Primary Integrated Science

Book seven

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Book 7

First Published 2020

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DEDICATION

This book is fondly dedicated to my mother Kate, who has supported me over years and a wonderful mother, my wife Mayimuna, who has been there for me, My children Rafiq and Rohaan and lastly to all my pupils.

ACKNOWLEDGMENTS

I would like to thank Dr. Kwasa Richards for his generosity in helping to make this book as complete as possible.

PREFACE

This book is written to help a primary seven pupil understand the primary seven science content.
The book is easy to understand by the learner as it is well illustrated.
To make assessment more meaningful and in accordance with the need of the curriculum, creative questions are given at the end of each topic.
Some topics in this book start with a practical activity from real-life situation which helps the pupil discover the scientific concepts. It is hoped that this will reduce the dependency of pupils on rote memorisation. The pupil will be able to apply the knowledge they have gained to judge, analyse and evaluate real life situations. Pupils can gain knowledge about science and their interest will increase when they complete the set of practical activities in this book.

Any suggestions for the improvement of this book would be gratefully appreciated.

Tekule Musa

CONTENTS

Topic 1: Muscular – Skeletal System

The **skeletal system** consists of bones and other structures. The types of tissues present in the skeletal system are bone tissue, cartilage, and fibrous connective tissue, which forms the ligaments that connect bone to bone.

The skeleton

A skeleton is a group of structures that support the body of an organism. From seeing a skeleton, you might think that bones are just dead, hollow structures. But in a living person, those hollow spaces are full of living cells. Bones have a blood supply and nerves. Bones are a living tissue that need proper feeding.

The skeleton provides shape and support to all the other body systems.
In addition, it allows movement, protects body tissues and organs, stores important materials, produces valuable blood cells, and holds a record of our past development, diet, illnesses, and injuries.

Types of skeletons

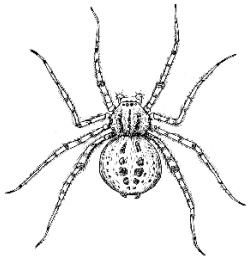
- **Exo skeleton**

  This is a type of skeleton found outside the body of an organism. This hard part provides protection to the internal organs and also supports their bodies, it limits the over growth of the organism. Organisms with this type of skeleton, shed it in order for growth to occur. The shedding of their outer exoskeleton is called ***moulting/ecdysis***.

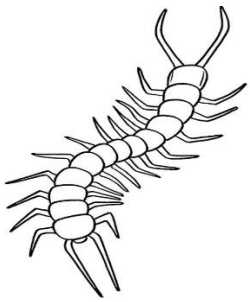
  Examples of organisms with exoskeleton

  - Insects like grasshoppers, crickets, houseflies, bees and many other insects.
  - Crustaceans like crabs, wood lice, shrimps, lobsters and prawns.
  - Myriapods like centipedes and millipedes.
  - Arachnids like spiders, scorpions, mites and ticks.

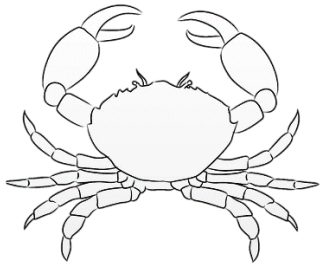
Butterfly



Spider



Centipede



Crab

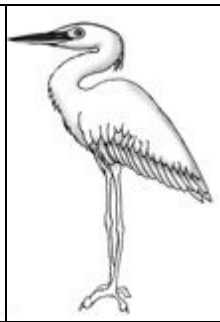
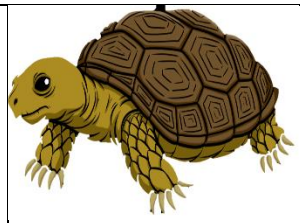
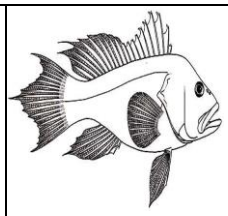
- **Endo skeleton**

  This is a type of skeleton that is found inside the body of an animal. This type of skeleton is made up of majorly bones and present in all vertebrates.

  Organisms with endo skeleton

  - Vertebrates such as mammals, reptiles, amphibians, fish and birds.

Note. Cartilaginous fish like sharks have cartilage that makes up their skeletons instead of the hard bones.

				
Mammals	Birds	Reptiles	Fish	Amphibians

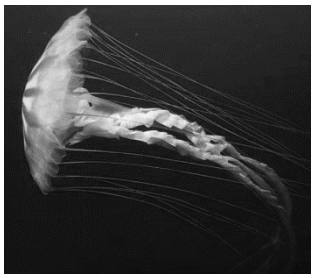
- **Hydrostatic skeleton**

  This is where the pressure of the fluid and action of the surrounding muscles are used to change the shape of an organism and produce movement. This type of skeleton is made up of a fluid that is under pressure.

Examples of organisms with hydrostatic skeleton

- Worms like flat worms, tapeworms and earthworms.
- Molluscs without shells like octopus, slugs and squids.
- Sponges
- Echinoderms like starfish, sea urchin, sea cucumber and brittle star.
- Coelenterates like jellyfish, corals, sea anemones and hydra.

Octopus



Jelly fish

Star fish

Earthworm

Activity

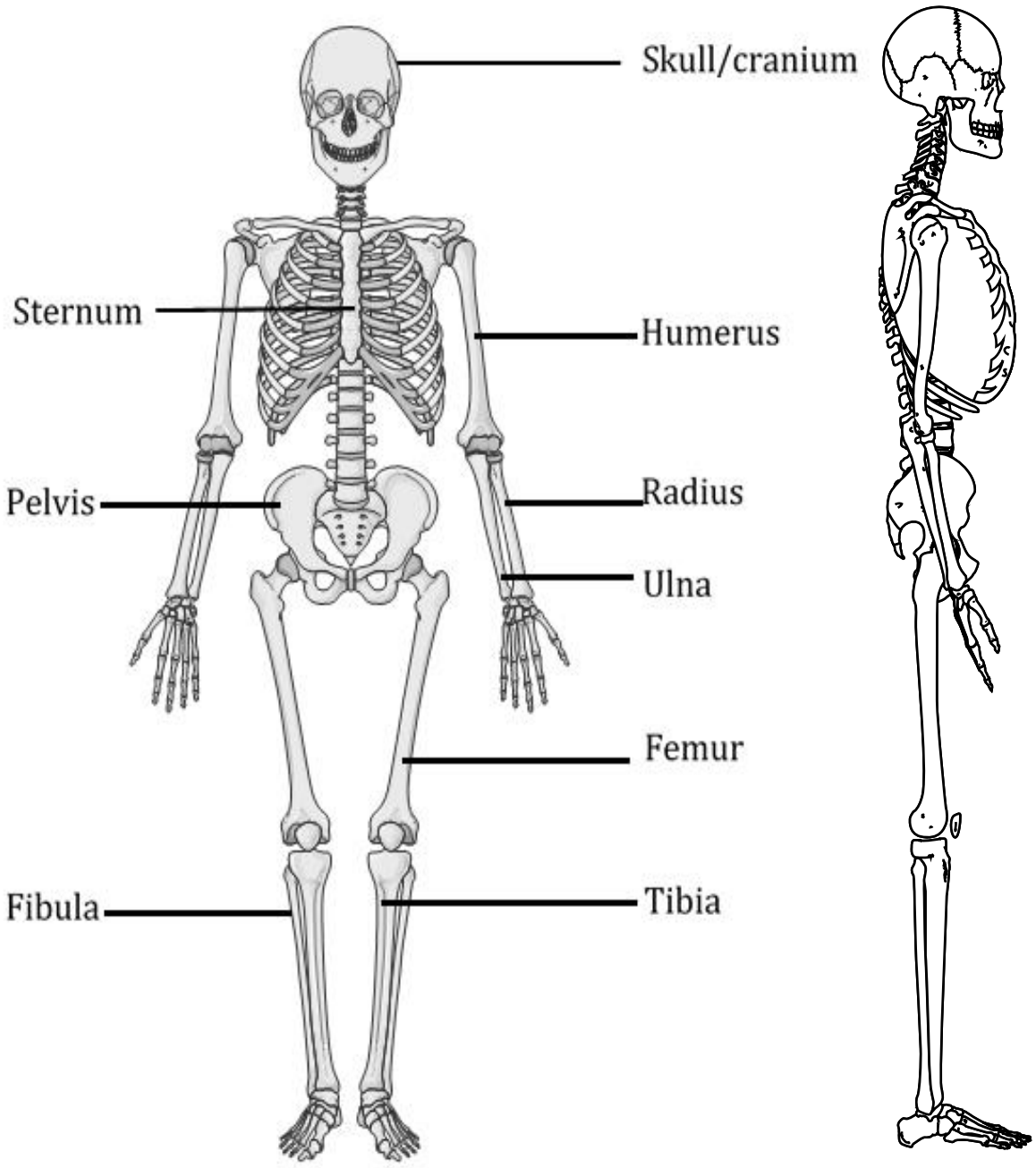
1. *Define the term skeleton.*
2. *Give any one way the skeleton is important to an organism.*
3. *How is moulting important to living organisms?*
4. *What type of skeleton do worms have?*
5. *Define an exoskeleton.*
6. *How is an earthworm with a hydrostatic skeleton able to move from one place to another?*
7. *Which type of skeleton is found in arthropods?*
8. *Name the group of fish that have cartilaginous skeletons.*
9. *Apart from support and movement, how else is an exoskeleton important to an organism like a grasshopper?*
10. *Name any two types of tissues that make up the skeletal system.*
11. *Which fibrous tissue in the skeletal system helps to connect bones to bones at a joint?*
12. *What type of skeleton does a tortoise have?*
13. *Name the type of skeleton found in molluscs.*

The human skeleton

A human skeleton is the framework of bones in the body. Imagine for a moment that people did not have skeletons. What comes to your mind? Probably that each of us would be a little heap on the floor, much like a jellyfish out of water. Such an imagination reflects the most obvious function of the human skeleton: to support the body.

An adult human being has about 206 bones excluding the teeth and a baby has over 306 cartilaginous tissues, which fuse and form bones as a baby grows.

The structure of the human skeleton



The human skeleton has two divisions:

1. **The axial skeleton**—which is composed of skull, vertebral column, ribs, breastbone, pelvic and pectoral girdles—this is the main part of the skeleton making up the head and trunk. The axial skeleton has **80** bones that protect vital organs like the heart, lungs, spinal cord and brain. This skeleton forms the foundation for the attachments of the appendicular skeleton.
2. **The appendicular skeleton**. The appendicular skeleton has 126 bones and includes the bones of the arms and legs and those of the shoulder and pelvic girdle.

Bones

A bone is a hard tissue that makes up the skeleton of vertebrates.
Bones are made up of calcium and phosphorus. Bones also have bone marrow. This is a soft tissue contained within the central cavity and internal spaces of a bone. The marrow is mostly concerned with the formation of blood cells: ***Red bone marrow*** forms most of the red blood cells in the body and helps destroy old blood cells. Another type of marrow, ***yellow bone marrow***, resides in the central cavities of long bones. It is mostly made up of fat. And is responsible for production of white blood cells, however, if the body suffers large amounts of blood loss, it can convert yellow marrow to red in order to make more red blood cells.

Classifications of bones

There are four types of bones;

1. **Long bones**-e.g. femur, tibia, fibula, humerus, radius, ulna,

   They contain the **white** bone marrow used to produce **white blood cells.**

2. **Short bones**- e.g. Phalanges, tarsals, carpals

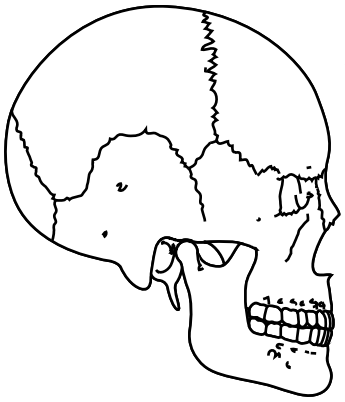
   They contain **red bone marrow** used to produce **red blood cells.**

   Red blood cells are **destroyed** in the **liver or spleen**.

3. **Flat bones** -e.g. Scapula, cranium (skull), ribs, sternum.

4. **Irregular bones** -e.g. vertebrae, sacrum, mandible, pelvis, coccyx

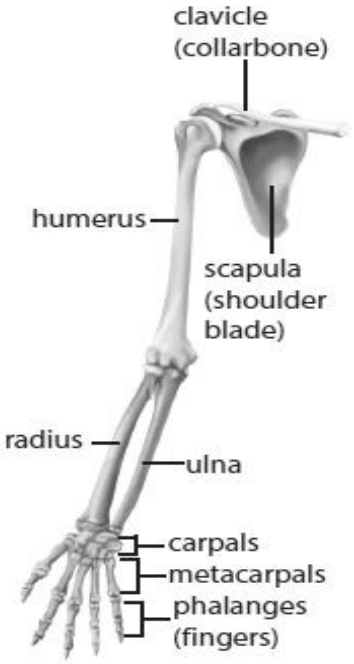
Flat bones of the skull



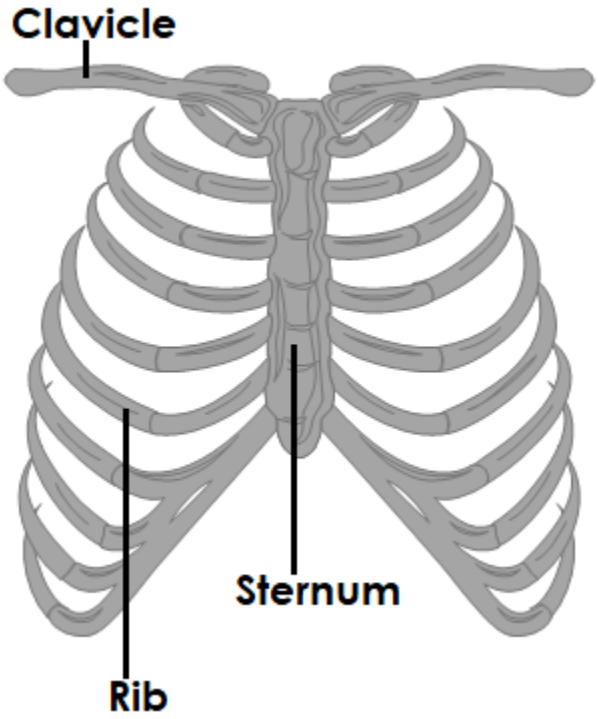
The skull consists of 22 separate bones that combine to form the cranium, which is the housing for the brain. Twenty-one of those bones are fused together by ***sutures***. The lower-most bone of the skull is the mandible or jawbone.

Bones of the upper limb (arm)

Hooked onto the pectoral girdle are the bones of the arm. Each arm consists of three principal bones: the humerus, ulna, and radius. Because of the joints in the bones, the arm is able to move. Also, arms are divided into three segments: upper arm, lower arm, and hand.

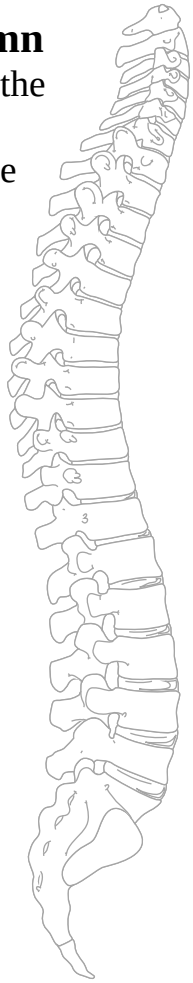


The ribcage



The rib cage is made up of 12 pairs of bones that encase vital organs in the chest. The bones curve from the back at the vertebral column to the front of the body. The upper seven pairs meet with the sternum, or breast bone. The remaining five pairs are attached to each other via cartilage and do not connect. The ribs are attached to one another by intercostal muscles forming a rib cage. These muscles and the rib cage regulate the size of the chest during breathing and they also protect the heart and lungs.

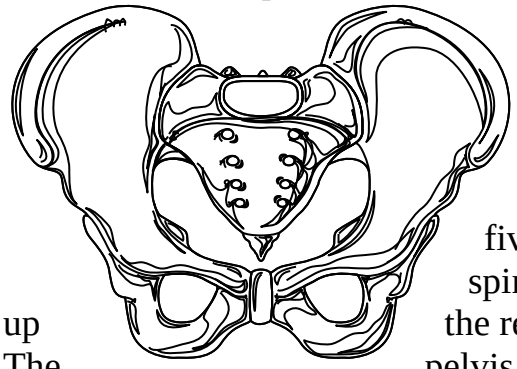
The spine/vertebral column



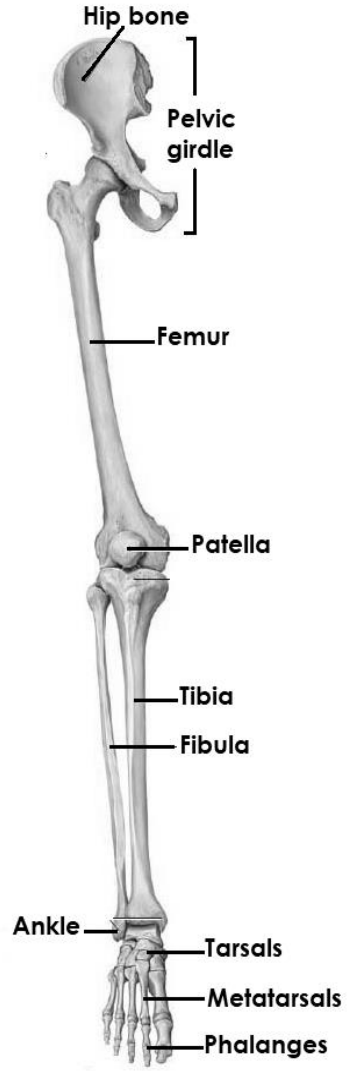
The spine, or vertebral column, is a series of irregularly shaped bones in the back that connects to the skull. At birth, humans have 33 or 34 of these bones. But bones fuse as we age, and the result is 26 separate bones in the spines of adults. The vertebral column protects the spinal cord.

The pelvis/pelvic girdle

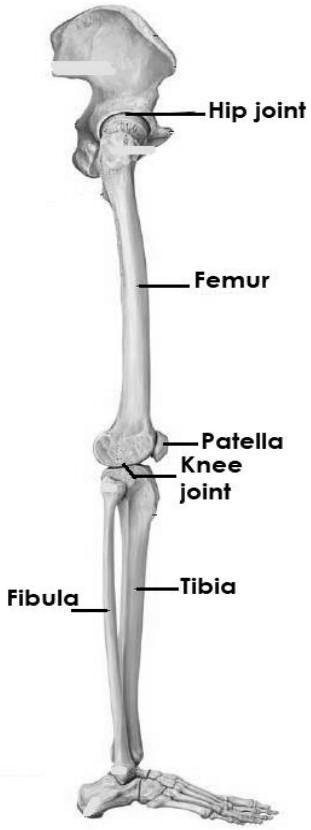
The bones of the pelvis are created by the fusion of three bones—ilium, ischium, and pubis—that fuse together as we grow older. These form the majority of the pelvis at the base of the spine as well as the socket of the hip joint. The sacrum—five fused bones at the bottom of the spine—and the coccyx or tailbone, make up the rest of the bones in the pelvic region. The pelvis protects the urinary bladder and the uterus in women.



The lower limbs (legs)



The femur, the largest and longest bone in the body, creates the other half of the hip joint and extends down to form part of the knee. It begins the bones of the leg. The other bones of the leg include the ***tibia***, ***fibula***, and the bones of the ***ankle*** and foot (***tarsals***, ***metatarsals*** and ***phalanges***)

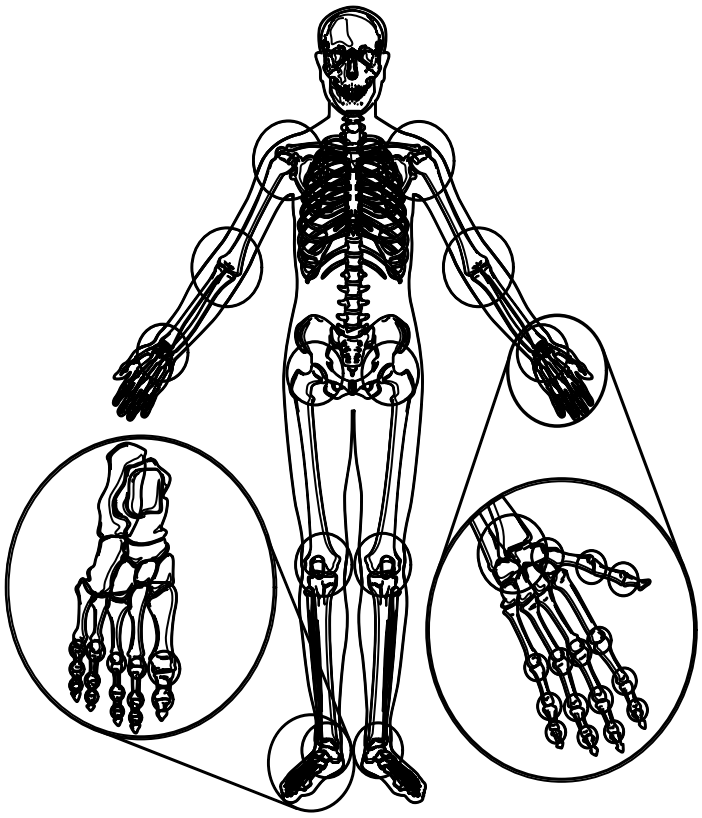


Lateral view

Activity

1. *Briefly explain the term bone.*
2. *Write down the three types of bones in the body.*
3. *State any examples of each of the bones below*
   - *i) Long bones*
   - *ii) Irregular bones*
4. *How are the bone marrow important to us?*
5. *Give any one example of a flat bone.*
6. *What is a human skeleton?*
7. *Which part of the skeleton protects each of the following?*
   - *i) Brain*
   - *ii) Spinal cord*
   - *iii) Heart*
   - *iv) Lungs*

Joints



A joint is a place in a body where two or more bones meet. The flexibility at a particular joint of the body is related to the functional requirements for that joint. So immobile or slightly movable joints serve to protect internal organs, give stability to the body, and allow limited body movements. In contrast, freely movable joints allow more extensive movements of the body and limbs.

