THE DREAM

SCIENCE PUPIL'S BOOK SEVEN TERM TWO

FIRST EDITION

BY

DREAM PUBLISHERS

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I personally wish to extend my deep sincere gratitude to my colleagues for your guidance that has been given to me so as the book is made.

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PREFACE

The DreamScience, Pupils' Book Seven has been developed basing on the revised Primary Seven science Syllabus as prescribed by the new curriculum of the National Curriculum Development Centre (NCDC). Uganda.

WRITTEN BY MASIGA RICHARD& THE G89 SCHOOLS FROM ELGON MOUNTAINS.

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TERM II

THEME: HUMAN BODY

TOPIC 7: EXCRETORY SYSTEM

Excretory system is a body system that deals with the removal of waste products from the body.

Excretion is the removal of waste products from the body.

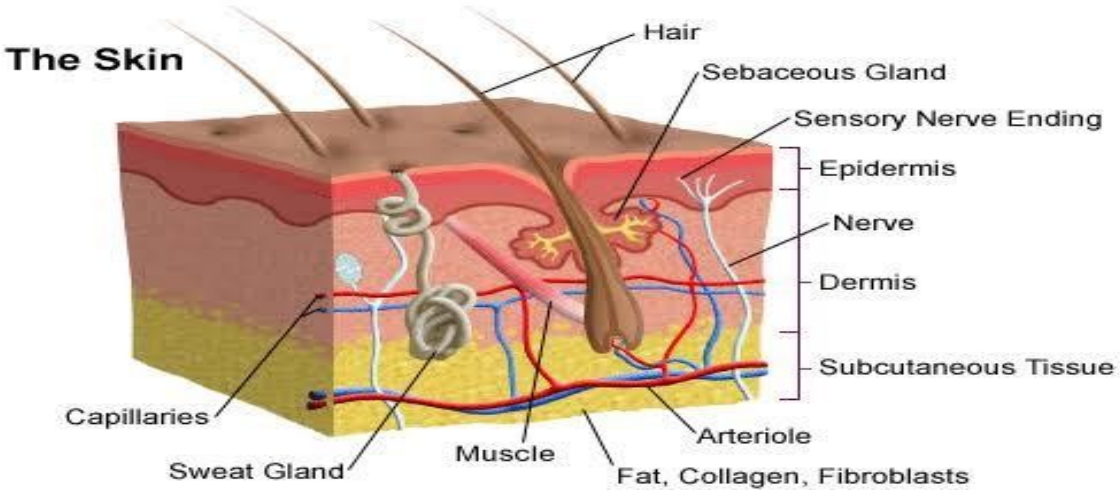
Organs of excretory system.

The body organs which carry out excretion are; 1. The skin.

2. The kidney.
3. The lungs.
4. Liver

THE SKIN

Illustration of the structure of the skin.



The skin is made of two main layers.

- Epidermis.
- Dermis.

The Epidermis:

This is the outer most layer / region of the skin.

The epidermis is made up of these layers.

1 Cornified layer.

2 The granular layer.

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3 The Malpighian layer.

Cornified layer:

- ✞ It is found on the top surface of the skin.
- ✞ It consists of dead cells that resist damage and bacterial invasion.

Malpighian

- ✞ Is a layer of cells which divide actively to produce the epidermis.
- ✞ In this layer, there are pigments granules and melanin that determine the skin colour

Granular layer.

- ✞ Contains living cells that gradually give way to form the cornified layer.
- ✞ Increases resistance to damage and bacterial invasion. ✞ It reduces the loss of water by evaporation.

The dermis

This region is the inner most layer of the skin and it stores fats under it.

This region contains the following parts.

1. **Capillaries:**Supply food and oxygen to the skin and removes excretory products. Capillaries help in temperature control.
2. **Sweat glands:**Secretes sweat, sweat contains excess salts, urea and water.
3. **Sweat duct**: Is an opening / pore that lead sweat to the surface of the skin.
4. **Hair follicle**: Is a deep pit of granular and Malpighian layer cells that multiply to build hair.
5. **Sebaceous glands;**produce oily substances called sebum that keeps the skin water proof.
6. **Subcutaneous fat;**The fat layer beneath the skin act as a heat insulator that helps to control heat loss.
7. **Nerves** – Transmit impulses for heat, touch etc.

Functions of the skin.

1. Excretes salts, water and some urea.
2. Regulates body temperature.
3. Skin stores fats.
4. Makes vitamin D by the help of sun light.
5. Protects the body against germ infections.

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6. Skin is the sense organ for feeling.

Body temperature regulation.

- Blood vessel vasodilate / widens allowing more blood to flow near the surface and more heat is lost by radiation.
- Sweat glands produce more sweat through which heat is lost by evaporation.
- Erector muscles relax causing hair to lie flat on the body to allow wind to easily sweep off heat.

On cold days.

1. Blood vessel narrow (vasoconstriction) and so blood is withdrawn from the surface limiting heat loss by radiation.
2. Decrease in sweat produce thus reducing heat lost by evaporation.
3. Through shivering, heat is produced by the contracting muscles.
4. Fats under the skin act as heat insulators.
5. Erector muscles contract causing hair to erect and trap air around the skin which act as an insulator to heat loss.
6. When hair erect, goose pimples appear on the skin.

Diseases of the skin.

The skin is commonly affected by
diseases like; 1. Ring worm.
2. Scabies.
3. Athlete's foot
4. Leprosy.

Disorders of the skin

1. Dandruff
2. Pimples
3. Bruises
4. Cuts
5. Corns
6. Herpes zoster

Care of the skin:

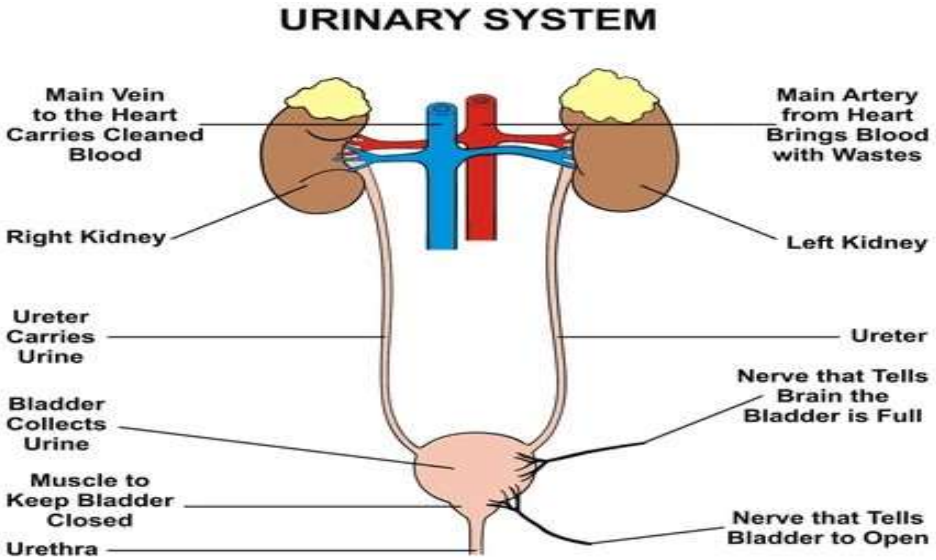
1. Wash your body daily with warm clean water and soap.
2. Rub your body with a towel after bathing.
3. Wounds and cuts should be well covered with sterilized bandages.
4. Take exercises daily to keep it working in proper order.

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5. Eat a balanced diet.

Urinary system

Urinary system is made up of organs that eliminate wastes from the body in form of urine.



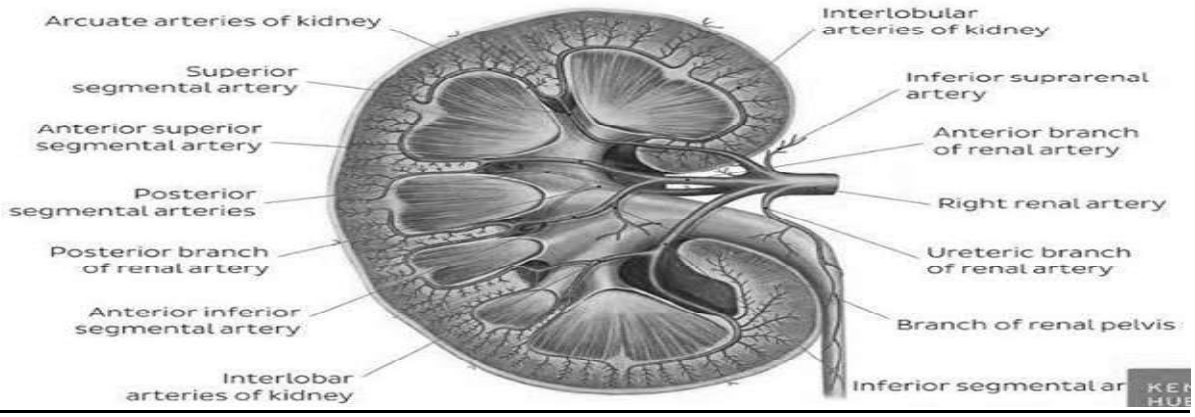
Other organs of urinary system.

1. Kidney
2. Ureter
3. Urinary bladder
4. Urethra

THE KIDNEYS

Kidneys are two brown bean shaped organs at the back of the abdominal cavity.

<u>Illustration of the internal structure of the kidney.</u>



<u>Parts of the kidney and their functions.</u>

1. **<u>Renal artery:</u>**
   Is a branch of aorta that supply oxygenated blood to the kidney.

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2. **Renal vein:**
   Takes deoxygenated blood from the kidney to the vena cava.
3. **Cortex:**Blood is filtered to remove Urea, Uric acid, excess salts and water.
4. **Medulla**
   Is a region where selective re-absorption takes place by the nephrons.
5. **Pelvis**
   Urine is collected here from the numerous nephrons.
6. **Urethra:**
   Urethra is a passage of urine to the Urinary bladder.
   NB: Urine is formed through ultra-filtration and selective re absorption in the kidney
7. **The Urinary bladder:** Is an elastic and muscular sack that stores urine briefly.

Diseases of the kidney.

1. Cancer of the kidney.
2. Kidney failure.
3. Kidney stones.
4. Bilharzias

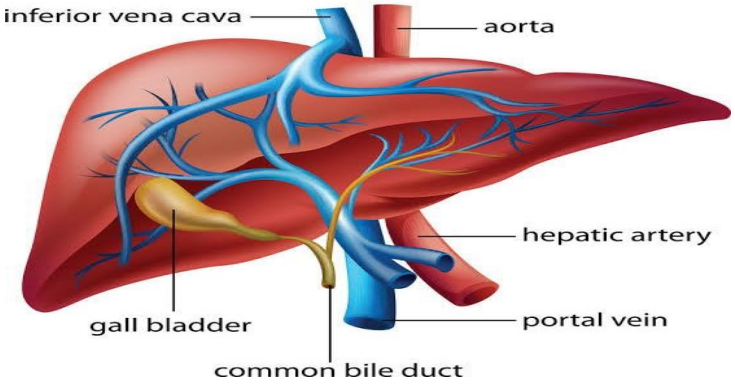
Waste products excreted by the kidney.

1. Uric acids.
2. Urea.
3. Excess salts.
4. Excess water.

THE LIVER

1. The liver is said to be the most important organ in the body because it performs many functions compared to other body organs.
2. The liver is a large reddish-brown organ below the diaphragm.
3. It is supplied with oxygenated blood by the hepatic artery.
4. The liver receives blood rich in digested food from the alimentary canal by the help of the hepatic portal vein.

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Functions of the liver.

1. The liver regulates blood sugar.
   - Too much sugars and lack of enough sugar in blood causes **diabetes**.
   - The liver control sugar levels by the help of insulin.
   - Insulin is produced by the pancreases and help to stimulate the liver to remove glucose from blood by converting it into glycogen for storage.
   - The liver deaminates amino acids and convert them into carbohydrates.
   - Alcohol, poisonous substances and poisonous drugs produced during metabolism are ma de harmless by the liver through the process of detoxication.
2. It helps in the process of excretion.
3. Stores vitamins and mineral slats.
4. It helps in detoxication process.
5. It produces heat energy.

Diseases of the liver.

- Cirrhosis of the liver.
- Hepatitis.
- Liver abscess. These are boils which form pus in the liver.

Care of the liver

- Avoid taking too much alcohol.
- Have a balanced diet.
- Always have exercises to keep it in a good working condition.

THEME: MATTER AND ENERGY

TOPIC 8: LIGHT ENERGY

Energy – Energy is anything that enables man to do work.

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LIGHT ENERGY.

Light is a form of energy which enables our eyes to see objects. Light is a form of energy which stimulates sense of seeing.

How we see objects.

- We see objects when they reflect light in our eye.
- Light travels from the objects to our eyes.
- Some objects give out their own light while others reflect light falling on them from other sources.

Sources of light.

- A source of light is an object which gives out light.

There are two types of sources of light.

(i) Natural sources of light.
(ii) Artificial sources of light.

Examples of natural sources of light.

1. The sun
2. The stars
3. Erupting volcanoes
4. Glow worms
5. Fire flies

Examples of artificial sources of light.

1. Electric bulbs
2. Torches
3. Lamps
4. Candles
5. Fires
6. Charcoal stoves.

These sources of light can either be luminous or non-luminous sourced of light.

Luminous sources of light

These are sources of light which emit (send) or produce their own light.

They are also called direct sources of light.

Examples of luminous objects.

1. The sun
2. The stars
3. Red hot charcoal

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4. Fire flies
5. Hands and figures of some clocks and watches
6. Some kinds of rocks
7. Working filament of the bulb
8. Bulbs
9. Burning charcoal 10. Erupting volcanoes **NB:**
Among luminous sources of light, some emit light when they are red hot. These sources are called incandescentsources of light.

Examples of incandescent sources of light.
1. The sun.
2. The stars.
3. Hot filament of bulbs.
4. Hot charcoal etc.

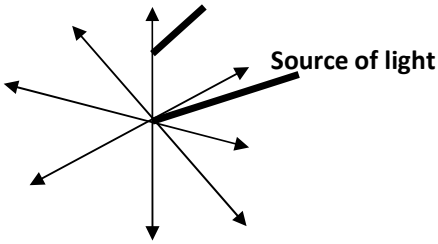
Non-luminous objects.
These are sources of light which do not emit their own light but just reflect light from another source.
They are also referred to as indirect sources of light or reflectors.

Examples of non-luminous objects.
1. The moon
2. The planets
3. Plane mirrors

Importance of light.
1. Light enables us to see objects using our eyes.
2. Plants use sunlight to carry out photosynthesis.
3. Heat and light from the sun help the eggs of reptiles, amphibians and fish to hatch.
4. Our bodies use sunlight to make vitamin D.

Transmission of light (how light travel)
- Light travels in straight lines to all directions from the source.

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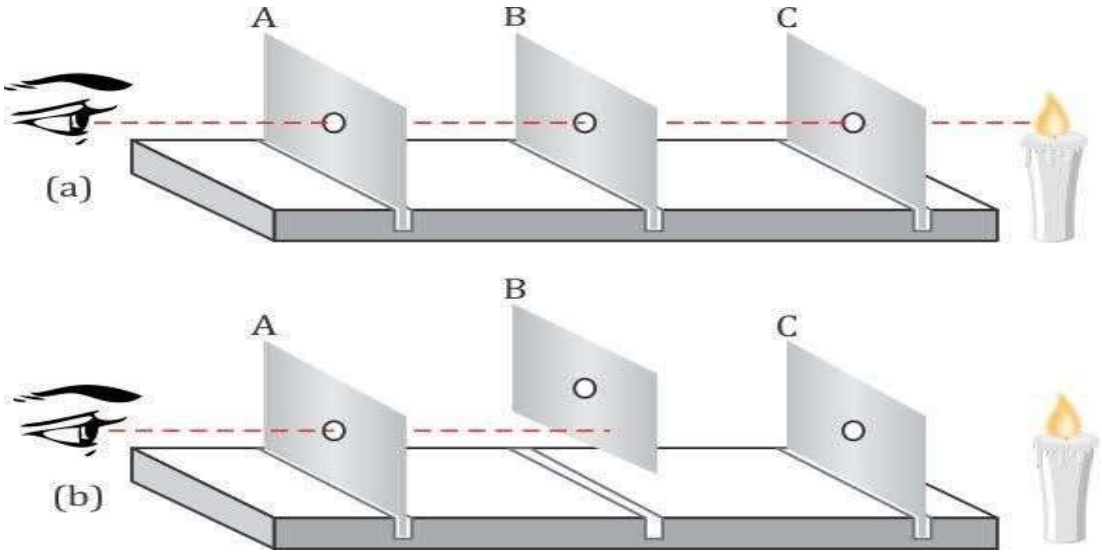


Experiments to show that light travels in straight lines.

Light travels in a straight line in any transparent medium e.g. glass, air, water and vacuum. We cannot see around corners behind corners because light travels in straight lines.

- The experiment above shows that light travels in straight lines.
- The three card boards have holes in their centre at exactly the same position.
- If arranged in a straight line, light travels through the holes from the candle to eye.
- When you shift one of the candles slightly, you will not see the light.

Experiment two.



In (i) when the cards are in straightline, light can be seen.

- In (ii) when a card is raised a little, light can't be seen. • This is why we can't see around corners.

