals, namely copper and zinc are twisted around each other. The ends are connected to a current detector [or a light bulb] while the twisted end is heated in a flame. Current flow will be indicated by the deflection of the needle or the lighting of the bulb

2. Lemon Battery [Simple Cell]



A lemon is softened to allow the juice (citric acid) to move around freely. A copper nail and a zinc nail are placed on the lemon as shown in the diagram. The two nails should not touch. The current that is produced will light the bulb.

3. Using light

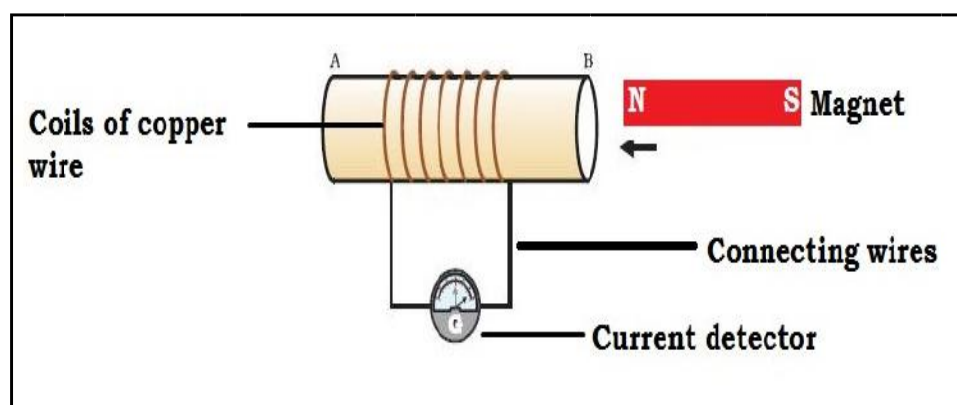


Source: <http://www.physics.org/article-questions.asp?id=51>

The cells that produce an electric current when light is shown on them are called “solar cells”.

Hundreds of these cells are used to produce an electric energy to operate instruments. The solar cells convert the sun’s energy into electricity. Example of an instrument that uses solar energy is a solar calculator.

4. Using Mechanical Energy



The set up above shows a magnet near a coil of copper wire. The coil is connected to a sensitive ammeter. When the magnet is stationary, there is no current in the coil. However, if we move the magnet towards the coil, the ammeter flicks to the right. When the magnet is pulled out, the needle flicks to the left.

This shows that we induced a current in the coil – but only whilst the magnet was moving. The direction of the current depended on the direction of the movement.

To get a lasting current from the coil, we have to keep pushing the magnet in and pulling it out. This will make the current go backwards and forwards. In other words, we have generated an alternating current.



What energy changes have taken place in the above examples?

Example	Energy Conversion
1. Using heat	heat energy to electrical energy
2. Using chemical	_____ energy to _____ energy
3. Using light	_____ energy to _____ energy
4. Using mechanical	_____ energy to _____ energy

Conductors

Conductors are materials that allow electric currents to flow freely or that electricity can flow through easily. Most metals are good examples of electrical conductors. Copper is the most popular material used for wires because it is a very good conductor of electrical current and it is fairly inexpensive when compared to gold and silver. Aluminum and most other metals do not conduct electricity quite as good as copper. Other examples of conductors are:

- Aluminum
- Platinum
- Gold
- Silver
- Water
- People and Animals
- Trees

Electricity will always take the shortest path to the ground. Your body is 60% water and that makes you a good conductor of electricity. If a power line has fallen on a tree and you touch the tree you become the path or conductor to the ground and could get electrocuted.

Insulators

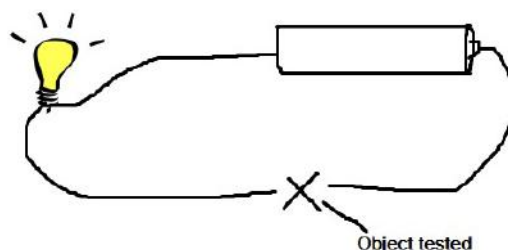
Insulators are materials that have just the opposite effect on the flow of electric current as in conductors. Some common insulator materials are:

- glass
- plastic
- rubber
- air
- wood.

Insulators are used to protect us from the dangerous effects of electricity flowing through conductors. If it flows through our body, the function of our heart can be disrupted by a strong electrical shock and the current can cause burns. Therefore, we need to shield our bodies from the conductors that carry electricity. The rubbery coating on wires is an insulating material that shields us from the conductor inside.



Use the set up shown to test whether the following objects are insulators or conductors. Tabulate your findings.

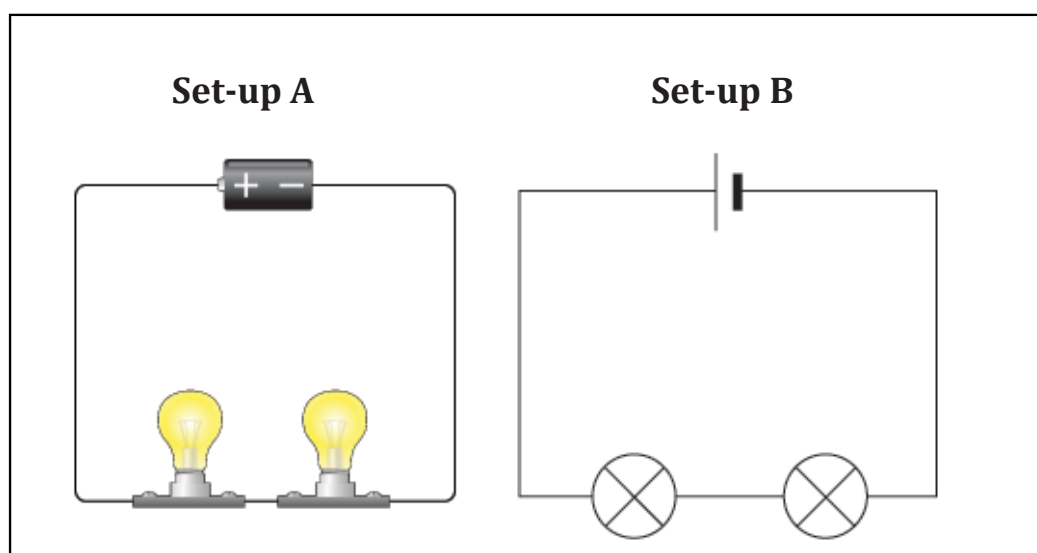


Electrical Circuits

A simple circuit consists of three elements:

1. a source of electricity (battery),
2. a path or conductor on which electricity flows (wire) and
3. an electrical resistor (lamp) which is any device that requires electricity to operate.

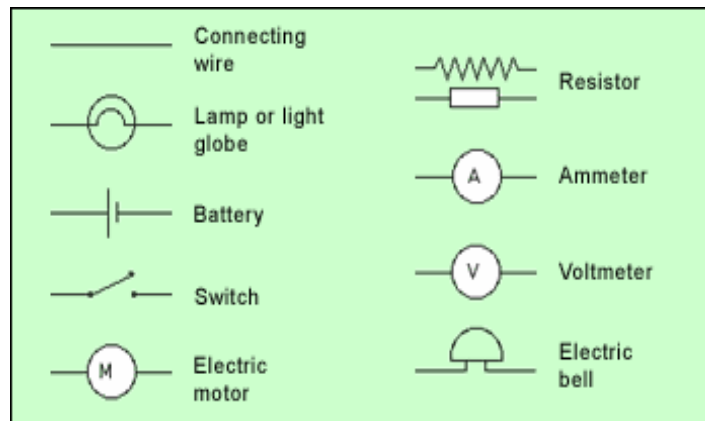
Shown below is a simple circuit containing a battery, two wires, and light bulb. The conducting path through the bulb, wires and battery is called a circuit. Electrons flow around this circuit from the - to the + terminal of the battery. The flow of - charge is called a current and it can be measured by placing an ammeter in the circuit.



The flow of electricity is caused by excess electrons on the negative end of the battery flowing toward the positive end, or terminal, of the battery. When the circuit is complete, electrons flow from the negative terminal through the wire conductor, then through the bulb (lighting it up), and finally back to the positive terminal - in a continual flow.



Set-up B is a circuit diagram for Set-up A which uses symbols when drawn. Other common symbols are shown below.



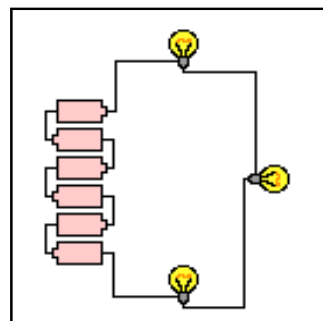
Source: <http://www.daydreameeducation.co.uk/s>

Circuit Connections

When there are two or more electrical devices present in a circuit with an energy source, there are a couple of basic means by which to connect them. They can be connected in series or connected in parallel.

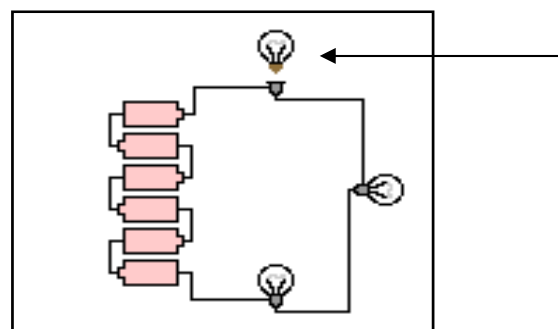
Series Arrangement

When all the devices are connected using series connections, the circuit is referred to as a series circuit. In a series circuit, each device is connected in such a way that there is only one pathway for charge flow. In other words, there are no branches.



Disadvantages of Series Arrangement

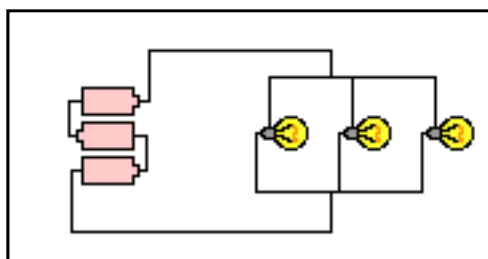
1. When more lamps are added to the series, the lamps will be dimmer than before.
2. If a lamp does not work, the rest will not work too.



Source: http://www.bbc.co.uk/bitesize/ks3/science/energy_electricity_forces

Parallel Arrangement

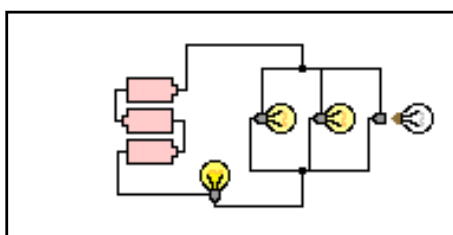
In parallel circuits different components are connected on different branches of the wire.



If you follow the circuit diagram from one side of the cell to the other, you can only passthrough all the different components if youfollow all the branches.

Advantages of Parallel Arrangement

1. Unlike a series circuit, the lamps stay bright even if you add more lamps in parallel.
2. If a lamp breaks or becomes faulty, the other lamps ondifferent branches keep working.