How is a joint adapted to a friction free movement?

-It contains synovial fluid which reduces friction at the joint.
-The bones are covered with cartilage at their ends.

Structure of a joint

A Tendon is a tough fibrous tissue that connects muscles to bones.

A Ligament is a fibrous elastic tissue that joins a bone to a bone. Ligaments are made of tough protein fibers and connect bones to each other.

Cartilage prevents the bone ends from frictional damage after rubbing directly onto each other. Cartilage creates smooth surfaces for the movement of bones that are next to each other, like the bones of the knee.

Inside a joint is **a lining of synovial membrane** which secretes **synovial fluid.**
Synovial fluid reduces **friction** by making the bones at a joint slippery.

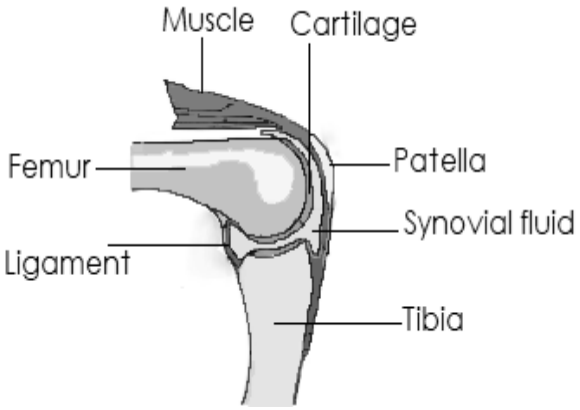
Classification of joints

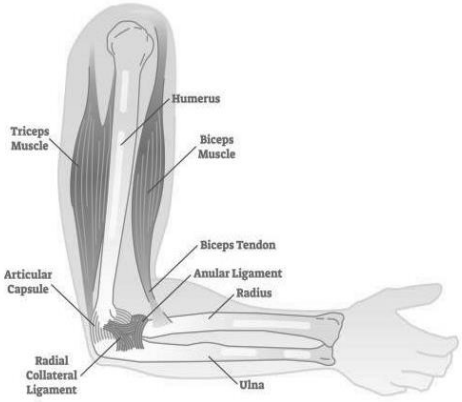
(Types of joints)

Joints may be either Movable, immovable or slightly movable.

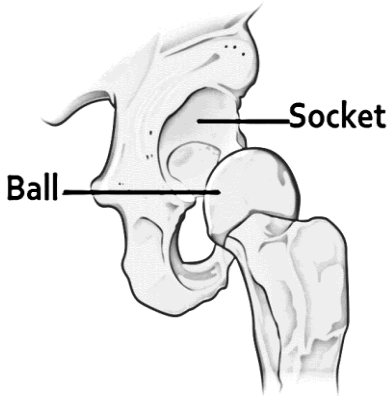
Types of movable joints

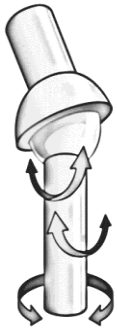
- **Hinge Joint**-It allows movement in one plane. In hinge joints, the slightly rounded end of one bone fits into the slightly hollow end of the other bone. In this way, one bone moves while the other remains stationary, like the hinge of a door. The elbow and the knee are examples of hinge joints. The knee is sometimes classified as a modified hinge joint, this is because it has a knee cap that prevents it from turning around.

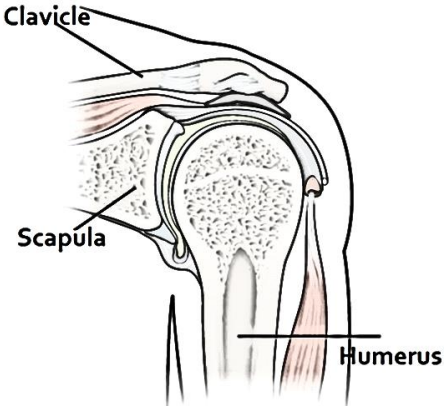




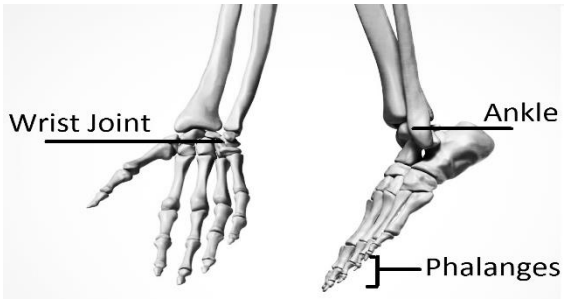
- **Ball and socket**- Ball and socket joints possess a rounded, ball-like end of one bone fitting into a cuplike socket of another bone. This organization allows the greatest range of motion, as all movement types are possible (all directions). Examples of ball-and-socket joints are the ***shoulder*** and ***hip joints***.



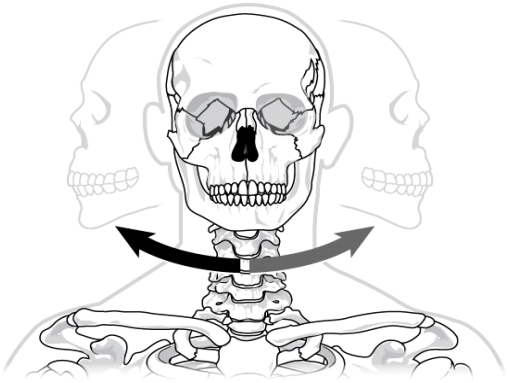




- **Gliding joint/plane joints**- They allow flat bones to slide over one another. Gliding movements occur as relatively flat bone surfaces move past each other. Gliding movements produce very little rotation. The joints of the carpal (wrist) and tarsal (ankle) bones are examples of joints that produce gliding movements.

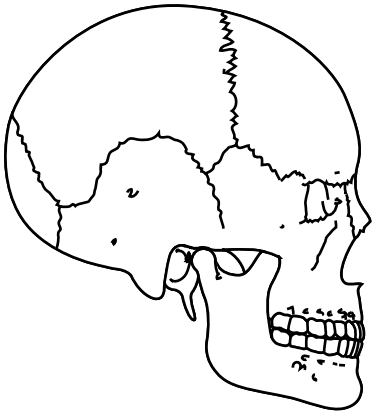


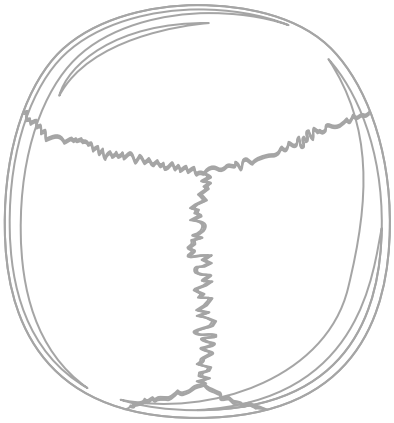
- **Pivot joint**- Pivot joints consist of the rounded end of one bone fitting into a ring formed by the other bone. This structure allows rotational movement, as the rounded bone moves around its own axis. An example of a pivot joint is the joint of the first and second vertebrae of the neck that allows the head to move back and forth (Figure below).



Example of immovable joint.

- Suture joints in the skull.





Activity
1. *How are joints important to the body?* 2. *What is a joint?* 3. *Write down one-way joints are similar to muscles.* 4. *Write down any one example of a hinge joint.* 5. *Why is a shoulder joint said to be a movable joint?* 6. *Apart from synovial fluid, name the other substance in joints that helps to reduce friction.* 7. *Name the immovable joints on the skull.* 8. *Which delicate body organ is protected by the skull?* 9. *How is the movement of a hinge joint different from that of a ball and socket joint?*

Muscles

Do you like to dance? Most of us do, or we may simply enjoy watching good dancers. The grace and coordination involved in dancing result from the interaction of many of the systems, but the one you think of first is probably the muscular system.

A ***muscle*** can be defined as an elastic tissue that contracts and relaxes to produce movement.

There are more than 600 muscles in the human body. Most of these muscles are attached to the bones of the skeleton by tendons, although a few muscles are attached to the under surface of the skin. The primary function of the **muscular system** is to move the skeleton. The muscle contractions required for movement also produce heat, which contributes to the maintenance of a constant body temperature.

Types of muscles

- ***Skeletal muscles (Voluntary muscles)***

  Skeletal muscles are made up of voluntary muscles, usually attached to the skeleton. Skeletal muscles move the body. They can also contract involuntarily by reflexes. For example, you can choose to move your arm, but your arm would move automatically if you were to burn your finger on a stove top. This voluntary contraction begins with a thought process. A signal from your brain tells your muscles to contract or relax. Quickly contract and relax the muscles in your fingers a few times. Think about how quickly these signals must travel throughout your body to make this happen.

Examples of skeletal muscles include;

- Biceps
- Triceps

- ***Cardiac muscles (Involuntary muscles)***

  Cardiac muscles are also involuntary muscles, found only in the heart. The cardiac muscle fibers all contract together, generating enough force to push blood throughout the body. When the cardiac muscle relaxes, the heart fills with blood. This rhythmic contraction must continue for your whole life, luckily the heart muscle never gets tired.

- ***Smooth muscles (Involuntary muscles)***

  Smooth muscles are involuntary muscles found within the walls of organs and structures such as the oesophagus, stomach, intestines, and blood vessels. These muscles push materials like food or blood through organs. Unlike skeletal muscle, smooth muscle can never be under your control.

Functions of smooth muscles in the body

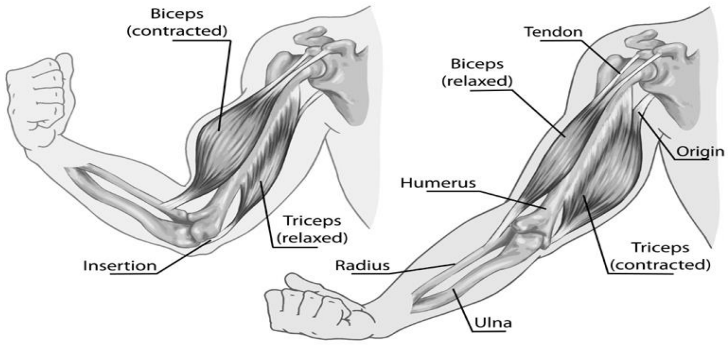
- The smooth muscle in the uterus helps a woman to push out her baby.
- In the bladder, smooth muscle helps to push out urine.
- Smooth muscles move food through the digestive tract by peristalsis.
- In arteries, smooth muscle movements maintain the arteries' diameter.
- Smooth muscle regulates air flow in lungs.
- Smooth muscle in the lungs helps the airways to expand and contract as necessary.
- Smooth muscles in arteries and veins are largely responsible for regulation of blood pressure.

Antagonistic muscles

These are muscles that work in pairs but have an opposite effect to each other. When one muscle is contracted, the other muscle from the pair is always elongated. For example, the ***biceps*** and ***triceps*** muscles work together to allow you to bend and straighten your elbow. When you want to bend your elbow, your biceps muscle contracts (Figure below), and, at the same time, the triceps muscle relaxes. The biceps is the flexor, and the triceps is the extensor of your elbow joint. Other muscles that work together are the ***quadriceps*** and ***hamstrings*** used to bend and straighten the knee. During daily routines we do not use muscles equally. For example, we use our biceps more than our triceps due to lifting against gravity.

Examples of antagonistic muscles include;

- Biceps (flexor)
- Triceps (extensor)
- Quadriceps
- Hamstrings



The ***biceps*** and ***triceps*** act against one another to bend and straighten the elbow joint. To bend the elbow, the biceps contracts and the triceps relaxes. To straighten the elbow, the triceps contract and the biceps relax.

Activity

1. *What is a muscle?*
2. *State the two types of muscles in our bodies.*
3. *What happens to the biceps muscles when the arm is bent?*
4. *Why are biceps and triceps muscles called antagonistic muscles?*
5. *How do the biceps and triceps muscles work in pairs?*
6. *Why are cardiac muscles called involuntary muscles?*
7. *Name any one voluntary muscle.*
8. *How do muscles cause body movements?*
9. *State any one importance of muscles in the body.*
10. *Why are biceps and triceps muscles called voluntary muscles?*

Summary

- Muscles that are under your conscious control are called voluntary muscles, while muscles that are not under your conscious control are called involuntary muscles.
- The three types of muscles in the body include skeletal muscle, smooth muscle, and cardiac muscle.
- The biceps help to contract the arm, while the triceps help extend the arm.
- Muscles move the body by contracting against the skeleton.
- Muscles work together in pairs to bend or straighten the joint.

Functions of the skeletal system

- ***Support***. The skeleton supports the body against the pull of gravity, meaning you don't fall over when you stand up. The large bones of the lower limbs support the rest of the body when standing.

- ***Protection***. The skeleton supports and protects the soft organs of the body. For example, the skull surrounds the brain, eyes and inner ear to protect them from injury. The bones of the rib cage help protect the heart and lungs. The spine protects the spinal cord. The pelvis protects the urinary bladder and the uterus in women.

- ***Movement.*** Bones work together with muscles to move the body.

- ***Making blood cells.*** Blood cells are mostly made inside certain types of bones. E.g. the red blood cells are made in the bone marrow of short bones.

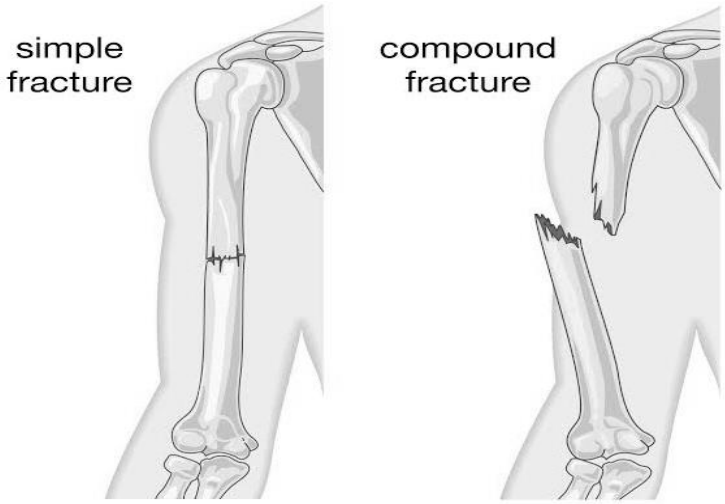
- ***Storage.*** Bones store calcium. They contain more calcium than any other organ. Calcium is released by the bones when blood levels of calcium drop too low. The mineral, phosphorus is also stored in bones.

Disorders of the muscular skeletal system

- **Fractures.** A fracture is a broken or cracked bone in the body.
  A fracture is called ***simple (closed)*** when the overlying skin is not broken and the bone is not exposed to the air; it is called ***compound (open)*** when the bone is exposed. ***A greenstick fracture*** occurs when the bone cracks and bends but does not completely break. ***A comminuted fracture*** is one in which the broken ends of the bone are shattered into many pieces.

Signs and symptoms of fracture

- Pain and tenderness at the site.
- Sensation of grating or grinding with movement.
- Inability to use the limb or body part supported by the bone.
- Deformity of the part.
- Swelling in the region of the fracture
- Discolouration of the overlying skin.
- Abnormal mobility of the bone.



- **Sprain.** A sprain is an over twisted (stretched) ligament. A sprain occurs due to injury to the ligament and the joint is twisted but there is no dislocation of the bones. Sprains can be mild to severe and can be accompanied by inflammation and pain. Severe cases also cause immobility of the body part.

  Signs and symptoms

  - Pain
  - Swelling
  - Bruising
  - Limited ability to move the affected joint.
  - Hearing or feeling a "pop" in your joint at the time of injury.

- **Spina bifida** -The spinal cord does not form properly.

- **Strains.** A strain is an over stretched (twisted) muscle.
  A muscle strain is an injury to a muscle or a tendon — the fibrous tissue that connects muscles to bones. Minor injuries may only overstretch a muscle or tendon, while more severe injuries may involve partial or complete tears in these tissues.

  Signs and symptoms

  - Pain or tenderness.
  - Redness or bruising.
  - Limited motion.
  - Muscle spasms.
  - Swelling
  - Muscle weakness.

- **Dislocations**

  A dislocation is an injury to a joint in which the ends of your bones are forced out from their normal positions. This painful injury temporarily deforms and immobilizes your joint. Dislocation is most common in shoulders and fingers. Other sites include elbows, knees and hips.

  Signs and symptoms of a dislocation

  - Visibly deformed or out of place.
  - Swollen or discoloured.
  - Intensely painful.
  - Immovable

Diseases of the muscular skeletal system

1. **Osteomalacia and Rickets**

   Osteomalacia is the lack of vitamin D in adults while ***rickets*** is found in children. Both diseases are characterized by reduced amounts of calcium and phosphorous in bones making them fragile. Kidney disease and heredity are other causes of these diseases.

   ## Signs and symptoms of Rickets and Osteomalacia

   - Weak bones especially leg bones.
   - Poor teeth formation.
   - Fractures very common.
   - Oxbow legs.
   - Knock-knee legs.

2. **Poliomyelitis**

   Polio is a contagious viral illness that in its most severe form causes nerve injury leading to ***paralysis, difficulty breathing*** and sometimes death. Caused by polio virus which attacks the nerve cells and spinal cord. The disease affects bones especially the limbs. Polio occurs in two types, these are ***non-paralytic polio*** and ***paralytic polio.***

   Non-paralytic polio causes signs and symptoms, which can last up to 10 days, these include: Fever**,** sore throat**,** headache**,** vomiting**,** fatigue**,** back pain or

stiffness**,** neck pain or stiffness**,** pain or stiffness in the arms or legs**,** muscle weakness or tenderness.

Paralytic polio. This most serious form of the disease is rare. Initial signs and symptoms of paralytic polio, such as fever and headache, often mimic those of non-paralytic polio. Within a week, however, other signs and symptoms appear, including: Loss of reflexes**,** severe muscle aches or weakness**,** loose and floppy limbs (flaccid paralysis)

How polio is spread.

- The virus can get into our bodies through drinking contaminated water.
- The virus can also get into our bodies by eating contaminated food.
- Polio virus can be transmitted through direct contact with someone infected with the virus.

Prevention and control of polio

- Immunisation with polio vaccine.
- Use latrines wherever possible.
- Wash hands with soap and water before eating food.
- Drink boiled water.

Complications of polio

Paralytic polio can lead to temporary or permanent muscle paralysis, disability, bone deformities and death.

4. **Arthritis-**. Osteoarthritis is the most common form of arthritis. It can affect both the larger and the smaller joints of the body, including the hands, wrists, feet, back, hip, and knee. The disease is essentially one acquired from daily wear and tear of the joint; however, osteoarthritis can also occur as a result of injury. The signs include; pain, stiffness and swelling of joints. ***Rheumatoid arthritis*** is a type of arthritis that is autoimmune in nature because the body's cells destroy the cells in the joints.
5. **Scurvy**- caused by lack of ascorbic acid (vitamin C) in the diet.
6. **Osteoporosis**, this disease is characterized by the thinning of bones (reduced mineral density) and it happens when your bones do not make enough bone tissue and lose minerals and fibres. The major cause of osteoporosis is imbalance of hormones. This condition is common in women under menopause.
7. **Bone cancer**
   A disease characterized by uncontrolled growth of cells of the bone.

8. **Muscular dystrophy**

   Muscular dystrophy (MD) is a group of inherited diseases in which the muscles that control movement (called voluntary muscles) progressively weaken and affected people continue to lose their ability to walk and make movements with their hands. In some forms of this disease, the heart and other organs are also affected.

9. **Tuberculosis of the spine.**

   Tuberculosis is caused by a bacterium called mycobacterium tuberculosis. The bacterium was first discovered by ***Robert Koch*** in 1882. The bacterium is spread through air. There are several types of mycobacteria. There is one which causes *Tuberculosis of the lungs* and the other which cause Tuberculosis of the spine or backbone.

   ## Symptoms of tuberculosis of the spine

   - Long lasting painful backache.
   - A lump grows on the spine.
   - Pain in the backbone while walking.
   - Paralysis of the legs and failure to walk.

   ## Prevention and control of tuberculosis

   - Immunisation with ***BCG vaccine***.
   - Isolate the infected person.
   - Treatment of the infected person.
   - Drink boiled or pasteurized milk because the bacteria also attack cows and can be spread through un-boiled milk.