NB:

We hear sound around corners because sound travels in waves but we can't see around corners because light travels in straight lines.

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Rays and beams of light.

A ray of light is a line along which light travels.
A ray of light is represented by an arrow.



A ray of light.

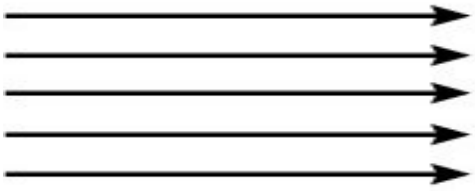
A beam of light

A beam is a group of light rays.
There are three types of beams of light.

(i) Parallel beams.
(ii) Diverging beams.
(iii) Converging beams.

(a) **A parallel beam**

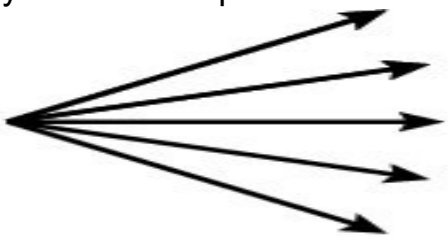
This is a type of beam where the light rays travelling from the source can not meet.



(a) Parallel beam

(b) **A diverging beam**

This is a beam where the light rays from the source spread out (diverge) e.g. car head lamp, bicycle head lamp and torches.

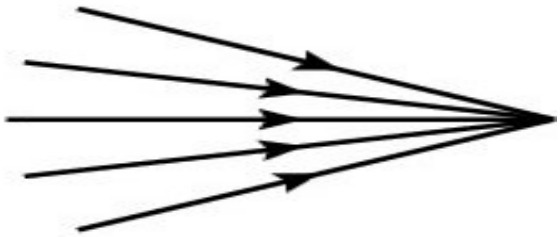


(b) Divergent beam

(c) **Converging beam.**

This is a beam of light where the light rays from the source come towards a point (converge).

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(c) Convergent beam

Speed of light

The speed of light is about 300,000Km/s in air and vacuum.
Light travels faster than sound in air.
Examples to prove that light travels faster than sound.

- We hear thunder after we have seen lightning. • At a race track, we see the flash of starter's gun before we hear the bang.
- The sound of an axe is heard after we have seen the axe strike when cutting.

Effects of light on different materials.

When light meets an object, one of the following will happen.

- Light can be absorbed, diffused or scattered.
- Light may be allowed through transmission.

Materials which affect light are grouped into:

(i) Transparent objects
(ii) Translucent objects (iii) Opaque objects

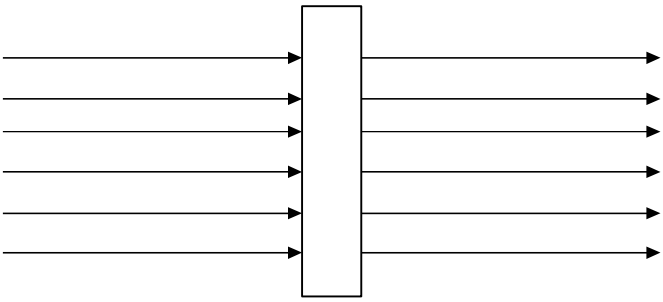
Transparent objects

These are objects which allow most of the light to pass through and we can see through them.

Examples of transparent objects.
Glass

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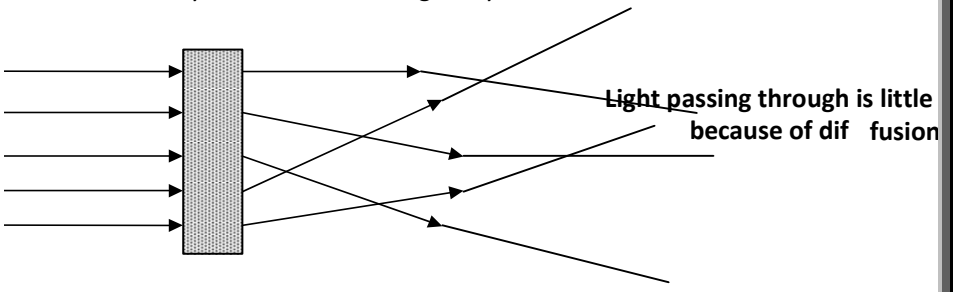
- **Water**
- **Air etc.**



Translucent objects

These are objects which allow some light to pass through but we cannot see through clearly.

We can not see through them because they diffuse or scatter light rays in all directions.



Examples of translucent objects:

1. Frosted glass.
2. Waxed paper
3. Cloth 4. Tissue paper
5. Light bulbs.

Opaque objects.

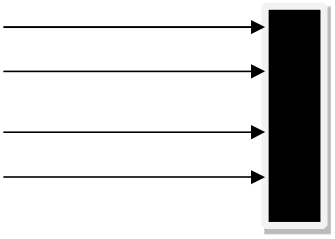
These are objects which don't allow any light to pass through them.

- We cannot see through them because light travels in straight lines.
- Opaque objects instead form shadows.

Examples of opaque objects.

- Wood
- Stones
- Metals.
- Walls.
- Bricks etc.

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No light passes through.

Shadows

A shadow is a region of darkness caused by obstruction of light by an opaque object.

- When the source of light is a small point, a sharp complete shadow is formed called a total shadow or umbra.
- When the source of light is big, a total shadow called umbra is surrounded by half or partial shadow called penumbra.
- If the source of light is put further away from the opaque object, the shadow will be smaller.
- If the source of light is nearer the opaque object the shadow is bigger than the object.

Eclipse

An eclipse is a shadow formed by the obstruction of light by either the moon or earth.

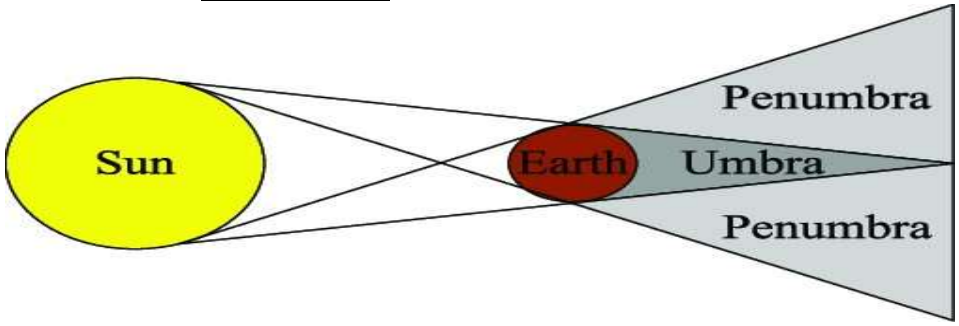
The word eclipse means 'cut off'

Note:

- The sun is stationary (in one place)
- The earth revolves round the sun on its fixed path called orbit.
- The moon revolves round the earth but its orbit is not fixed.

Eclipse of the sun-solar Eclipse.

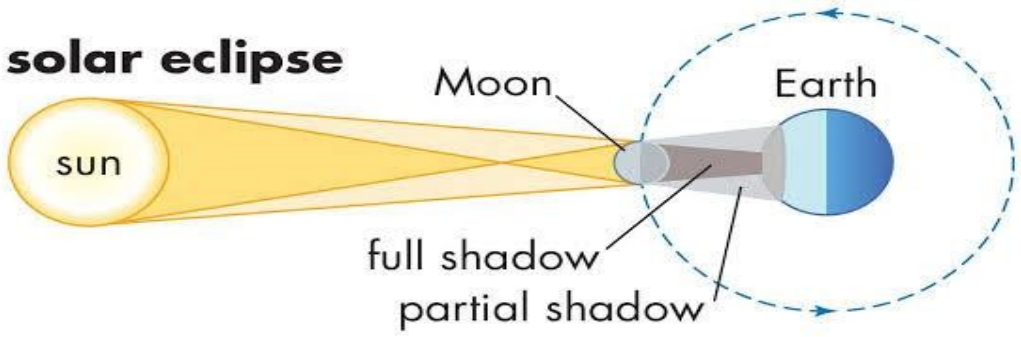
- It occurs when the moon comes in between the sun and the earth. • When this happens the sun casts the shadow of the moon onto the earth. **Illustration.**



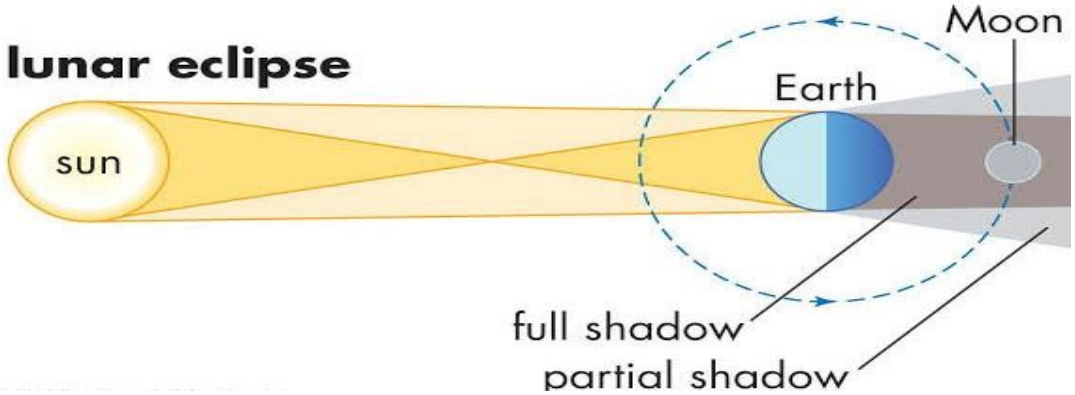
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Annular eclipse of the sun.

- It occurs in the same way as the solar eclipse. But when the moon is far away from the earth and the umbra fails to reach the earth.
- When this happens the earth only receives the penumbra and the sun will be encircled by a ring.



The eclipse of the moon occurs when the earth comes in between the sun and the moon. This happens only when there is a full moon.



The moon is in total eclipse so it doesn't reflect any light.

Reflection of light.

Reflection is the bouncing back of light rays when they strike a shining opaque object.

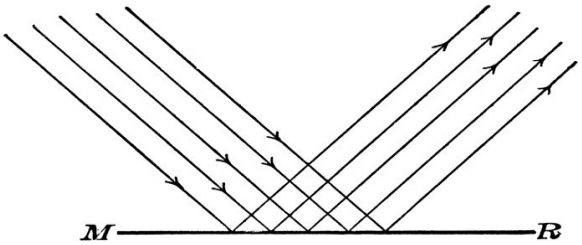
Types of reflection.

There are two types of reflection.

Regular reflection.

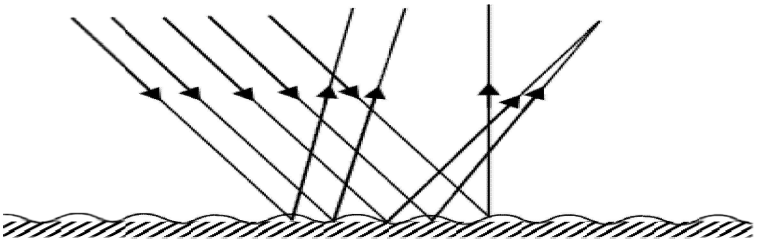
- Is the type of reflection where the beam of light is sent back in a definite direction.
- It is produced when light falls on a smooth shinny surface e.g. mirrors.
- We are able to view ourselves in plane mirrors because they are highly polished and give a regular reflection.

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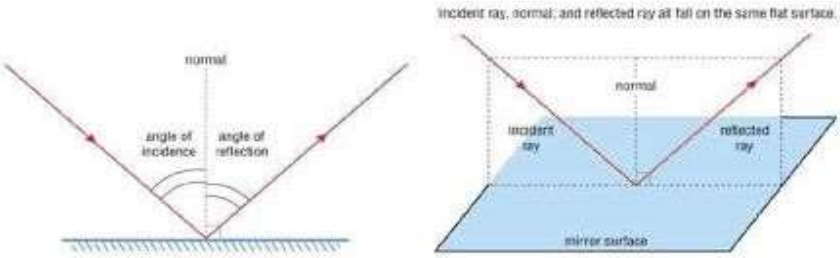
Irregular reflection.

- Is a type of reflection where the beam is scattered and thrown back in all directions.
- Rough unpolished surfaces give irregular reflection (diffuse reflection)
- We are unable to see clear images on walls because they give irregular reflection.



Reflection principles and its laws

1. The angle of incidence equals the angle of reflection.
2. The incident ray (r_i), the reflected ray (r_r), and the normal all lie in the same plane



Laws of reflection:

- The incident ray, the reflected ray the normal at the point of incidence all lie in the same plane.
- The angle of incidence is equal to the angle of reflection.

NB: when the incident ray strikes the mirror at an angle of 90^0 the reflected ray takes the same route and this is called total internal reflection.

Qn:

The incident ray makes an angle of 60^0 to the mirror. What is the angle of reflection?

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The normal makes 90^0 to the mirror

$60^0 + i = 90^0$.
$60 - 60 + i = 90^0 - 60^0$
i
$=30^0$.

< of incidence = < of reflection.
< of reflection $= 30^0$.

Reflection of light by different materials.

- Dark dull materials are good absorbers of light which is converted to heat.
- In hot weather people prefer white clothes and in cold weather they prefer dark clothes.
- A black dress appears black because it absorbs all colours and reflects none.
- White objects appear white because they reflect all colours and absorbs none.
- Green objects appear green because they absorb all the other colours and reflect only green into our eyes.

Image and Objects:

An image is a light picture.

Characteristics of images formed by plane mirrors.

- The distance of the object from the mirror is the same as the distance of the image behind the mirror.
- The images are laterally inverted.
- The image is the same size as the object.
- The image is always upright / erect.
- The image is virtual i.e. cannot be cast on the screen.

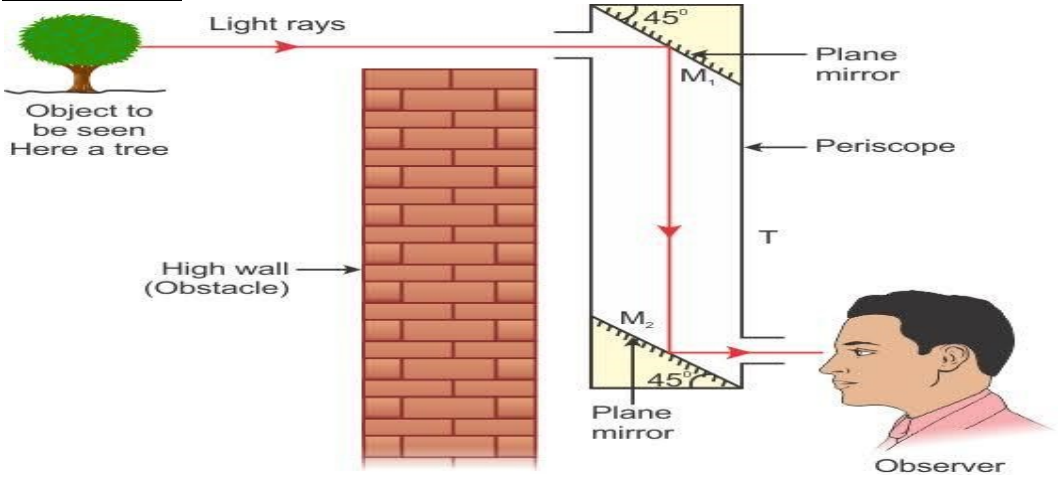
Use of plane mirrors.

1. They are used to see certain parts of the body that we cannot see directly. E.g. behind the head.
2. They are used in periscopes.
3. A periscope is an instrument which consists of a tube with two mirrors fixed inside facing each other and inclined at 45^0.
4. The mirrors are parallel to each other.

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5. A periscope is used to see around corners by soldiers in trenches and in submarines.

Illustration



Curved mirrors.

- These are mirrors which are sphere like in shape.
- They obey the laws of reflection.
- The different types of curved mirrors are made by silvering on one side.

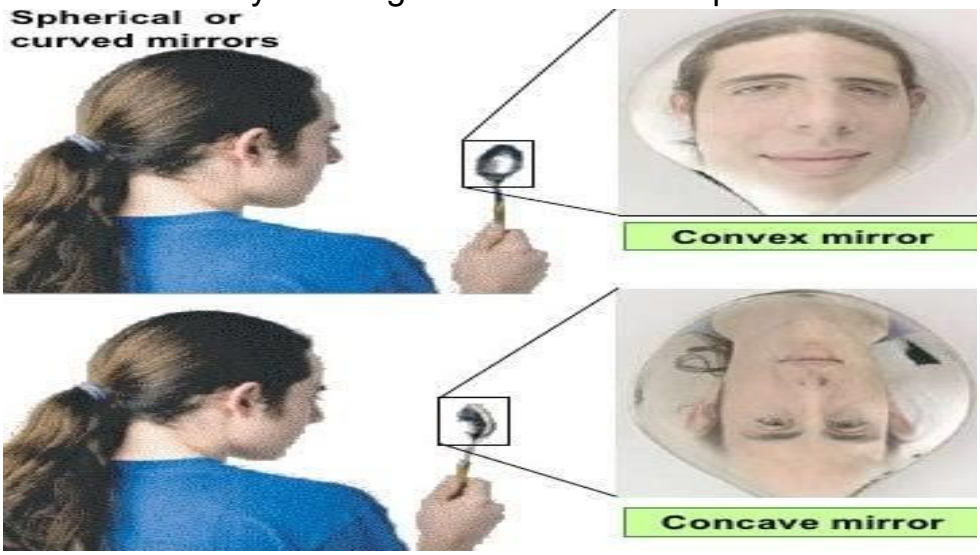
Types of curved mirrors.