← This arrangement is used for wirings at home.

Energy Usage at Home

Energy usage varies for different households. Some may use more than others depending on the electrical appliances they use. Most homes have high electricity bills due to misuse of appliances and electronics. Many lightings at home do not use energy saver bulbsand some appliances are used frequently when other strategies are available to save energy.

FORMULA FOR ESTIMATING ENERGY CONSUMPTION

Watts: Power, as measured in watts which is the amount of power required to operate an electrical appliance or device. Appliances will have its wattage written on them.



Use this formula to estimate an appliance's energy use:

$$(\text{Wattage} \times \text{Hours Used Per Day}) \div 1000 = \text{Daily Kilowatt-hour (kWh) consumption}$$

1 kilowatt (kW) = 1,000 Watts



Multiply this by the number of days you use the appliance during the year for the annual consumption in kWh per year.

ESTIMATING ANNUAL COST TO RUN AN APPLIANCE

Multiply the annual consumption in kWh per year (that you calculated above) by your local utility's rate per kWh (\$0.3484) consumed to calculate the annual cost to run an appliance.

EXAMPLES:

Light bulb: [in a month]

$$\begin{aligned} & (60\text{Watts} \times 4 \text{ hours/day} \times 28 \text{ days/month}) \div 1000 \\ & 6.72\text{kWh} \times \$0.3484/\text{kWh} \\ & = \$2.34/\text{month} \end{aligned}$$

Personal Computer and Monitor:

$$\begin{aligned} & [120 \text{ Watts} \times 4 \text{ hours/day} \times 365 \text{ days/year}] \div 1000 \\ & = 175.20 \text{ kWh} \times \$0.3484/\text{kWh} \\ & = \$61.04/\text{year} \end{aligned}$$

ELECTRICITY BILL

The following steps will enable you to calculate the approximate monthly electricity bill for domestic customers.

Step 1: Calculate Electricity Cost

Units used (kWh) = Present Month's Reading – Previous Month's Reading

Electricity Cost VEP (VAT Exclusive) – Units used x \$0.3484cents*

Step 2: Add VAT for Total Bill

VAT = Electricity Cost VEP x 15%

Total Bill VIP (VAT Inclusive Price) = Electricity Cost VEP + VAT

Step 3: Total Amount Due

Total Amount Due = Total Bill VIP + Amount Overdue and Relating to Prior Bills

Calculation

Issue Date	
06-Dec-2008 to 06-Jan-2009	
READING	
PRESENT	PREVIOUS
001494	001384

← extracted from

Source: <http://www.fea.com.fj/pages.cfm/customer-care/how-calculate-your-bill.html>

Step 1: Calculate Electricity Cost

Units used = 1494kWh – 1384kWh = 110kWh

Electricity Cost = 110kWh x \$0.3484 = \$38.32

Step 2: Add VAT for Total Bill

VAT = \$38.32 x 15% = \$5.74*

Total Bill VIP = \$44.06 [\$38.32 + \$5.74]

Total Current Charges (VIP) \$44.06

Step 3: Add current charges to any Amount Overdue and Relating to Prior Bills to obtain Total Amount Due

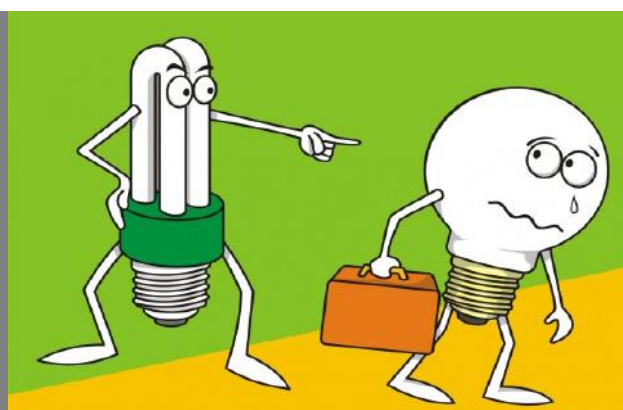
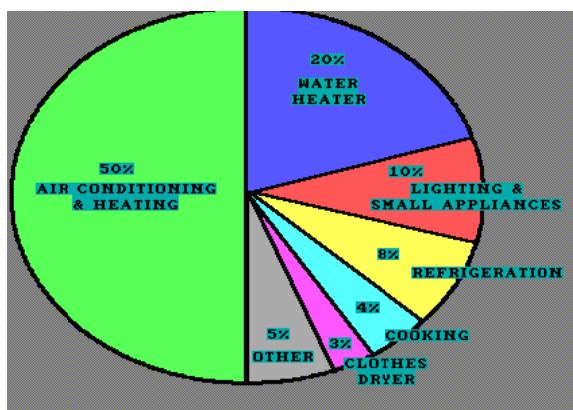
OVERDUES		
Opening Balance	\$21.51	DR
Bal	\$21.51	DR

← extracted from an FEA bill

Total Amount Due = \$44.06 + \$21.51 = \$65.57

How to Conserve Energy at Home

- Unplugging an item when it is not in use to prevent phantom loads(energy leakage).Appliances such as the TV, coffee maker and stereo draw power even when off, in standby or low power mode.
- Changing the settings or using the item less often
- Purchasing a new, more efficient product.
- Replace aging appliances with newer energy efficient ENERGY STAR models.
- Wash economically [only use a washing machine when there is a full load but hand rinse if it is only a few clothes].
- Use the clothes line on a hot sunny day instead of the drier
- Turn off any appliances you are not using, especially by switching off lights when you leave the room. Don't leave fridge or freezer doors open for longer than necessary, and don't forget that your freezer needs to be defrostedregularly for it to run efficiently.
- Use energy-efficient appliances. From light bulbs to kitchen goods to home entertainment equipment, there are more energy-efficient appliances now in the market.



<http://electricsaver1200.com/blog/energy 1>

<http://electricsaver1200.com/blog/energy 1>



	kg CO ₂ /yr saved	Payback time
Unplug mobile phone chargers	4	Instant
Switch off lights in empty rooms	25	Instant
Don't overfill kettle	29	Instant
Wash your clothes at 30 degrees instead of 40	45	Instant
Insulate pipes	65	1 Year
Compost kitchen waste	90	N/A
Drying clothes in air rather than tumble dryer	100	Instant
Unplug unused electrical equipment	120	Instant
Draught-proof	150	3 Years
Buy low-energy appliances	170	9 Years
Use energy saving bulbs	190	1 Year
Put insulation on the hot water jacket	195	4 Months
Turn down the heating	290	Instant
Install solar water heating	325	60 Years
Install double glazing	720	30 Years
Install cavity wall insulation	800	Around 2 Years
Insulate loft	1,050	Around 1 Year
Install solar panels	1,200	58 Years
Install a ground source heat pump	1,800	13 Years
Install a biomass boiler	5,000	40 yrs



UNIT 3: FORCES

3.3.1

MACHINES

A machine is anything that can make our work easier. Machines make our work easier in three different ways:

1. It multiplies the force we use
2. It multiplies speed [make things go faster]
3. It changes the direction of force.

Given below are simple examples of machine

1. Broom 	2. Airplane 
3. Cricket Bat 	4. Lawn Mower 
5. Steps 	6. Tractor 
7. Fishing Rod 	8. Spanner 

Source: <https://www.google.com/search>

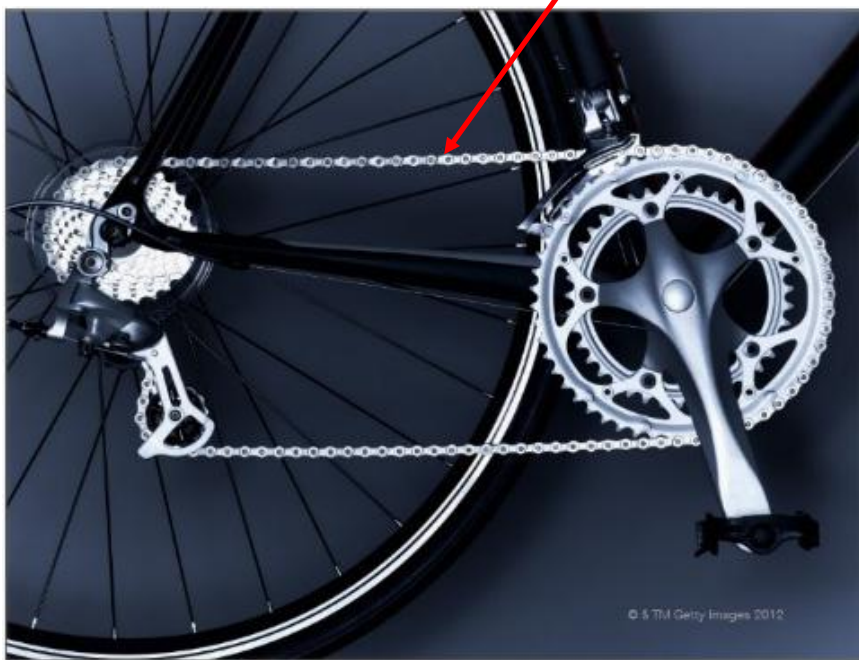
Simple machines include gears, pulleys, lever, and wheel and axle and inclined plane.



GEARS

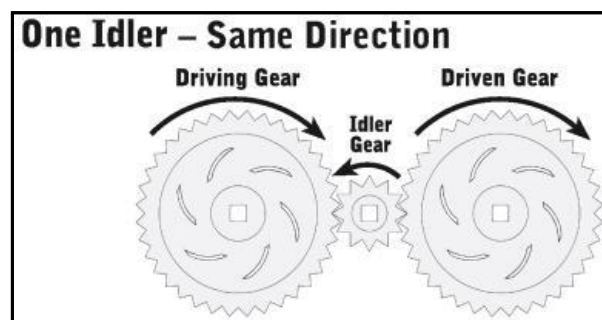
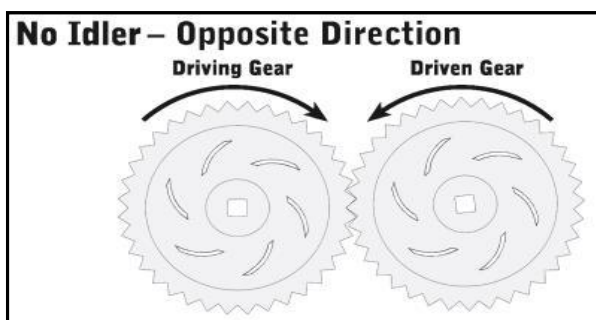
Gear wheels are wheels with teeth on them. The teeth of one gear usually fit into the teeth of another. Gears are used to transfer the force from one wheel to another. In a bicycle, the large gear wheel attached to the pedals is connected to the smaller gear wheel on the back wheel by the chain.

Chain connects front and rear gear wheels.