10. **Tetanus**

    It is caused by a bacterium found in the soil called ***clostridium tetani***. The bacteria enter the body through fresh cuts or wounds. It attacks muscles making them stiff and also breathing becomes difficult. In new born babies, it can enter through the umbilical cord if it's cut with a dirty un-sterilised instrument like a razor blade or knife.

    ## Signs and symptoms of tetanus

    - Stiff muscles all over the body.
    - Spasms when touched.
    - The baby stops sucking mother's breasts.

Prevention and control of tetanus

- Early immunization with DPT vaccine on the left upper thigh.
- Treatment of the infected people.

11. **Leprosy**

    It is caused by bacteria. It is spread through direct body contact with an infected person. It attacks both muscles and bones.

Prevention and control of leprosy

- Isolating infected person.
- Avoid sharing towels, basins, beddings with an infected person.
- Treat early cases with antibiotics.

Health habits that help to keep the skeletal system in a healthy working condition

- Do daily physical exercises.
- Feed on a balanced diet.
- Ensure proper body posture.
- Brush and floss your teeth twice a day.
- Eat foods rich in calcium. Calcium-rich foods include leafy green vegetables, broccoli, tofu, and fish such as salmon.
- Get enough vitamin D. Most people get plenty of this by spending regular time outdoors, but a vitamin D supplement can help those in areas that don't get much sunlight.
- Do weight-bearing exercises. These include things like walking, jogging, and climbing stairs.
- Wear protection. Always wear protective gear when riding a bike or playing contact sports to avoid bone fractures and other potentially serious injuries.

Exercises are important because;

- The heart muscles grow stronger and larger.
- The heart delivers more blood to the muscles.
- More enzymes are made in the muscle tissue to break down glucose and fatty acids.
- Ligaments and tendons become stronger to reduce chances of injury
- Joints become more flexible.
- Weight is lost, i.e. you don't become extra fat.
- The risk of heart attack is reduced.
- Digestion of food is carried out quickly and easily.

Posture

Posture is a way of positioning the body.

The correct sitting Posture.

- Sit up straight on the chair.
- Place both feet on the floor.
- Put all your weight on both bottoms.

Importance of correct posture

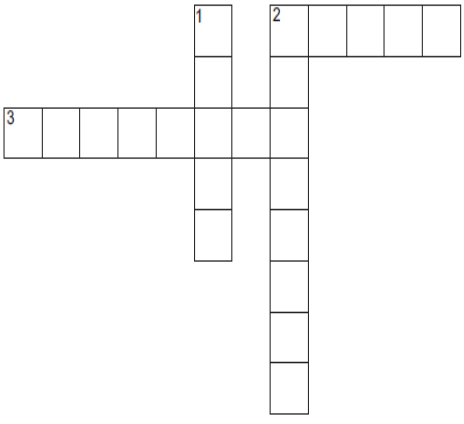
- Prevents back aches like chest pain and back ache.
- It prevents one from growing bent bones.

Summary

- Many bones also contain a soft connective tissue called bone marrow in the pores of the spongy bone. Bone marrow is where blood cells are made.
- Bones, cartilage, and ligaments make up the skeletal system.
- Functions of the skeletal system include providing support, protecting the delicate organs of the body, aiding in movement, and making blood cells.

Activity

1. ***Complete the crossword puzzle using the clues below:***



Across

2. *This is the bony framework that encloses our brain. (5)*

3. *This is a break or crack in the bone.*

Down

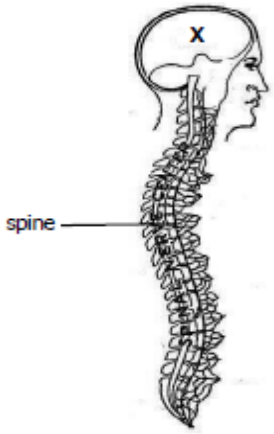
1. *This is the part of the body to which the head and limbs are attached. (5)*

2. *This is the framework of bones that supports our body. (8)*

2. *Give any two ways of keeping the skeletal muscular in a healthy working condition.*
3. *State any one importance of proper sitting posture during eating of food.*
4. *State any two ways in which exercises are useful to the skeletal system.*

5. *Which mineral salt is required for strengthening of bones?*
6. *How is the cartilage important at a joint?*
7. *Give any one sign of tuberculosis of the spine.*
8. *Apart from the vertebral column, give any two other parts of the human skeleton used for protection.*
9. *Name the part protected by the vertebral column in the human body.*
10. *Give any one health habit that helps to strengthen the human body.*
11. *Which disease of bones is spread through food contamination?*

The diagram below shows an important body organ protected by the human skeleton. Use it to answer questions 12 and 13.



12. *Write down one danger of damaging the above body organ.*
13. *Name the part of the skeleton that protects part marked X.*
14. *Name the type of joint found in each of the following parts of the human body.*

    i) Shoulder
    ii) Wrist

15. *What advice would you give to a person to keep the skeletal system in healthy working condition?*
16. *State the function of each of the following structures in the human skeleton*

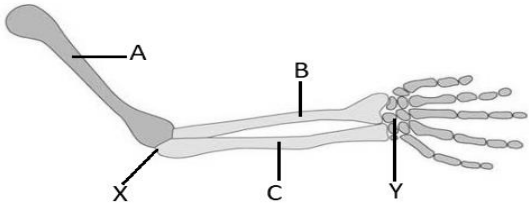
    i) Ligament
    ii) Tendon
17. *Give any one example of a long bone in a human skeleton.*
18. *Name one disease that affects a human skeleton.*
19. *State the injury that results from tearing of muscles.*
20. *Name any two bones that form the joint at the knee of the human body.*
21. *What name is given to the joint at the knee?*
22. *In which one way is friction reduced at a joint?*
23. *Give any one sign of a compound fracture.*

Word list

- **Bone marrow.** Soft tissue in spongy bone that makes blood cells.
- **Antagonistic muscles.** Muscles that work in pairs and have an opposite movement.
- **Cardiac muscle.** Involuntary muscle found only in the walls of the heart.
- **Cartilage.** Dense connective tissue that provides a smooth surface for the movement of bones at joints.
- **Contraction.** Shortening of muscle fibers.
- **Extensor.** Muscle that contracts to cause a joint to straighten.
- **Flexor**. Muscle that contracts to cause a joint to bend.
- **Involuntary muscle.** Muscle that is not under your conscious control.
- **Ligament.** Band of fibrous connective tissue that holds bones together.
- **Muscle fiber.** Long, thin cell that has the ability to contract, or shorten.
- **Moulting.** To shed or lose the outer covering of skin, feathers or fur.
- **Skeletal system.** All the body's bones, cartilage, and ligaments.
- **Spongy bone.** Light, porous inner layer of bone that contains bone marrow.
- **Bone density.** A measure of the amount of minerals (mostly calcium and phosphorous) contained in a certain volume of bone.
- **Skeletal muscle**. Voluntary muscle that is attached to bones of the skeleton and helps the body move.
- **Smooth muscle.** Involuntary muscle that is found in the walls of internal organs, such as the stomach.
- **Sprain.** A torn or an over stretched ligament.
- **Strain.** A torn or an over stretched muscle.
- **Tendon.** Tough connective tissue that attaches muscle to bones.
- **Voluntary muscle.** Muscle that is under your conscious control.

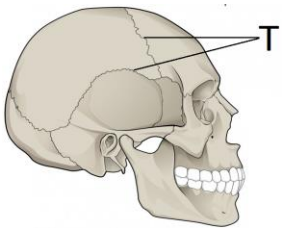
Revision exercise 1

1. What is a human skeleton?
2. What is a joint?
3. Give any one function of joints in the body.
4. How is a tendon different from a ligament?
5. Which disease of bones causes paralysis of the body?
6. Apart from protecting delicate body organs, state any other function of the skeletal system.
7. Name any one mineral salt stored in bones.
8. How is a sprain different from a strain?
9. Why are biceps and triceps muscles called antagonistic muscles?
10. How is the movement of a hinge joint different from that of a ball and socket joint?
11. Which part of the skeleton protects the spinal cord?
12. How do the triceps and biceps muscles work in pairs?
13. What germ causes poliomyelitis?
14. Name any one place in the body where a pivot joint is found.
15. Use the diagram below of a human limb to answer the questions that follow.



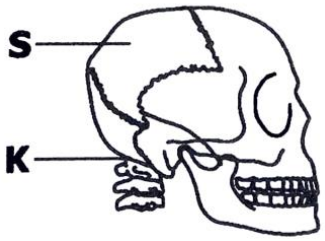
a) Name bone marked **A**, **B** and **C**.
b) Identify the joints indicated by letters **X** and **Y**.

16. Use the diagram below to answer the questions that follow.



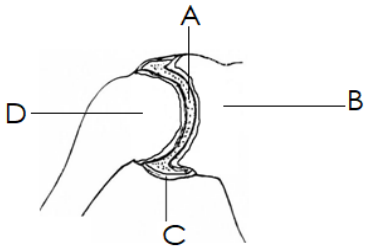
a) Name the joint indicated by letter T.
b) Which delicate body organ is protected by the above part of the skeleton?

17. Mention any one disorder of the skeletal system.
18. Name the joint formed by the femur and the tibia.
19. Apart from the synovial fluid, name any other part that prevents friction at a joint.
20. How does the synovial fluid help to reduce friction at a joint?
21. The diagram below is of a human skull and a neck vertebra. Use it to answer the questions that follow.



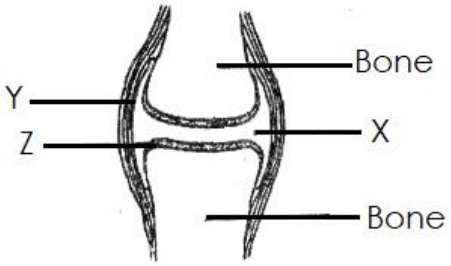
a) Name the movable joint at **K**.
b) Which delicate organ is protected by **S**?

22. The diagram below shows parts of a joint. Study and use it to answer the questions that follow.



a) Name parts marked **B** and **C**.
b) State the function of parts marked **A**.
c) What type of joint is shown in the diagram above?

23. The diagram below shows a human joint. Use it to answer the questions that follow.



a) Name the parts marked with letters **Y** and **Z**.
b) Give the function of the fluid found in the place marked with letter **X**.
c) What type of joint is shown in the diagram?

Topic 2: Electricity and magnetism

Electricity

Electricity is a form of energy produced by a flow of **electrons**.
Or electricity is a form of energy produced by electrons.
Electrons are negatively charged particles orbiting around an **atom**.

An atom is the smallest particle of matter. When electricity gathers in one place it is known as **static electricity** (the word static means something that does not move); electricity that moves from one place to another is called **current electricity**.

Types of electricity

- Static Electricity
- Current Electricity

Static electricity

Electricity is caused by electrons, the tiny particles that "orbit" around the edges of atoms, from which everything is made. Each electron has a small negative charge. An atom normally has an equal number of electrons and protons (positively charged particles in its nucleus or center), so atoms have no overall electrical charge. A piece of rubber is made from large collections of atoms called molecules. Since the atoms have no electrical charge, the molecules have no charge either—and nor does the rubber.

What is static electricity?

Static electricity is an imbalance of **electric** charges within or on the surface of a material. The charge remains until it is able to move away by means of an **electric** current or **electrical discharge.** When two objects are rubbed together to create static electricity, one object gives up electrons and becomes more positively charged while the other material collects electrons and becomes more negatively charged." This is because one material has weakly bound electrons, and the other has many vacancies in its outer electron shells, so electrons can move from the former to the latter creating a charge imbalance after the materials are separated. This is because of the friction between the insulators being rubbed

How static electricity works

Suppose you rub a balloon on your sweater over and over again. As you move the balloon back and forward, you give it energy. The energy from your hand makes the balloon move. As it rubs against the wool in your sweater, some of the electrons in the rubber molecules are pulled free and gather on your body. This leaves the balloon with

slightly too few electrons. Since electrons are negatively charged, having too few electrons makes the balloon slightly positively charged. Your sweater meanwhile gains these extra electrons and becomes negatively charged. Your sweater is negatively charged, and the balloon is positively charged. Opposite charges attract, so your sweater sticks to the balloon.

Dangers of static electricity

Static electricity can build up in clouds. This can cause a huge spark to form between the ground and the cloud. This causes lightning – a flow of charge through the atmosphere.

Here are some examples of dangers associated with static electricity:

- It causes lightning.
- It is dangerous when there are flammable gases or a high concentration of oxygen. A spark could ignite the gases and cause an explosion.
- It is dangerous when you touch something with a large electric charge on it. The charge will flow through your body causing an **electric shock**. This could cause burns or even stop your heart. A person could die from an electric shock.
- It is a nuisance when dust and dirt are attracted to insulators such as TV screens and computer monitors.
- It is a nuisance when clothes made from synthetic materials cling to each other and to the body.

Note

- Refueling aircrafts and tankers also poses a particular danger. If the fuel passing along the hose to the vehicle was allowed to build up a static charge, a resulting spark might ignite the fuel. The hoses are earthed to stop this from occurring.
- Anti-static sprays, liquids and cloths prevent the build-up of charge by allowing it to conduct away.

Lightning

Lightning is caused by static electricity. As rain clouds move through the sky, ice crystals inside them sink to the bottom, while water droplets rise to the top. The crystals have one kind of charge (negative) while the water droplets have the other kind (positive). It's the separation of these charges that allows a cloud to build up its power. Eventually, when the charge is big enough, it leaps to Earth as a bolt of lightning. Lightning causes thunder, a sound from the shock wave which develops as nearby gases of the discharge experience a sudden increase in pressure. Lightning occurs

commonly during thunderstorms and other types of energetic weather systems, but volcanic lightning can also occur during volcanic eruptions.

Dangers of lightning

- Lightning burns and destroys buildings.
- Lightning leads to electrocution or death of people.
- Lightning leads to death of animals.
- Lightning destroys plantations.

Safe guarding against lightning

Outdoor Safety Tips

The best defense is to avoid lightning. Here are some outdoor safety tips that can help you avoid being struck:

Do's

- **Be aware**
  Check the weather forecast before participating in outdoor activities. If the forecast calls for thunderstorms, postpone your trip or activity, or make sure adequate safe shelter is readily available.
- **Separate**
  If you are in a group during a thunderstorm, separate from each other. This will reduce the number of injuries if lightning strikes the ground.
- **Go indoors**
  Remember the phrase, "**When thunder roars, go indoors**." Find a safe, enclosed shelter when you hear thunder. Safe shelters include homes, offices, shopping centers, and hard-top vehicles with the windows rolled up.
- **Seek shelter immediately even if caught out in the open**

  If you are caught in an open area, act quickly to find adequate shelter. The most important action is to remove yourself from danger. Crouching or getting low to the ground can reduce your chances of being struck but does not remove you from danger.

  If you are caught outside with no safe shelter nearby, the following actions may reduce your risk:

    - Immediately get off elevated areas such as hills, mountain ridges, or peaks.

- Never lie flat on the ground. Crouch down in a ball-like position with your head tucked and hands over your ears so that you are down low with minimal contact with the ground.
- Never shelter under an isolated tree.
- Never use a cliff or rocky overhang for shelter.
- Immediately get out of and away from ponds, lakes, and other bodies of water.
- Stay away from objects that conduct electricity (barbed wire fences, power lines, windmills, etc.).

Don'ts

- **Don't stay in open vehicles, structures, and spaces.**
  During a thunderstorm, avoid open vehicles such as convertibles, motorcycles, and golf carts. Be sure to avoid open structures such as porches, gazebos, baseball dugouts, and sports arenas. And stay away from open spaces such as golf courses, parks, playgrounds, ponds, lakes, swimming pools, and beaches.
- **Don't stay near tall structures.**
  Do NOT lie on concrete floors during a thunderstorm. Also, avoid leaning on concrete walls. Lightning can travel through any metal wires or bars in concrete walls or flooring.

Indoor Safety Tips

Even though your home is a safe shelter during a lightning storm, you may still be at risk. Here are some tips to keep safe and reduce your risk of being struck by lightning while indoors.

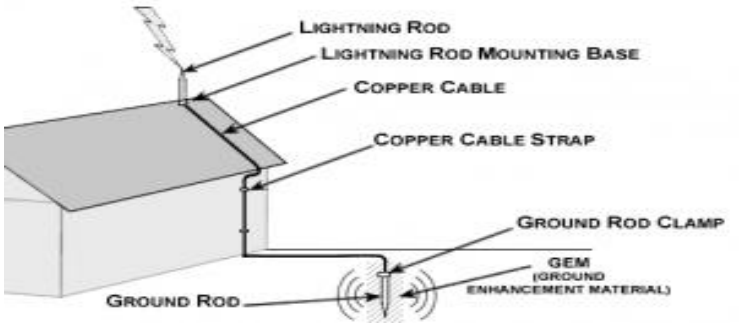
- **Avoid water**
  Do NOT bathe, shower, wash dishes, or have any other contact with water during a thunderstorm because lightning can travel through a building's plumbing.
- **Avoid electronic equipment**
  Do NOT use your computers, laptops, game systems, washers, dryers, stoves, or anything connected to an electrical outlet. Lightning can travel through electrical systems, radio and television reception systems, and any metal wires or bars in concrete walls or flooring. Equip your home with whole-house surge protectors to protect your appliances.
- **Avoid corded phones.**
  Corded phones are NOT safe to use during a thunderstorm. Do NOT use them. However, it is safe to use cordless or cellular phones during a storm.
- **Avoid windows, doors, porches, and concrete**
  Do NOT lie on concrete floors during a thunderstorm. Also, avoid leaning on

concrete walls. Lightning can travel through any metal wires or bars in concrete walls or flooring.

- **Installing lightning conductors on buildings.**

How a lightning conductor works

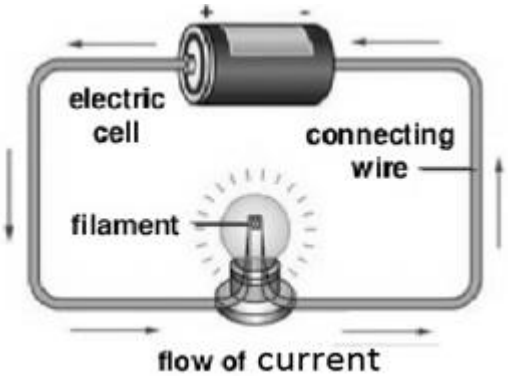
Lightning conductor is a metal rod or wire fixed to an exposed part of a building or other tall structure to divert lightning harmlessly into the ground. If lightning hits the structure, it will preferentially strike the rod and be conducted to ground through a wire, instead of passing through the structure, where it could start a fire or cause electrocution. Lightning conductors are all made of conductive materials, such as copper and aluminium.



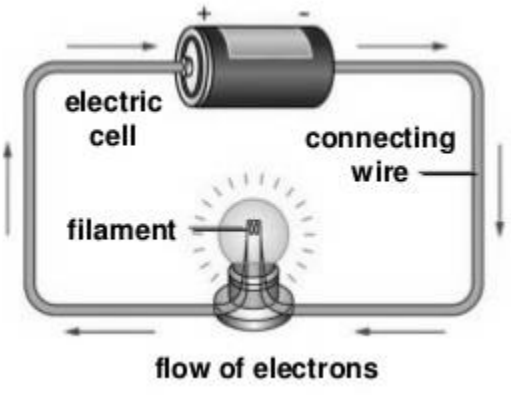
Current electricity

When electrons move, they carry electrical energy from one place to another. This is called **current electricity** or an **electric current**. Electric currents are also involved in powering all the electrical appliances that you use, from washing machines to flashlights and from telephones to MP3 players. These electric currents last much longer. Electric current is measured in **amperes** (amps) and refers to the number of charges that move through the wire per second.

The diagram showing the flow of current/ electricity/ electric current



The diagram showing the flow of electrons

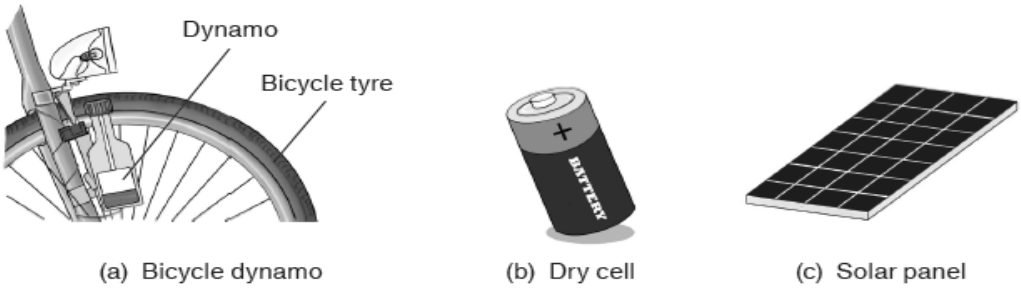


Types of current electricity

1. Direct current (DC)

If the current flows in only one direction it is called direct current, or DC. Batteries and solar cells supply DC electricity. A typical battery may supply 1.5 V.

Sources of DC: chemical batteries, dry cells and solar cells.