- There are two types of curved mirrors.

(i) Concave mirrors
(ii) Convex mirrors

(a) Concave mirrors (converging mirrors)

- It is made by silvering the outside of the sphere.



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Characteristics of images formed by concave mirrors• The image is larger than the object (magnified).

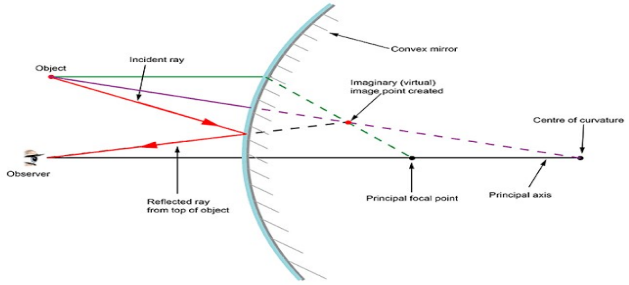
- They are erect (upright)
- They are laterally inverted.
- They are virtual (i.e. Formed behind the mirror so they cannot be cast on the screen)

Uses of concave mirrors.

- They are used by barbers as shaving mirrors.
- They are used by dentists.
- They are used in search lights, electric torches, head lamps as polished and silvered concave metals
- They are also used in telescopes.
  Telescopes have large concave mirrors, which assist in focusing beams of light from heavenly bodies. Telescopes help in studying about the stars and planets.

Convex mirrors (Diverging mirrors)

They are made by silvering the inside of the sphere.

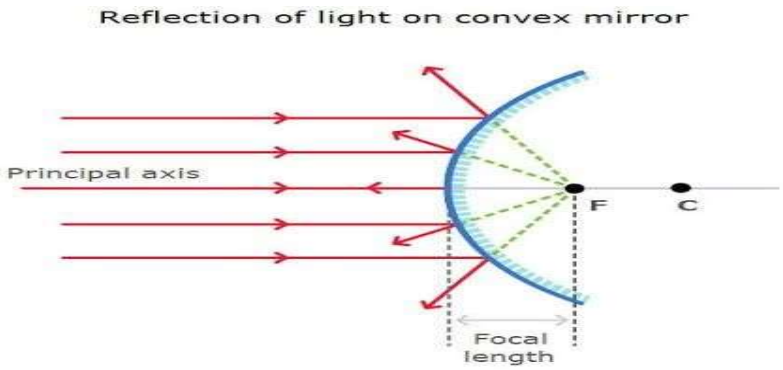


Characteristic of images formed by convex mirrors.

- The image is smaller than the object – diminished.
- The image is upright – erect.
- The image is laterally inverted.
- The image is virtual – behind the mirror.

A beam of light on a convex mirror.

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Use of convex mirrors.

1 They are used as a driving mirror on vehicles.
2 They form upright images.
3 They give a wide view of the distant object.
4 They are used in super markets to see what customer do. 5 Security mirrors in bus and cars.

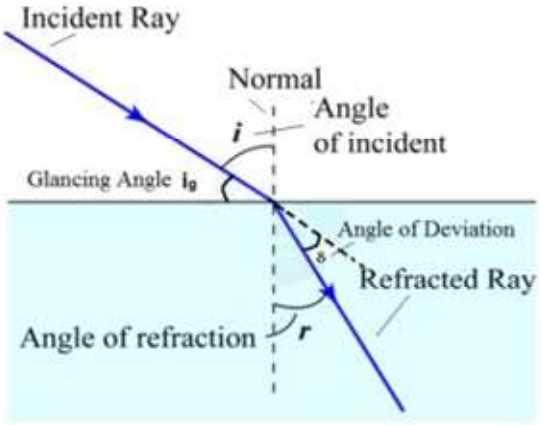
Refraction of light.

Refraction is the bending of light as it passes from one transparent medium to another.

e.g

- From air to gas
- From air to water.
- From glass to water.

Refraction is caused by change in speed of light as it passes from one transparent medium into another which have different densities.



Note

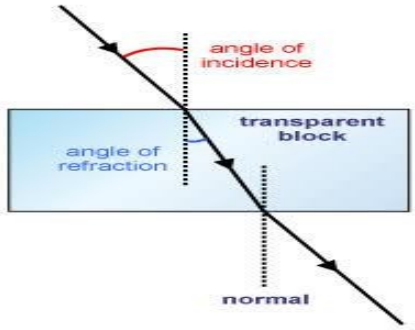
When a ray of light passes from one medium to a more optically dense medium, the ray bends towards the normal and vice versa is true.

The law of refraction

- The incident ray and the refracted ray are on opposite side of the normal.

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- The incident ray, the refracted ray and the normal all live in the same plane. **Refraction of light through a glass block / prism.**

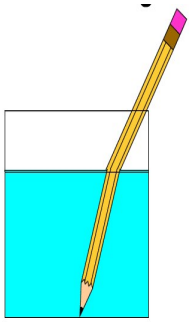


Effects of refraction.

(i) A swimming pool appears shallower than its real depth because of refraction. This is seen by placing a stone in a glass, and then view it from the top.

A ruler or stick partly dipped at an angle into some water in a glass appears bent or broken due to refraction.

(ii) Refracted stick fixed vertically and partly dipped in water appears to be shorter than its real length.



Light bends inwards because the speed of light is slower in water

(iii) A mirage is an optical illusion caused by the bending of light rays due to layers of air having different densities and temperature e.g. sheet of water seen on a high way during a hot day. It appears like a pool of water seen ahead on the road on a hot day.

Effects of mirages.

- Mirages may lead to accidents on high ways.
- Mirages cause false images along high ways in deserts.

(iv) Words under a glass block appear to be raised on a different line from those away from the glass because of refraction.

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LENSES

A lens is a transparent material with curved side capable of refracting light. The curved surfaces of a lens help to bend or refract light passing through the lens.

Types of lenses.

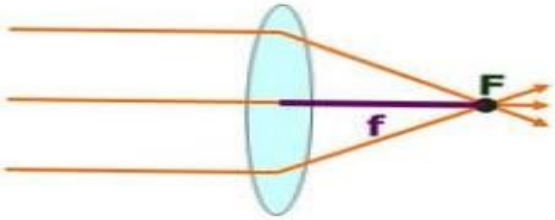
There are two types of lenses.

(i) Convex lens.
(ii) Concave lens.

Convex lens (converging lens)

Is a lens which is thicker in the middle and thinner at the edges.

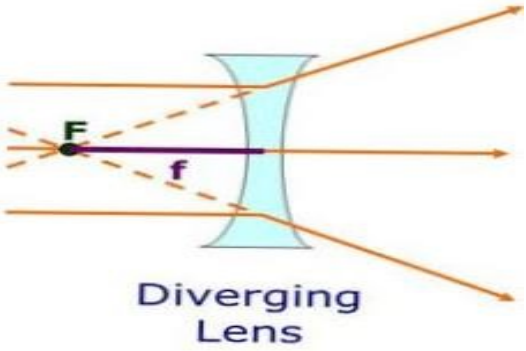
Illustration.



- When a parallel beam strikes a convex lens comes together at a point in front of the lens.

Concave lens (diverging lens)

- This is a lens which is thinner in the middle and thicker at the edges.



NB: The converging meniscus and diverging meniscus are used in spectacles. When a parallel beam of light reaches the concave lens it spreads outwards after passing through the lens.

Uses of lenses.

1. Lenses are used in photographic cameras.

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2. Lenses are used in microscopes used by doctors to see germs.
3. Used in spectacles worn by people with eye defects.
4. Used as magnifying glasses.
5. Used in projectors which focus information on film slides into big pictures on the screen.
6. Used in binoculars to see distant things in magnification. In general lenses are used in optical instrument.

Optical instruments.

Optical instruments are instruments which use either lenses, prisms, plane mirrors or curved mirrors.

Examples of optical instruments.

1. Cameras
2. Microscopes
3. Spectacles
4. Magnifying glasses
5. Telescopes
6. Binoculars
7. Projectors

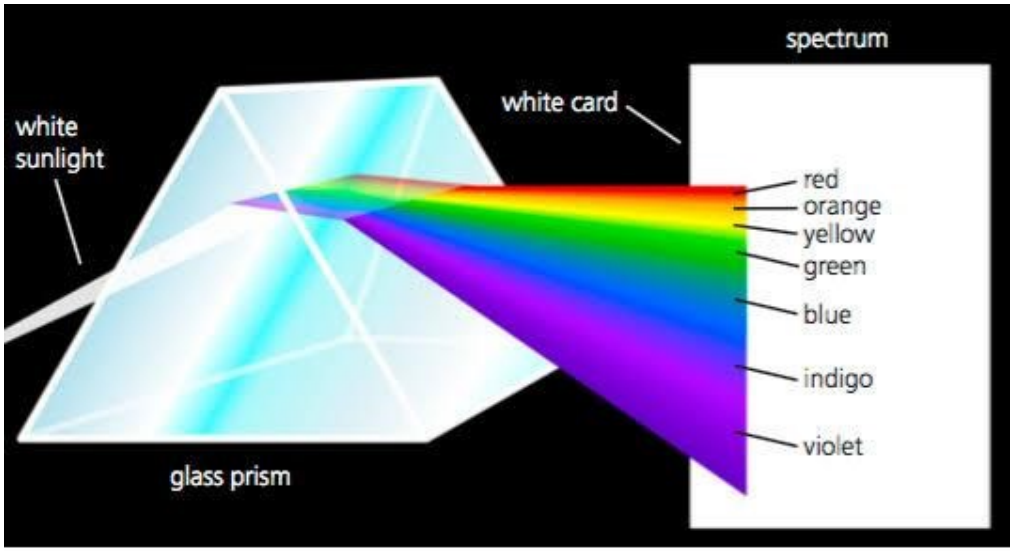
Dispersion of light.

Dispersion of light is the splitting of white light into the seven colours of the spectrum.

- Dispersion of light is due to refraction of light.
- A spectrum is a band of seven distinct colours.
- A spectrum is formed when white light is split by the act of a prism.
- A prism is a device that splits white light into seven colours.
- An example of a natural light spectrum is a rain bow.

Colours of the spectrum.

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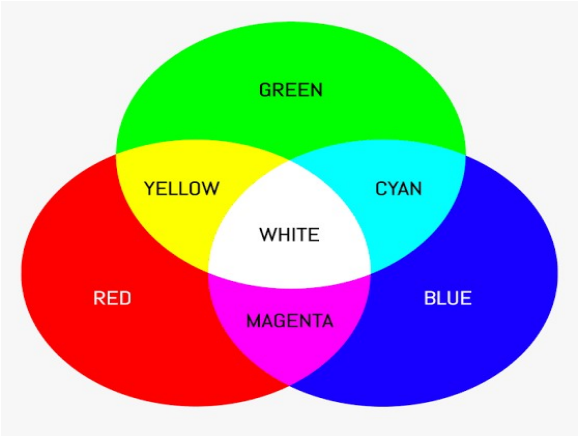
Primary colours and secondary colours.

A primary colour is one that cannot be obtained by mixing other colours e.g. red, blue and green.
A secondary colour is colour made by mixing two primary colours e.g. yellow, magenta, peacock blue pr cyan.

How to make secondary colours.

- Red + green = Yellow.
- Red + Magenta = white.
- Blue + yellow = Cyan or peacock blue.

Illustration:

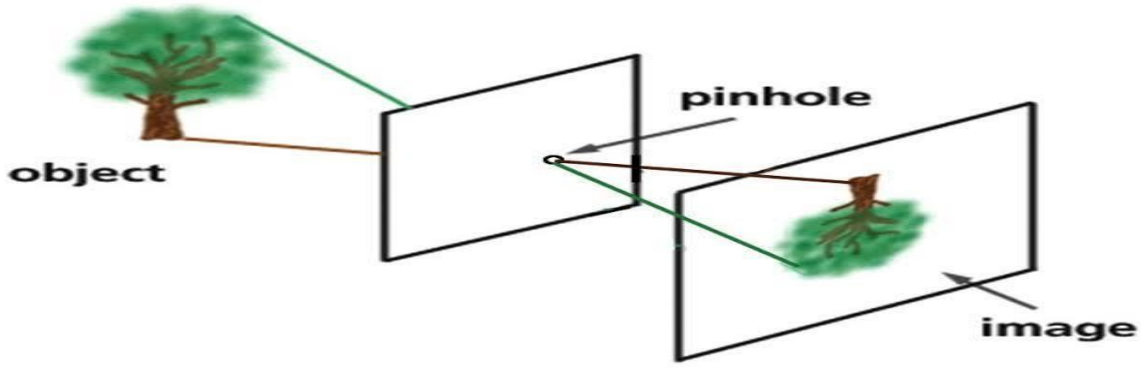


White is a universal colour.

A pin hole camera

A pinhole camera works on the principle that light travels in straight lines. That is why an inverted image is formed on the screen.

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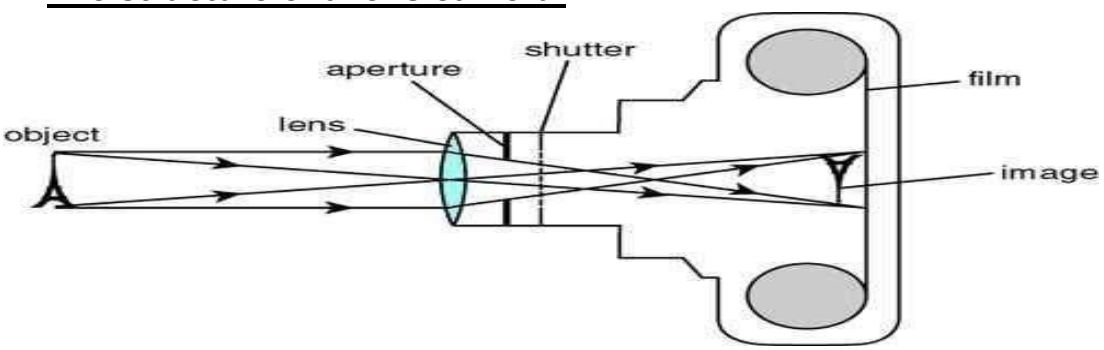
Characteristics of images formed by a pinhole camera.

- The image is diminished – smaller than the object.
- The image is inverted – upside down.
- The image is real i.e. it can be cast on the screen.

The lens camera:

- A camera is an optical instrument because it uses a convex lens.
- It consists of a light proof box with five functional parts. i.e. the lens, diaphragm, shutter, film and focusing ring.

The structure of a lens camera.



Functions of each part.

- **The film** – Is a light sensitive piece of paper on which an inverted image is formed.
- **The diaphragm** – It regulates the amount of light energy that has been allowed into the lens. It has the aperture (a circular hole) which can be changed according to the amount of light required.
- **The lens** – the lens focuses the image on the film. The film works as a screen.
  The camera uses a convex lens.
- **The shutter** – The shutter uncovers the aperture for a fraction of a second thus admitting light into the camera. This exposes the film.
- **The focusing ring**. This adjusts the distance of the lens from the film i.e. moving the lens forward or backward.

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How the camera works

- Light is allowed into the camera by the lens, diaphragm and shutter, it falls on the film and the film is exposed.
- The exposed film is removed from the camera in a dark place and put a certain chemical to develop it. The result of developing is a negative.
- It is called a negative because the bright parts of the object photographed appear dark and the dark parts appear bright.
- The negative is printed to give a positive (photograph) which has the same shades as the object.

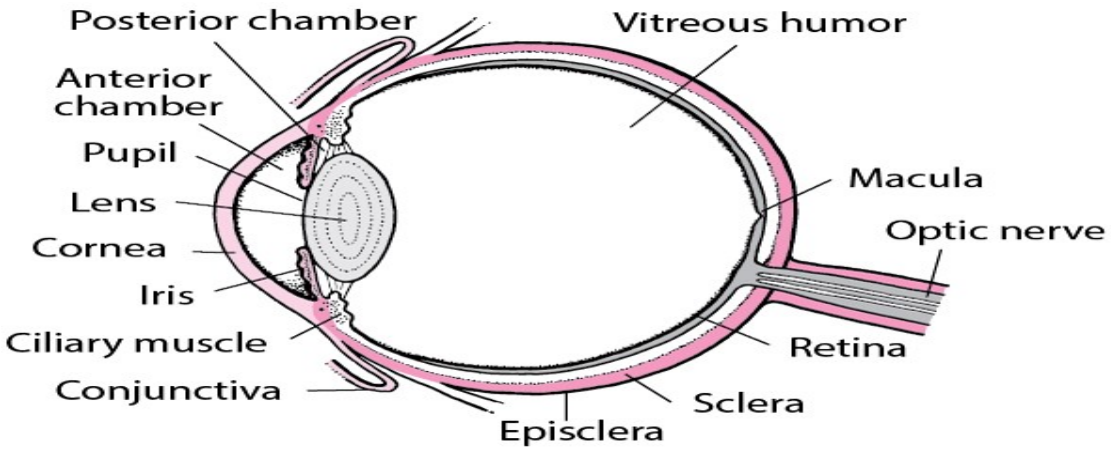
Characteristics of images formed by a camera.