Source: http://www.zazzle.com/close_up_of_bicycle_chain_pedal_and_gears

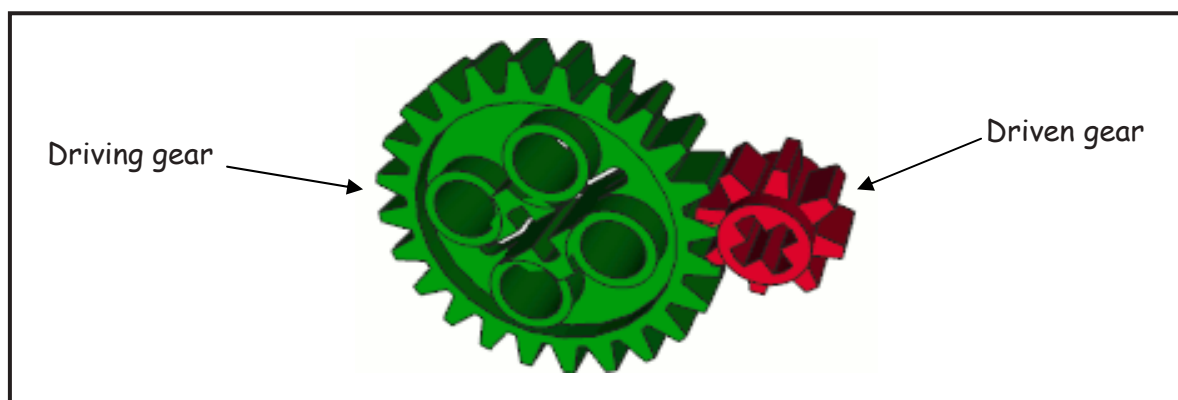
One gear can make another one turn faster, but it can also make it turn in a different direction. When you turn a big gear to the right, the little one will move to the left. This is good for many machines where the direction needs to change in order for the machine to work.



An idler gear is a gear wheel that is inserted between two or more other gear wheels.

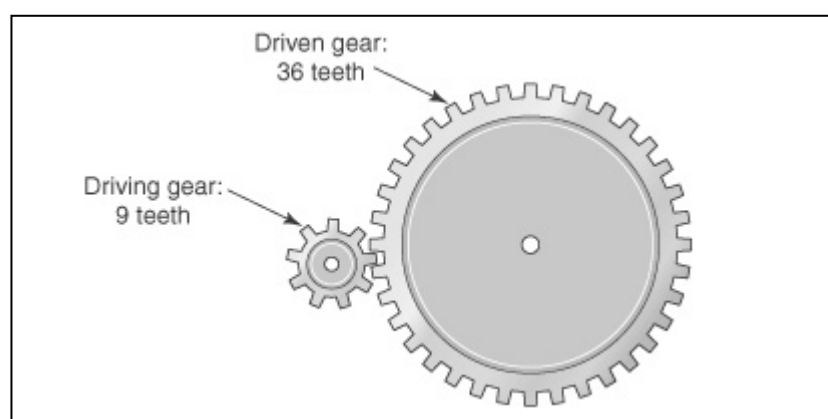


Gears can speed things up or slow things down. Look at the diagram below. The large gear wheel has more teeth on it than the smaller gear wheel. The larger gear wheel is called the driving gear because it is attached to the motor and therefore supplies the force. The smaller gear wheel is called the driven gear.



This arrangement of gears turns the driven gear faster. Machines that use a larger driving gear include hand beaters and hand drills. In these machines the drill bits have to rotate very fast to do their job. When driving gear turns clockwise, driven gear will turn anticlockwise.

Machines that have a smaller driving gear than the driven gear are for slow rotation.



This arrangement is used in rotating displays in shops where the displays have to rotate slowly so that you can see the goods.

Uses of Gears

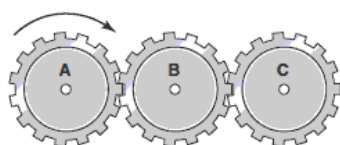
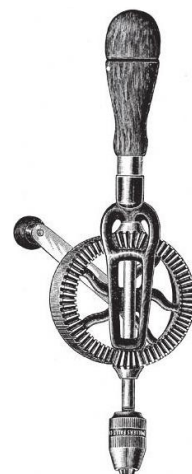
Gears are everywhere! Some rides at an amusement park or festival use large gears which make them spin in circles (like the spinning Ferris wheel during Hibiscus festival). Huge wind turbines use gears to convert the slow motion of the blades into much faster motion to make electricity.

Gears are in small things, too, like tiny music boxes or remote controlled cars. They are used in clocks to make the minute and the hour hand go around. They are used in motors: big car motors, and little motors that make your toys move. Most of the time they are hidden away inside so you can't see them, but if you look at a can opener, you will be able to see two gears. Turning the handle will make one of the gears move, and the other one will move in the opposite direction. You can also see gears on a bicycle. With some bikes, the wheels will move at different

speeds when you pedal because of gears connected by a chain.

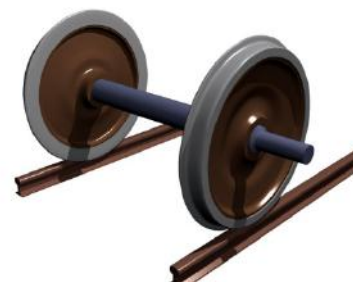
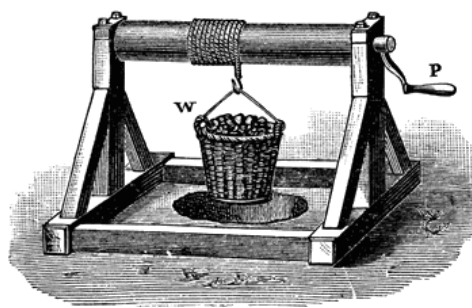
ACTIVITY

- A. A hand beater or a hand drill will be needed for this activity.
1. Turn the handle on the driving gear and observe how fast the driven gear turns.
 2. Count the number of teeth on the two gear wheels and record. Divide the larger number by the smaller number and record your answer.
 3. Slowly turn the driving gear wheel through one revolution and count how many times the driven gear wheel turns.
- * How many revolutions does the driven gear wheel turn for every turn of the driving gear?



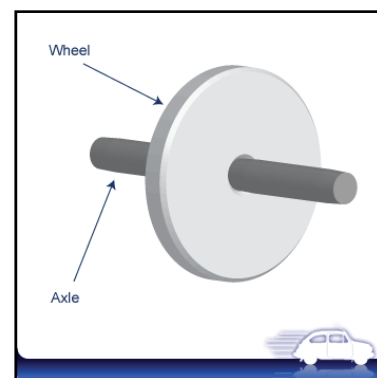
- * What can you infer about the relationship between the number of teeth on the gear wheels and how fast they turn?

WHEEL AND AXLE



A wheel and axle is a simple machine made up of two circular objects of different size. The axle (a small wheel) is attached to the center of a larger wheel. All wheels need an axle. The wheel and axle must move together to be a simple machine. A wheel and axle lifts or moves loads.

Effort applied to the wheel turns the axle, or effort applied to the axle turns the wheel. They move together. When effort is applied to the wheel, the wheel and axle spreads the force over a greater distance. If the radius of the wheel is two times larger than the radius of the axle, every time you turn the wheel once, the force will be multiplied by two. A wheel and axle can produce a gain in either effort or distance, depending on how it is used.





Examples of a wheel and axle can be found in doorknobs, roller skates, pencil sharpener with a handle, steering wheels of a car, screw drivers, treadle sewing machine and wheels of a car, to name a few.

Because the wheel is larger than the axle, it always moves through a greater distance than the axle. Such a situation multiplies the force applied to the axle, but as always requires a trade off by moving the effort over a greater distance. Steering wheels and screwdrivers are common examples. Changing the diameter of either the wheel or the axle controls the mechanical advantage – the amount of help that using a simple machine provides - of a wheel and axle system. As the diameter of the wheel increases (and the axle stays the same), the mechanical advantage increases and a greater force is applied to the axle.

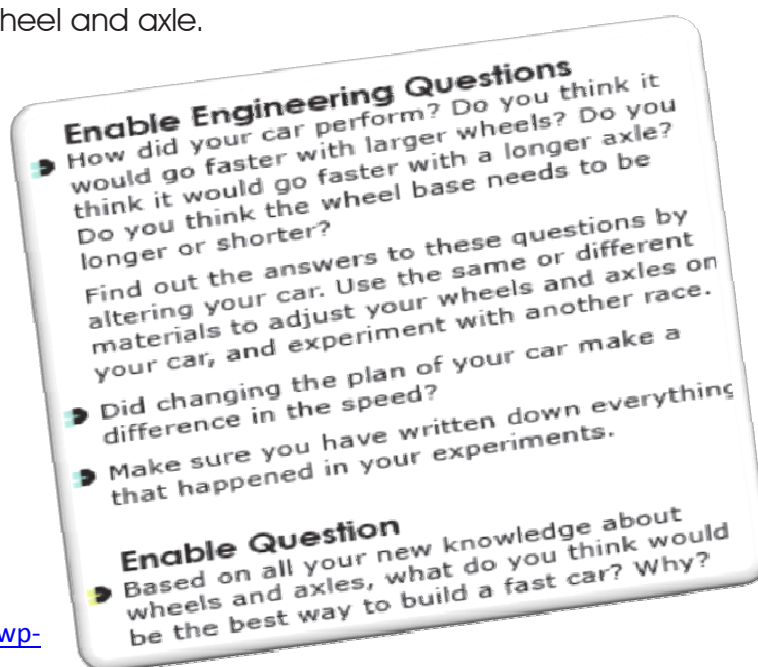
Exercise - Wheel and Axle : Making your own car!

Materials

- Axle: skewers, pencils, broom stick, or hard plastic drinking straw.
- Wheel: thread spools, plastic container lids, water bottle lids, Styrofoam
- Frame: tissue box, piece of wood, water bottle[as above]
- Design: glue, paint, glitter, other art material [optional]

Method

1. take an empty water bottle or frame of your choice and make 4 holes that will be placeholders for the axle.
using your materials, brainstorm different ways to select the best place for the axle. do you need a stronger/larger axle?
2. poke the broom stick through the holes in the water bottle lids.
does your car frame sit evenly on your axles? do you need to adjust your placement?
3. poke holes through your water bottles lids and poke them through the bottle right through to the other side.
4. observe the movement of your wheel and axle.

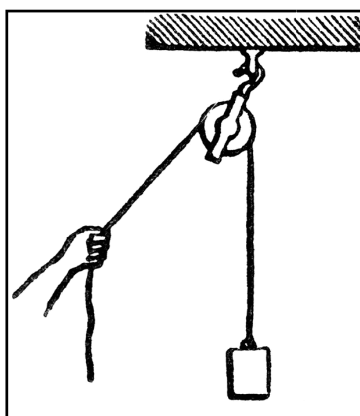


Source: <http://enableeducation.com/blog/wp->

PULLEYS

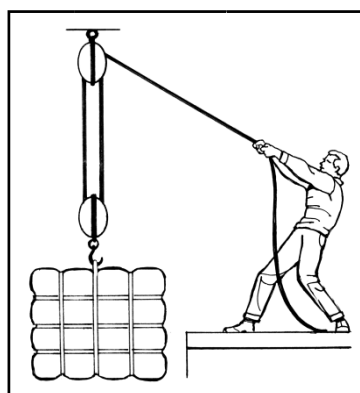
Lifting a bucket of sand is hard work. However, by using a pulley system, you can pull downwards to move the bucket upwards. This is easier than pulling the bucket upwards directly.