(a) Bicycle dynamo (b) Dry cell (c) Solar panel

Electric cells

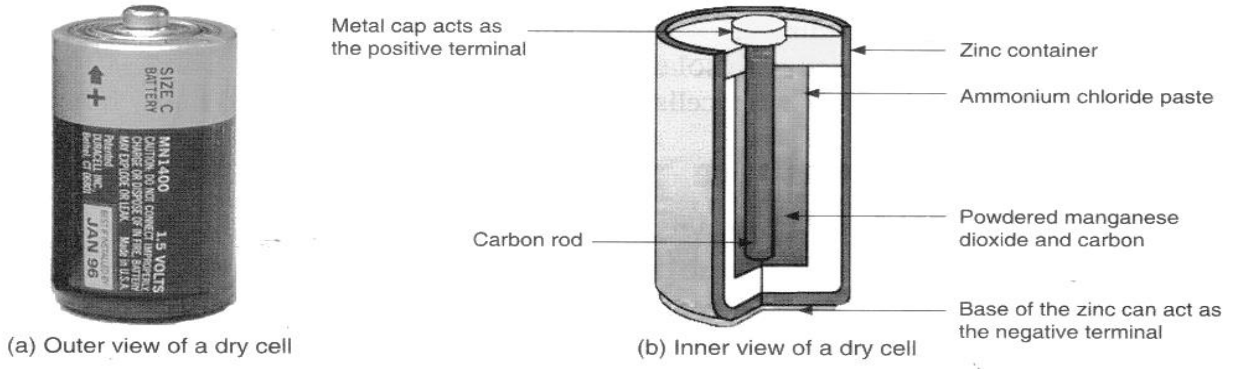
An electric cell is a device that changes chemical energy to electrical energy.

Types of electric cells

- Primary cells, these are cells which cannot be recharged and their chemical reaction which produces electrical energy cannot be reversed e.g. the simple cells, dry cells.
- Secondary cells, these are cells that can be recharged and the chemical reaction that produces electricity can be reversed by passing the current through the opposite direction.

Parts of a dry cells

A dry cell changes chemical energy into electrical energy. It consists of two ends (terminals). One end has a positive charge while the other has a negative charge.



Functions of parts

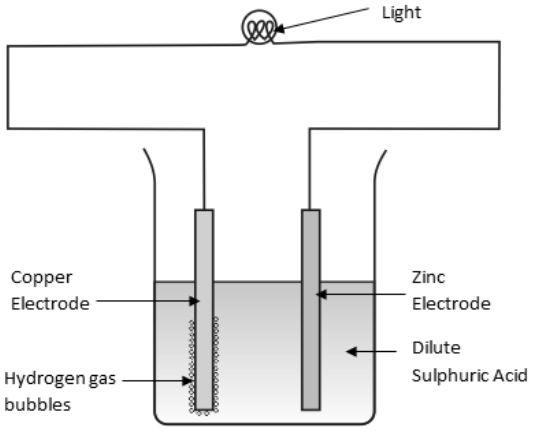
- The metal cap is the positive terminal. It covers the carbon rod. The carbon rod is a non-metallic conductor.
- The Zinc container is the negative terminal.
- The ammonium chloride helps in the transfer of electrons.
- The manganese IV Oxide acts as a depolariser. This helps to remove bubbles of gases produced in the cell.

Simple cell (Wet cell)

It consists of a zinc plate and a copper plate dipped in dilute sulphuric acid.
The zinc plate acts as the **negative** electrode; the copper plate acts as the **positive** electrode. Sulphuric acid acts as an **electrolyte**. The zinc loses electrons more than copper, so placing zinc and copper in a solution can cause electrons to flow through an external wire.

An ***electrode*** is a piece of metal that allows electric current to pass through it when placed in an electrolyte.

An ***electrolyte*** is a substance which when in molten or solution form, conducts electricity.



Activity: Making a lemon wet cell

Materials needed

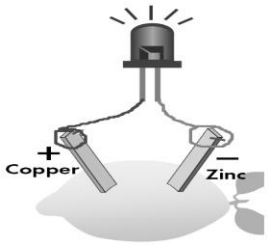
- A large orange.
- A galvanized iron nail for the zinc terminal.
- A copper wire.
- A LED bulb.

Steps/procedure

1. Pierce two holes through the large lemon.
2. Insert in one hole the galvanized iron nail and in the other hole insert the copper wire.
3. Connect a small LED bulb on the top of the galvanized iron nail and the copper wire.

Observation

A very small flash of light is seen because a lemon produces less than 1V of current.



2. Alternating Current (AC)

If the current constantly changes direction it is called ***alternating current***, or AC. The Ugandan mains supply is about 240 V. Current flows in two directions. i.e. from the source to the appliance and the back. E.g. hydro electricity.

Sources of AC; fast flowing water, wind, steam, uranium.

Forms of electricity

- **Hydroelectricity**

  This is the electricity produced by the powerful flowing water. At a power station, kinetic energy of flowing water turns turbines which are connected to generators that produce electricity.

- **Thermal electricity**
  Produced from fossil fuels.
- **Solar electricity**
  Produced from the sun.
- **Nuclear electricity**
  Produced from nuclear power stations**.**
- **Geothermal electricity**
  Produced from hot rock in the earth.

Activity
1. *Write down two types of electricity* 2. *State any two forms of electricity* 3. *Draw a diagram to show flow of electricity* 4. *What type of electricity is commonly used by most urban areas in Uganda?* 5. *Briefly explain the term alternating current.* 6. *What is current electricity?* 7. *Give any one source of direct current electricity.* 8. *Which type of electricity is lightning?* 9. *State any one danger of lightning to people.* 10. *How can lightning be prevented from striking buildings?* 11. *What causes static electricity?* 12. *What type of current electricity is produced by a dynamo?*

Conductors and insulators of electricity

Conductors of electricity

Conductors are materials that allow electricity to pass through them.
Metals have at least one electron that can move around freely, and all metals are conductors. Conductors have freely moving electrons.

Examples of conductors of electricity

- Metals like; Iron, copper, tin, silver, zinc, lead, brass. Silver is the best conductor but it is not commonly used in electrical installations because it is expensive.
- Water from rivers, lakes, springs and wells.
- Carbon (non-metallic conductor)
- Salts e.g. sodium chloride.

Uses of conductors

- For making circuits in devices.
- For transmission of electricity.
- For wiring in houses.

Insulators of electricity

Insulators are materials that don't allow electricity to pass through them.
Electrons in insulators are not freely moving.

Examples of insulators

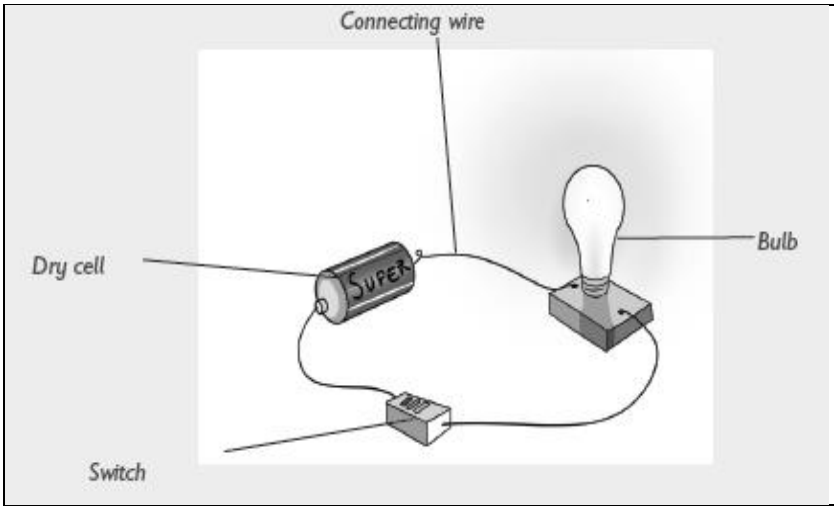
- Distilled water, this lacks mineral salts
- Cotton wool
- Rubber
- Plastics
- Dry wood
- Glass

Importance of insulators

- They protect electricity users from electric shock.
- They prevent short circuits when wiring.

Electric circuits

For an electric current to happen, there must be a **circuit**. ***A circuit is a closed path around which an electric current flows.*** A circuit is usually made by linking electrical components together with pieces of wire cable. Thus, in a flashlight, there is a simple circuit with a switch, a lamp, and a battery linked together by a few short pieces of copper wire. When you turn the switch on, electricity flows around the circuit. If there is a break anywhere in the circuit, electricity cannot flow. If one of the wires is broken, for example, the lamp will not light. Similarly, if the switch is turned off, no electricity can flow.



Activity: making a simple circuit.

Materials needed

- Dry cell, Switch, Wire, Bulb.

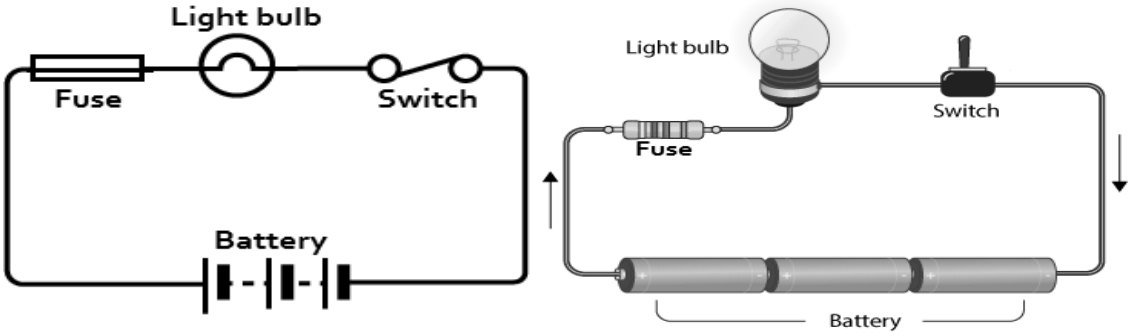
Set up an experiment as shown aside.

1. Put on the switch. What happens to the bulb?
2. Now, put off the switch. What happens?
3. Write a report about your findings and present to the rest of the class.

Components of a simple electric circuit

- Light bulb
- Wire
- Dry cell/battery

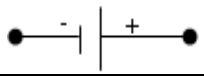
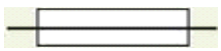
A diagram showing a circuit



Other components (parts) of a circuit

- Switch
- Fuse
- Ammeter
- Voltmeter

Symbols used in electric circuits

Component (part)	Symbol	Use
Light bulb		To produce light and heat
Open switch		To open and close the circuit at one's will
Dry cell		To produce electricity
Ammeter		To measure current
Voltmeter		To measure voltage
Fuse		To control current entering the circuit

Fuse

Fuse is an electrical safety device that operates to provide protection of an electrical circuit against too much current. Its essential component is a thin metal wire or strip that easily melts when too much current flows through it, thereby stopping or interrupting the current.

Importance of a fuse

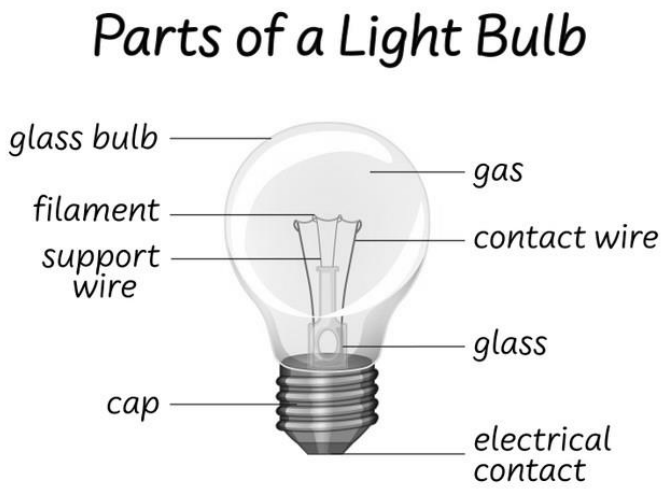
To control the amount of current entering the circuit.

How a fuse works

By melting and breaking the circuit in case of too much electricity.

Advantages of using a fuse

- A fuse controls the risks of fire out breaks.
- A fuse protects appliances from being damaged by too much current.



Uses of parts of a bulb

- **Filament:** It produces light. It is made of **tungsten** from a mineral called **wolfram.**

Adaptation of the filament to its function

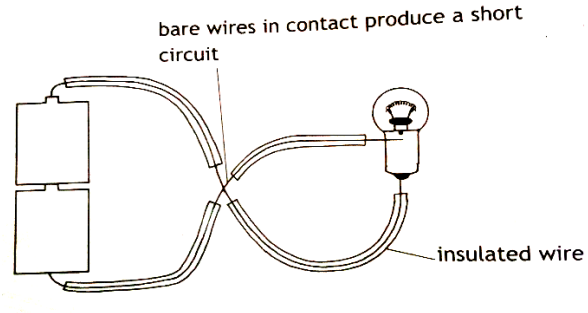
- It has a high melting point.
- It is coiled to increase electric resistance.

- **Conducting wire**: It conducts electricity to the filament.
- **Glass envelop**: Protects the inside parts of the bulb. It prevents nitrogen and argon gases from escaping. It is transparent to allow light to pass through.
- **Filament support**: It supports the filament.
- **Electrical contact**: It allows electricity into the bulb.
- **Insulating material**: It separates the conducting wires.

Activity
1. *Why is a filament of an electric bulb coiled?* 2. *State any component of a circuit that use an alloy.* 3. *How is the reflector important in an electric torch?* 4. *Which gas is commonly used in electric bulbs?* 5. *Give one reason why the glass of a bulb is transparent?* 6. *Which type of electricity is produced by generators?* 7. *Why do people installing electricity wear rubber gloves?*

Short circuits

A short circuit is a path of low resistance towards the flow of current.
A short circuit is also an abnormal connection between two nodes of an electric circuit intended to be at different voltages. This results in an excessive current flowing through the circuit. It causes electric appliance damage, overheating, fire or explosion.



Causes of short circuit

- Poor wiring when installing electricity in buildings.
- Pushing metallic objects in electric sockets.
- When bare electric wires get into contact.
- Wrong connection of wires in electric equipment.
- Overloading sockets.

Effects of short circuit

- Destruction of electrical equipment.
- Leads to fire that may burn the building.
- Leads to death of people and animals.

How to avoid short circuit

- Electric wires should be covered with an insulating material.
- Installation should be done by experts only.
- Repair of electric appliances should be done by experts.

Advantages of using electricity

- It is quick or fast to use.
- It is clean and smokeless.
- It is environmentally friendly (Conserves the environment).
- It is easy to operate.

Disadvantages of electricity

- It is expensive to install.
- Electricity can shock.
- It can burn buildings in case of a short circuit.

Safety precautions in handling electricity and electrical appliances.

DON'T ever play with electricity!

Electricity is amazingly useful—but it can be really dangerous as well. Electricity from power plants is at thousands of times higher voltages and massively more dangerous than the electricity in your home. **If you are silly enough to touch or play near power equipment, you could die an extremely nasty and unpleasant death**—electricity doesn't just shock you, it burns you alive. Heed warnings like this one and stay well.

Electricity can also be dangerous in your home. Household electric power can kill you, so be sure to treat it with respect too. Don't play with household power sockets, push things into them or use wet hands. Avoid over loading the socket. Don't open electrical appliances, because dangerous voltages can linger inside *for a long time* after they are

switched off. If you want to know what something electrical looks like inside, search on the web—you'll find a safe answer that way.

It's generally okay to use small (1.5 volt) flashlight batteries for your experiments if you want to learn about electricity; they make small and safe voltages and electric currents that will do you no harm. Ask an adult for advice if you're not sure what's safe.

Differences between static electricity and current electricity

	Static	**Current**
1	Takes place in insulators.	Takes place in conductors.
2	The charge is on the surface.	Charge is inside the conductor.
3	The charge does not flow.	Charge flows through the conductor from one place to another.
4	Protons (+) and electrons (-) are both necessary for this type of electricity.	Only electrons flow.

Topical questions

1. *Briefly explain the term electricity.*
2. *Why is electricity called a form of energy?*
3. *Give any one way in which electricity can prevent deforestation.*
4. *Why is it important to properly handle electric appliances?*
5. *Draw a symbol of an electric bulb.*
6. *Suggest any one way in which we can prevent our electric appliances from being destroyed by electricity.*
7. *State any one difference between conductors and insulators.*
8. *Why are electric wires carrying current from the source raised some meters high from the ground?*
9. *Cite any one disadvantage of using electricity in the environment*
10. *Draw a diagram to show the flow of current.*
11. *Cite any one danger of lightning to the environment*

12. *State the static electricity in nature.*
13. *Briefly explain how to overcome the dangers of caused by short circuits in the environment.*
14. *Why is the filament of an electric bulb coiled?*
15. *How is a fuse important in an electric circuit?*

Magnetism

Magnetism is the force exerted by magnets when they attract or repel each other. **Magnetism** is caused by the motion of electric charges. Every substance is made up of tiny units called atoms. Each atom has electrons, particles that carry electric charges. Spinning like tops, the electrons circle the nucleus, or core, of an atom. Their movement generates an electric current and causes each electron to act like a microscopic magnet.

Magnet

A magnet is a piece of metal that attracts other magnetic substances. A magnet can also be defined as a piece of metal with a magnetic field around it.

What are magnetic materials?

These are substances that can be attracted by a magnet.
They can easily be magnetized. Magnets do not attract every type of metal. Magnets attract some metals like iron, steel, nickel, and cobalt

Examples of magnetic materials

- Iron (most common magnetic substance)
- Nickel
- Cobalt
- Steel

What are non-magnetic substances?

These are materials that cannot be attracted by magnets.

Examples of nonmagnetic substances

- Dry wood
- Plastic
- Lead
- Glass
- Cloth
- Copper

Types of magnets

There are two main types of magnets;

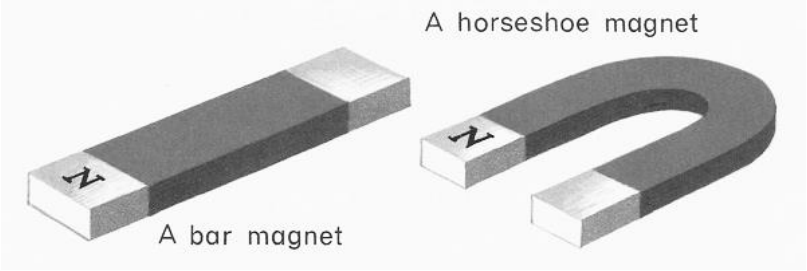
- Artificial magnets.
- Natural magnets.

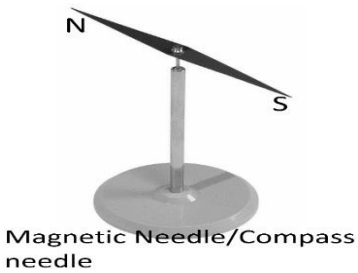
Artificial magnets

These are magnets made from steel and other strong magnetic materials.

Examples of artificial magnets and their shapes

- **Bar magnet**. This is a bar of uniform cross section. It may be rectangular or circular.
- **Horse shoe magnet**; It has a u shape.
- **Magnetic needle.** It is thin and pointed at both ends and balanced at the centre.





Natural magnets

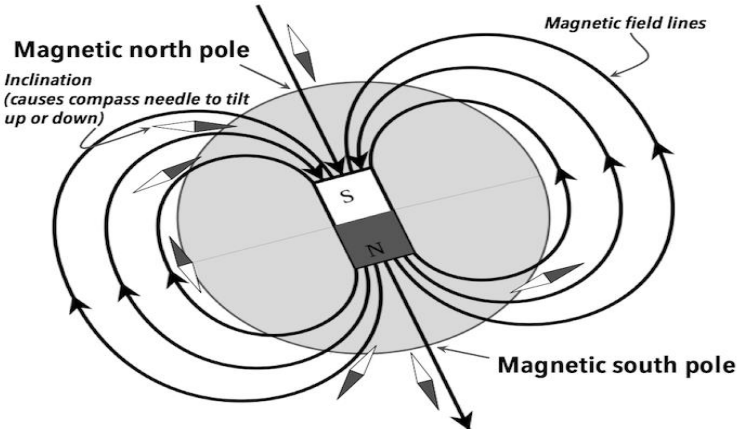
They don’t lose magnetism.

They include the earth and lodestone.

Examples of natural magnets

The Earth. It is a huge natural magnet. Its magnetic field is weak, that is why you can’t feel it.

A magnet's north pole points to Earth’s magnetic north pole. How can this happen. Aren't like poles supposed to repel? Shouldn't the north pole of the compass be pointing to the south pole of the Earth? The answer may surprise you. Earth’s magnetic north pole is actually the south pole of magnet Earth! It’s called the magnetic north pole to avoid confusion. Because it's close to the geographic north pole, it would be confusing to call it the magnetic south pole.

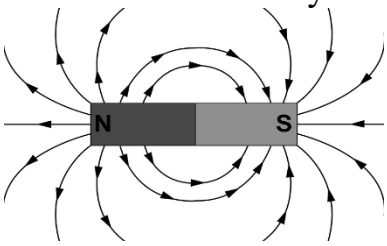


Lodestone/magnetite. Lodestone is a magnetic ore which occurs naturally in the earth. It was discovered near the ancient city of magnesia in Asia Minor. It was the first magnet to be discovered by people. People have known about magnetite for thousands of years. The earliest compasses used magnetite. Their magnetic pointers showed direction.