1. The images are real.
2. The images are inverted.
3. The images are diminished.

The Human Eye

The eye is an organ of sight.
It is spherical in shape and enclosed in a socket of the skull called the orbit.

The structure of the eye.



- **Retina.**
  - This layer contains light sensitive cells called rods and cones.
  - Human being see clearly during day because they have more cones than rods.
  - Cones help in day light and colour light.
  - Rods help in dim and night vision.

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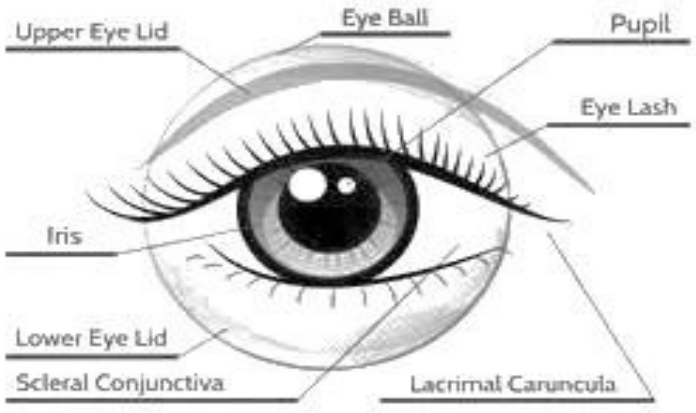
- It is on the retina when the images are formed.

- **Fovea (yellow spot)**
  - It has the highest concentration of cones.
  - It gives accurate interpretation of the image and is where the sharpest image is formed.
- **Blind spot.**
  - This spot doesn't have any light sensitive cell.
  - It is where the optic nerve leaves the eye and also where blood vessels and nerves join the optic nerves.
- **Lens**
  - Refracts light rays and focus the image on the retina.
- **Suspensory ligament**
  - Holds the lens in position by attaching it to the ciliary body.
- **Aqueous and virtuous humour.**
  - These are salt solutions, sugar solution and proteins in water.
  - They refract light to produce an image on the retina. - They help to maintain the shape of the eye. • **The optic nerve**
  - Transports nerve signals to the brain for interpretation.
- **Eyelashes.**
  - They help to trap large air borne particles.
- **Tear glands.**
  - They lie under the eyelids.
  - They secrete a solution of sodium hydrogen carbonate and sodium chloride (Tear).
  - They have an enzyme which kills bacteria.

NB:

The eye has the ability to focus near and far objects on the retina by changing the shape of the lens. This focusing of near and far objects by the lens is called accommodation.

Front view of the eye



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Functions of parts of the eye.

1. The eyelids.

- They cover and protect the eye.
- Blinking can be voluntary or by reflex action.
- Blinking distributes a fluid (tears) over the surface of the eye to prevent it from drying.
- Tears clean up the eye and kills some germs which enter the eye.

2. Conjunctiva.

- Is a thin layer which lies inside the eyelid.
- It is kept moist and clean by a slow continuous stream of liquid from the tear glands.

3. Sclerotic.

- It is a tough non-elastic coat around the eyeball.
- It supports and maintains the shape of the eyeball.

4. Cornea.

- It is a transparent part of the sclerotic. It helps to refract and converge light.

5. Choroid

- It has a dense net work of blood capillaries supplying food and oxygen to the eye.
- It is pigmented black to reduce internal reflection of light within the eye.

6. Iris

It regulates the size of the pupil and controls the amount of light entering the eye.

It also determines the colour of the eye.

- **Pupil.** Admits light into the eye.

Characteristics of images formed by the eye.

1. The images are real.
2. The images are inverted.
3. The images are diminished.

Similarities between the eye and camera.

The human eye	The photographic camera

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1. Image falls on the light sensitive retina 2. Has a convex lens. 3. It is covered by a black layer choroid. 4. Iris controls the amount of light by regulating the size of the pupil. 5. The image is real, inverted and diminished. 6. The eyelids keep out light. 7. The ciliary muscles determines accommodation of the lens.	1. Image falls on alight sensitive ilm. 2. Has a convex lens. 3. It is covered by a light proof bo x. 4. The diaphragm controls the amount of light by regulating the siz e of the aperture. 5. The image is real, inverted an diminished. 6. The shutter keeps out light. 7. Focusing ring determines the distance of the lens from the film.

Difference between a human eye and camera.

The human eye	The photographic camera
1. Distance between the lens and retina is fixed. 2. Shape of lens easily to focus at different distances. 3. Lens is soft and elastic. 4. Image is focused by making lens thicker. 5. Aqueous and vitreous humour refracts light. 6. The iris adjust itself.	1. The distance between the lens and film changes. 2. The shape of the lens does not change. 3. The lens is hard. 4. The image is focused by moving lens. 5. Only the lens refract light. 6. The diaphragm can be adjusted.

Eye defects

- It is the inability for an eye to focus certain distance normally.

- **Cause**
  - The eye ball being too long or eye lens being too thick.
  - This causes the image from distant objects be brought to focus in front of the retina.
  - Short sightedness can be corrected by wearing spectacles with diverging lens (concave lenes). **Eye strain.**
- Abnormal shape of the eye ball.
- Abnormal shape of the lens.
- Colour blindness.

<u>Examples of eye defects.</u>

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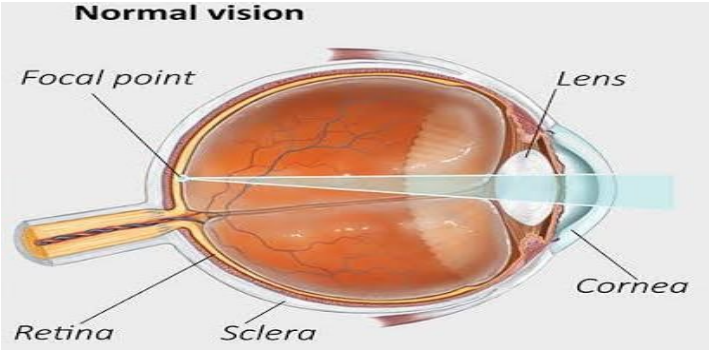
- There are four eye defects in common in humans namely.
  a) Short sightedness (myopia)
  b) Long sightedness (hypermetropia)
  c) Old age sight (presbyopia)
  d) Astigmatism.

- **Short sightedness**

  Short sightedness is a condition when a person can only see near objects clearly but cannot see distant objects.

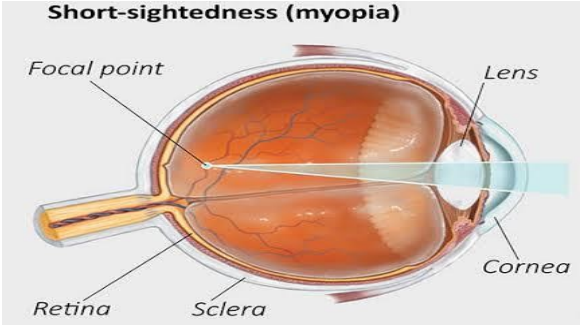
Normal eye sight.

Both near and distant objects can be focused on the yellow spot on the retina.



Short sightedness (myopia)

This occurs when the eye ball is longer than the normal or when the lens is too thick and the objects close to the eye can be focused properly but the point of focus for distant objects is Infront of the retina.



Correction of short sightedness.

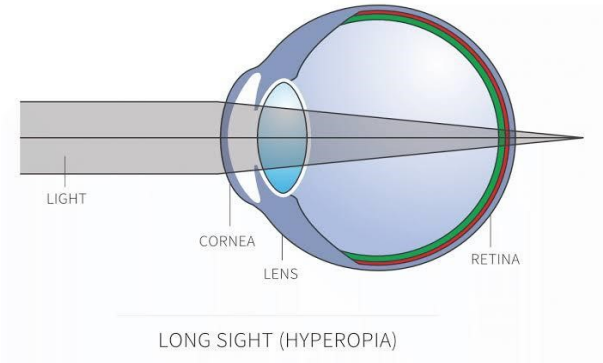
Short sightedness is corrected by wearing spectacles with diverging lenses (concave lenses).

Long sightedness:

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Long sight is a condition when certain people can see distant objects clearly but can not see near by objects.
Small or short eye ball or too thin eye lens.
The above causes the image from close objects be brought to focus behind the retina.

Illustration



This occurs when the eyeball is shorter than the normal or when the eyeball is small or the lens is too thin.
Distance objects can be focused properly but the point of focus for close objects is behind the retina.

Correction of long sightedness

Long sightedness is corrected by wearing spectacles with convex lenses.

Old age sight (presbyopia)

When the lens loses its elasticity it can no longer change in shape. It becomes suitable for only distant vision (long sight). Old age sight people usually require reading glasses which have converging lenses. This happens in old age above sixty years.

Astigmatism.

It is the most common of all eye defect.
It is caused by the surface of the cornea not being perfectly smooth or spherical.
This result is blurred vision.
Astigmatism is corrected by wearing spectacles with cylindrical lenses.

DISEASES OF THE EYE

Conjunctivitis.

- It causes the swelling of conjunctiva.

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- It is caused by gonorrhoea.

There are three types of conjunctivitis.

1. Acute conjunctivitis.
2. Chronic conjunctivitis.
3. Gonorrhoea conjunctivitis.

Signs of conjunctivitis

1. The white part of eye becomes pink.
2. Watery discharge from the eyelid with mucus and pus.
3. Scratching and burning sensation in the eyelid.
4. Looking at light cause pain.

Trachoma

Caused by bacteria.

- It is highly contagious and infectious disease.
- It is common in places with poor hygiene and overcrowding where water is scarce and people don't wash hands and their eyes.

How trachoma spread1 By houseflies.

2 Sharing hands wit an infected person.
3 Sharing of the same basin with an infected person.
4 Shaking hands with another infected person.

Signs and symptoms

1 Redness and itching on the eye.
2 Watery discharge from the eyelids.
3 Swelling of the eyelids.
4 Pain while looking at light.

River blindness.

- It is caused by a tiny filaria worm (onchocerca vulvulus).
- It is carried by a small hump known as a black fly or simulium fly.
- This fly breeds in fast flowing rivers.

Signs and symptoms• Itching skin rashes.

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- Severe skin itching.

Prevention and control.
- Spraying using insecticides against the adult fly.
- Treatment of the infected person.

Other diseases.

Blepharitis.
- This is an inflammation of the margin of the eyelid.
- The eyes itch and burn and swell.

Cataracts.
- This is when the lens of the eye becomes grey and opaque.
- They are caused by an injury or continued exposure of the eye to high temperature.

Glaucoma.
- Caused by increased internal pressure of fluids.
- It can come about by itself or progress from another diseases.

Iritis.
The swelling caused by other diseases or injury to eye.

Sty
- This is a small inflammation on the eyelid. It looks like a small boil.
- It is usually a sign of poor general health, anaemia or diabetes.

Corneal ulcer.
It is caused by an injury to the cornea.

Night blindness

Care of the eye.
- Don't rub your eyes with dirty fingers.

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- Don’t strain your eyes by reading;
  a) Very small prints with too little or direct sunlight.
  b) In moving vehicles.
  c) In wrong postures like in bed.
- Don’t expose your eyes to very bright or glaring light.
- Always wash your eye with clean water and soap, every morning and evening.
- Never look directly at the sun, it may spoil your retina.
- If there is anything wrong with your eyes visit an eye specialist.
- When reading use a correct distance of about 30cm. • Don’t share towels or clothes with people who have sick eyes.

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THEME:MATTER AND ENERGY

TOPIC 9: ELECTRICITY AND MAGNETISM

Electricity

- Electricity is a form of energy produced by the flow of electrons.
- **Electrons** are negatively charged particles of an atom.
- **An atom** is he smallest possible unit of matter that can take part in a chemical change.
- Atoms link together to form molecules.

What is an electric current?

An electric current is a flow of electrons through the conductor. We measure electric current by use of an ammeter which gives units in amperes (amps)

Use of electricity

Electricity is used in; 1. Lighting.

2. Cooking.
3. Operating machines.
4. Heating.
5. Protection / security fences. **Advantages of using electricity** 1. It is quick or fast to use.
2. It is clean and smokeless.
3. It is environmentally friendly.
4. It is easy to operate.

Dangers or dis-advantages of using electricity.

- It can shock and kill.
- It can burn property.

Types or forms of electricity

There are two types of electricity

1. Static electricity
2. Current electricity

Static electricity.

- This is the type of electricity where electrons do not flow.
- Static electricity is produced by friction between insulators.

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- Lightning is an example of static electricity in nature.

Examples of static electricity.

- Lightning in nature.
- Rubbing insulators against each other.

Lightning and thunder

1. Lightning is caused when clouds become heavily charged with static electricity by means of friction.
2. This is when positively charged clouds rub against negatively charged clouds.
3. When positively charged clouds meet negatively charged clouds, a huge spark of light is seen and this is what we call lightning.
4. During lightning the surrounding air becomes strongly heated, expands and contracts suddenly which causes a vibration that produces sound called thunder.
5. The continuous noise is due to the echoes.
6. Lightning is seen before thunder is heard because light travels faster than sound in air.

Advantages of lightning in nature.

- It converts atmospheric nitrogen into nitrates for plants to use.

Dangers caused by lightning.

- It damages buildings.
- It can cause fires.

Prevention of dangers caused by lightning.

1. Install lightning conductors on tall buildings.
2. Avoid standing under tall trees during a rain storm.
3. Avoid swimming in open water during rain.
4. Always put on rubber shoes.

Current electricity.

- Is the type of electricity where electrons flow through a conductor.

Types of current electricity.

- They are two types of current electricity:- 1 Direct current electricity (DC).

2 Alternating current electricity (AC).

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Direct current electricity.

This is the type of current electricity which flows in only one direction, that is from the source to the appliance.

Sources of direct current.

1. Dry cells
2. Simple or wet cells
3. Accumulators

Alternating current electricity.

Is the type of current electricity which flows in both directions, that is forward and backward.

It can be stored in form of direct current electricity and it can be stepped up and down

Sources of alternating current electricity.

1. **Hydro-electricity:**

- This is the electricity produced by the powerful running water.
- At a power station, kinetic energy of moving water turns turbines which are connected to generators that produce electricity.
- Hydro-electricity can also be produced by tides along coasts.

2. **Thermal electricity:**

- Is the type of electricity produced by burning fuel, coal or oil which contain stored chemical energy.

3. **Atomic electricity:**

- Is the type of electricity produced by burning atomic uranium mineral.

4. **Solar electricity:**

- Is the type of electricity got from the sun.
- It is got by using solar cells which trap heat and light from the sun that are sent to solar batteries to produce electricity.

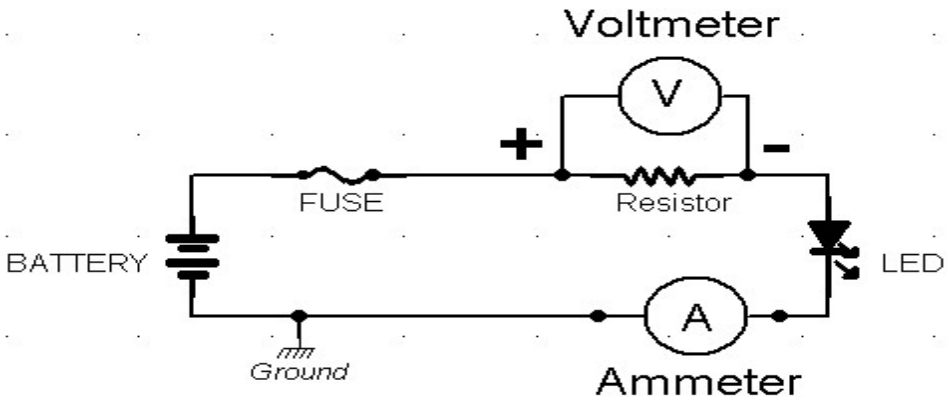
5. **Geo-thermal electricity:**

- Is the type of electricity produced by steam from hot springs.

AN ELECTRIC CIRCUIT

- An electric circuit is a complete path through which an electric current flow.
- Current is the flow of electrons.

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Parts of an electric circuit and their uses:

Ammeter:Measures electric current in a circuit.

Conducting wires: Is a medium for conducting current from the source to the appliance.

Switch: Completes or breaks the circuit at ones will.

Fuse: Is a safety device which breaks the circuit in case of too much current flow. Battery: Stores chemical energy that is changed to electric energy when the circuit is complete.

- The bulb has the ability to change electric energy to heat and light energy.