A pulley is a grooved wheel with a rope over it. A single pulley does not multiply force but simply changes the direction of force.



Single pulley

To multiply force, you need to use more than one pulley. This allows you to lift very heavy loads by using only a small effort.



Double pulleys

How can pulleys make our lives easier?

A single pulley changes the direction of a force, which can make it much easier for us to move something. Pulleys can also provide us with a mechanical advantage when we use several together and more rope. This process lessens the amount of force required to lift something. Using multiple pulleys decreases the amount of force necessary to move an object by increasing the amount of rope used to raise the object. The mechanical advantage (MA) of a pulley system is equal to the number of ropes supporting the movable load.

In today's highly-technical world, engineers still use pulleys to make difficult tasks easier. Without them, our lives would be much more difficult.

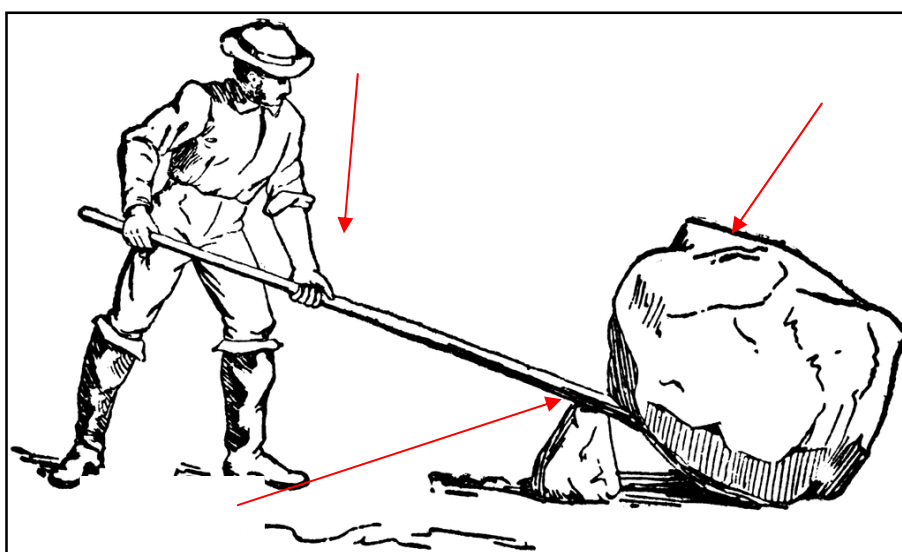
USES OF PULLEYS

Pulleys are used in many ways, everyday. What kind of pulleys can you think of? Some common examples are large construction cranes that use pulleys to lift heavy objects with what would normally be a very underpowered motor, weight machines at a gym, some elevators, flagpoles, window blinds, bicycle rings/chains, clotheslines, water well bucket/rope, zip lines, motors, rock climbing devices, and sailing and fishing boats.

LEVER

Levers are one of the basic tools that were probably used in prehistoric times. Levers were first described about 260 BC by the ancient Greek mathematician Archimedes (287-212 BC).

A lever is a simple machine that makes work easier for use; it involves moving a load about a fixed point called the pivot or fulcrum(F). A force called the effort(E) is applied at one point of the lever. This helps to overcome another force called load (L) at another point.



Source: <https://www.google.com/search?biw=1517&bih=741&q=man+with+crowbar>

Many of our basic tools use levers, including scissors, pliers, hammer claws, nut crackers, and tongs, arm and many others.

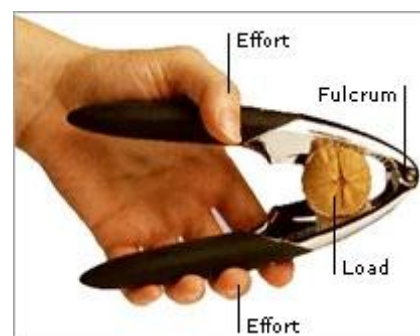
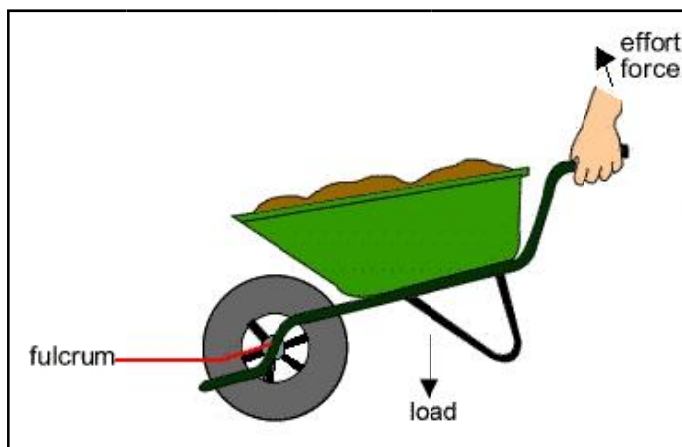
Levers make use of the turning effect of forces to produce:

- a large force
- a large movement

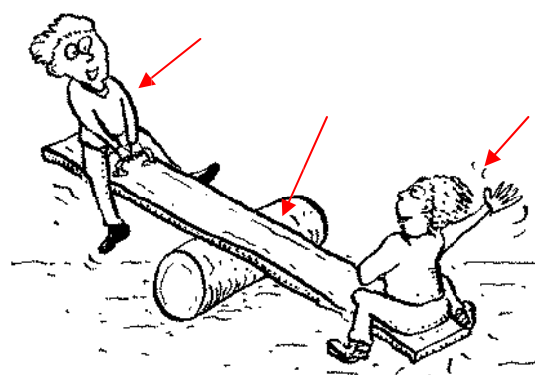
The closer the fulcrum is to the load, the less force (effort) you need to use. There are different types of lever around us. Some levers have the fulcrum between the load and the effort but much closer to the load[as shown in the above diagram].

This means that you only need a small effort to exert a large force. Some levers have the fulcrum at the end of the lever.

Fulcrum at the end of the lever



Fulcrum between effort and load



The unit of Force is Newton (N).

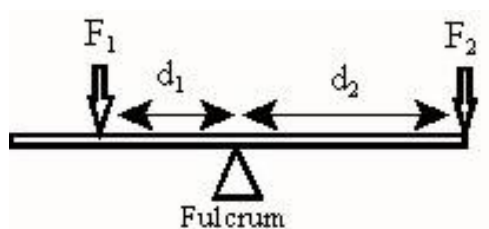
A lot of things we do in our everyday life make use of the turning effect of a force. The turning effect of a force is the ability of a force to make something turn about a certain point. Thus, we say the turning effect of a force depends on:

- the size of the force
- the distance of the force from the pivot.

The unit for Work Done is Joules (J)

A force is said to do work when it acts on a body so that there is a displacement. Thus a force does work when it results in movement.

The figure shows a lever, e.g. a board, supported at the center by a fulcrum.

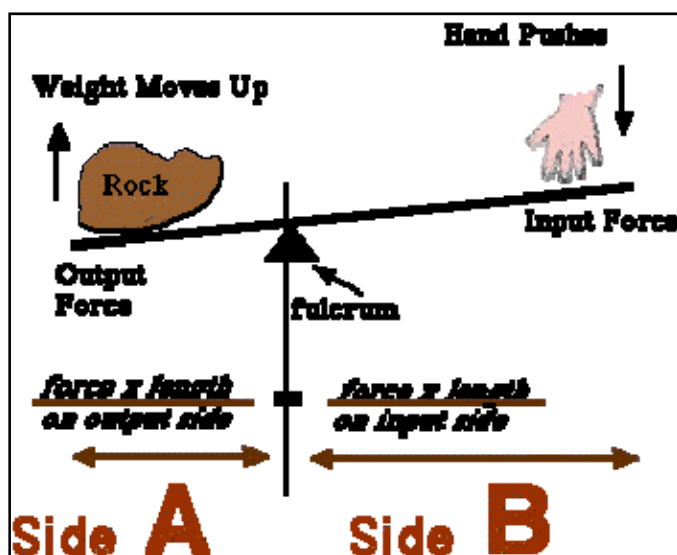


If one person pushes down on the left side with a force F_1 , a distance d_1 from the fulcrum, and another person pushes down on the right side with a force F_2 , at a distance d_2 from the fulcrum, they will be in balance if $F_1 d_1 = F_2 d_2$. Work done can be calculated by multiplying the force by the distance it moves.

Therefore,

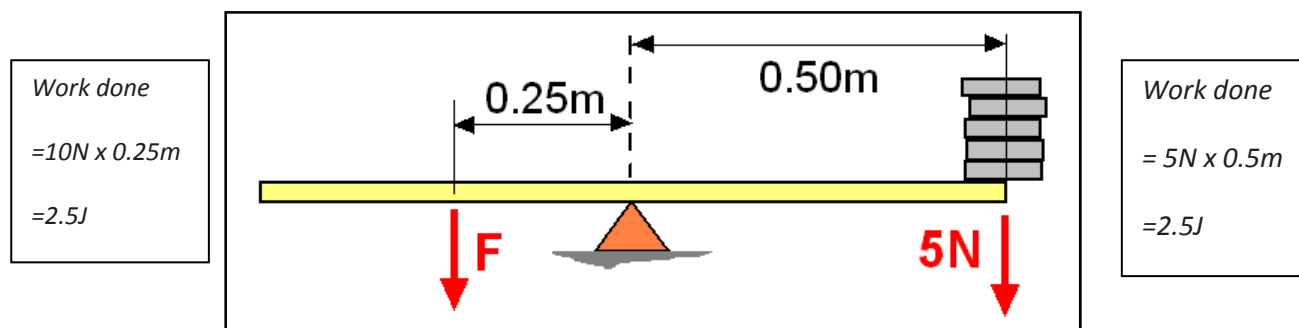
$$\text{Work Done} = \text{Force} \times \text{Distance}$$

$$F_1 d_1 = F_2 d_2$$



Example:

For the lever system shown, what would be the effort force needed to lift the 5N load that will keep the lever balanced?



Source: <https://sites.google.com/site/rmackrellphysics/home/2010-11/4th-form>

Effort Force x Effort Distance = Load Force x Load Distance

$$F_1 \times d_1 = F_2 \times d_2$$

$$5\text{N} \times 0.5\text{m} = F \times 0.25\text{m}$$

$$2.5\text{N.m} = 0.25F$$

$$F = 10\text{N}$$



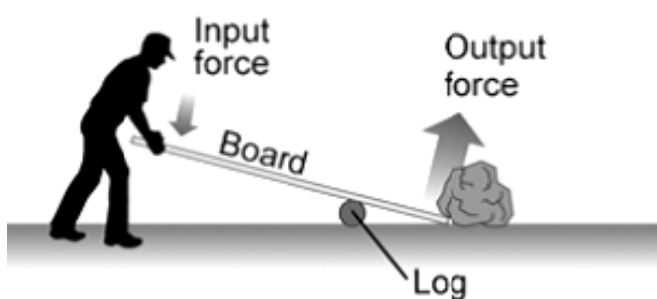
Mechanical Advantage

We use simple machines to make tasks easier. While the output work of a simple machine can never be greater than the input work, a simple machine can multiply input forces OR multiply input distances (but never both at the same time). Mechanical Advantage is the ratio of Load Force to Effort Force OR Effort Distance to Load Distance.

$$\text{Mechanical Advantage} = \frac{\text{Load Force}}{\text{Effort Force}} \text{ OR } \text{Mechanical Advantage} = \frac{\text{Effort Distance}}{\text{Load Distance}}$$

Example

A construction worker uses a board and log as a lever to lift a heavy rock. If the load is 500N and the effort force used to lift it is 50N, what would be its mechanical advantage?