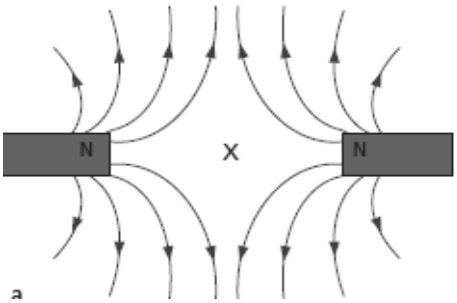
Fig: Lodestone/Magnetite

Properties of magnets

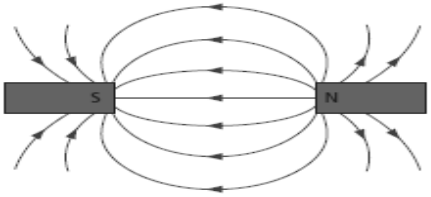
- **Magnets have Magnetic Poles**. The **poles** are the places on a magnet to which magnetic materials, such as iron filings, are attracted. They are near the ends of a bar magnet and occur in pairs of equal strength.
  All magnets have two magnetic poles, these are north-pole and south pole. They have these names because they always line up with Earth's ***north-south axis***.



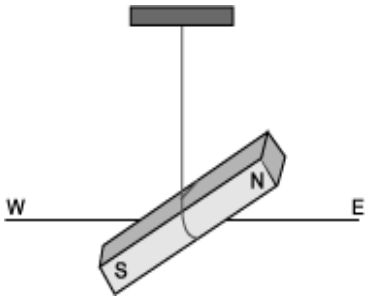
- **Like poles of a magnet repel**



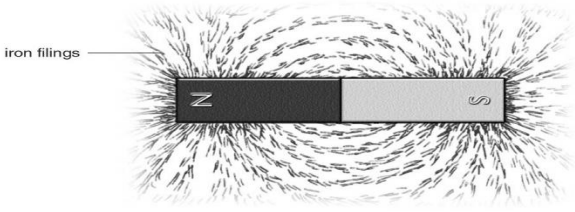
- **Unlike poles attract each other**

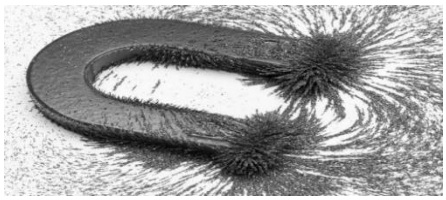


- When a magnet is freely suspended by a piece of thread it will always rest in the north –south direction.

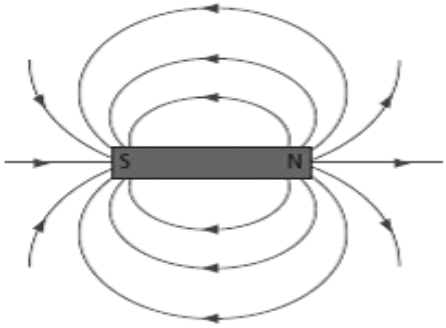


- Magnets are stronger at the poles/Magnetism is more concentrated at the poles of a magnet.

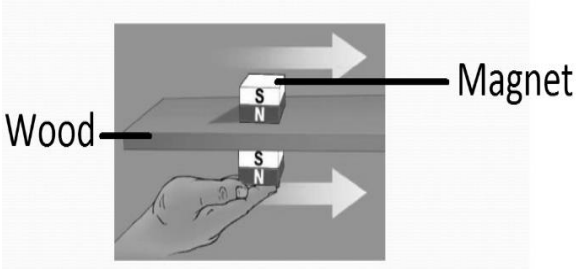




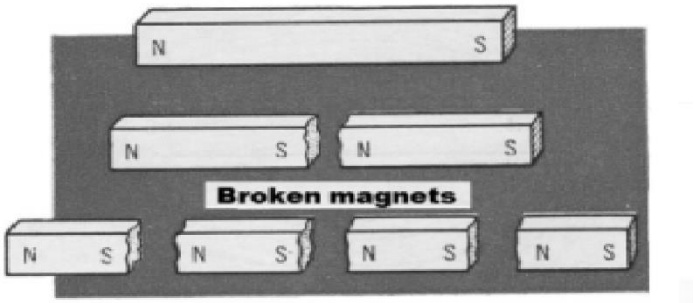
- Magnets have magnetic fields around them. The space surrounding a magnet where it produces a magnetic force is called a **magnetic field**.
(The magnetic lines of force run from the north pole to the south pole of a magnet)



- **Magnetism passes through non- magnetic materials**



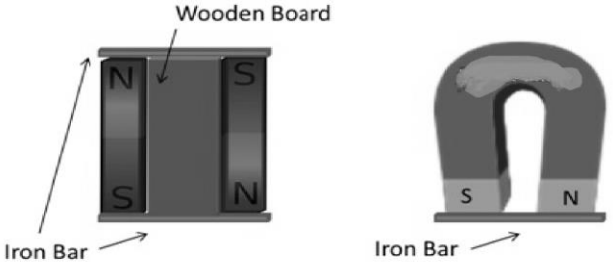
- **Broken pieces of magnets regain their poles instantly**



- **Magnets become weaker with age.**

Preventing magnets from losing magnetism

- Keeping them using iron keepers.



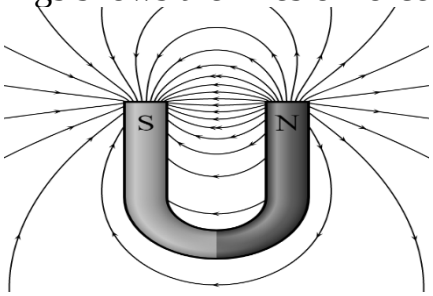
Methods to store Magnets

Laws of magnets

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

What is magnetic field?

Magnets have what is called a magnetic field. This is an area around the magnet in which it can attract other magnetic materials. This invisible field surrounds a magnet. This is the area where a magnetic force is exerted. Tiny bits of iron, or iron filings, are used to help see the field. These iron filings are then placed under a sheet of glass. When the magnet is placed on the glass, it attracts the iron filings. The pattern of the iron filings shows the lines of force. These lines of force outline the magnetic field.



Properties of magnetic fields.

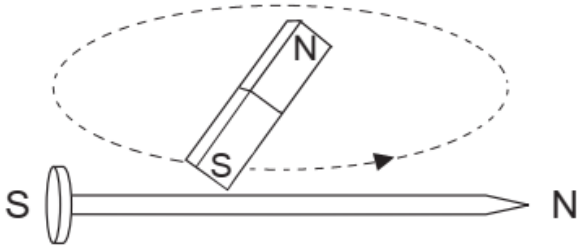
- They originate from **North Pole** and end at the **South Pole.**
- The lines forces do not intersect with each other.

- A line of force is continuous; it starts from the North Pole and ends at the South Pole.
- There is no line of force within the magnet itself.

Methods of making magnets

In most substances, equal numbers of electrons spin in opposite directions, which cancels out their magnetism. That is why materials such as cloth or paper are said to be weakly magnetic. In substances such as iron, cobalt, and nickel, most of the electrons spin in the same direction. This makes the atoms in these substances strongly magnetic—but they are not yet magnets. To become magnetized, another strongly magnetic substance must enter the magnetic field of an existing magnet. The magnetic field is the area around a magnet that has magnetic force.

- **Stroking by single touch:**



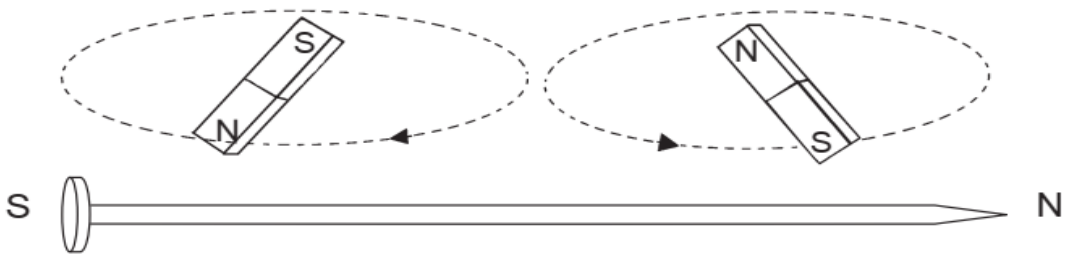
An iron or steel nail can be made into a magnet by stroking it repeatedly (at least 20 times) with a magnet in one direction only. It is stroking by single touch because one magnet is used.

Note.

- When you stroke a piece of iron along a magnet, the north-seeking poles of the atoms in the iron line up in the same direction. The force generated by the aligned atoms creates a magnetic field. The piece of iron has become a magnet.
- Stroking in an anticlockwise direction with the North pole touching the head of the iron nail will make the head of the nail the North pole and its tip the South pole.

- **Stroking by double/divided touch**

It is called so because two magnets are used.



The two magnets are used to stroke the iron nail.

After stroking the iron nail repeatedly with a magnet, the iron nail will become a magnet.

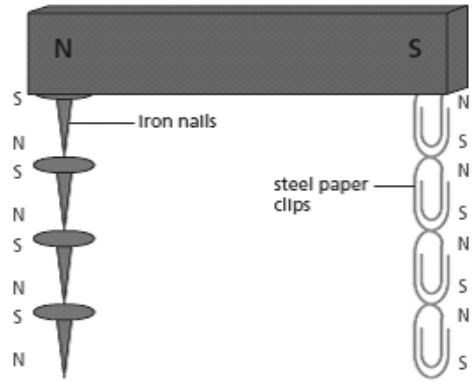
We say that the iron nail has been **magnetised**.

The greater the number of strokes you give the iron nail, the stronger its magnetism.

To test if the magnet you have made really works, bring it close to some iron filings and see if any attraction takes place.

- # By induction

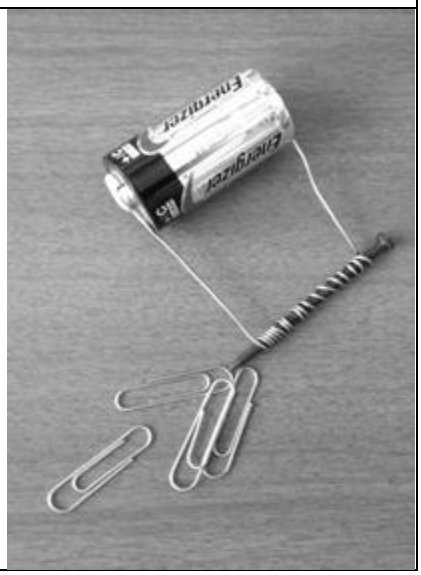
  If you bring a bar magnet close to pile of paper clips, the paper clips will become temporarily magnetized. As a result, the paper clips will stick to the magnet. They will also stick to each other. Here paper clips (magnetic object) become magnetized by ***induction***.



Note

Magnets formed by induction are called ***induced magnets.***

- # By electrical method

Activity: Making an electromagnet.	
Materials required ● Thin gauge, coated copper wire/ insulated wire. ● 2inch Nail ● Sandpaper ● D size battery ● Paperclips ● Tape **Steps** 1. Sandpaper 1 cm of the coating off both ends of the copper wire. 2. Wind (wrap) the wire around the nail as many times as you can, leaving the ends free and	

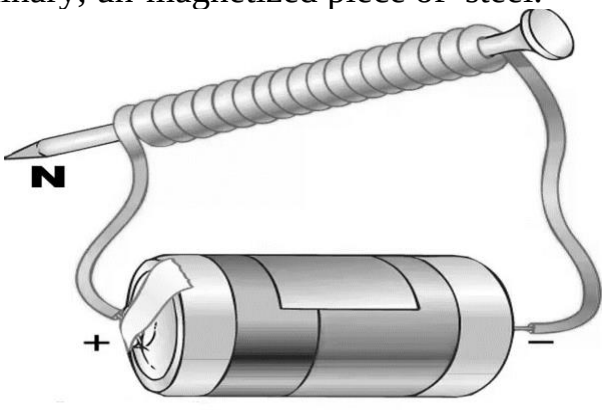
without overlapping them.

3. Tape the ends of the wire to the battery.

Safety note: Electricity will now be running through the coil and nail. It will get hot and may burn if touched. Use a pen to push the magnet off the battery and let the coil cool before adjusting the set-up or dismantling.

4. See how many paperclips your magnetised nail can pick up.
5. Experiment with your materials, changing one thing at a time to make your electromagnet pick up as many paperclips as it can. (You may have to ask your teacher for more materials). Try changing:
   - the number of wire coils
   - how tight the coils are around the nail.
   - the strength of the battery.
   - the type of wire.
   - the gauge of wire.
   - the type of nail.
   - the size of nail.
6. Discuss your findings and try to explain your results.

Some substances can be magnetized by an electric current.
When electricity runs through a coil of wire, it produces a magnetic field. The field around the coil will disappear, as soon as the electric current is turned off. A magnet made by using electricity is an ***electromagnet.*** An ***electromagnet*** is a magnet that can be switched on and off with electricity. When the current flows, it works like a magnet; when the current stops, it goes back to being an ordinary, un-magnetized piece of steel.



Electromagnets are made stronger by;

- By increasing the coils (turns) around the soft iron.
- By increasing the voltage (electrical strength).

Determining the poles an electromagnet
The direction of flow of current.

- If current flows in an **anticlockwise** where it enters the solenoid is the ***south*** pole (S).

Using the right-hand grip rule.

- Grasp the solenoid in the **right hand** with **thumb pointing in the direction of current.**
- The thumb points to **the North Pole.**

Demagnetizing a magnet

This is the making of a magnet to lose its magnetism.

Ways of demagnetizing a magnet

- Hammering/hitting strongly.
- Strong heating.
- Leaving a magnet in an east-west direction for a very long time.
- By keeping the magnets with like poles together.
- By passing an **alternating current** through a magnet.
- Leaving it to rust.

Summary

- A magnet is an object that attracts certain materials such as iron. Magnets have a magnetic field. It is this magnetic field that exerts a force on some materials. Opposite magnetic poles attract each other. Unlike poles repel each other.
- Magnetism is the ability to be attracted by a magnet. Only some metals are attracted to magnets. These metals include: iron, cobalt, and nickel. When these materials are magnetized, they become temporary or permanent magnets. Magnetite is a natural permanent magnet.
- A magnet has two ends called **poles**, one of which is called a north pole or north-seeking pole, while the other is called a south pole or south-seeking pole.
- The north pole of a magnet points roughly toward Earth's north-pole and vice-versa. That's because Earth itself behaves like a gigantic magnet.
- If you cut a bar magnet in half, you get two brand new, smaller magnets, each with its own north and south-pole.
- If you pass a magnet a few times over an un-magnetized piece of a magnetic material (such as an iron nail), you can convert it into a magnet as well.

Uses of magnets in modern world of work.

You might be surprised just how many things around you work by magnetism or electromagnetism. Every electric appliance with an electric motor in it (everything from your electric toothbrush to your lawn mower) uses magnets to turn electricity into motion. Motors use electricity to generate temporary magnetism in wire coils. The magnetic field thus produced pushes against the fixed field of a permanent magnet, spinning the inside part of the motor around at high speed. You can harness this spinning motion to drive all kinds of machines.

There are magnets in your refrigerator holding the door closed. Magnets read and write data (digital information) on your computer's hard drive and on cassette tapes in old-fashioned personal stereos.

More magnets in your hi-fi loudspeakers or headphones help to turn stored music back into sounds you can hear.

If you're sick with a serious internal illness, you might have a type of body scan called MRI (magnetic resonance imaging), which draws the world beneath your skin using patterns of magnetic fields.

Magnets are used to recycle your metal trash (steel food cans are strongly magnetic but aluminium drinks cans are not, so a magnet is an easy way to separate the two different metals).

Magnets are used in compasses by sailors, pilots and explorers to show direction, and in electric bells to produce sound.

Magnets are also used for transport in maglev (magnetic levitation) trains. These electric trains run on very strong electromagnets.

Appliances that use electricity

- Flat irons
- Heaters
- Driers
- Washing machines
- Electric fans

Appliances that use magnetism

- Magnetic compasses.
- Magnetic tapes.

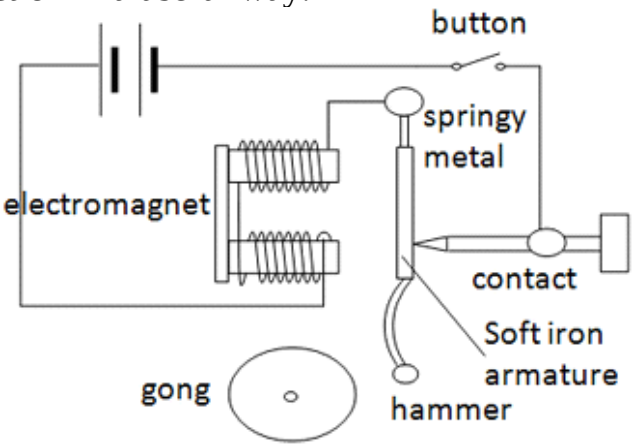
Appliances that use both electricity and magnetism

- Fridges
- Radios
- Televisions
- Mobile phones
- Electric bell

An Electric bell

Introduction

The electric doorbell is a simple circuit that triggers a sound on the completion of circuit by pressing the button. It is this simplicity that makes doorbell such a marvel. The simple devices in the doorbell puts the scientific principle of electromagnetism into action in a useful way.



How it works

Now that you have an understanding of the important parts in an electric bell, the step-by-step process of how an electric bell works is described below:

- The switch is pressed and current flows through the circuit.
- The electromagnet is powered and generates a magnetic field that attracts the iron strip towards it.
- The hammer strikes the gong.
- When the striking arm strikes the gong, the contact is broken and current stops flowing through the circuit.
- This causes the electromagnet to lose its magnetic field.
- The connected spring arm returns the striker to its original rest position.
- The contact is restored and current flows through the circuit (provided the main switch is still pressed).
- The process is repeated from the beginning.

Practical work: Making an electric bell.

Things You'll Need

- A small bell
- A makeshift clapper (a strip of metal with a tiny hammerhead on one end)
- 10 meters of 28-gauge magnet wire
- Standard electrical wire
- 2 AA batteries
- Several wood screws
- 2 4-inch nails
- Small wood blocks in a U shape
- A wooden board

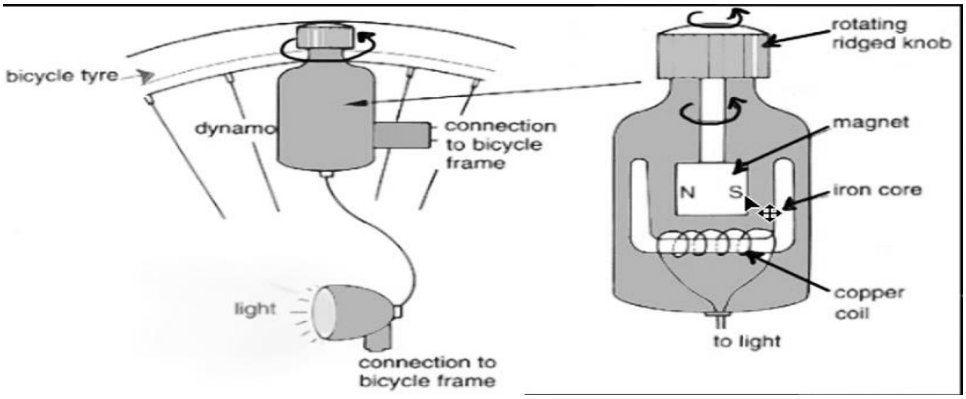
Steps

- Wrap the magnet wire around one of the nails and sand off any insulation from either end of the wire. This will be our electromagnet.
- Slide the electromagnet through a hole in one upright of the wooden U.
- Using a wood screw, mount the metal clapper into the bottom interior of the wooden U in such a way that the hammerhead can freely move back and forth. Then, connect one wire end from the electromagnet to the bottom of the clapper.
- Slide the other nail through a hole drilled into the other upright of the wooden U and attach a standard electric wire to it.
- Attach the standard wire from the nail to either the positive or negative end of the two AA batteries connected in series. Attach the free wire from the electromagnet to the other end of the batteries.
- Mount the entire setup so that it lies flat on the wooden board and allows room for the bell to be mounted near the head of the clapper. Adjust both the nail and the electromagnet so that the clapper rapidly oscillates back and forth.
- Mount the bell on the wooden board so that the clapper repeatedly strikes it when the circuit with the electromagnet is complete.

Generating electricity using a dynamo

Dynamo

A **dynamo** is an electrical generator that creates direct current using a commutator. This device makes direct current electric power using electromagnetism. It is basically a DC generator, i.e. an electrical machine which converts mechanical power into direct current electrical power. A dynamo converts mechanical energy into electrical energy. A dynamo uses **a permanent magnet** and a coil of wires on electro magnets. During the turning, the **mechanical energy** is turned into **electric energy.**



Increasing the electricity produced by a dynamo

- By speeding the bicycle
- By increasing the turns (coils)

Activity: Producing electricity using a simple dynamo

Materials needed: Bicycle with dynamo and bulb.

What to do:

i. Obtain a bicycle with a dynamo and bulb installed.
ii. Turn the bicycle upside down so that both wheels face up and its pedals are free.

iii. Switch on the bulb when the bicycle wheels are not moving. What happens to the bulb?
iv. Rotate the bicycle pedals slowly at first. Switch on the bulb and observewha t happens.
v. Rotate the bicycle pedals very fast while the bulb is switched on. How does the bulb appear?
vi. Allow the wheel to rotate until it stops. What happens to the bulb? What conclusion can you make from the experiment above? Compare your notes with others.