NB:

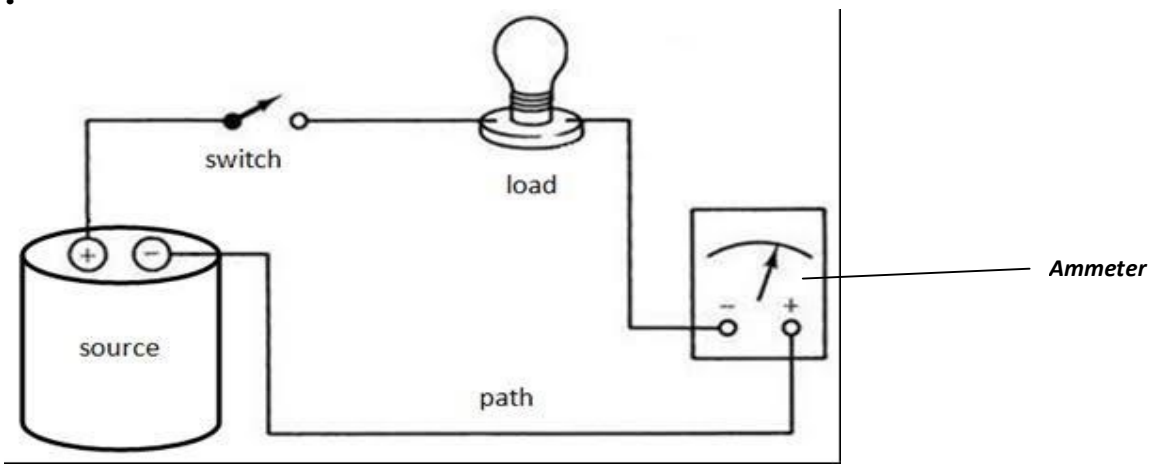
- In a simple electric circuit, electricity / current flows from the positive terminal to the negative terminal.
- Electrons flow from the negative terminal to the positive terminal.
- For current to flow easily, the positive terminal must be connected to the negative terminal if you are using more than one dry cell, e.g
- Electricity will flow if the dry cells are connected in series as shown in (a), but it will not flow as shown in (b) and (c).

Component of an electric circuit

- Dry Cell.
- Switch.
- Conductors/ wires
- Fuse.
- Light bulb

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- Ammeter
- Volt meter



Functions of each part of the circuit

- **Ammeter**: It is used to measure electric current or flow of current. -**The switch**: it breaks and complete the circuit at one's own will.
- **The bulb**: Once the circuit is complete, the bulb produces light. A bulb has the ability to change electric energy to heat then to light energy.

The bulb will stop lighting if any of the following takes place:

1. When the filament burns out or if it blows.
2. When the fuse blows, burns out or breaks.
3. When the dry cells become exhausted.
4. If it is not fixed properly.
5. If the dry cells are not arranged properly.
6. If the circuit isn't complete.
7. If the conductor / wire isn't connected properly,

Dry cells

- Dry cells produce electricity for the appliance.
- It store electricity in form of chemical energy.
- It convert or change chemical energy to electric energy once the switch is closed or pressed.
- The cells must be arranged in series in that the positive terminal meets the negative. **A fuse**
- It is safety device which breaks the circuit in case of too much flow of current.
- It is simply a wire made of an alloy of tin and lead (solder)
- The alloy has a low melting point. So, it easily melts and breaks the circuit

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How does a fuse work?

A fuse wire melts and breaks the circuit if current is greater than rated value flows through it.

This prevents large current from harm or damage.

Advantages of fuses

1. Reduces the risks of electric fires in houses.
2. They protect the delicate electric equipment (appliance) by breaking the circuit before damage is done.

Reasons why a fuse may blow or break.

1. Old and weakened wires
2. Overloading the circuit
3. Presence of a short circuit
4. Too much flow of current from the source.

Energy changes in a circuit

- When the circuit is complete, chemical energy in a dry cell is changed to electricity.
- In a bulb, electricity is changed to heat and then heat to light energy.

Types of a circuit

(a) **Parallel circuit**: Is one in which all positive terminals are connected by one conductor and all negative terminals are connected by one another.

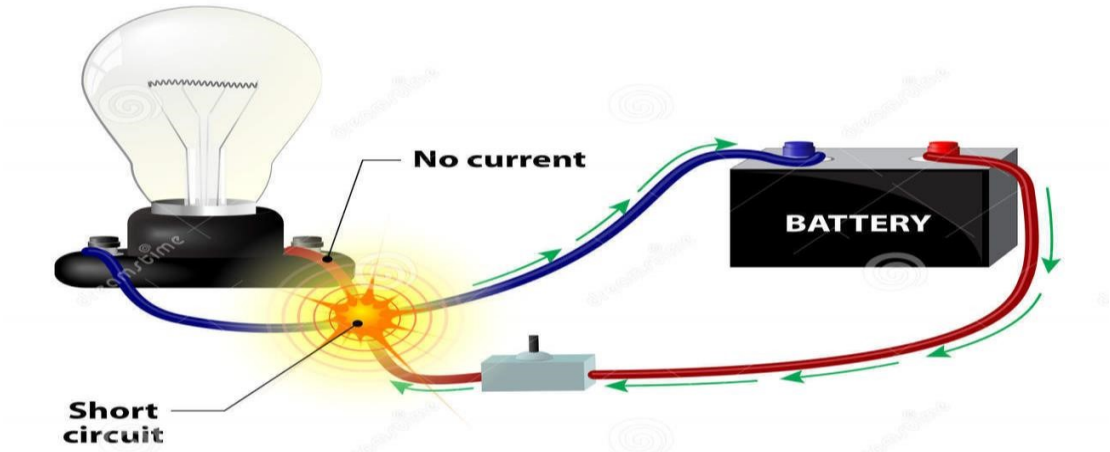
(b) **Series circuits:** Is one in which the positive terminal of one cell is connected to the negative terminal of another cell to form a battery.

SHORT CIRCUITS

- Is a path of electricity with low resistance to electric pressure.
- Is a short path taken by electricity
- A path with low resistance to flow of current.

An illustration about a short circuit

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When the switch is closed, the bulb doesn't light up.
The match stick instead lights up showing a short circuit which produces heat and fires sometimes.

Causes of Short Circuits

1. Dampness or rain which spoils the insulation.
2. Pushing metallic objects in the sockets.
3. Age of too old wires.
4. Over loading the circuit.
5. Damage made by rats or cockroaches to the insulation.
6. Use of faulty electrical appliances
7. Pouring water in electric appliances.
8. Poor wiring during electric installation.

Signs of short circuits

1. Over heating in the circuit.
2. Too much or little flow of electricity in the circuits.
3. Some electric appliances may give electric shock.
4. Some electric appliances may fail to work. **Dangers of Short Circuits.**

- Short circuits may cause fire that may destroy property.
- Short circuits lead to destruction of electrical appliances.

How to Prevent Short Circuits

1. Using properly insulated wires.
2. Having electrical installations done by experts only.
3. Having electrical repairs done by qualified personnel.
4. By use of insulators

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Insulators / conductors:

Conductors

Conductors are substances which allow electricity to flow through them.

Examples (Liquid conductors / Non-metallic conductors)

1. Water
2. Acids
3. Alkalis
4. Carbon
5. Wet wood

Examples of metals that conduct electricity

1. Silver is the best conductor of heat but it is very expensive
2. Copper
3. Lead
4. Iron
5. Zinc
6. Tungsten Note :

1. Distilled water doesn't conduct electricity because it lacks mineral salt.
2. Copper is commonly used because it is cheaper 3. Silver is not commonly used because it is expensive.

NB: Application of conductors

- When cooking
- Ironing

Insulators

Are materials which do not allow electricity to flow through them

Examples

1. Rubber
2. Glass
3. Plastic
4. Dry clothes
5. Dry wood

NB : They protect users from electric shock / circuits.

Electric cells:

Electric cells a device that stores and produces electricity.

There are two types of electric cells. (a) Primary cells.

(b) Secondary cells

Primary cells

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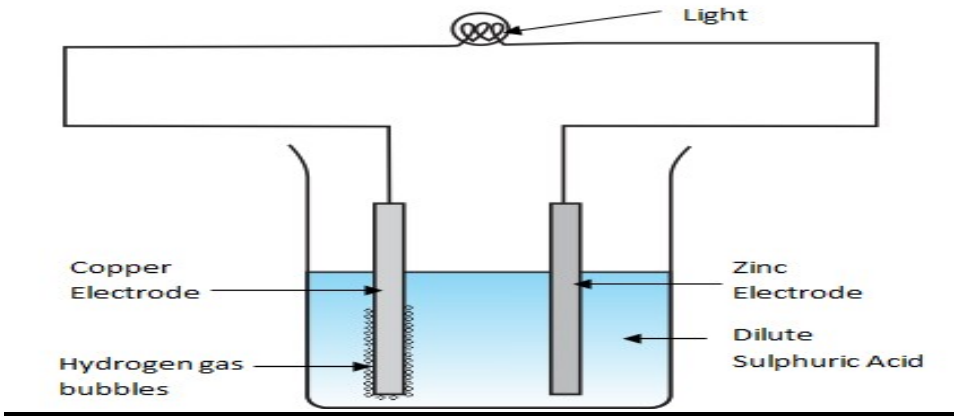
- These are cells that cannot be recharged once they are used up.

Examples of primary cells •

Simple cells or wet cell.

- Dry cell.

<u>Parts of a simple cell</u>. (diagram)



1. **<u>Copper rod:</u>**It acts as the positive terminal (Anode) 2. **<u>Zinc plate:</u>** It acts as the negative terminal (cathode) 3**. <u>Dilute sulphuric acid:</u>**
Acts as an electrolyte .
An electrolyte is a liquid that allows electricity to pass through e.g. Lemon juice, salt solution, sulphuric acid, water etc.

- *A simple cell is not efficient because of two factors.*
  (a)Polarization.
  (b)(b) Local action

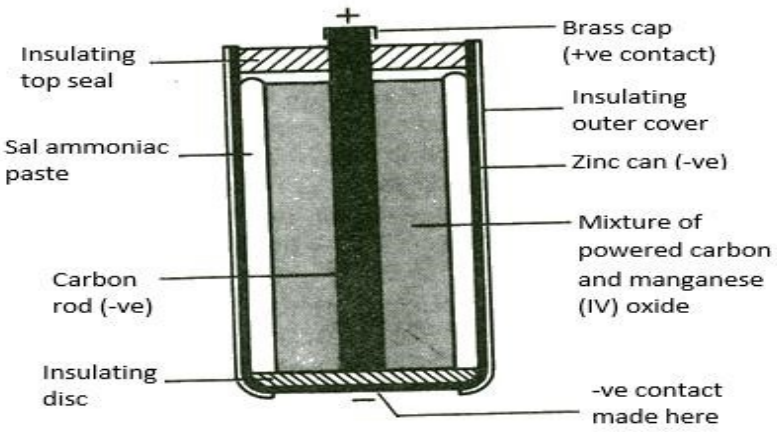
Polarization is when bubbles of hydrogen gas cover the copper rod stopping the flow of electrons.
Local action is when bubbles of hydrogen gas are seen coming off the zinc plate.

<u>Disadvantages of simple cells.</u>

- It is bulky.
- It can only be used in upright position.
- It produces electricity for a short time.

Dry cell (diagram)

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Brass cap – the contact for the p[positive terminal

Pitch or top seal:

- Prevents ammonium chloride jelly from drying up.

Ammonium chloride paste:

- Helps in the transfer of electrons.

Electrolyte:

- It is made up of powdered carbon and manganese oxide.
- The powdered carbon provides a partial conductor across the inside of a cell It reduces the work of the cell in moving electrons Reduced the internal resistance of the cell.
- Absorbs hydrogen.

Manganese oxide

- Prevents a build up of hydrogen gas around the carbon rod.
- It is a depolarizing agent.
- Depolarization leads to leaking of cells when exhausted.

Carbon rod:

- Is a non-metallic conductor of electricity found in a dry cell.
- It is made form graphite.

Zinc can:

- It acts as the negative terminal.

Secondary cells:

- These are cells which can be recharged once exhausted.

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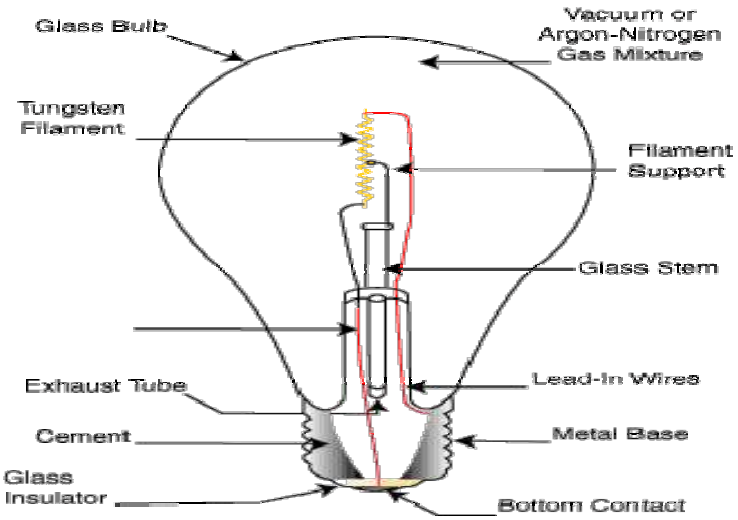
Examples of secondary cells

- Lead acid battery • Telephone batteries.

An electric bulb.

- Is an electric appliance that changes electricity to heat and light energy.

Parts of an electric bulb



Brass cap: Enables the bulb to be fixed in the lamp holder.

Sealing tube: Enables air to be removed from the bulb and this prevents the filament from combining with oxygen.

Coiled filament:

- The filament changes electrical energy to heat and then light energy.
- The filament is coiled to increase resistance to electric pressure.
- The filament is made up tungsten which has a high melting point.
- Tungsten is got from a mineral called wolfram.

Glass bulb

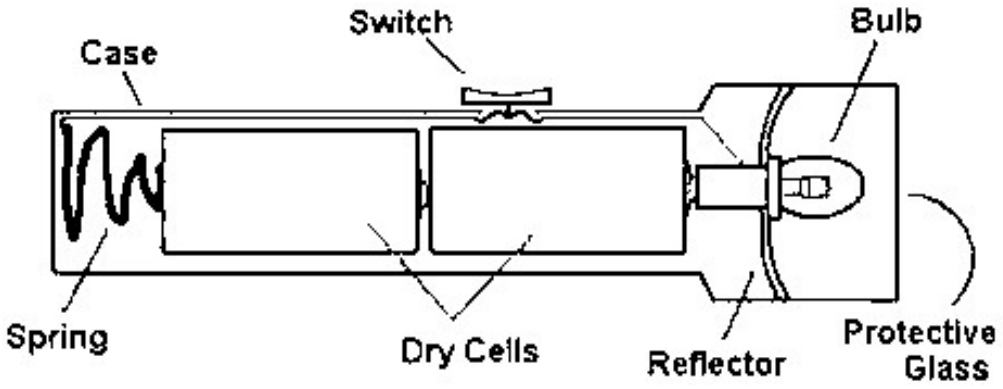
- Holds a mixture of two gases. Argon and Nitrogen.
- These gases prevent the evaporating of tungsten.

An electric torch:

A torch uses dry cells. In most cases, the dry cells are placed in series.

Parts of the torch

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1. **The switch**: Breaks and completes the circuit at a user wish.
2. **The Bulb**: Changes electric energy into heat and heat to light energy.
3. **The battery (dry cell)** : changes the stored chemical energy to electric energy.
4. **The reflector**: The reflector directs lights into a diverging beam
5. **The case and springs**: Completes the circuit and also keeps the dry cells tightly closed.

However, the torch may fail to work if; 1. The bulb is not fixed properly.
2. The dry cells are not arranged properly
3. The cover is not properly fixed.
4. When the dry cells are wrongly arranged.
5. When the dry cells are used up.
6. When the bulb is blown.
7. When some parts of the torch are rusted.
8. When the used bulb has a higher voltage than the used torch.

If it starts working properly and then later fails.

- The bulb could have blown
- The dry cells could have become exhausted

Merits / advantages of using current electricity.

1. It is easy to use compared to charcoal or firewood.
2. It is quick so it saves time.
3. It helps to conserve the environment by saving trees for firewood and charcoal.
4. Neat and clean work is produced using electricity.
5. It can easily transform into other forms of energy e.g electric to heat, electric to light, electric to sound, electric to magnetic.

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6. It does not pollute the environment.

Demerits / disadvantages of using electricity

1. It causes fire
2. It shocks and kills people once used carelessly
3. Poor people can't afford paying bills, so it is expensive.

Equipment / appliances which use electricity in our homes

- Telephone receiver, radio receiver, flat iron, television set, juice blender, electric kettle, water heater, micro wave oven.

Calculation of voltage:

- One dry cell has a voltage of 1.5V.
- To calculate the voltage of an electric appliance, you multiply the number of dry cells by 1.5 volts.

Plugs and sockets:

There are two types of plugs, i.e. a two-pin plug and a three-pin plug.

Three pin plugs

- Three pin plugs are used in flat irons, cookers, water, heaters, coils, hot plates, electric kettles etc.



Wiring a three-pin plug / cable / grid.

- Neutral wire, coloured black or blue takes back the current to the source.
- Live wires usually red or brown brings current from the source.
- Earth wire green or yellow minimizes any electric leakage or excess current and also prevents us from being shocked. (diagrams)

Devices connected to electricity:

(i) Generator:

- A generator produces electricity by changing mechanical energy in form of kinetic energy to electric energy.
- This is done by rotating coils of wire in a strong magnetic field.

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How to make a generator produce more electricity:

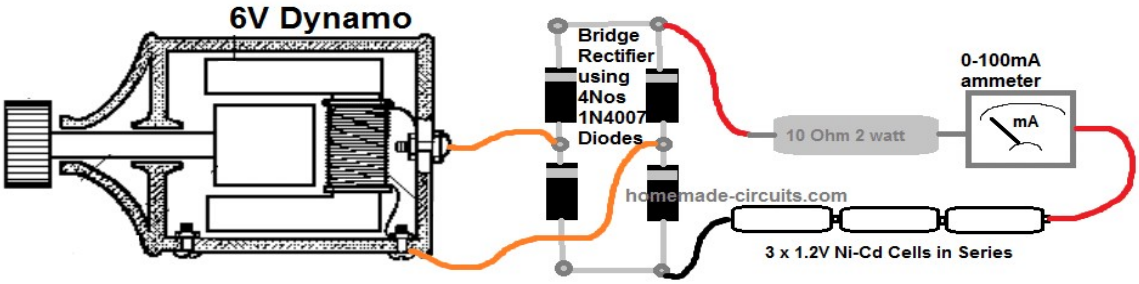
1. Increasing the number of turns in the coil.
2. Increase the magnetic filed.
3. Increasing the speed of rotation.