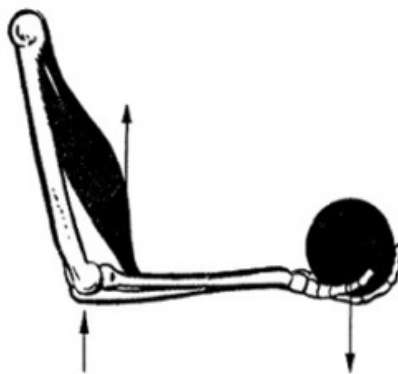


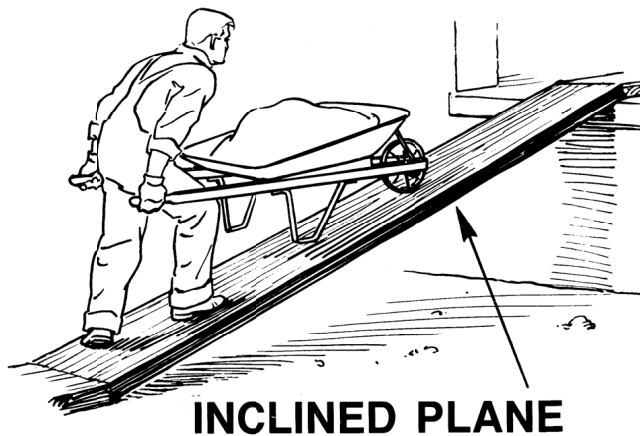
$$\begin{aligned} M.A &= \frac{\text{Load Force}}{\text{Effort Force}} \\ &= \frac{500N}{50N} \\ \therefore &= 10 \end{aligned}$$

When Mechanical Advantage is more than 1, force has been multiplied.
When mechanical advantage is less than 1, speed has been multiplied.

Exercise

For the diagram given below, label the fulcrum (F), load (L) and effort (E)





Inclined plane is a simple machine. Three simple examples are the ramp, wedge and screws.

1. THE RAMP

The inclined plane is simply a flat surface raised at an angle, like a ramp. It is a way of lifting a load that would be too heavy to lift straight up. The angle (the steepness of the inclined plane) determines how much effort is needed to raise the weight. The steeper the ramp, the more effort is required.

The ramp makes life easier not by altering the amount of work that is needed, but by altering the way in which the work is done. Work has two aspects to it:

- i. the effort that you put in, and
- ii. the distance over which you maintain the effort.

If the effort increases, the distance must decrease, and vice versa. It reduces the effort needed to raise an object by increasing the distance that it moves.

2. WEDGE

A wedge is a simple machine made up of two inclined planes put together. These 2 planes meet and form a sharp edge. Wedges are used to push two objects apart, or cut an object into pieces. It can also hold objects in place.

A wedge gets in between objects and splits it apart. An object like wood, can be split apart with a wedge (an axe)



3. SCREW

A screw is a simple machine made up of another simple machine. It is an inclined plane wrapped around a cylinder.

The screw has 2 parts. The inclined plane is the thread that wraps around the screw. The cylinder is the long rod.



LINEAR MOTION

Linear motion is motion along a straight line. Linear motion is the most basic of all motion. According to Newton's first law of motion, objects that do not experience any net force will continue to move in a straight line with a constant velocity until they are subjected to a net force. Under everyday circumstances, external forces such as gravity and friction can cause an object to change the direction of its motion, so that its motion cannot be described as linear.

Linear motion is measured in two parts; speed and direction. Together these make up the velocity.

VELOCITY

The symbol for velocity is v .

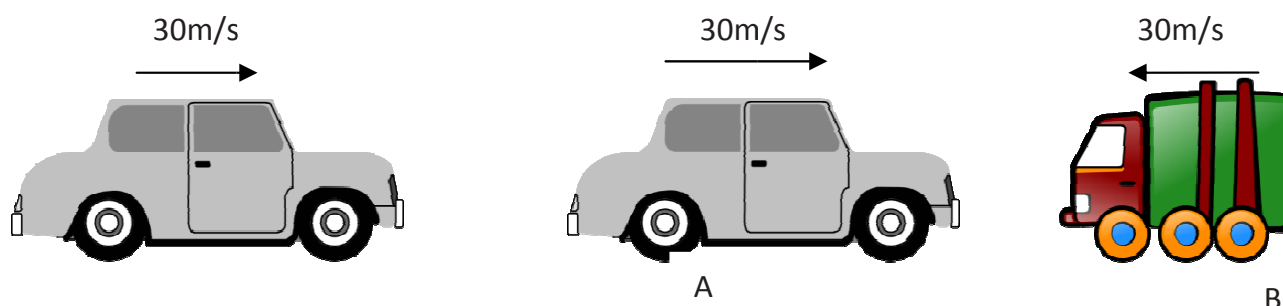
The velocity of an object refers to an object's speed and the direction in which the object moves. Velocity is a vector quantity that refers to "the rate at which an object changes its position. The units for velocity are the same as for speed.

Velocity is calculated by dividing the change in an object's displacement by the time taken for a change in displacement to occur.

$$\text{velocity, } v = \frac{\text{Change in displacement}}{\text{Change in time}} = \frac{\Delta d}{\Delta t}$$

Example

There are three cars A, B and C travelling in the directions shown. The speed of each car is also shown.



All three cars have the same speed. A and B also have the same velocity, because both their speed and direction are the same. A and C (and B and C) have different velocities because, although their speed are the same, they are travelling in different directions.

Distance - time graphs

On a distance–time graph:

- a horizontal line means the object is stopped
- a straight line sloping upwards means it has a steady speed.

The steepness, or gradient, of the line shows the speed:

- a steeper gradient means a higher speed
- a curved line means the speed is changing.

If the direction of travel is being considered:

- A negative distance is in the opposite direction to a positive distance.
- A straight line sloping downwards means it has a steady speed, and a steady velocity in the negative direction.

Between 30 s and 50 s the cyclist stopped. The graph has a steeper gradient between 50 s and

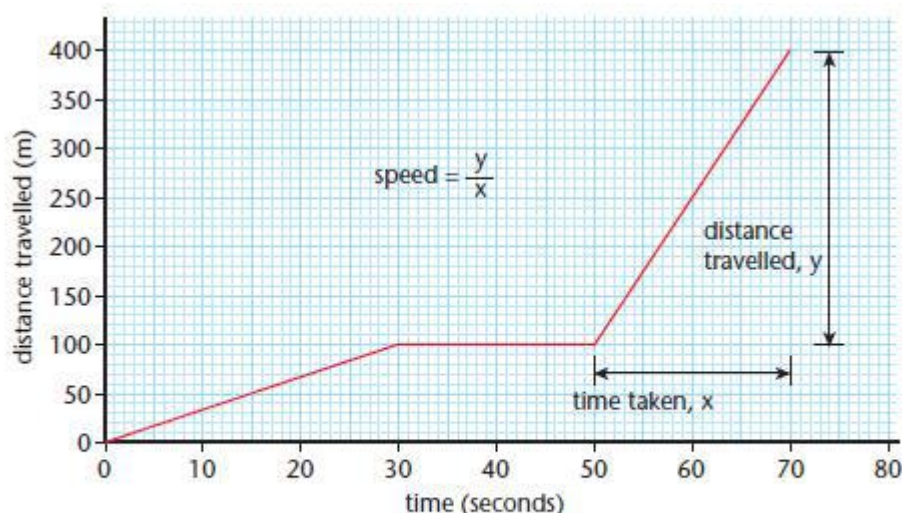


Fig. 9.1 Distance–time graph for a cycle ride.

70 s than between 0 s and 20 s – the cyclist was travelling at a greater speed.

To calculate a speed from a graph, work out the gradient of the straight line section as shown above in Fig. 9.1:

$$\text{speed} = \frac{y}{x} \text{ where } y = 400 \text{ m} - 100 \text{ m} = 300 \text{ m and } x = 70 \text{ s} - 50 \text{ s} = 20 \text{ s.}$$

$$\text{speed} = \frac{300 \text{ m}}{20 \text{ s}} = 15 \text{ m/s.}$$

DISPLACEMENT

Displacement is a vector quantity that refers to “how far out of place an object is”; it is the object’s overall change in position. Displacement must give attention to direction.

Example

Brian walked 20km from Suva to Nausori. The distance travelled would be 20km but his displacement would be 20km East of Suva.

SPEED

Speed is the distance travelled in a certain time. It is usually measured in meters per second [m/s or m.s⁻¹]

$$\text{Average Speed [m/s]} = \frac{\text{distance travelled [m]}}{\text{time taken [s]}}$$

Example

A sprinter runs 100m in 10seconds. Calculate the average speed in m/s.

Solution:

$$\begin{aligned}\text{Average Speed [m/s]} &= \frac{\text{distance travelled [m]}}{\text{time taken [s]}} \\ &= \frac{100\text{m}}{10\text{s}} \\ &= 10\text{m/s}\end{aligned}$$

Exercise

Calculate the average speed in m/s of the following:

- a.) A car travels 8km in 10 minutes.
- b.) Sound travels a kilometrein 3s
- c.) A boat travels 110km in 6 hours.

ACCELERATION

When an object changes velocity, that is, speeds up, slows down or changes direction, it is said to accelerate. Acceleration, a , is calculated by dividing the change in velocity by the time taken for the change in velocity to occur:

$$\begin{aligned}\text{Acceleration} &= \frac{\text{change in velocity}}{\text{change in time}} \\ &= \frac{\Delta v}{\Delta t}\end{aligned}$$

The unit for acceleration is m/s^2 or m.s^{-2} .

Acceleration also is used to describe change in speed.

$$\text{Acceleration} = \frac{\text{change in speed}}{\text{change in time}}$$

Example

A car, travelling at 5m/s, speeds up to 30m/s in a time of 10s.

The change in speed is

$$\begin{aligned}\Delta v &= 30 - 5 \\ &= 25\text{m/s}\end{aligned}$$



and the time taken is $\Delta t = 10\text{s}$

$$\text{thus } a = \frac{\Delta v}{\Delta t}$$

$$= \frac{25}{10}$$

$$= 2.5\text{m/s}^2$$

Deceleration is used to describe motion when an object slows down. It uses the same equation as acceleration.