Generator

The type of current electricity produced by a generator is **A.C**

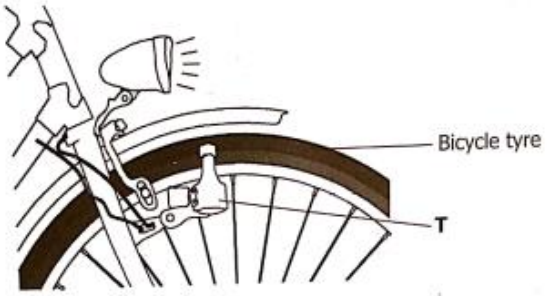
It changes **Mechanical energy** to **electric energy**.

Uses of dynamos and generators

- Provide electricity for light.
- Provide energy to run machines.
- Provide energy for cooking.
- Generators are used in hospital theatres incase power goes out.

Activity:

1. *The diagram below shows an equipment on a bicycle that is used to produce electricity. Study and use it to answer the questions that follow. Name the equipment labelled **T**.*



(b) Give the function of the bicycle tyre in producing electricity.
*(c) State the energy change that takes place in equipment labelled **T** when it is in use.*
*(d) State **one** way in which the amount of electricity produced by the equipment labelled **T** can be increased.*

Word list

Alternating current. Electricity in which electrons flow in two directions.

Conductors. Materials that allow electricity to pass through them.

Direct current. Electricity that flows in only one direction.

Dynamo. A device that converts mechanical energy to electrical energy.

Electricity. Form of energy produced by electrons.

Electric circuit. The complete path of electricity.

Fuse. A device that controls current entering the circuit by melting and breaking the circuit in case of too much current.

Generator. A device that converts mechanical energy to electrical energy.

Insulators. Materials that do not allow electricity to pass through them.

Lodestone. A natural magnet.

Magnetic field. An area around a magnet where magnetism exists.

Magnet. A material with a magnetic field.

Magnetism. The property of a magnet that enables it to pull or push other magnetic materials.

Magnetic materials. Materials that can be attracted by a magnet.

Permanent magnets. Magnets that keep magnetism for long.

Static electricity. An imbalance in the flow of charges.

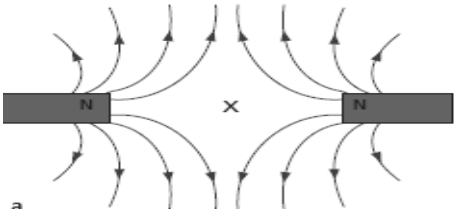
Transformer. A device used to step up or down the power of an alternating current.

Temporary magnets. Magnets that lose magnetism easily.

Revision Exercise 2

1. *How is magnetism different from a magnet?*
2. *State the any one law of magnetism.*
3. *How are magnets important to the following?*

   a) Doctors b) pilots c) teachers
4. *Cite one item that uses both magnets and electricity.*
5. *How are magnets found in radios important?*
6. *Write the term AC in full.*
7. *What is the importance of the hammer found on an electric bell?*
8. *State one way of making magnets.*
9. *In which one way can a P.7 child make a magnet lose its magnetism?*
10. *Briefly explain how strong heating a magnet can make it lose its magnetism?*
11. *State any one advantage of secondary cells over primary cells.*
12. *Name the non-metallic conductor found in a dry cell.*
13. *Why is distilled water not a good conductor of electricity?*
14. *How is the function of a fuse different from that of a switch?*
15. *How can the strength of an electromagnet be increased?*
16. *Describe how an electric bell works.*
17. *Why is a magnet used to separate pierces of iron from beans?*
18. *How are magnets useful in hospitals?*
19. *Which property of magnets is shown in the diagram below?*



Topic 3: Energy resources in the environment

Energy is needed to heat buildings, to make cars move, to provide artificial light, to make computers work, and so on. The list is endless. This 'useful' energy needs to be produced in controllable energy transfers. For example, in power stations a supply of useful energy in the form of electricity is produced. The 'raw materials' for energy production are **energy sources**. These may be **non-renewable** or **renewable**. The sun is the source for all our energy resources.

Resource

A resource is anything that people use to satisfy their needs.

Energy resource

An energy resource is anything that provides people with useful energy.

Types of energy resources

- Renewable energy resources. – Things that can be replaced naturally when used up.

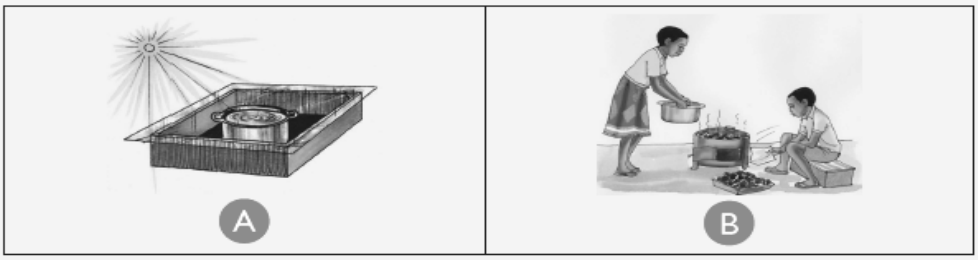
Examples: Plants, animals, water, wind and sun

- Non-renewable resources. - Things that cannot be replaced when used up.

Examples: Minerals like uranium and plutonium, fossil fuels like petrol, natural gas and coal.

Case Study

1. Look at the sources of energy below.



2. Which source of energy can get finished? What happens when it gets finished?
3. Given a choice between the two, which one would you prefer for cooking? Why?
4. Write short notes about the advantages and disadvantages of the two sources of energy.

The sun as major source of energy in the environment

The sun is the main source of energy on earth.

- Heat from the sun helps in rain formation.
- Heat from the sun helps to preserve our food by sun drying.
- Sunlight energy helps the human skin to make vitamin D.
- Sunlight energy helps us to see.
- Sunlight energy is used to make solar electricity.
- Sunlight energy enables plants to make food.
- Heat from the sun helps to dry our clothes.

Solar energy is harvested using the following equipment;

Solar energy

- Solar energy is the energy obtained from the sun.
- Solar energy is obtained majorly by solar panels which are made up of silicon and cardium.
- **Solar cooker**
  A solar cooker uses a concave reflector (parabolic mirror) that reflects light at one single point.

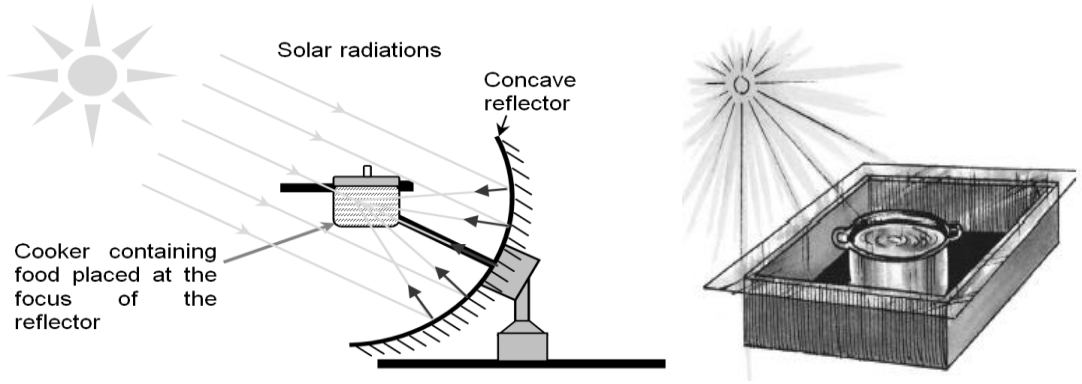
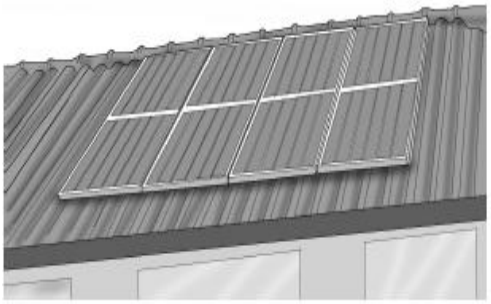
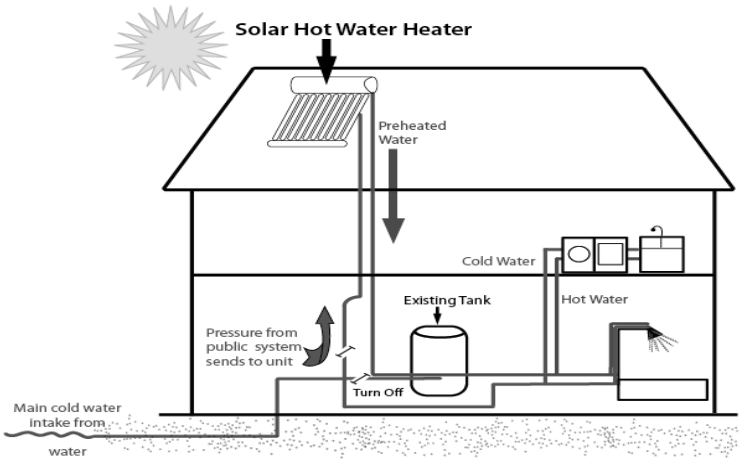


Fig: Solar Cookers.

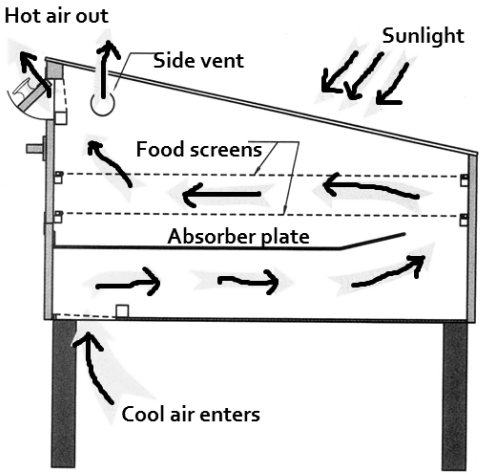
- **Solar panel**
  A solar panel converts sunlight energy to direct current electricity, this can then be converted to alternating current using an inverter.



- **Solar water heaters**
  A solar heater is used for warming water at home and in swimming pools.



- **Solar dryer**
  This kind of dryer uses sunlight energy to dry harvested crops, it is painted inside with black in order to absorb more heat energy.



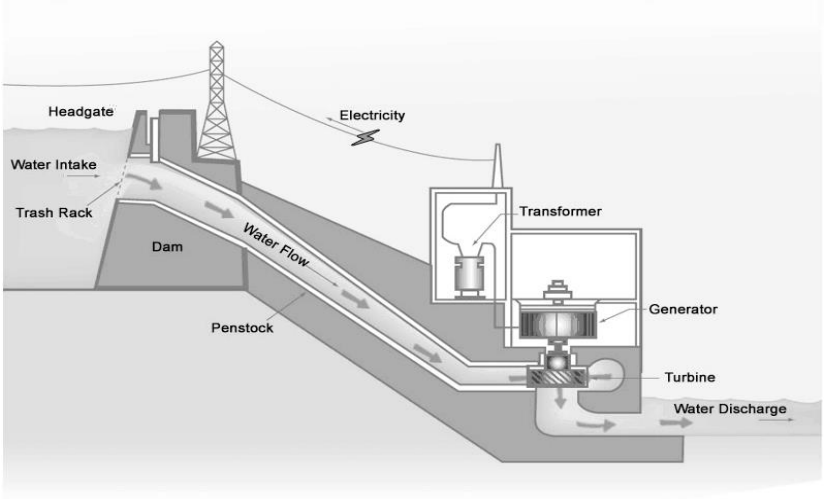
Solar energy is plentiful and clean (does not produce smoke). However, two of the biggest challenges with using solar energy to make electricity are:
1. a backup energy source must be used on cloudy days.
2. solar energy is very spread out, so it must be collected from a huge area to be a significant source of energy.

Water as an Energy resource

Water can be used to drive turbines directly. There are several ways that water can be used, including waves, tides, steam and falling water in hydroelectric power schemes.

- **Hydro-electricity**
  Hydroelectric power (HEP) stations use the kinetic energy in moving water. Often, the water comes from behind a dam built across a river valley. The water high up behind the dam contains gravitational potential energy. This is transferred to kinetic energy as the water rushes down through tubes inside the dam. The moving water drives electrical generators, which may be built inside the dam.

  Hydro electricity is the form of electricity produced by the power of flowing water at a fall.



Advantages

- Water power in its various forms is a renewable energy resource and there are no fuel costs.
- No harmful polluting gases are produced.
- Hydroelectric power stations are very reliable and can be easily switched on.

Disadvantages

- Hydroelectricity dams destroy the habitats for aquatic life (animal and plant species).
- Hydroelectricity dams flood farmland and push people from their homes.
- Hydroelectricity dams interfere with water transport.

- **Steam**

  Steam with Kinetic energy helps to power **steam engines.**

- **Tidal energy**

  This is the form of energy got from **water tides** on the sea shores.

  Tides are periodic rises and falls of large bodies of water.

  The tides are caused by gravitational interaction between the earth and the moon. Huge amounts of water move in and out of river mouths each day because of the tides. A tidal barrage is a barrier built over a river estuary to make use of the kinetic energy in the moving water. The barrage contains electricity generators, which are driven by the water rushing through tubes in the barrage.

- **Geothermal energy**
  Hot water and steam from deep underground can be used to drive turbines: this is called geothermal energy. It is got from hot springs/ thermal springs where steam is trapped.

How hot springs develop

Several types of rock contain radioactive substances such as uranium. Radioactive decay of these substances releases heat energy, which warms up the rocks. In volcanic areas, the rocks may heat water so that it rises to the surface naturally as hot water and steam. Here the steam can be used to drive turbines and electricity generators.

Advantages

- Geothermal energy is a renewable energy resource and there are no fuel costs.
- No harmful polluting gases are produced.

Disadvantages

- Most parts of the world do not have suitable areas where geothermal energy can be exploited.

Fossil fuels

These include coal, crude oil (petroleum) and natural gas, formed from the remains of plants and animals which lived millions of years ago and obtained energy originally from the Sun. At present they are our main energy source.
Burning fossil fuels in power stations and in cars pollutes the atmosphere with harmful gases such as carbon dioxide and sulfur dioxide. Carbon dioxide emission increases the greenhouse effect and global warming.

Petroleum/crude oil

It is an energy resource from the ground formed from animals that died many years ago, the changes in the earth created a lot of heat and pressure on them hence turning into petroleum.

Examples of petroleum

Petrol, petrol gas, diesel, oil, jet fuel, paraffin.
These fuels are got from crude oil by the process called fractional distillation.

Importance of petroleum products

- Used to generate thermal energy that can run machines and vehicles.
- They are burnt to produce light and heat.

Coal

This is a hard-black material found below the ground. It is a solid fossil fuel formed from the remains of plants.

Importance of coal

- Used as fuel in steam engines.
- Coal is burnt to produce thermal electricity
- It is used to make tar for surfacing roads.

Other products from petroleum

Plastics, polythene paper, tar, dye, detergents, Vaseline, mattresses, grease, paint, fertilizers, paints.

Natural gas. This fuel is formed between hard rocks on top of petroleum.

Uranium

- It is used to make atomic bombs.
- It is used as fuel in nuclear powered sub marines.
- Uranium is burnt to produce atomic (nuclear) electricity.

Nuclear power

The main nuclear fuels are uranium and plutonium. In a nuclear power station, nuclear fuel undergoes a controlled chain reaction in the reactor to produce heat. Heat is used to change water into steam in the boiler the steam drives the turbine (heat to kinetic energy) this drives the generator to produce electricity - kinetic to electrical energy

Advantages

- Unlike fossil fuels, nuclear fuels do not produce carbon dioxide or sulfur dioxide.
- Nuclear fuel produces more energy than coal.

Disadvantages

- Like fossil fuels, nuclear fuels are non-renewable energy resources.
- Although modern reactor designs are extremely safe, if there is an accident, large amounts of radioactive material could be released into the environment.
- Nuclear waste remains radioactive and is hazardous (harmful) to health for thousands of years, so it must be stored safely.
- It is difficult to store radioactive waste from nuclear plants.

Plants as energy resources

- They are source of food.
- They are source of wood fuel.
- Plants provide bio fuels.

Wood fuel

Fuel. A fuel is anything that can be burnt to produce heat and light.

Forms of wood fuel

- Charcoal, obtained after burning wood under limited supply of oxygen.
- Firewood
- Saw dust
- Wood shavings
- Maize cobs
- Briquettes

Uses of wood fuel

- Wood is used for cooking.
- Wood is used for firing bricks.
- Wood is used for burning ceramics.
- Wood is used in brooders to warm chicks.
- Wood is burnt to supply heat for warming houses in cold weather.

Biomass (vegetable fuels)

Biomass refers to organic matter used as fuel. These include cultivated crops (e.g. sorghum, corn, sugarcane, bamboo, oil palm and wheat), crop residues (e.g. cereal straw), natural vegetation (e.g. gorse), trees (e.g. spruce and eucalyptus) grown for their wood, animal dung and sewage. **Biofuels** such as alcohol (ethanol) and methane gas are obtained from them by fermentation using enzymes or by decomposition by bacterial action in the absence of air.

How to conserve plant resources

- Through afforestation and re-afforestation.
- Use fuel saving stoves.
- Use other alternative sources of fuel like biogas.
- By covering food when cooking it.
- Educate people about the advantages of plants in the environment.

Conservation means the protection of resources in the environment.

How to conserve non-renewable energy resources

- By using other alternative energy means e.g. wood fuel, wind power etc.
- By use of bicycles instead of cars that use fossil fuels.

Wind as energy resources

Wind is moving air or wind is air in motion.

Wind is caused by change in atmospheric pressure.

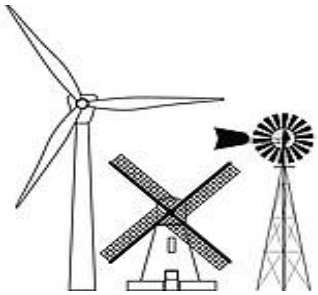
Uses of wind as an energy resource

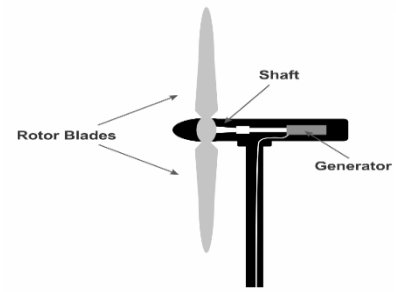
- Used for winnowing.
- Used to turn wind mills to produce electricity.
- Wind is also used to draw water from underground using wind mills.
- Used to sail boats.
- Helps to disperse seeds.
- Used in pollination.
- Used to fly kites.
- Speed up evaporation and hence increases the speed to dry things.

How wind energy is harvested

It can be harvested by using wind mills. The figure below shows some common wind mills used for generation of wind power.

Wind mills in a wind farm produce too much noise. A ***wind farm*** is an area with many wind mills used for producing electricity.





Animals as energy resources

- Animals like oxen are used to plough land.
- Some animals like the donkeys are used for transport.
- Some animals are used as source of food.
- Some animals like oxen and ass are used to pull carts.
- Animals provide wastes for making biogas.

Biogas production

What is biogas?

This is methane that is produced from the rotting organic matter.
The gas is called biogas because it is produced using materials from living things. These can be dead organisms, dead parts or wastes, materials such as cow dung, plant materials and animal urine. Other than disposing of such materials, we can use them profitably to obtain biogas. These materials are put together in a buried, sealed, air-tight container called a ***biogas digester***. They are left to decompose or

ferment with the help of the bacteria upon which biogas is produced. This gas can be used for cooking, lighting or heating. When the gas formation stops, the remains in the digester are called sludge and can be used as manure in the garden.