(ii) Dynamos.

A dynamo produces electricity by converting mechanical energy in the form of kinetic energy into electric energy.

• An example of a dynamo is found on a bicycle and bigger ones on vehicles. Those in vehicles help in charging the batteries.

A bicycle dynamo



Electric motors

Electric motors are the reverse of generators and dynamos. Generators and dynamos use mechanical energy to produce electricity while motors use electric energy to produce mechanical energy.

Uses of motors

1. They start engines of cars
2. They move buses / trains
3. They are used in lifts, vacuum cleaners, egg beater, electric sewing machines, radio cassettes, etc.

Static electricity:

Static electricity is a form of electricity in which electrons don't move **Static** means **not moving or stationary**.

1. It has two static charges, positive and negative charges.
2. The positive and negative charges.
3. The positive and negative charge attracts each other while positive and positive or negative and negative repel each other.
4. Like charges repel each other while unlike charges attract each other.
5. Static electricity is produced by friction.

Note:

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Static is always made when insulators are rubbed together.

1. One insulator gains electron and becomes negatively charged while the one which loses electrons becomes positively charged.
2. Different charges, (positive and negative), attract each other while some charges, negative and negative or positive and positive repel each other.
3. Static electricity is also called stationary electricity.
4. The negative charges are called electrons while the positives are called protons.

Differences between static and current electricity

Static	Current
It occurs in insulators i.e plastics	It occurs in conductors i.e metallic cab es
The charge is on the surface of the insulator	The charge is inside the conductor.
The charge doesn't flow from one point to another	The charge flows along the conductor the entire conductor is filled with the charge. e
Static electricity has both protons and electrons active.	Current electricity has only electrons active.

LIGHTNING

1. It is a form of static electricity.
2. It is sometimes referred to as a form of electricity in nature.
3. It is caused when clouds become heavily charged with static electricity by means of friction between the clouds and big masses of air in space. The clouds may be charged either positively or negatively.
4. When a positively charged cloud meets a negatively charged cloud, attraction occurs and a huge spark passes between the two clouds.
5. This spark may sometimes pass to the ground, which we call lightning or the electrons may jump from the clouds to the earth or from the earth to the clouds.
6. During this passage of lightning, the surrounding air becomes strongly heated and expands suddenly and then contracts quickly as is cools, the air is thus set vibrating producing or continuous noise is due to echoes.

Effects of lightning:

- Can cause damage to buildings.

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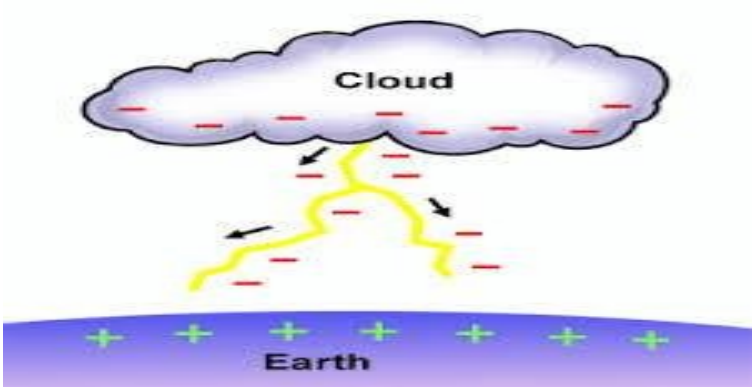
- Can set things on fire e.g trees and buildings. So it is not advisable to stand under trees when it is raining because lightning may strike the tree.

Advantages of lightning

- During lightning, nitrogen is transformed into nitrates and fixed into the soil.

Prevention of lightning:

1. Lightning usually strikes the tallest point.
2. To prevent this, a lightning conductor or lightning ancestor is used on the tallest point of the building.
3. It consists of a spiked rod attached to a long copper or aluminium rod, one end of which is buried in the earth.
4. If lightning strikes the building, it passes harmlessly through the rod and into the earth.



Rules governing electricity – the Nevers

1. Never touch a switch with wet hands because water conducts electricity.
2. Never over load connections
3. Never put anything in the fuse box or meter box.
4. Never connect an electric appliance you're not sure of.
5. Never touch an electric plug while bare footed
6. Never stand under trees when it is raining, lightning may strike the tree.
7. Report to UMEME offices near you for any broken mains or hanging wires or ring 185 across all networks.

Safety precautions in handling electricity / electrical appliances 1. Switch off electrical appliances incase of a problem

2. Do not touch live bare electric wire.
3. Never throw objects on the main power line

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4. Have all electric repairs done by experts
5. Never operate electrical equipment with wet hands.
6. Never push metallic objects into electric sockets.

Illustration showing dangers of electricity



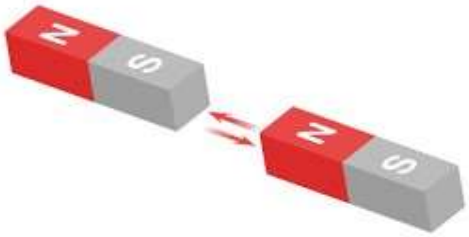
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MAGNETISM

Magnetism is a force in a magnet that has the ability to push or pull magnetic substances

Magnet

A magnet is a piece of metal with the ability to attract magnetic substances A magnet is made up of two poles named the North pole and south pole. **Illustration**



Magneticsubstances are materials which are attracted by a magnet.

Examples of magnetic materials

1. Iron
2. Steel
3. Lead
4. Cobalt

Non-magnetic materials are materials which are not attracted by magnets

Examples of non-magnetic materials

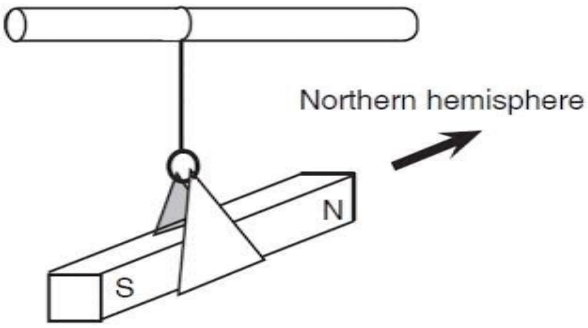
1. Rubber
2. Plastic
3. Paper
4. Cloth
5. Wood

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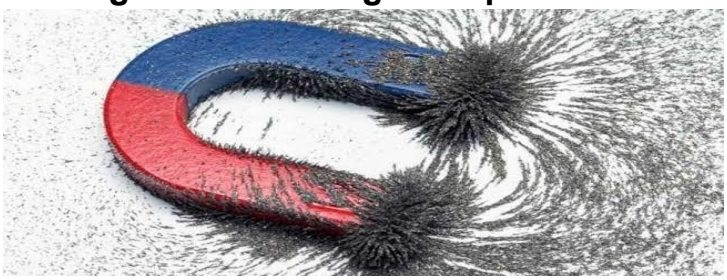
Magnetism is the property of a magnet, which enables it to pull or push other magnetic substances or materials
Magnetism is the ability of a magnet to attract other magnetic substances.

The illustration of properties of magnets

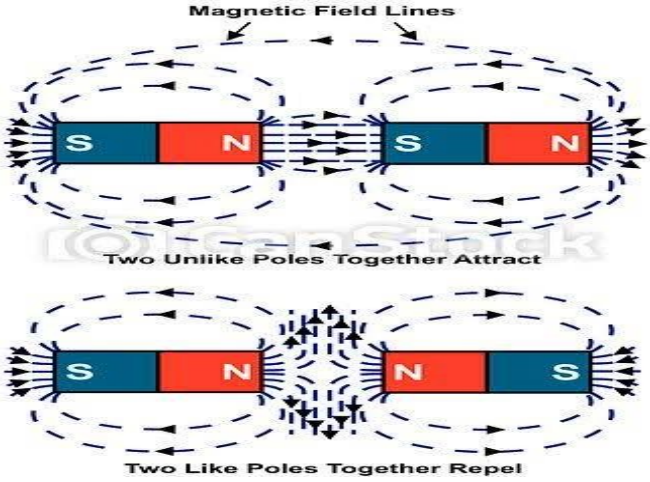
1. **A freely suspended magnet faces in the North – south direction**



2. **Magnets are strongest at poles**

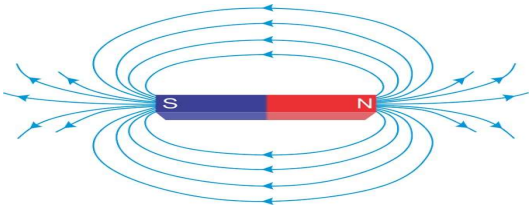


3. **Like poles of a magnet repel while unlike poles attract each other**

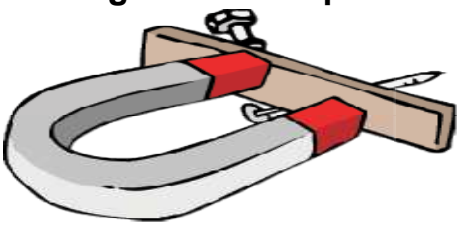


4. **Magnetic lines of force run from North pole to south pole**

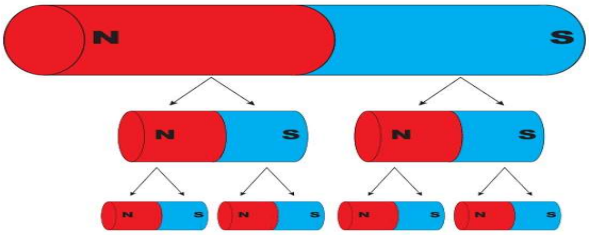
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5. **Magnetism can pass through a non-magnetic material**



6. **When a magnet is broken into pieces each piece becomes an independent magnet.**



Types of magnets

1. Natural magnets
2. Artificial magnets

Natural magnets:

1. These are magnets that exist on their own without a man making them
2. They are:

(a) Lodestone (Magnetite)
(b) The earth

Artificial magnets:

These are magnets made by man.
They are named according to their shapes.

These include;

1. Horse shoe magnet
2. Bar magnet
3. Needle magnet
4. Cylindrical magnets
5. Electro magnets. **Types of artificial magnets** These are:

Temporary magnets.

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Are magnets which lose their magnetism easily e.g electro magnet

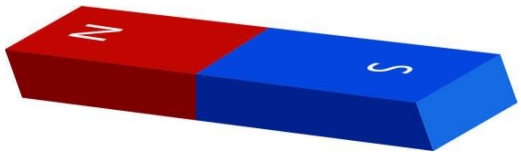
Permanent magnets.

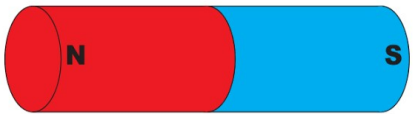
Permanent magnets retain their magnetism for a long time.

Examples of permanent magnets

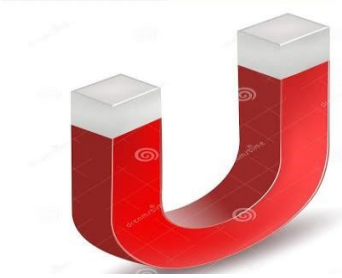
1. Horse shoe
2. Bar magnet
3. Cylindrical magnets
4. Needle magnet

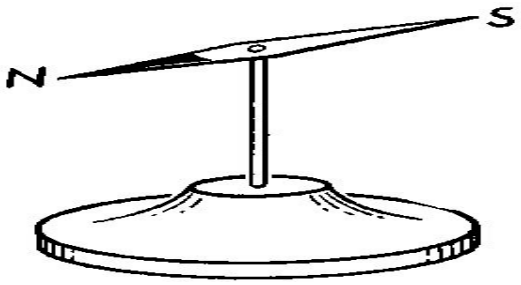
a) Bar magnets





Cylindrical magnet **Rectangular bar magnet**





b) Horse shoe magnets **(iii) Compass needle/magnet**

needle

<u>Terms used in magnetism:</u>

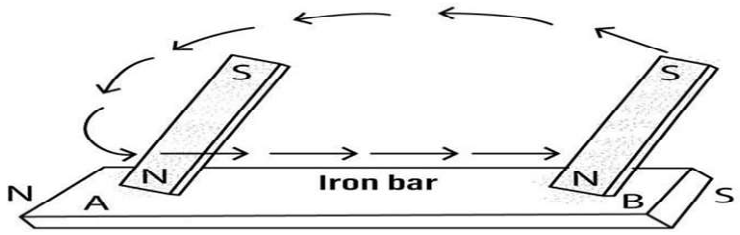
6. **Poles of magnets**: These are the ends of a magnet
7. **Magnetic field**: This is an area around a magnet where the force of magnetism is formed.
8. **Magnetic lines of force**: These are lines around a magnet through which magnetism runs from North to South pole. (illustrations)

Ways of making magnets.

1. Stroking method
2. Induction method
3. Electrical method **Single touch method**

This is done by stroking a magnetic substance with another magnet in the same direction with the same pole of the magnet. The end of the magnetic substance last touched or stroked becomes the opposite pole of the magnet used.

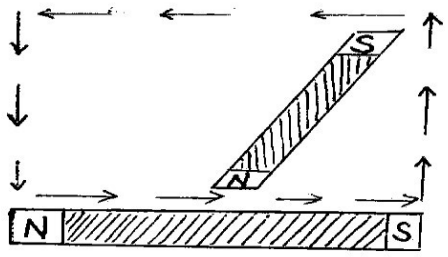
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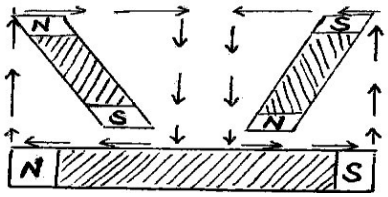


Single touch method

Double touch method / double stroking:

- This method is done by stroking using two bar magnets.
- Unlike poles and opposite direction must be kept and followed.
- Still opposite poles are produced at the point last stroked.



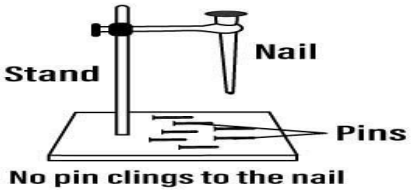


The induction method:

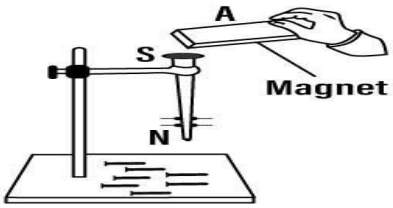
This is achieved or done by attaching a magnetic substance (steel bar) on to a permanent magnet.

The magnetic substance becomes magnetized by induction. The unlike poles are immediately formed to the ends of the magnet.

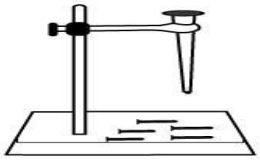
Note: the new magnets are known as <u>induced magnets.</u>



No pin clings to the nail



Some pins cling to the nail



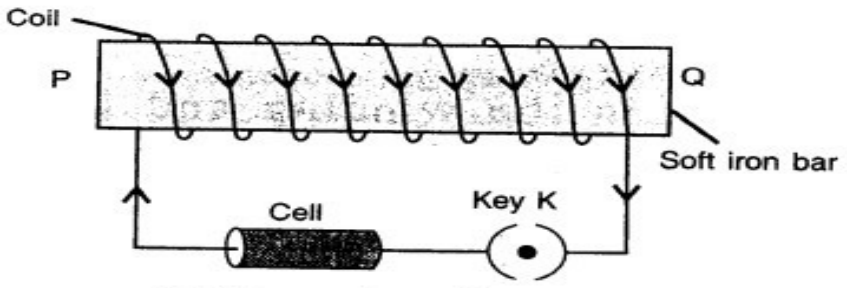
On removal of the magnet, pins fall down

The electrical method

This is done by placing a steel or iron bar in a coil of wire called a solenoid and electric current passed through the coil.

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This is the best method of making magnets, but the magnets made by this method are called <u>electro magnets.</u>

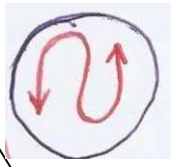


Making a bar electromagnet

The polarity of an electromagnet can be found using the following rule; If current flows clockwise, the end where current enters the solenoid, becomes the <u>Northpole</u> and if it flows anti – clockwise, the end acts like a South pole.



Clockwise



Anti-clockwise

Demagnetization

Demagnetization

Demagnetization or demagnetizing is a way of making a magnet to lose its magnetism

Ways of destroying magnets (demagnetization) 1. By strong heating.
2. By hammering / hitting.
3. By leaving the magnet in an East-west direction for a very long time.
4. Leaving magnets in water to rust.
5. Keeping magnets without iron keepers.
6. Keeping magnets with similar poles together for a long time.
7. Passing it through alternating current voltage several times.