Example

A parachutist in free fall eventually opens her parachute and finds that in 1.8 seconds she slows down from 50m.s^{-1} to 5m.s^{-1}

$$\text{The parachutist's acceleration is } a = \frac{\Delta v}{\Delta t}$$

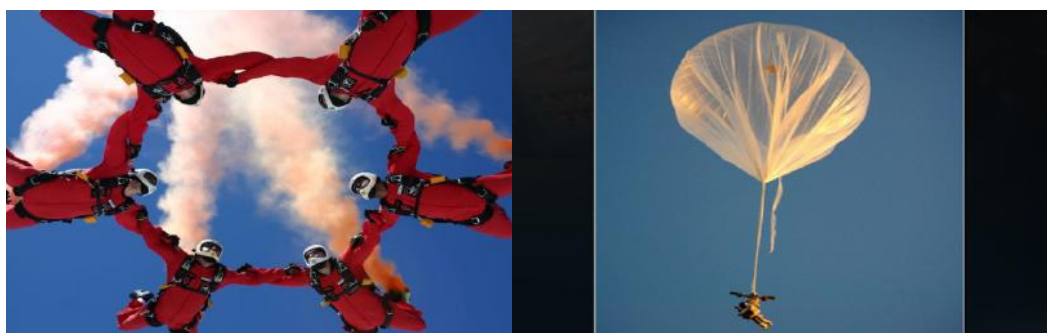
$$= \frac{-45}{1.8}$$

$$= -2.5\text{m.s}^2$$

We can say that the parachutist is decelerating at 25m.s^{-2} or accelerating at -25m.s^{-2} .

FREE FALL

A free falling object is an object that is falling under the sole influence of gravity. Any object that is being acted upon only by the force of gravity is said to be in a state of free fall.



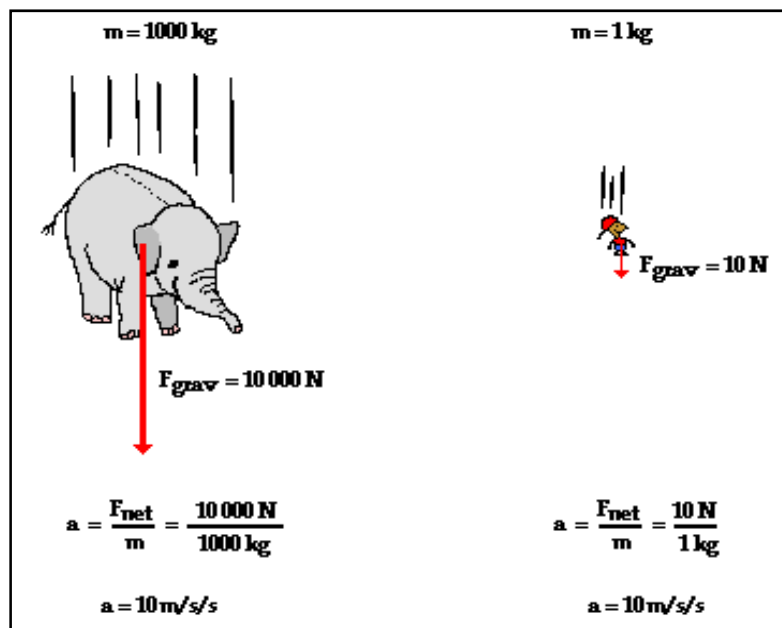
<http://www.google.com/url?sa=i&rct=j&q=&>

There are two important motion characteristics that are true of free-falling objects:

- Free-falling objects do not come across air resistance.
- All free-falling objects (on Earth) accelerate downwards at a rate of 9.8 m.s^{-2} .

Under such conditions, all objects will fall with the same rate of acceleration, regardless of their mass.

Consider a 1000kg baby elephant and a 1kg mouse free falling.



Source: <http://www.physicsclassroom.com/class/newtlaws/u2l3e.cfm>

The ratio of force to mass (F_{net}/m) is the same for the elephant and the mouse under situations involving free fall

Physics Lab Activities: **Applications of free fall**

Do the following investigations. Show your calculations neatly on a separate sheet of paper. Clearly label each section. Turn in one paper for each person.

Option 1 - Measure your reaction time -- Pair

1. Hold your fingers open about one inch.
2. Have your partner hold a ruler or meter stick vertically between your fingers so that 0 cm is between your fingers.
3. Drop the meterstick and have your partner try and catch it.
4. Record the distance the meterstick travels through the fingers.
5. Repeat for three trials and average the distances
6. Use the average displacement of the meterstick and the fact that the meterstick is in free-fall to calculate the time it took to catch the meterstick - Your reaction time.
7. Repeat and calculate the reaction time of the person dropping the meterstick.



Option 2 - **Measuring your hang time (total time in the air) while jumping and estimating your initial jump velocity. -- pair**

1. Have one person jump vertically upward and place a piece of masking tape at the highest point that he/she can reach on the wall.
2. Measure the height of the jump (distance from your fingertips held straight above your head while standing on the ground to the tape)
3. Calculate the amount of time you were in the air (remember: at your maximum height, your velocity is zero, and the time is $\frac{1}{2}$ the total jump time)
4. Calculate your initial velocity (this could be used to find the force your legs apply to floor)

Source: <http://www.physicsclassroom.com/class/newtlaws/u2l3e.cfm>



CHAPTER 4: EARTH AND BEYOND

UNIT 1: SOLAR SYSTEM

4.1.1

OUR SOLAR SYSTEM



COMET

A comet is an icy body that releases gas or dust. They are often compared to dirty snowballs, though recent research has led some scientists to call them snowy dirtballs. Comets contain dust, ice, carbon dioxide, ammonia, methane and more. Some researchers think comets might have originally brought some of the water and organic molecules to Earth that now make up life here.



Source: http://www.planetsforkids.org/page.php?seo=what_is_a_comet

As a comet approaches and get close to the sun it starts spewing dust and gas. This debris forms a tail which is the image we are familiar with, the tail will always point away from the sun. The main reason for this is because of the sun's heat and radiation. Occasionally a comet streaks through the inner solar system; some do so regularly, some only once every few centuries. Many people have never seen a comet, but those who have won't easily forget the celestial show.

METEORITES

Meteorites are fragments of rock and/or metal that fall to Earth from space. Having broken away from a larger extraterrestrial body, meteorites can measure anything from a fraction of a millimeter to the size of a football pitch and bigger.



Source: NASA Website

As it enters the earth's atmosphere, they are accelerated to speeds of over 11.2 kilometers per second. It glows, flashing across the sky like a firework, before finally crashing to the ground. Most meteorites are fragments that have come away as two asteroids collide. Asteroids are irregular-shaped rocks that orbit the sun.

There are three main types of meteorites.

- iron meteorites are almost completely metal.



- stony iron meteorites have nearly equal amounts of metal and silicate crystals.



- stony meteorites are dominated by silicate minerals.



Source: AEROLITE METEORITES WEBSITE

Each group of meteorites is split into many more classes and types depending on the minerals they contain, their chemistry and their structure.

There are three types of meteorites: stony, iron, and stony-iron. A meteorite is heavier than an ordinary rock and will be attracted to a magnet. The condition of a meteorite can range from fresh to very weathered.

MILKY WAY



The Milky Way is the galaxy that contains our Solar System. Its name “milky” is derived from its appearance as a dim glowing band arching across the night sky in which the naked eye cannot distinguish individual stars.



Source: <http://www.physicsclassroom.com/class/newtlaws/u2l3e.cfm>

Image of the night sky above Paranal on 21 July 2007, taken by ESO astronomer Yuri Beletsky. A wide band of stars and dust clouds, spanning more than 100 degrees on the sky, is seen. This is the Milky Way, the Galaxy we belong to. At the centre of the image, two bright objects are visible. The brightest is the planet Jupiter, while the other is the star Antares. Three of the four 8.2-m telescopes forming ESO's VLT are seen, with a laser beaming out from Yepun, Unit Telescope number 4. The laser points directly at the Galactic Centre. Also visible are three of the 1.8-m Auxiliary Telescopes used for interferometer. They show small light beams which are diodes located on the domes. The exposure time is 5 minutes and because the tracking was made on the stars, the telescopes are slightly blurred.)



UNIT 2: EARTH

4.2.1

ORIGIN OF THE EARTH

THE BIG BANG THEORY

Most astronomers suggest that galaxies formed shortly after a cosmic “big bang” that began the universe some 10 billion to 20 billion years ago. In the milliseconds following this explosion, clouds of gases began to come together, collapse, and compress under gravity to form the building blocks of galaxies.

Scientists are divided on just how galaxies first formed. Some believe that smaller clusters of about one million stars, known as globular clusters, formed first and later gathered into galaxies. Others believe that galaxies formed first and that only later did the stars within them begin to gather into smaller clusters.

Scientists cannot be sure exactly how the universe evolved after the big bang. Many believe that as time passed and matter cooled, more diverse kinds of atoms began to form, and they eventually condensed into the stars and galaxies of our present universe. However, many are still contradicting with the idea of the “big bang”.

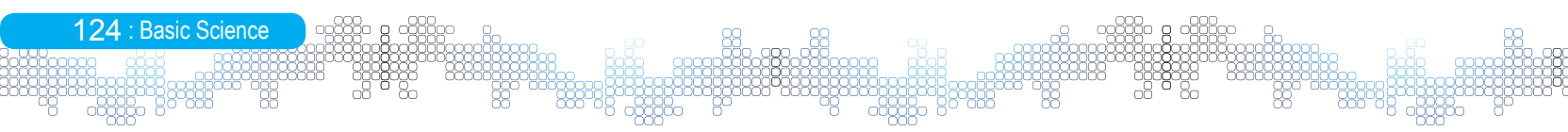
CREATION

Christians believe that the world was created by God. In the Bible it says, “*In the beginning God created the heavens and the earth*”. Genesis 1:1

The world was created in six days.

Made	Day 1	Sunday	Space	Light created and divided from darkness...
	Day 2	Monday	Sky & Sea	Atmosphere created and divided from the oceans...
	Day 3	Tuesday	Land	Land is created and divided from the oceans, seas, rivers, etc...Vegetation made.
Filled	Day 4	Wednesday	Space Filled	Sun, moon and stars are created to fill the sky, hold the light, serves as signs...
	Day 5	Thursday	Sky and Sea Filled	Water is filled with creatures; Sky is filled with creatures...
	Day 6	Friday	Land Filled	Land is filled with creatures, Man is created as the pinnacle of creation...

Creation theory is a theory about the origin of the universe. The theory in a general sense suggests that God’s actions resulted in the creation of the universe. He spoke and things came to be. It stands in direct opposition to theory of evolution such as the Big Bang Theory. After creation there was life on earth. The Bible says in Genesis 1 and 2 that after God had created the perfect environment, man was then created to subdue it.



LIVING ON EARTH

Earth is unique in the Solar System as being the only planet which is able to support life in all its forms; from basic living micro-organisms to highly sophisticated and intelligent human beings. There are many reasons why this happens.

To name a few, on earth we have:

1. **WATER**

Earth has water which is believed to be the most important chemical necessary for life. It contains the oxygen needed for life.