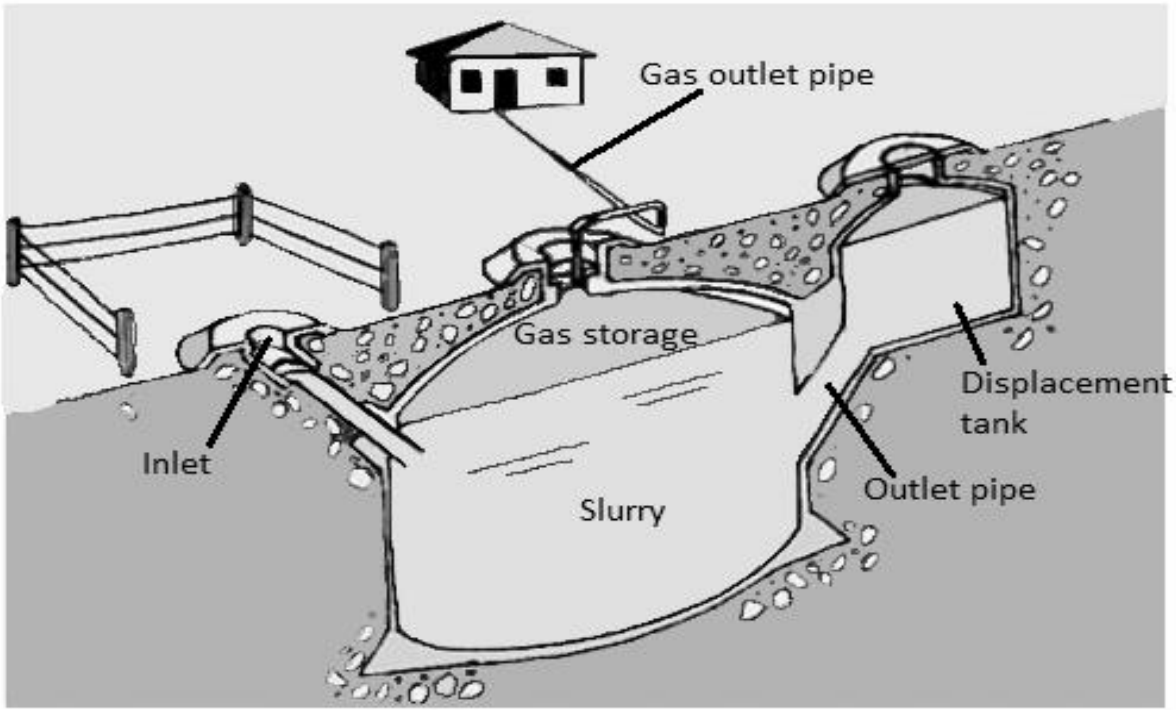
Wastes used to produce biogas

- Cow dung
- Plant materials
- Animal urine

Steps of making biogas digester

The above materials are put into an air-tight container called a **biogas digester,** where they are worked on by anaerobic bacteria to ferment and biogas is formed. When the gas formation stops, the remains can be used as manure.

Structure of Biogas digester



Uses of the parts

- **Inlet pipe** is for putting the plant residues and animal wastes into the digester.
- **Emptying tank** is where the used-up matter is collected and removed then taken to the gardens as manure.
- **Digester** is where decomposition or fermentation by the help of bacteria takes place. Water is added into the digester to speed up the rate of decomposition.
- **Gas outlet** traps the biogas and directs it to where it is needed for use.

Uses of biogas

- For cooking.
- For lighting.
- For heating.

Advantages of biogas

- Biogas burns very cleanly and produces fewer pollutants during cooking than any other fuel except electricity.
- Biogas provides heat immediately whenever it is lit no waiting time is required.
- Most biogas burners can regulate the rate at which the gas burns and the amount of heat that is produced.
- The use of biogas prevents deforestation.
- The by-product (slurry) from the digester can be used as fertilizer.
- Biogas is a renewable fuel.

Disadvantages of biogas

- High costs of constructing the digester, tubes, gas stove, and pots.
- Biogas can increase the workload of people as it is often made their task to run the digester. It is quite a physical burden to move all the biomass feedstock and water to feed the digester, also the slurry must be removed and taken to the field.
- It is not viable for elderly or sick people to run a biogas plant on their own, if they don't have labour to assist them in the maintenance of the digester.
- Installations (depending on material and location) must be protected against theft and damages. Especially metal tubes are a valuable good and often prone to theft.
- Cultural rules might not accept the handling of dung or faeces and their use as fuel for cooking.
- Biogas is difficult to store and to transport to other consumers.

Activity

1. *Name any two animal wastes and two plant residues used in production of biogas.*
2. *State any two uses of biogas.*
3. *Give any two ways in which the use of biogas for cooking is better than using firewood.*
4. *State any one advantage of using biogas.*
5. *State any one disadvantage of using biogas.*
6. *How does covering food when cooking help to conserve wood fuel?*

Energy changes

Energy is continually being transferred from one form to another. Some forms, such as electrical and chemical energy, are more easily transferred than others.

Examples of energy changes/transfers

Device	Energy change
Light bulb	Electrical to heat and light energy.
Steam engine	Heat energy to kinetic energy.
Water heater	Electrical energy to heat energy.
Electric motor	Electrical energy to kinetic energy(mechanical).
Dynamo	Kinetic energy(mechanical) to electrical energy.
Electric generator	Kinetic energy to electrical energy.
Dry cell/battery	Chemical to electrical energy.
Friction	Kinetic energy to heat energy.
Microphone	Sound to electrical energy

Summary of the energy resources

The table below shows the different sources of energy and their uses in the environment

Energy resources	Importance (uses)
Solar energy (Heat and light from the sun)	• People use heat from the sun to dry harvested crops and preserve other food by sun drying. • Heat from the sun helps in rain formation by causing evaporation of water bodies and transpiration in plants. • Solar energy is converted into solar electricity. This is done using solar panels or solar cells. Solar lamps, solar radios, solar cookers, and solar heaters and solar water pumps use solar electricity.
Wind energy	• Wind is used in winnowing. This is separating husks (chaff) from seeds or grains. • Wind energy helps in sailing dhows and small boats on water bodies. • Wind energy is used for turning or driving windmills to produce electricity. Electricity produced by windmills can be used to pump water from underground and also for powering grinding mills

Energy resources from water

a) For producing hydroelectricity

Hydroelectricity is produced using kinetic energy from fast flowing water. Power dams are built with big wheel-like structures called turbines. These turbines are connected to generators. When water at the dam flows across the turbines, the turbines rotate causing the generators to start so that the kinetic energy from the water is changed to electric energy.

b) For producing steam to run steam engines

Steam is vapour from boiling water. Steam has the ability to move things since it possesses kinetic energy. Steam energy is used to power machines like steamboats, steam trains and steamships.

c) Water tides are used for producing tidal energy

A tide is a regular rise and fall in the level of water at the sea or ocean. It is caused by gravitational attraction between the moon and the sun.

Turbines are built in places where water tides occur and they are connected to generators for producing electricity.

Energy resources from fossil fuels

- A fuel is anything that can be burnt to produce heat or light energy. Fossils are remains of animals and plants which died millions of years ago.
- Petroleum (crude oil), coal and natural gas are fossil fuels because they are formed from the remains of plants and animals which died long ago.
- Petroleum is separated into different products like petrol, diesel, paraffin which are burnt to produce energy for running different machines.
- Coal and natural gas are also burnt to produce heat energy which is used for cooking, boiling water, etc.

Energy resources from plants

- Plants provide us with food in form of fruits, leaves, root tubers and stem tubers.
- Plants provide wood fuel. Firewood, charcoal, wood shavings and sawdust are examples of wood fuel which when burnt produce heat energy for cooking food, boiling water, and warming ourselves, etc.

- Plants are a source of biofuel. This is fuel made directly from living matter. Bio diesel and bio ethanol are examples of bio fuels.
- Plant residues like banana peelings, cassava peelings and potato peelings are used to produce biogas.

Energy resources from animals

- Some animals are used as means of transport, e.g. donkey, camel, horse and oxen.
- Animals also provide us with food e.g. milk, meat, eggs from birds, honey from bees.
- Animals like oxen are used for ploughing.
- Animal dung, urine and droppings are used to produce biogas.

Project work:
Making your own biogas

- Put some cow dung, leaves and other plant and animal materials into a jerry can.
- Pour water into the jerry can to make the jerry can half full.
- Stir the mixture.
- Close the jerry can tightly.
- Leave the mixture for 7-10 days.

You will observe that the jerry can "swells" (becomes bigger). This is because the biogas that is produced accumulates in the jerry can.

Word list

Resource: Anything used for a certain purpose.

Energy: The ability to do work.

Energy resource. A resource that provides useful energy to people.

Fossils. Remains of plants and animals that lived long time ago.

Solar energy. The energy obtained from the sun.

Fuel. Anything that can be burnt to produce heat and light.

Fossil fuel. Fuels obtained from once lived organisms.

Nuclear power. The energy obtained after burning uranium and plutonium.

Wind power. The energy obtained from wind.

Biogas. Methane gas produced by the decomposing matter in a digester.

Tides: The rise and fall of water at sea level caused by gravitational forces of the moon, the sun and rotation of the earth.

Thermal energy. The energy produced from burning fossil fuels.

Biofuels. Fuels obtained from vegetable oils.

Biomass. The total amount of living matter in an environment.

Tidal energy. The electricity obtained from tides.

Geothermal energy. The electricity obtained from hot springs.

Hydroelectricity. The energy obtained from the kinetic energy of flowing water.

Kinetic energy. The type of energy possessed by bodies in motion.

Conservation. The protection of resources in the environment.

Revision exercise 3

1. *In which one way do plants depend on?*

   a) Cattle b) human beings c) goats

2. *Mention any one advantage of using biogas over using firewood.*
3. *How is a biogas digester important in the production of biogas?*
4. *Cite any one thing used in the making of biogas.*
5. *Write down any three ways how animals depend on non-living things in the environment.*
6. *In what way can a farmer use the residue left after making bio gas.*
7. *State any two uses of biogas to human beings.*
8. *Why is wind said to be a form of energy?*
9. *How does use of biogas contribute towards the control of environmental degradation?*
10. *What danger caused when biogas containers are kept near the reach of young children?*
11. *What is energy?*
12. *What are energy resources?*
13. *How can the sun be used as an energy resource?*
14. *What form of electricity is obtained from wind?*
15. *What causes wind?*
16. *How does an energy saving stove help to conserve wood fuel?*
17. *How is the use of biogas friendly to the environment?*
18. *Why are solar panels painted with black?*
19. *Why is a wind mill placed in an area without plants and buildings?*
20. *Why is the inside of a solar drier painted with black?*

Topic 4: Simple Machines and Friction

Friction

Friction is a force that opposes movement of two surfaces that are in contact. The two surfaces should be touching each other.

When you try to move two pieces of wood over each other, you will feel that it is difficult. That difficulty is because of a force. That force is called friction. The **nature of the surface** and **weight of an object** are factors affecting friction.

Activity:

Carry out the following activity and discuss the results observed.

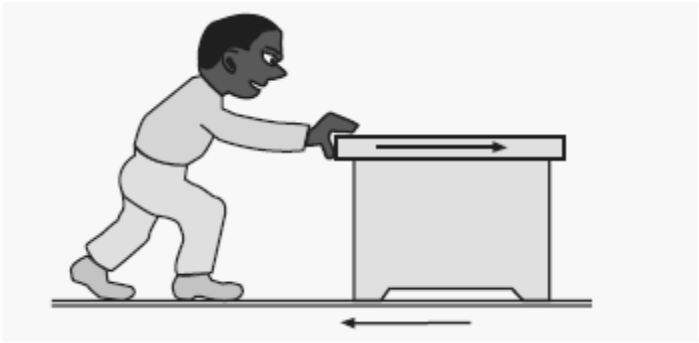


Fig: Pushing a box.

1. Push a heavy object (such as the teacher's desk) gradually till it moves at a steady speed.
2. Carefully describe what you felt.
3. Try to define friction force in your own words.
4. Discuss friction and find out if it is good or bad giving typical examples.
5. Plan how you would reduce friction between the desk and the floor.

Types of frictional force

1. **Static frictional force**: This is a frictional force between two stationary surfaces just starting to move relative to each other.
2. **Dynamic/kinetic frictional force**: This is a frictional force between two surfaces moving relative to each other.

Advantages/application of friction (Friction as a useful force)

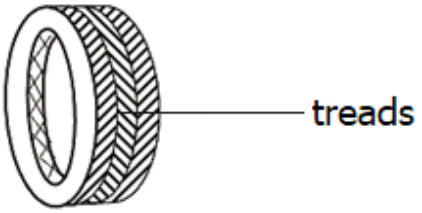
- Friction helps in writing.
- Friction helps in stopping moving cars when the brakes are applied.
- Friction helps in sharpening tools.
- Friction helps in climbing trees and when moving uphill.
- Friction helps in striking matchsticks on a matchbox.

Disadvantages of friction (Friction as nuisance)

- Friction causes wear of car tyres and shoe soles.
- Friction produces unnecessary heat and noise (sound)
- Friction retards (delays) work done using machines as it makes people use a lot of force.
- Friction reduces the efficiency of machines**.**

Ways of increasing friction

- Putting treads on car tyres and shoe soles. Treads increase grip between the tyres and the road surface.

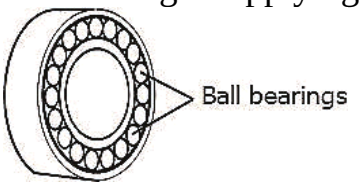


- Friction can also be increased by tarmacking or placing murram on slippery roads.
- Putting spikes on play boots. Spikes increase grip between shoe soles and the ground.

- Making bicycle handles with grips. This increases friction so as to prevent the rider's hands from sliding off.

Ways of reducing (decreasing) friction

- Using ball bearings. They reduce friction by keeping moving parts separate.
- Lubricating. Applying oil or grease in moving parts of machines.



- Using rollers and wheels. They decrease areas of contact between moving parts.
- Streamlining the shape of objects like aeroplanes, cars and boats. The body of fish and birds are naturally streamlined in order to overcome viscosity friction.

Activity

1. *Define the term friction.*
2. *State three ways friction is applied in our daily life.*
3. *Give two ways in which friction is a nuisance.*
4. *State a reason why car tyres are made with threads.*
5. *In one way explain how friction can be increased on a slippery surface.*
6. *Why are some objects streamlined?*
7. *State any two items that are streamlined?*

The moment of a force

When you try to close a door at a point very close to the hinge, you notice that you need to press very hard. This means you need to use a lot of force. However, if you try to close by pressing at a point far from the hinges, you apply just a small amount of force. The force causes the door to turn and close. This turning effect of a force is called the **moment of the force**. The moment of a force is the product of the force and the distance from the turning point.

For the force above, the moment can be calculated as

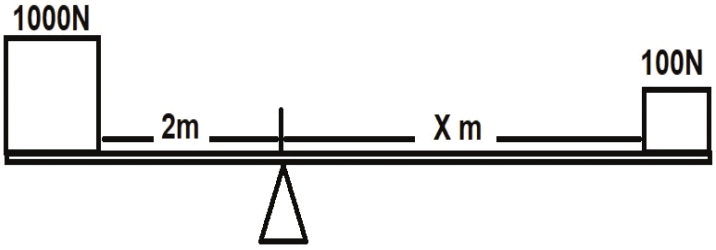
Moment = force x distance

Moment = 100 x 5

Moment = 500 Nm

The principle of moments

The principle of moments states that when a body is in equilibrium, the sum of clockwise moments is equal to the sum of the anticlockwise moments.



The 1000 N force is an anticlockwise force
The 100N force is a clockwise force
From the principle, the sum of the clockwise moments is equal to the sum of the anticlockwise moments.

Load X Load arm = Effort X Effort arm

L X LA = E X EA

1000 x 2 = 100 x

2000 = 100X

X = 20m

Simple machines

Activity 1:

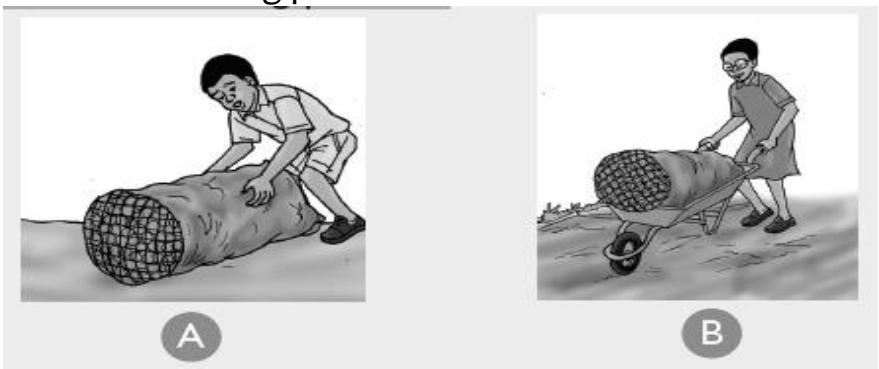
Study the picture below.

Look at the picture showing people working in a construction site.

1. Is it easier to move materials as shown in the picture?
2. Suggest what you can use to move the materials shown in the picture faster.

Activity 2: Carrying heavy weight

Look at the following pictures.



Who of the above pupils one above finds it easier to carry the load? Explain why?

From the above picture find out;

1. What a simple machine is.
2. The difference between working with and without a simple machine.

A **simple machine** is a device that makes work easier. Machines simplify work. In science, work is said to be done when a force is moved through a distance. Therefore, work has two components; a force being moved and a distance through which the force is moved.

Simple machines make work easier by;

- Reducing the effort used to overcome the load.
- Moving the load over a longer distance when the effort moves through a short distance.
- Changing the direction in which the effort is applied.

Examples of simple machines

Hand axes, wheelbarrows, fishing rods, screwdrivers, car jacks and bottle openers are examples of simple machines

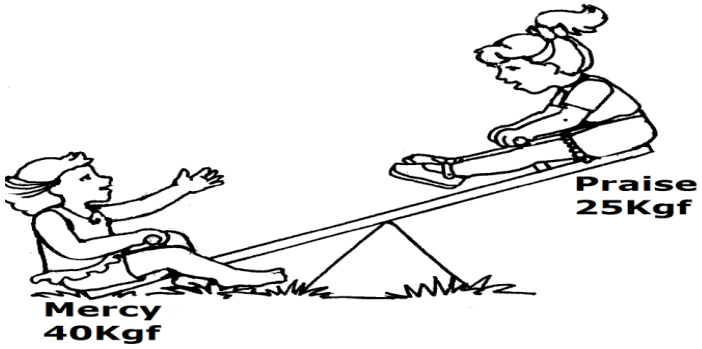
Types/classes of simple machines

- Levers
- Inclined planes/slopes
- Pulleys
- Screws
- Wheel and axle
- Wedges

Activity

1. *What is a simple machine?*
2. *List any two ways in which machines make work easier.*
3. *Apart from levers and inclined planes, mention any two other classes of simple machines.*
4. *Why is a hoe called a simple machine?*

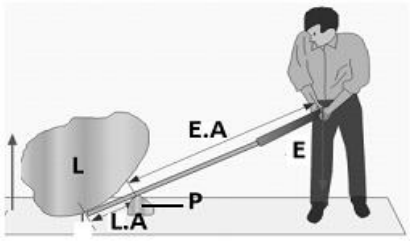
   Use the diagram below to answer question 5.



5. *What must Mercy do in order to balance with Praise on the see saw?*
6. *Which type of simple machine is a see saw?*

7. Give any two examples of simple machines.
8. Name any one force that should be overcome when using a see saw.
9. Give any one way in which machines are useful to people.

Levers



How levers work

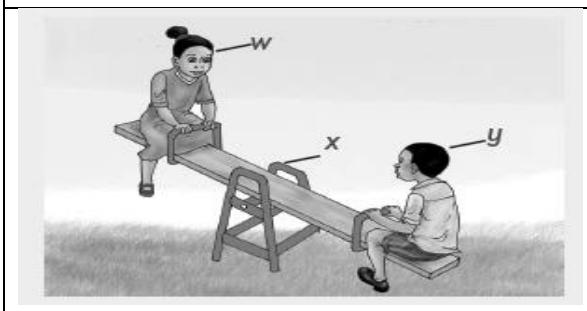
A lever is a rigid (stiff) rod or bar that turns at a fixed point called ***pivot*** or ***fulcrum***. There are three main parts of a lever; the load, effort and pivot (fulcrum).

- **Load** is the object being overcome (moved) by the machine.
- **Effort** is the force applied on a machine to overcome the load.
- **Pivot** (***fulcrum***) is the fixed point at which a machine turns or rotates.

Other parts

- **Load arm** is the distance between the fulcrum and the load.
- **Effort arm** is the distance between the fulcrum and the effort.

Activity: How levers work



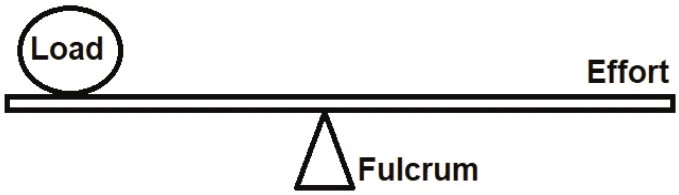
1. Why does the girl (W) go up on the above seesaw?
2. What will happen to the seesaw when the boy (Y) moves closer to part X?
3. In which class of levers do you think the seesaw belongs?

Classes of levers

Levers are classified according to the position of the load, the effort and the pivot (fulcrum) on a machine

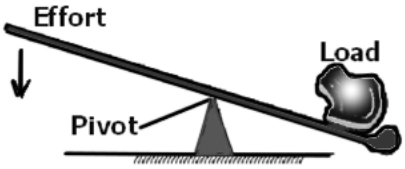
First Class Levers

These are levers in which the **pivot** (fulcrum) is between the **load** and the **effort**.

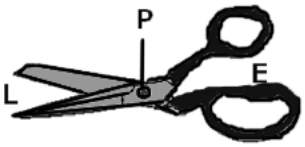


Note: When the effort arm is longer than the load arm, less effort is used to overcome the load. However, when the effort arm is shorter than the load arm, more effort will be needed to overcome the load but the load is moved through a longer distance.