<u>Ways of protecting magnets against demagnetization.</u>

1. By painting them to prevent them from rusting.
2. Keeping them in iron keepers.
3. Storing them while facing in the north-south direction.

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4. Storing them with unlike poles together.
5. Protecting them against strong heat.

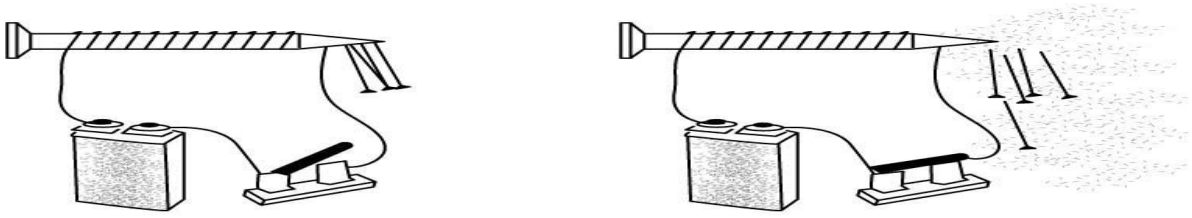
Uses of magnets

1. They are used to pick up pins, needles or any other magnetic substances.
2. Used in hospitals to remove iron fragments from eyes, wounds, etc.
3. Keeps doors of cabinets and refrigerators closed.
4. Magnets hold kitchen knives, spoons, etc. onto the walls.
5. They are use in compasses in aeroplanes and submarines to find direction.
6. Used in earpieces and telephone receivers.
7. Used in generators in the production of electricity.
8. Used in loudspeakers and microphones.
9. Used by watch repairer, cobblers and shoe makers to hold tinny nails.

Electrical method

Electrical methodis a method where current is used to make a magnet. The magnet made is called an electro magnet.

Illustration



a. Iron nail behaves like like a magnet

b. Iron nail no longer behaves like a magnet

Magnetizing by using electric current

Ways of increasing the strength of an electro magnet

1. Increasing the voltage
2. Increasing the turns in the solenoid **Advantage of using an electro magnet.**
   - Its strength can be increased

An electromagnet can be demagnetized by passing it through alternating current.

Examples of equipment that use electro magnets

1. Electric bell
2. Sound amplifiers
3. Generators

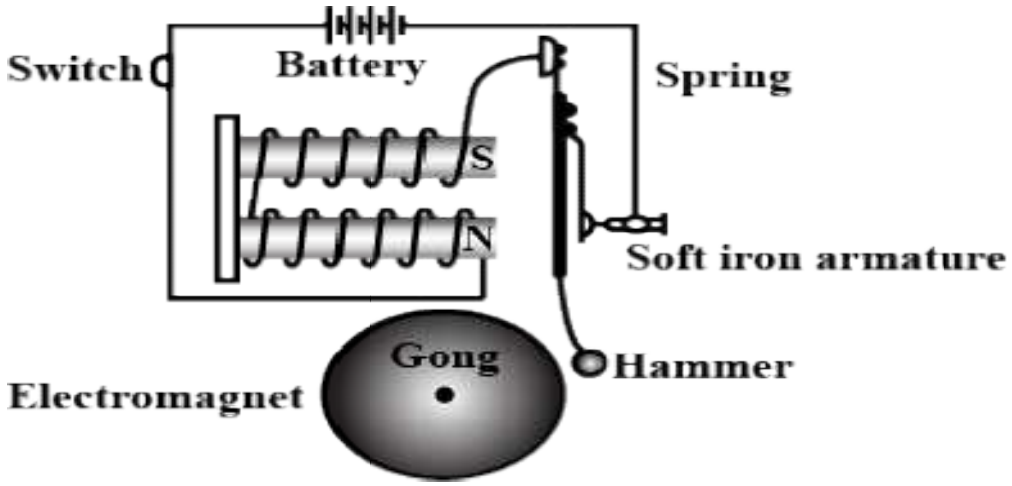
Use of electric magnets

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1. It is used in lifting heavy metallic scrap during smelting
2. Used in electric bells

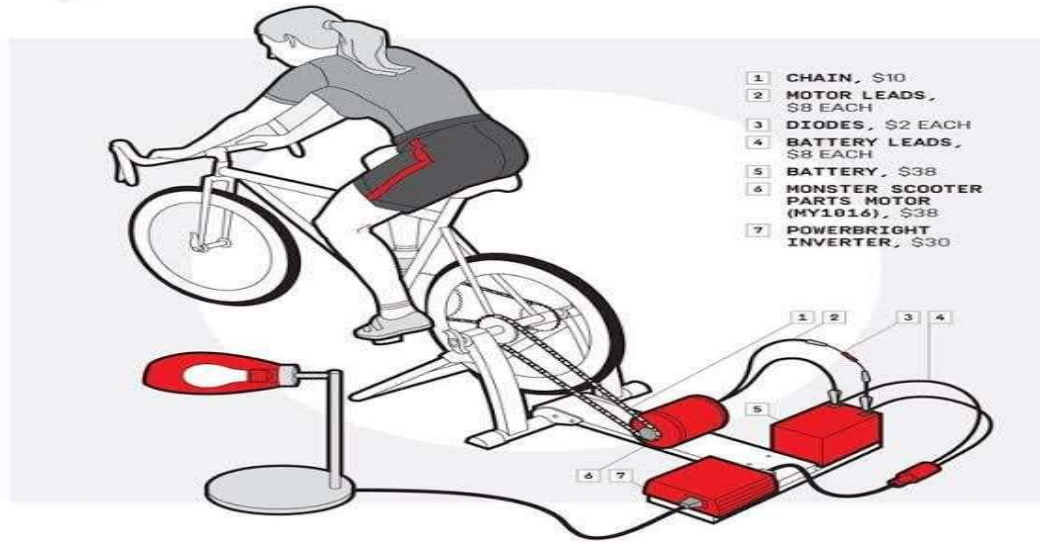
Electric bell

An illustration of an electric bell



Generating electricity using a dynamo

1. A dynamo is an electrical generator which produces electrical energy in form of direct current
2. It converts mechanical energy to electrical energy.
3. It helps in production of electricity when the magnet is made to rotate.
4. Dynamos are found in bicycles and vehicles **Illustration**



THEME: MATTER AND ENERGY

TOPIC 10: SIMLPE MACHINES AND FRICTION

What is a machine?

- A device or tool used to simplify man's work.

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How do machines simplify work?

- By reducing the forced used to do a piece of work.
- Changing the direction of forces.
- Increasing the speed of doing work.

Types of machines.

The two types of machines are

a) **Complex machines**

Complex machines are these made of many component parts and need training to use them. E.g tractor, sewing machine.

b) **Simple machines** – these with few parts and do not need special training to use them. e.g knife , panga , hoe

Common terms used in machines.

(i) Work:- is a product of force and distance moved by the load.
Work can also be defined as the result of any action requiring energy.
Work done = force x distance.
Work is measured in units called joules

(ii) Force: is a push or pull exerted on an object. Force measured in Newtons (ℕ). **NB:** 1kg = 10N.

(iii) Power: Is the rate at which energy is changed from one form to another i.e. rate of doing work. Power is measured in units called watts (W) or Kilowatts (KW).
NB: 1KW = 1000w.

(iv) Mass: is the quantity of matter contained in a body. Mass is measured in grams.

TYPES OF SIMPLE MACHINES.

What are the main groups of simple machines?
The six main groups of simple machines are;

(i) Levers
(ii) Inclined plane (The slope)
(iii) Wedges
(iv) Screws
(v) Pulleys
(vi) Wheels and axle

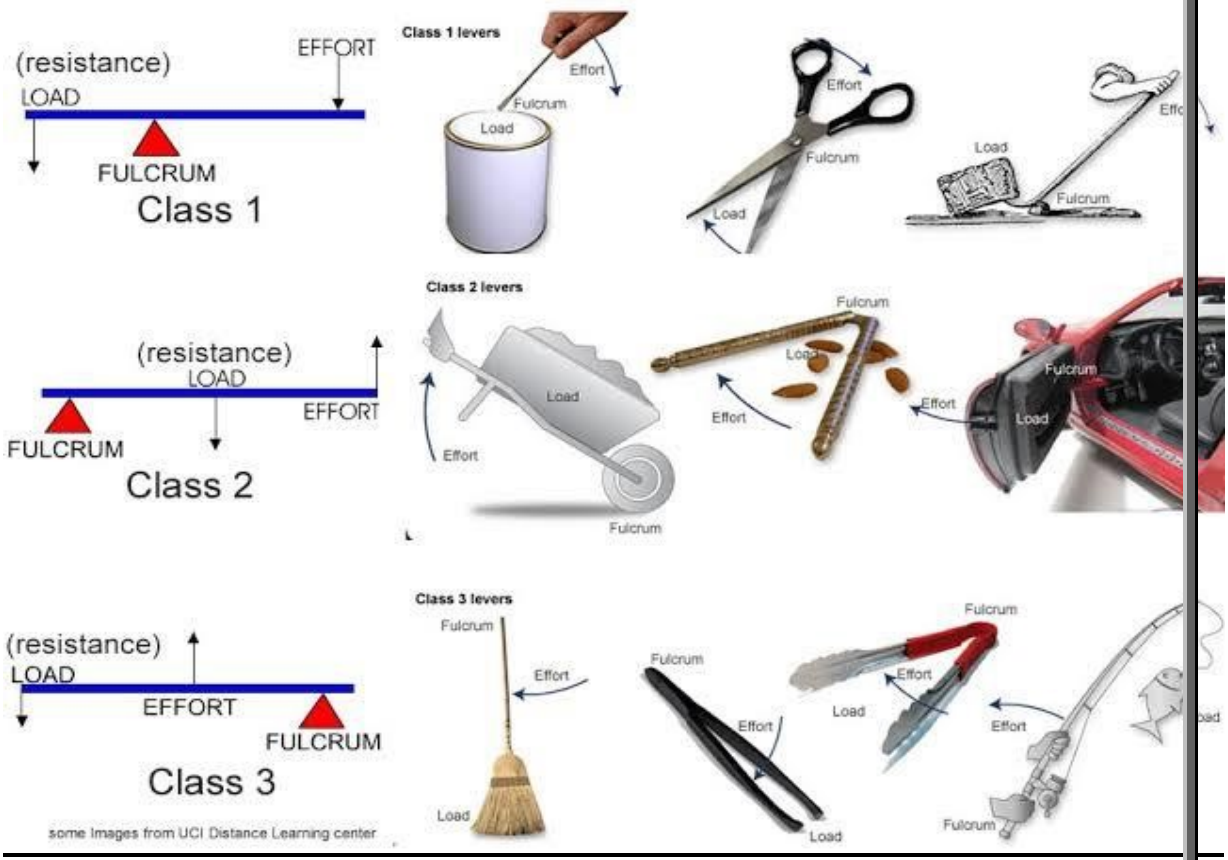
a) LEVERS

What is a lever?

- Rigid Bar (rod) turning freely at a fixed point called pivot (fulcrum).

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- Name the main parts of a lever. **The main parts of a lever**
  1. **Load (L)** – the force (weight) that is to be overcome. - some times load is called **resistance**.
  2. **Effort (E)** – the force we exert (apply) when using a lever.
  3. **Fulcrum (F)** is a fixed turning point.
  4. **Effort arm** – the distance from effort to the fulcrum.
  5. **Load arm** – is the distance from load to the fulcrum.



CLASSIFICATION OF LEVERS

- Levers are grouped according to position and arrangement of load, fulcrum and effort.
- They are classified into three groups, namely;
  1. First class lever.
  2. Second class lever.
  3. Third class lever
- The classes are determined basing on the force that lies between the other two.

FIRST CLASS LEVERS (**EFL / LFE**)

This is where the fulcrum lies between the load and effort.

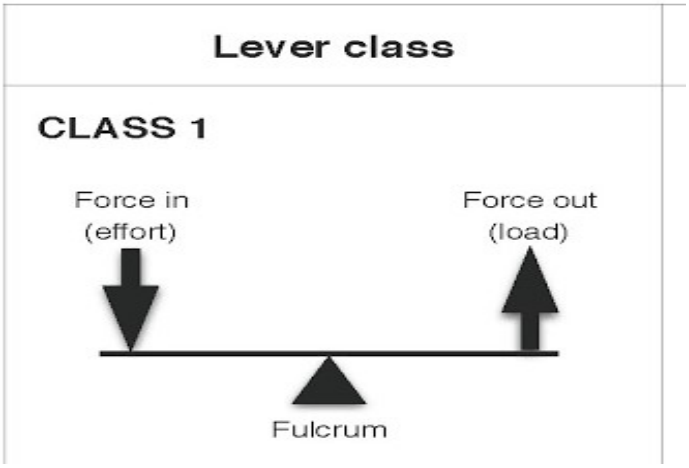
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Examplesof first class levers are;

1. Crow bar.
2. scissors
3. Pliers
4. See saw
5. Lid opener
6. Beam balance

- **How do first class levers simplify work?**

- By reducing the load arm and increasing effort arm so that less force is used. - Load and effort move in different directions.



NB : A pair of scissors and pliers are called double lever because they have two stiff rods with one turning point

<u>SECOND CLASS LEVERS</u> (PLE/ ELP)

- This is where the load is placed between the pivot (fulcrum) and effort.
- **What are the examples of 2nd class levers?**
  (i) Wheelbarrow
  (ii) Human foot (iii) Bottle opener (iv) Oar of a boat (v) Nut cracker.

How does a second-class lever simplify work?

- Makes load and effort move in the same direction.
- Reduces the load arm and increases effort arm so that less effort is used.

<u>THIRD CLASS LEVER</u>

- This is the lever where the effort lies between the load and fulcrum.

Examples of third-class levers.

1. Pair of tongs
2. Pair of tweezers

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3. Human arm
4. A spade when in use
5. fishing rod
6. A hoe in use

What is the advantage of using a third-class lever?

- The effort moves through a shorter distance.

MOMENTS

What is a moment?

- This is the turning effect of a force about a point.
- A force acting on a point left of the pivot tends to turn it anti clockwise while a force acting on the right tends to turn the lever clockwise.
- For the lever to balance or be in equilibrium, the left side moments must be equal to the right-side moments.

The Law of levers

- The sum of clockwise moments equals the sum of anticlockwise moments. OR the product of clockwise moments is equal to the products of anticlockwise moments i.e. Load X Load arm = Effort x Effort arm.

Worked examples on levers

- A man weighs 80kg and sits 4m away from the pivot of a sea saw. Where will his wife who weighs 60Kgs sit in order for them to balance?

Solution:

Load = 80Kg

Load arm = 8m

Effort = 60Kg

Effort arm = X m

Load x Load arm = Effort x Effort arm

80 x 4m = 60 x X

$320 = 60x$

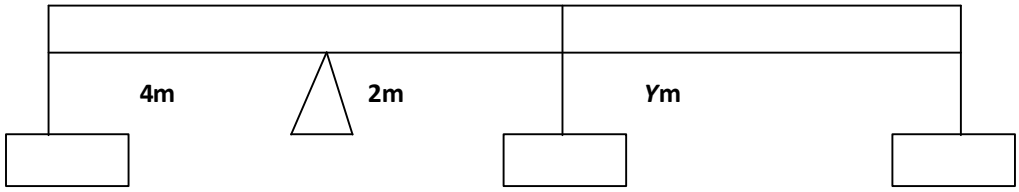
$\frac{\cancel{320}^{16}}{\cancel{60}_{3}} = \frac{\cancel{60}^{1}x}{\cancel{60}_{1}}$

$\frac{\cancel{16}^{}}{\cancel{3}_{1}}\ 5\frac{1}{3} = X$

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The wife should be $5^{1}/_{3}$m away from the fulcrum.

Example 2.
Calculate the value of Y needed to balance the scale.



1

5Kg
5Kg
10Kg

(L x LA) = (Ex EA) + (E x EA)
(15 x A) = (5 x 2) + (10 x (2 + y))

60 = 10 + 20 + 10Y

60 = 30 + 10y

60 - 30 = 30 - 30 + 10y
= 10y

$\frac{30}{10} = \frac{10y}{10}$

3 = y
Y = 3m

Exercise

Terms used with machines

Mechanical advantage (MA)

- This is the number of times a machine simplifies a given work.
- MA is the ratio of load to effort i.e.

MA = Load
Effort.

NB: If the MA of machine is greater than 1 less effort is used.
Whereas when the MA is less than one a lot of effort is needed.

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Worked example:

An effort of 40N is applied to a lever to overcome a load of 200N.

Calculate the MA of the machine.

Solution: $MA = \frac{Load}{Effort}$

$= \frac{200N}{40N}$

$= 5$

NB: It means work becomes five times easier to do.

2. VELOCITY RATIO: (VR)

- This is the ratio of the distance effort moves to distance moved by the load.

VR = DME i.e. $\frac{Distance\ Effort\ moves}{DML\ \ Distance\ load\ moves.}$

The velocity ratio of a lever is the ratio of length of effort arm / Length of Load arm

3. EFFICIENCY OF A MACHINE

The efficiency of a machine is the ratio of the work output to work input of a machine.

Efficiency of a machine is always expressed in % and is normally less than 100 due to friction.

- The output is the work done on the load by the machine.
- The input is the work done by the effort on the machine.

How can the efficiency of a machine be improved?

- Replacing and repairing worn out parts.
- Regular oiling (lubrication) to minimize friction.