2. **ATMOSPHERE**

Earth has a breathable atmosphere. Oxygen is the gas that is required for the life of most creatures. This is present in earth's atmosphere and also in water. Oxygen is constantly put into the atmosphere by plants and trees.

3. **CLIMATE**

Earth has a suitable climate. This is caused by the moderate amount of carbon dioxide in the planet's atmosphere, which is constantly refreshed whenever there is a volcanic eruption. The temperature on Earth does not go from one extreme to the other.

4. **LIGHT**

All planets receive light from the Sun, but no planet uses it as usefully as Earth. Trees and plants on the planet produce oxygen through a process called photosynthesis. Plants need the Sun to grow.

4.2.2

OUR CHANGING EARTH

WHAT IS CLIMATE CHANGE?



Climate change is a large-scale, long-term shift in the planet's weather patterns or average temperatures. It simply refers to general changes in climate patterns, including temperature, precipitation, winds, and other factors.



Scientists have warned that the world's climate has changed a lot, and has affected many living and non-living things. Many places that were warmer are now getting colder, and many colder regions are getting much more colder or even warmer (known as Global Warming).

The following are examples of climate change:

1. Higher temperatures
the average temperature of the planet's surface - has risen by 0.89 °C from 1901 to 2012.
2. Changing rainfall
3. Changes in nature
Changes in the seasons are bringing changes in the behavior of species, for example, butterflies appearing earlier in the year and birds shifting their migration patterns.
4. Sea level rises-
Since 1900, sea levels have risen by about 19 cm globally, on average. The rate of sea-level rise has increased in recent decades.
5. Retreating glaciers-Glaciers all over the world - in the Alps, Rockies, Andes, Himalayas, Africa and Alaska - are melting and the rate of shrinkage has increased in recent decades.
6. Sea ice-Sea ice melting does slightly contribute to sea level rise since the fresh melt water is less dense than the salty ocean water it displaces. According to Dr. Robert Grumbine of NOAA's sea ice group, if the entire world's sea ice melted, it would contribute to about 4 millimeters of global sea level rise. This is a tiny figure compared to the 20 feet of potential sea level rise locked up in the ice of the Greenland Ice Sheet, which is on land.
7. Ice sheets- Together, the ice sheets from Greenland and Antarctica hold more than 99% of the world's freshwater ice. These are enormous stores of frozen water, held on land. If they fully melted, Greenland and Antarctic would respectively cause 7.2 m and 61.1 m of global sea level rise.

CAUSES OF CLIMATE CHANGE

A layer of greenhouse gases – primarily water vapor and including much smaller amounts of carbon dioxide, methane and nitrous oxide – act as a thermal blanket for the Earth, absorbing heat and warming the surface to a life-supporting average of 59 degrees Fahrenheit (15 degrees Celsius). Most climate scientists agree the main cause of the current global warming [warming those results when the atmosphere traps heat radiating from Earth toward space] trend is human expansion of the “greenhouse effect”.

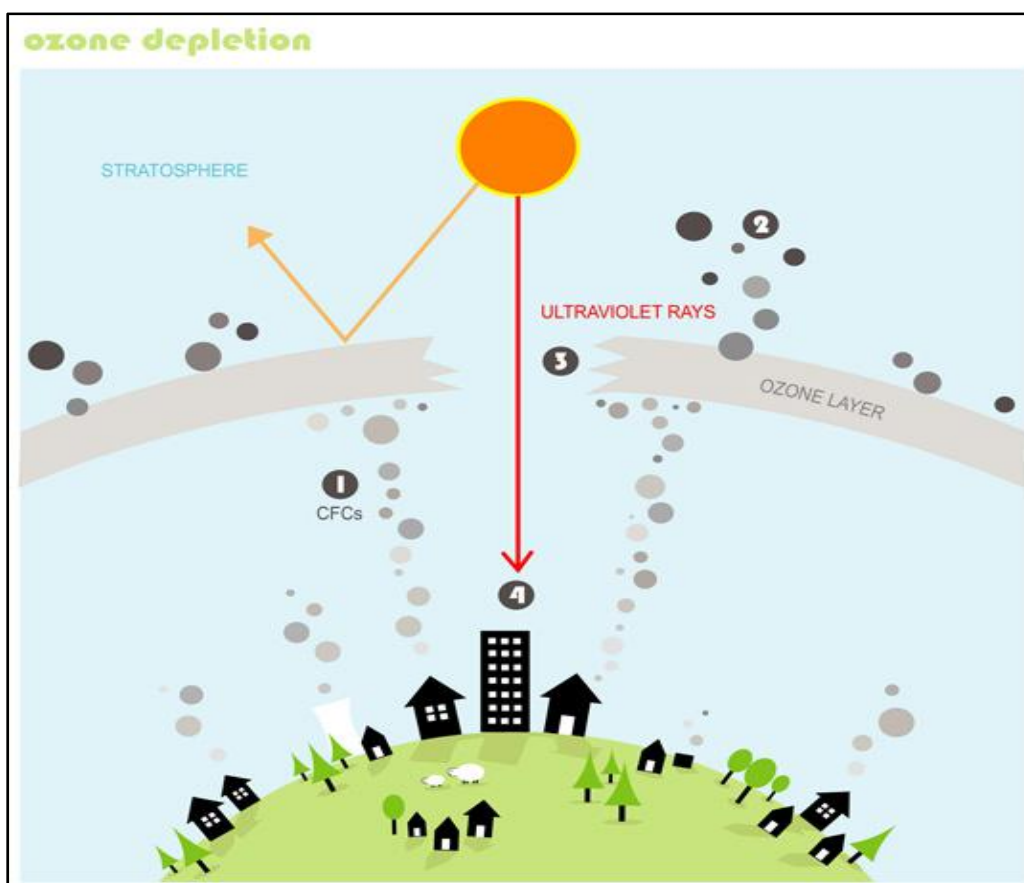
These climate change effects are due to the increase in greenhouse gases in the atmosphere. These gases, carbon dioxide, methane, nitrous oxide and fluorocarbons, are principally from the burning of fossil fuels, forest destruction and agriculture (rice field cultivation and the keeping of livestock). Water vapour in the atmosphere also plays a role. The increase in carbon dioxide is largely due to the burning of fossil fuels (coal, oil and gas) over the last two centuries. It is the major greenhouse gas produced by humans, which is having the single greatest effect on climate change.

OZONE DEPLETION

The ozone layer absorbs most of the Sun's harmful radiation (UV radiation). Without the ozone layer, life would not exist due to the presence of very strong and harmful radiation from the sun..



The ozone layer protects Earth from dangerous UV radiation from the sun — which can cause mutations. In humans, a depleted ozone layer would likely mean higher rates of skin cancer, cataracts, and immune system problems. Further, an increase in UV radiation could affect plants and marine ecosystems in unpredictable ways — which could, in turn, trigger other ecological changes.



Source: <http://www.environmedia.com/what-are-the-consequences-of-ozone-depletion.htm>

1. CFC's released and rise into ozone layer
2. UV releases chlorine (Cl) from CFC's
3. Cl destroys ozone
4. Depleted ozone-more UV so more skin cancer

Ozone is present in the stratosphere. The stratosphere reaches 30 miles above the Earth, and at the very top it contains ozone. The sun's rays are absorbed by the ozone in the stratosphere and thus do not reach the Earth. Ozone is a bluish gas that is formed by three atoms of oxygen (O_3). The form of oxygen that humans breathe in consists of two oxygen atoms, O_2 . The ozone layer protects both plant and animal life on the planet. The fact that the ozone layer was being depleted was discovered in the mid-1980s. The main cause of this is the release of CFCs, chlorofluorocarbons.

GREENHOUSE EFFECT

In some countries, people build a small glass house to plant crops in it. It is built to keep the sun's heat from escaping from the glasshouses.



Source: http://www.crooking.com/nft_lettuce_herbs.shtml

In a way, the earth is like a glasshouse. The earth has some very important gasses in the atmosphere that keeps us warm. Some of these gases are water vapor, carbon dioxide, nitrous oxide and methane.

When the sun heats the earth, these gases keep the heat on the earth's surface. Without these gases, heat would escape back into space and Earth's average temperature would be about 60°F colder.

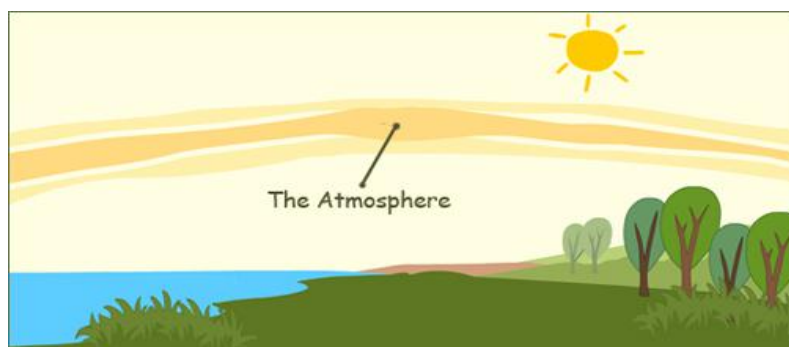


Tip...

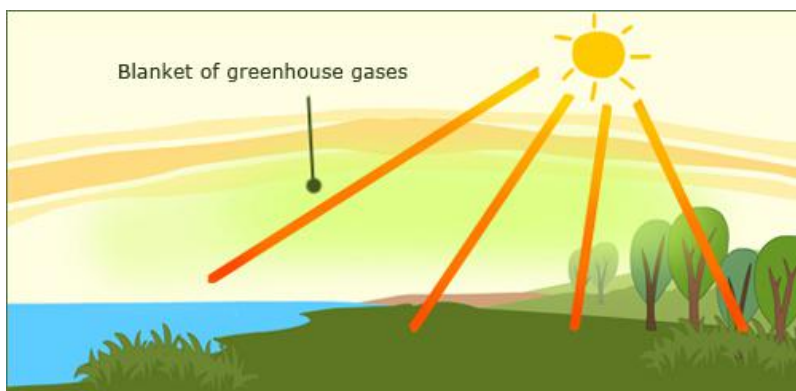
Did you know that Methane (a greenhouse gas) is produced when vegetation is burned, digested or rotted with no oxygen present? Garbage dumps, and grazing cows and other livestock release lots of methane.

How does the Greenhouse Effect happen?

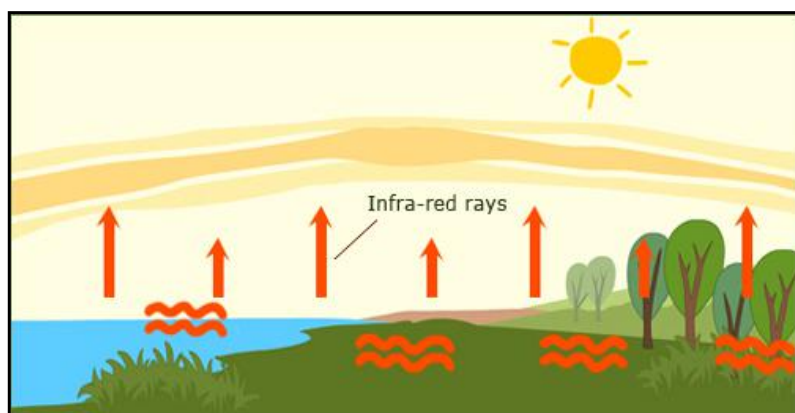
The earth's atmosphere is all around us. It is the air that we breathe.