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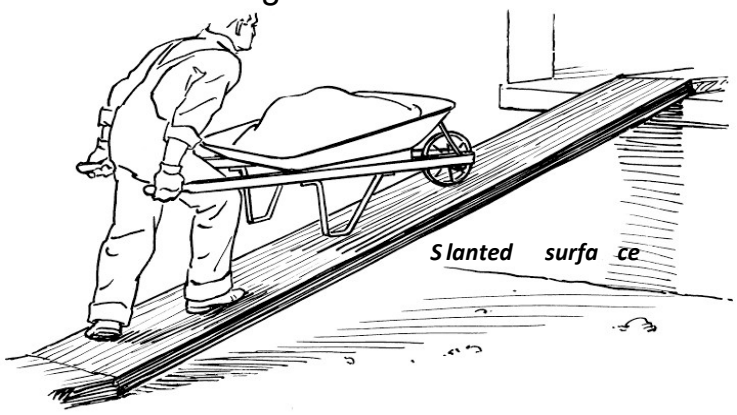
Efficiency = output x 100.
Input

Example: By using a machine, an effort of 30N was moved through a distance of 15m to raise a load of 120N to a height of 3m. Calculate the efficiency of the machine.

Efficiency = Load x Load distance x 100.
Effort x Effort distance.
= 120N x 3m
30N x 15m
= 4 x 100.
5
= 80%

INCLINED PLANES /SLOPES.

- An inclined plane is a sloping (slanting) surface connecting a lower level to a higher level.



Vertical height

Angle of inclination

- The vertical height of the inclined plane is the distance moved by load while the slanting surface is the distance moved by the effort.

How do inclined planes simplify work?

By increasing the length of the plane and reducing the angle of inclination. Give the examples of inclined planes. (illustrate them)

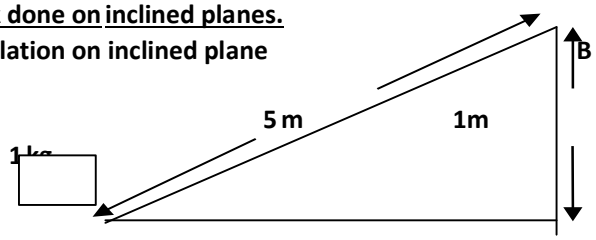
- Stair case (steps) • • Winding road (uphill).
- Ramp

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A ladder leaning against the wall.

Work done on inclined planes.

Calculation on inclined plane



A C

Calculate the work done if the load is moved from A to B.

Work done = force x distance

= 10N x 1m

=

10Joules

Velocity ratio = $\frac{\text{DEM}}{\text{DLM}}$

= $\frac{5\text{m}}{1\text{m}}$

Velocity ratio = 5

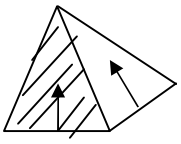
Uses of inclined plane.

- Loading heavy goods onto Lorries.
- Climbing tall buildings.
- Helps vehicles ascend (climb) steep hills.
- For builders to carry materials to higher levels.

WEDGES

What is a wedge?

- A wedge is an inclined plane with two sloping surfaces i.e. double inclined plane.



Examples of wedges, illustrate them. (diagrammatically)

1. An axe
2. A panga
3. Bullet
4. Knife

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5. Scissors
6. Nails
7. Chisel

Uses of wedges:
1. For splitting logs of wood
2. For cutting objects.
3. For sewing
4. For digging

SCREWS.
A screw is an inclined plane wound round a rod.
Illustration.



Examples of machines that use screws
1. Bolts and nuts
2. Bottles lids
3. Motor car jack
4. Spiral stair cases.

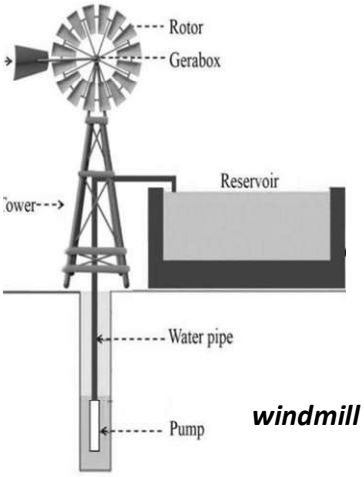
Uses of screws
1. Car screw jack is sued to lift vehicles.
2. To hold two or more things together.
3. To drill holes in wood or metal.
4. To tighten bottle tops.

WHEELS AND AXLE
These are machines composed of two rotating wheels fixed together. The wheel is fixed on a small wheel called axle or shaft onto which it rotates.

Examples of wheel and axle machines.
- Car steering wheel.
- Handle of bicycles.

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- Pedal and chains of bicycles
- Windlass.
- Sewing machine



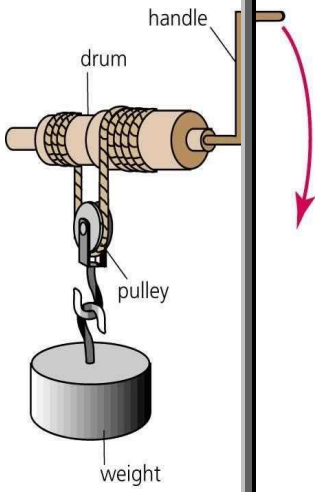
windmill

- Windmill



Bicycle handle

- Door knobs



Sewing machine

Application of wheels and axle in daily life.

- Used in windlasses to draw water.
- Sprocket wheels and chains used driving bicycles.
- Car steering wheels.
- Door knobs used to open doors.

GEARS AND BELT DRIVES.

- Gears are special forms of wheels with teeth around their edges.
- They are sometimes called **cog-wheels or toothed wheels**.
- If teethed-wheels are connected with chains / belts they move in the same direction.
- When cog-wheels are joined together, the teeth interlock.
- As one wheel rotates, it turns the other but they move in opposite directions.

<u>Examples of machines that use gear wheels</u>

1. Watches
2. Gear boxes
3. Motor cycles
4. Bicycles
5. Electric toys

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6. Bulldozers

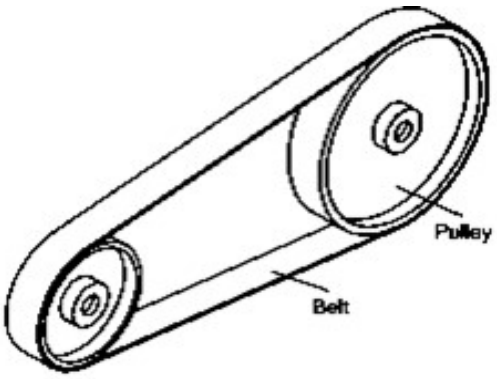
Advantages of using gear wheels1. They help to multiply force.
2. They change the direction of movement (rotation)
3. They multiply the speed of rotation 4. They can slow the speed of rotation.

Drive belts:

- Drive belts transmit motion from one wheel to another.
- Both wheels move in the same direction.
- If a driven wheel has 48 teeth and the driving wheel has 12 teeth, the driving wheel will make 4 revolutions in each single revolution of the driven wheel.

Examples of machiness that use drive belts.

- Bicycles.
- Sewing machines.
- Grain mills.
- Cooling fan of car radiators.
- Conveyor belts – that move things from one place to another as in escalators, bottling line in factories, moving luggage in air posts etc.





Drive belts *windmill*

PULLEYS:

What is a pulley?

- A freely rotating wheel with a grooved rim.
- A rope / chain passes over the grooved rim.
- The groove prevents the rope from sliding.
- The frame to which the pulley is fixed in called a block.

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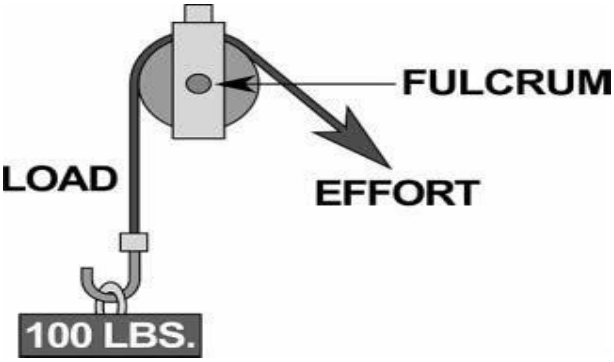
Three types of pulleys

1. Single fixed pulley
2. Single movable pulley.
3. Block and tackle / multiple/ fixed movable pulleys

a) <u>SINGLE FIXED PULLEY</u>.

In a single fixed pulley, the block in attached to a frame and only the wheel moves.

A single fixed pulley acts as a first-class lever, with the axle at the centre as a fulcrum.



A single fixed pulley changes the direction of force.

- By pulling down wards it is easier to raise an object.
- It has a mechanical advantage of one.

Question: Find the effort applied to pull a load of 50kgf using a single fixed pulley.

$$MA = \frac{L}{E} \qquad MA = \frac{1}{}$$

$$L = 50kg$$

$$1 = \frac{50kgf}{E} \qquad E = ?$$

$$E \times 1 = \frac{50}{E} \times E$$

$$E = 50Kgf$$

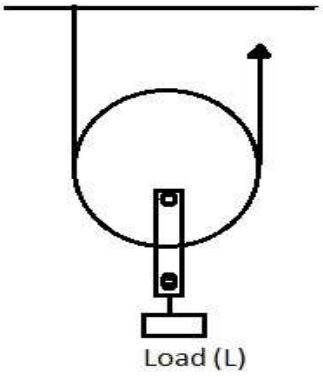
The force needed to lift the load is the same as the load.

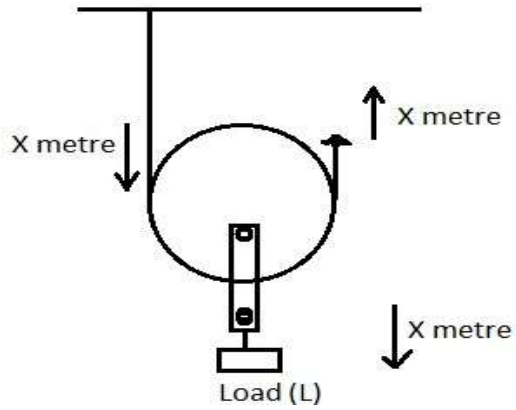
b) <u>SINGLE MOVABLE PULLEY.</u>

- In a movable pulley, the whole pulley block moves along the rope.
- It does not change the direction of force, both load ad effort move in the same direction.

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- It has a mechanical advantage of 2.
- The effort needed is half the load.





Qn: What force will be needed to raise a load of 50kgf using a single movable pulley.

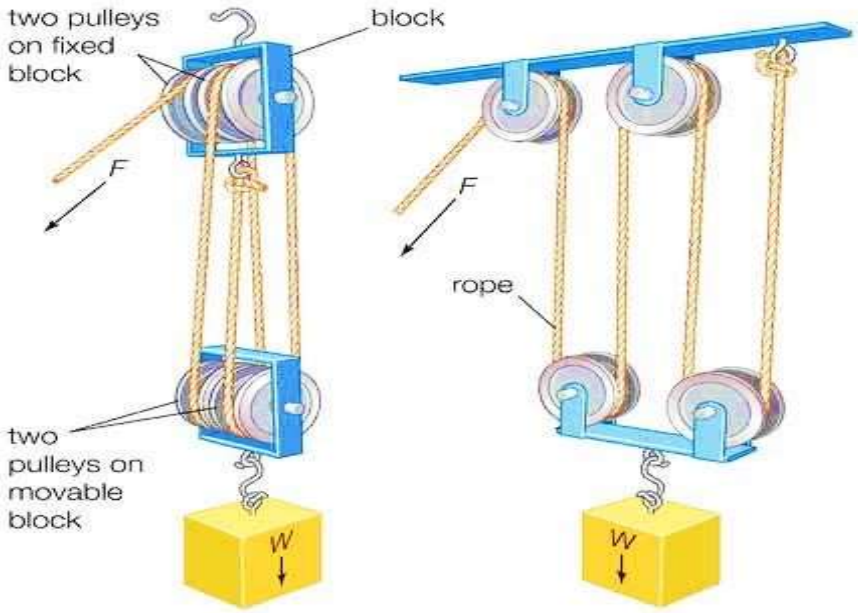
MA = 2 MA = $\frac{L}{E}$ 2 x E = $\frac{50}{E}$ x E $\frac{2E}{E}$ = $\frac{50}{1}$

L = 50Kgf 2 1 2 1

E = ? 2 = $\frac{50}{E}$ E 25Kgf

- Single movable pulley acts as a second-class lever with the fulcrum and effort at either side of the wheel.

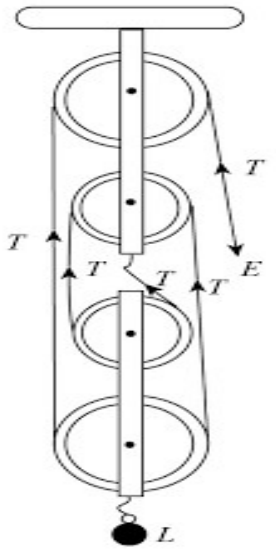
Double pulley system (combined fixed and movable pulley) This is the type of pulley system composed of movable parts



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BLOCK AND TACKLE

- This is the type of pulley system which consists of several movable pulleys and several fixed pulleys



The mechanical advantage of a block and tackle is determined by the number of wheels in the block.

Uses of pulleys in daily life.

1. They are used by break down vehicles to pull stranded vehicles.
2. They are used in lifts / elevators.
3. They are used on cranes to lift and load heavy loads.
4. They are used in scaffolds by painters to paint tall buildings.
5. They are use on flag poles to raise flags at school.
6. They are used in curtain boxes to draw curtains.

FRICTION

Friction is the force that tends to oppose motion between objects.

Types of friction:

- **Static friction** is the friction between two surfaces which are trying to move but have not yet started moving.
- **Dynamic friction** is the friction between two surfaces when one is moving over the other.
- **Viscosity friction** is the friction in liquids and gases.

Advantages of friction as a useful force

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Friction helps us
in:- 1. Walking
without sliding.
2. Movement of vehicles.
3. Lighting a match stick.
4. Braking of moving vehicles.
5. Climbing trees.
6. Writing using a pen.
7. Grinding corn, grain, flour etc.
8. Washing clothes.

The demerits (disadvantages of friction as a nuisance force.

1. Friction reduced the speed of movement.
2. Reduces the efficiency of machines.
3. Causes unnecessary heat in machines.
4. Causes wear and tear of things.
5. Delays work.
6. Makes one use a lot of effort.

Ways of increasing friction.

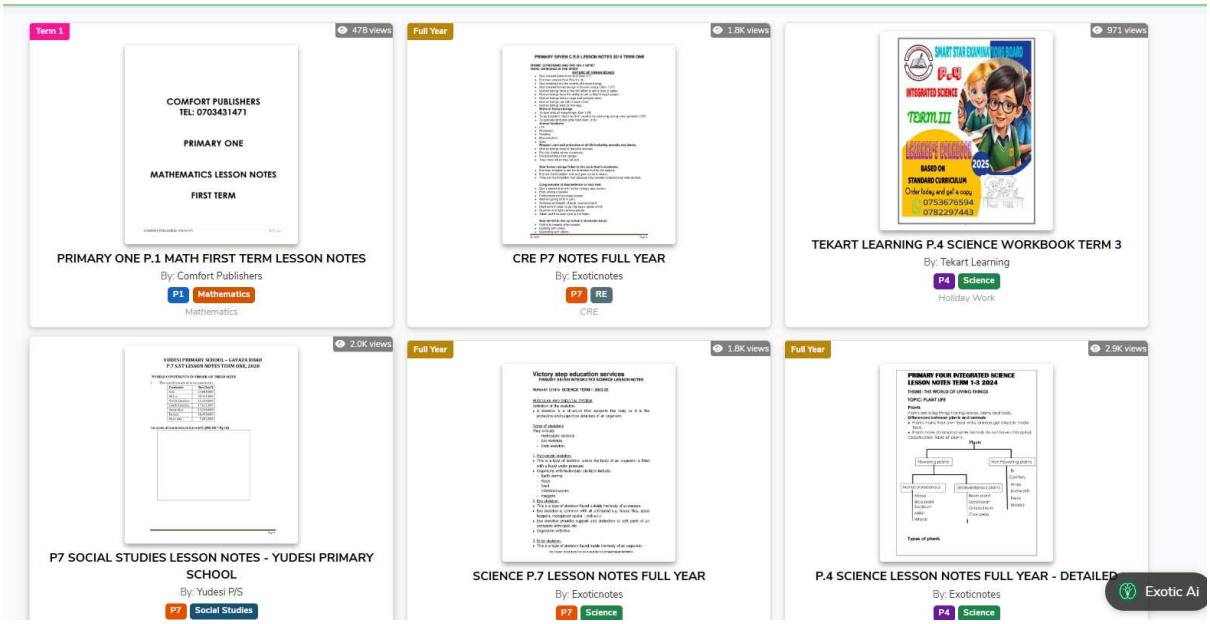
1. By putting treads on tyres or shoes.
2. Putting grips on handles of objects.
3. Putting spikes or studs on playing or sports shoes.
4. Making surfaces rough.
5. Putting tarmac on road surfaces.

Ways of reducing friction.

1. Making rough surfaces smooth.
2. Oiling or greasing (lubrication) of moving parts.
3. Using ball bearing.
4. Using rollers.
5. Streamlining the bodies of moving vessels.

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