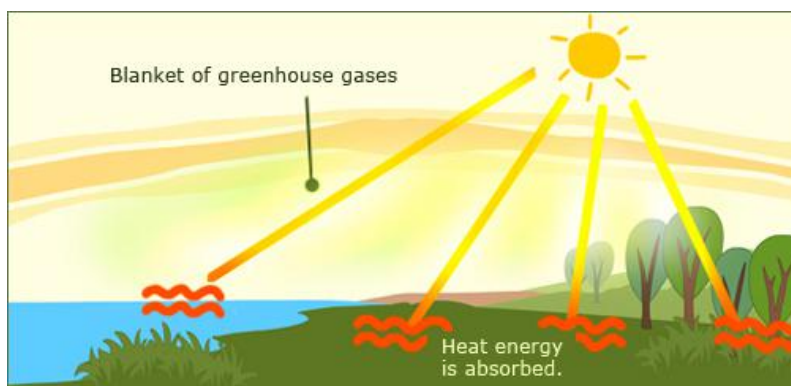
Sunlight enters the Earth's atmosphere, passing through the blanket of greenhouse gases.



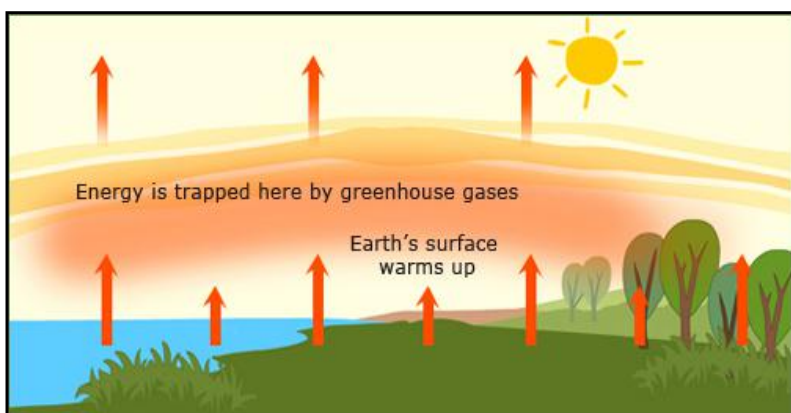
As it reaches the earth's surface, the land and water absorbs the sunlight's energy.



Once absorbed, the energy is sent back into the atmosphere in the form of infra-red rays.



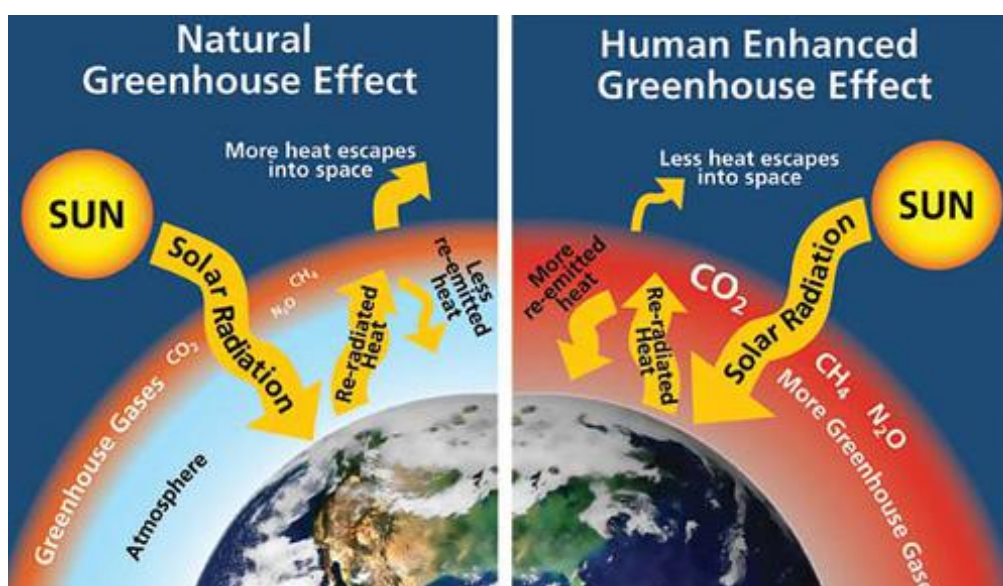
Some of the energy passes back into space, but much of it remains trapped in the atmosphere by the greenhouse gases, causing our globe (earth) to warm up. This warming is what we call Global Warming, and it is caused by the greenhouse effect.



The greenhouse effect is important. Without the greenhouse effect, the earth would not be warm enough for humans to live. But if the greenhouse effect becomes stronger, it could make the earth warmer than usual. Even a little extra warming of the earth may cause problems for humans, plants and animals

GLOBAL WARMING

Global warming is primarily a problem of too much carbon dioxide (CO₂) in the atmosphere - which acts as a blanket, trapping heat and warming the planet. As we burn fossil fuels like coal, oil and natural gas for energy or cut down and burn forests to create pastures and plantations, carbon accumulates and overloads our atmosphere. Certain waste management and agricultural practices aggravate the problem by releasing other potent global warming gases, such as methane and nitrous oxide.



While some regions are likely to get wetter as the world warms, other regions that are already on the dry side are likely to get drier.

Global warming affects evapotranspiration—the movement of water into the atmosphere from land and water surfaces and plants due to evaporation and transpiration

RISE IN SEA LEVEL

Two major mechanisms are causing sea level to rise.

1. Shrinking land ice, such as mountain glaciers and polar ice sheets, is releasing water into the oceans.
2. As ocean temperatures rise, the warmer water expands. Trapped within a basin bounded by the continents, the water has nowhere to go but up. In some parts of the world, especially low-lying river deltas, local land is sinking (known as subsidence)—making sea levels that much higher.

The consequences of sea level rise include:

- *Threats to coastal communities*
Some 40 percent of the world's population lives within 62 miles (100 kilometers) of the ocean, putting millions of lives and billions of dollars' worth of property and infrastructure at risk.
- *Saltwater intrusion*
Sea-level rise can mean that saltwater intrudes into groundwater drinking supplies, contaminates irrigation supplies, or overruns agricultural fields. Low-lying, gently sloping coastal areas are particularly vulnerable to contamination of freshwater supplies.



HOW HAVE PEOPLE ADAPTED TO SUCH CHANGES

Response to climate change seeks to reduce vulnerability of biological systems to climate change effects. Vulnerability refers to the inability to withstand the effects of a hostile environment. Humans are already adapting to climate change, and further adaptation efforts will be necessary during coming decades. However, adaptation alone is not expected to be able to cope with all projected effects since the options diminish and the costs increase with rising temperatures. Below are some ways people have adopted to climate change:

1. **Mitigation** measures that aim to reduce greenhouse gases emissionsto help avoid, reduce or delay impacts, is implemented in order to ensure that adaptation capacity is not exceeded.
2. **Drought tolerant crop varieties**
Indigenous communities around the world are highly vulnerable to climate change but have centuries-old knowledge of adapting to extreme weather patterns. In recent years they have
 - i. adjusted their migration patterns and switched to more drought resistant strains of livestock.
 - ii. have tried intercropping which improves a farmer's chances of getting at least one good crop and can improve soil quality.
3. **Improving education and information**
4. **Land-use planning**, and is focused on the allocation of space to balance economic prosperity with acceptable living standards and the conservation of natural resources.
5. **More spending on irrigation**
6. **Rainwater storage**
7. **Weather control** - Russian and American scientists have in the past tried to control the weather, for example by seeding clouds with chemicals to try to produce rain when and where it is needed

Adapting to climate change is seen as a very costly practice



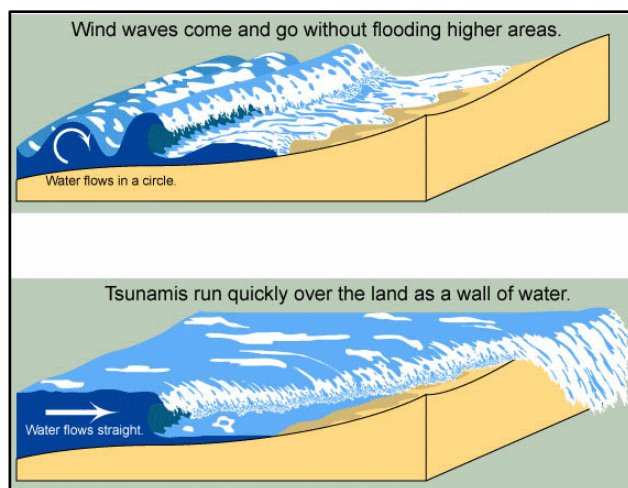
Tip...

Sustainable development refers to a mode of human development in which resource use aims to meet human needs while ensuring the sustainability of natural systems and the environment, so that these needs can be met not only in the present, but also for generations to come.

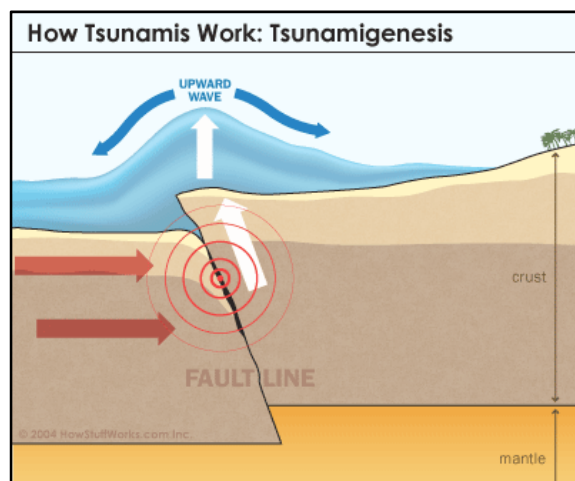
EARTHQUAKES AND TSUNAMIS

HOW DO TSUNAMIS DEVELOP?

A tsunami is a huge wave in the ocean that develops as a result of an earthquake. It can reach a height of 100 feet (30 meters). A tsunami can travel even faster than a commercial jet. This powerful wall of water reaches the coast and can cause a lot of damage.



Usually, it is an underwater earthquake that causes a tsunami to develop.



This happens when the plates underneath the Earth's surface move so that one slips under another. From deep in the ocean the energy of the earthquake causes the water level to rise above sea level. Gravity causes the water to spread into a wave that travels at an incredible speed and with amazing power. A tsunami gets bigger as it gets close to shore. When it hits shallow water the huge wave travels more slowly. The water from along the shore moves into the ocean, and then the massive wave crashes onto the shore and keeps traveling inland.

To determine whether an earthquake will generate a tsunami, and to predict how severe it will be, researchers measure the height and energy of the ensuing wave by using ocean-pressure sensors and tide gauges, according to the United States Geological Survey (USGS).