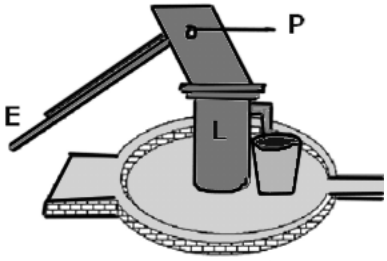
Examples of first-class levers



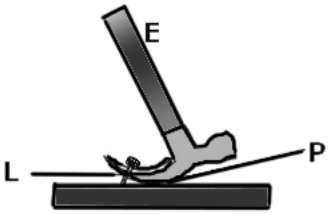
Crowbar



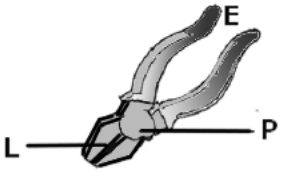
Pair of scissors



Borehole



Claw hammer

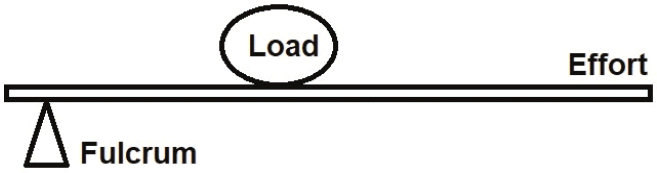


Pair of pliers

Other examples of first-class levers are ***pincers*** and ***seesaws***.

Second Class Levers

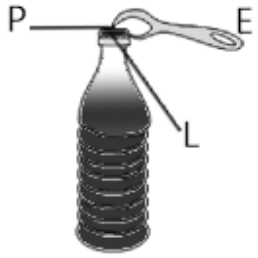
These are levers in which the ***load*** is between the ***effort*** and the ***pivot*** (fulcrum).

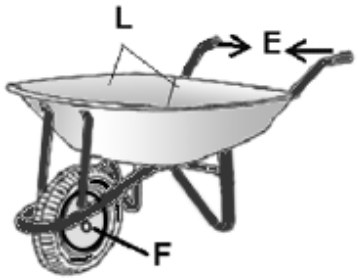


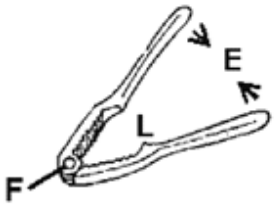
When using a second-class lever, the effort is applied at a distance farther from the pivot than the load. First and second-class levers are referred to as force multipliers because less effort is applied to overcome a bigger load.

Examples of second-class levers

Bottle opener, wheel barrow, nut crackers







When using a second-class lever, the effort is applied at a distance farther from the pivot than the load. First and second-class levers are referred to as ***force multipliers*** because less effort is applied to overcome a bigger load.

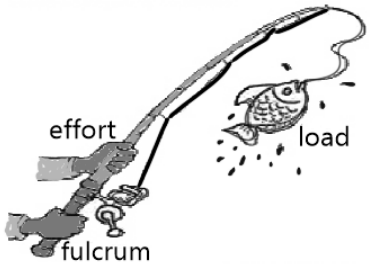
Third Class Levers

A third-class lever machine is the one in which the *effort* is between the *fulcrum* and the *load*.

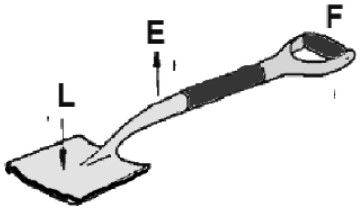
For the third-class levers, the distance moved by the load is greater than the distance moved by the effort. The advantage of using third class levers is that they are ***distance multipliers***.

Examples of third-class levers

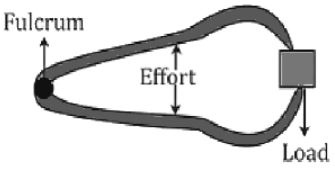
Fishing rod, spade, pair of tongs, tweezers, human arm



Fishing rod



Spade

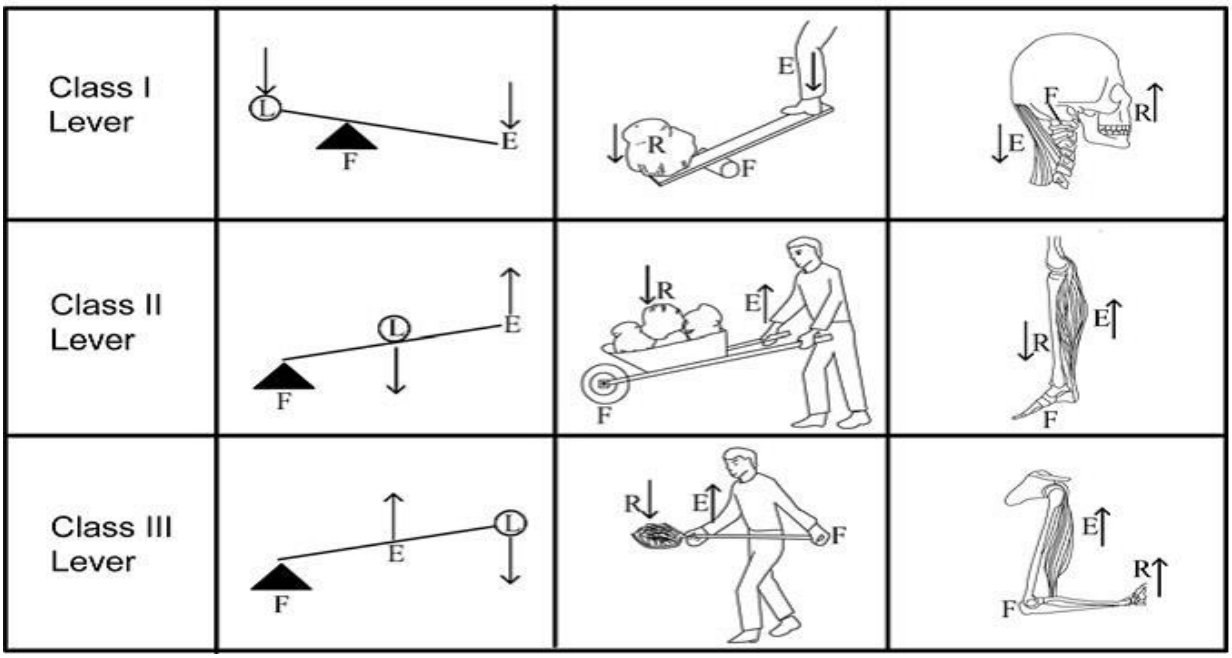


Pair of tongs

Uses of levers in daily life

- Pair of sugar tongs is used to hold glowing charcoal.
- Pair of scissors is used for cutting papers and clothes.
- Claw hammers are used for driving nails into wooden materials.
- For fishing using fishing rods.
- For opening bottles using bottle openers.

The human body as a machine



F- Pivot, E – Effort, L (R) – Load,

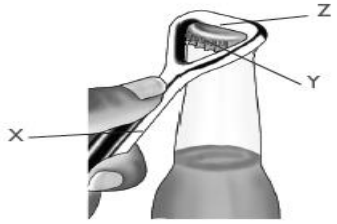
Comparing Classes of Levers

All three classes of levers make work easier, but they do so in different ways.

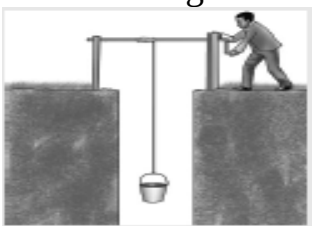
- When the effort and load forces are on opposite sides of the fulcrum, the lever changes the direction of the applied force. This occurs only with first-class levers.
- When both the effort and load are on the same side of the fulcrum, the direction of the applied force does not change. This occurs with both second-class and third-class levers.
- When the effort is applied farther from the fulcrum than the load is, the load is greater than the effort, and the ideal mechanical advantage is greater than 1. This always occurs with second-class levers and may occur with first-class levers as well.
- When the effort is applied closer to the fulcrum than the load is, the load is less than the effort, and the ideal mechanical advantage is less than 1. This always occurs with third-class levers and may occur with first-class levers.
- When the effort and load are the same distance from the fulcrum, the load equals the effort, and the ideal mechanical advantage is 1. This occurs only with some first-class levers.

Activity

1. What is a lever?
2. What determines the class of a machine?
3. To which class of levers does a wheelbarrow belong?
4. What name is given to the turning point of a machine?
5. State the class of levers in which the effort is between the fulcrum and the load.
6. Look at the diagram A below. Can you label the parts named X, Y and Z?
7. In which class of levers does it belong?

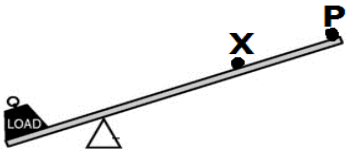


8. In which category of simple machines does the one shown in the diagram below belong?

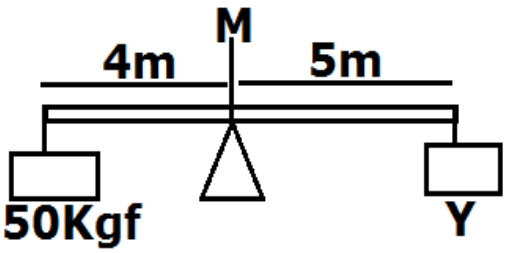


9. Apart from the one below, name any other machine from the same category.

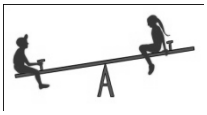
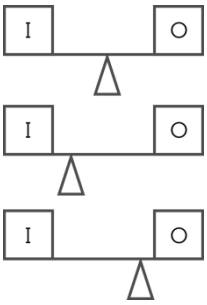
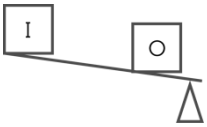
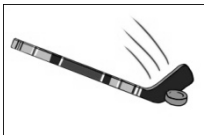
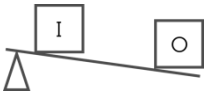
Use the diagram below to answer questions that follow.



10. Use an arrow to show the direction of the effort on the above diagram.
11. At what point X and P will a person hold in order to use less force?
12. Give a reason for your answer in 7 above.
13. In which class of levers is a fishing rod?
14. *Use the diagram below to answer questions that follow.*
    a) Name part marked **M.**
    b) Calculate the weight at **Y** required for the see saw to balance.



Mechanical Advantage of levers

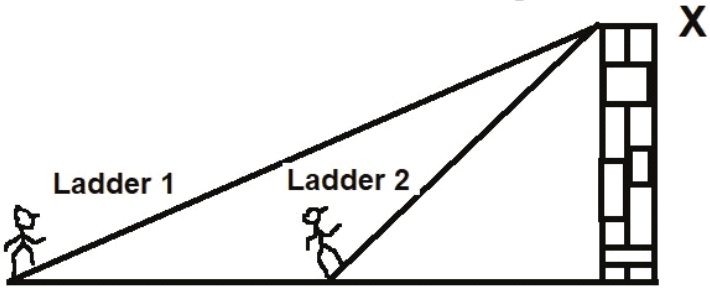
Class of Lever	Example of Lever in This Class	Location of effort, load & fulcrum	Ideal Mechanical Advantage	Change in Direction of Force?
First class	Seesaw 		1 < 1 > 1	yes yes yes
Second class	Wheelbarrow 		> 1	no
Third class	Hockey stick 		< 1	no

- Δ = fulcrum, I = effort, O = load

Inclined planes

Introduction

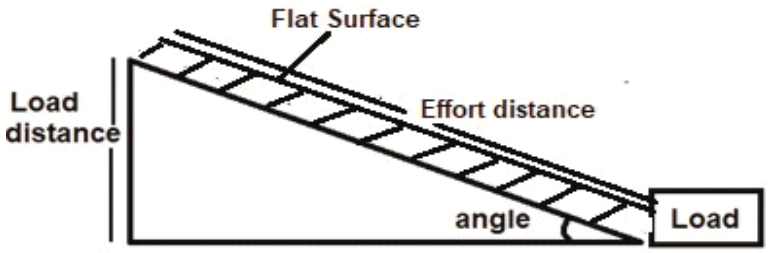
Below are two ladders used to climb a wall to point X.



In case you were given these two ladders, which ladder will make you;

- Walk a longer distance to reach X?
- Feel a lot of pain in your thigh muscles when climbing?

The two ladders represent a type of simple machines called inclined planes.
An ***inclined plane*** is a simple machine made up of a flat surface raised at an angle.

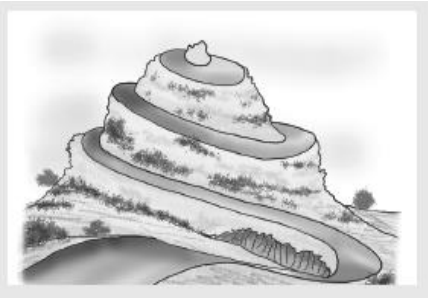


Importance of inclined planes

- They are used for rolling heavy loads to higher levels.
- They are used to load and offload vehicles.
- They help people to climb raised places like storied buildings, hills, etc.

Note: Less effort will be used when the slope is longer and gentler.

Examples of inclined planes



Winding road

Ladder

Ramp

Other examples are stairs and slides.

Mechanical Advantage of an inclined plane

For an inclined plane, less force is put into moving an object up the slope than if the object were lifted straight up, so the mechanical advantage is greater than 1. The more gradual the slope of the inclined plane, the less (effort) input force is needed and the greater the mechanical advantage.

Wedges

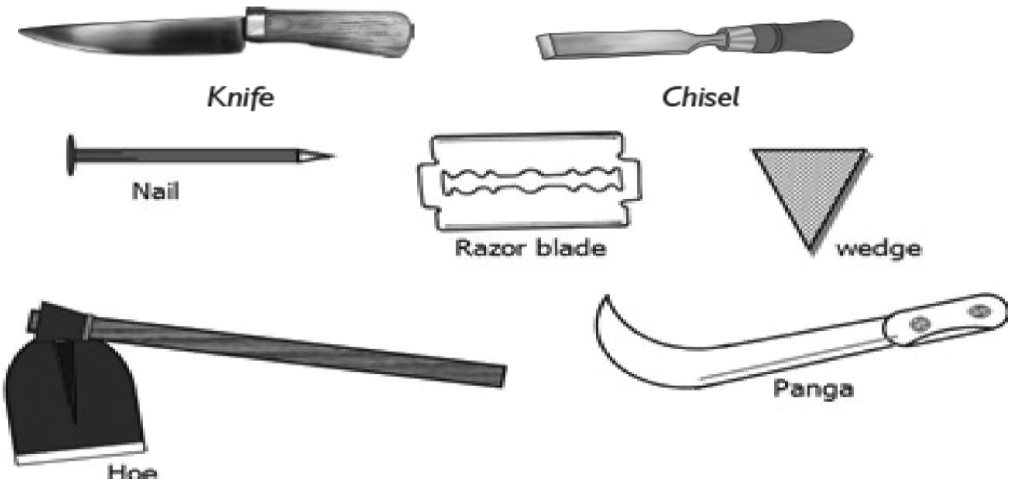
A wedge is a double inclined plane with a sharp edge. Cutting edges of most hand tools are the shape of a wedge. Knives, axes, hoes, nails and rakes, among others, have cutting edges in the shape of a wedge.

Uses of wedges

- They are used for splitting some objects like wood into smaller pieces.

- They are used for cutting some objects into parts.
- Some wedges are used for peeling.
- They are used for piercing and widening holes on objects.

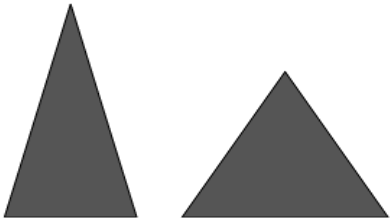
Examples of wedges



Mechanical Advantage of a wedge

A wedge applies more force to the object (load) than the user applies to the wedge (effort) so the mechanical advantage of a wedge is greater than 1. A longer, thinner wedge has a greater mechanical advantage than a shorter, wider wedge. With all wedges, the trade-off is that the (load) output force is applied over a shorter distance, so force may need to be applied to the wedge repeatedly to push it through the object.

Q: Which wedge in the **Figure** below do you think would do the same amount of work with less input force?

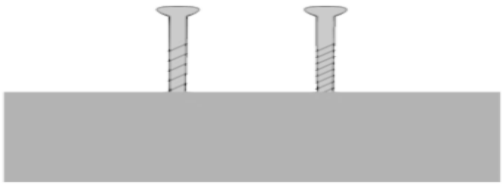


A: The wedge on the left has a greater mechanical advantage, so it would do the same amount of work with less input force.

Screws

A screw is a metal rod with a raised thread running around it.

Look at the two screws in the **Figure** below. In the screw on the right, the threads of the inclined plane are closer together. This screw has a greater mechanical advantage and is easier to turn than the screw on the left, so it takes less force to penetrate the wood with the right screw. The trade-off is that more turns of the screw are needed to do the job because the distance over which the input force must be applied is greater.



Q: Why is it harder to turn a screw with more widely spaced threads?

A: The screw moves farther with each turn when the threads are more widely space, so more force must be applied to turn the screw and cover the greater distance.

Uses of screws

- Lifting very heavy things e.g. screw jack.
- It makes movement upstairs easier e.g. using a spiral staircase.
- Used to fasten things together (hold and join pieces of metals or wood together).

Examples of screws

Screw jack, drill/brace, screw nail, bolts and nuts.

Engineer vice

Screw nail

G- clamp

Motor car jack

Mechanical Advantage of screws

This is the number of times a machine simplifies work. It is the ratio of the load to the effort. The force applied by the screw (load) is always greater than the force

applied to the screw (effort). Therefore, the mechanical advantage of a screw is always greater than 1.

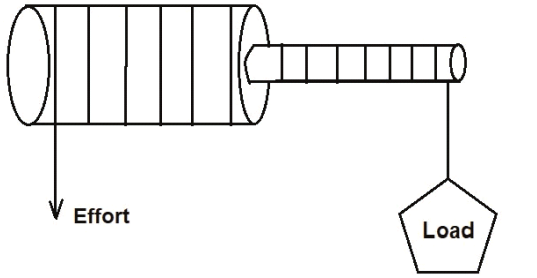
Activity

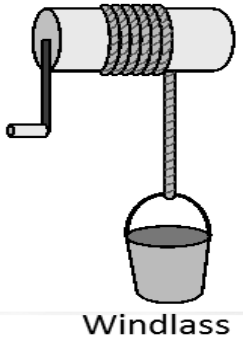
1. How is the above simple machine useful to the woman in the picture?
2. In which type of simple machines can it be classified?

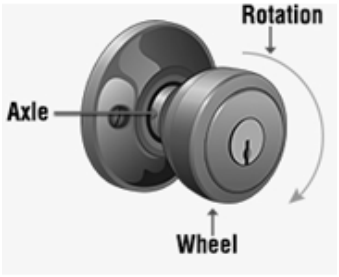
Wheel and Axle

A wheel and axle system consists of two cylinders connected together. The bigger cylinder is the wheel and the smaller one is the axle. The two cylinders are connected by a string. The load and effort are attached to the string. The two cylinders rotate together. Usually, the load is attached to the axle while the effort is attached to the wheel. The **wheel** and **axle** is a simple machine that has two wheels, one large and smaller one fixed together.

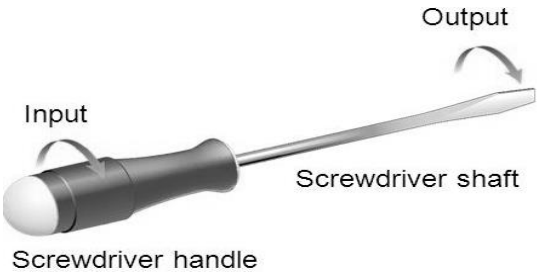
Examples include a door handle (doorknob), a steering wheel, windlass, egg beater and screw driver.

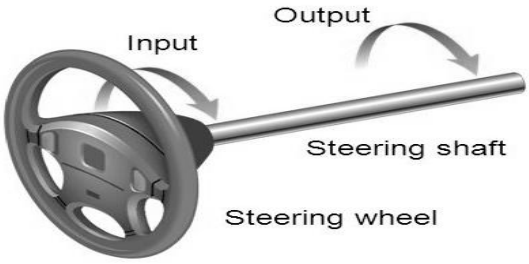






Doorknob





Applications of wheel and axle machines

- They are used for drawing water from underground tanks using a windlass.
- For drilling holes in wooden materials using a brace.

- For fixing and removing screw nails using a screwdriver.
- They are used for preparing eggs for frying using an eggbeater.

Mechanical Advantage of a wheel and axle

A wheel and axle may either increase or decrease the effort, depending on whether the effort is applied to the axle or the wheel.

- When the (effort) input force is applied to the wheel, as it is with a doorknob, the axle turns over a shorter distance but with greater force, so the mechanical advantage is greater than 1. This allows you to turn the doorknob with relatively little effort, while the axle of the doorknob applies enough force to slide the bar into or out of the doorframe.

Pulleys

Introduction

When hoisting the school flag, does one person have to climb up to pull the flag? I guess not. So, what makes it possible that a person standing on the ground pulls the flag upwards?

Up on the flag post is a pulley. This pulley helps to change the direction in which force is applied. In this lesson, you are going to learn about pulleys, what they are and how they work.

What is a pulley?

A pulley is a wheel with a grove along which a string passes. The wheel rotates freely on a fixed axle. The groove prevents the rope or chain from sliding (slipping) off the rim. A frame holds or supports the pulley**.**

Types (Classes) of pulleys

There are three types of pulleys which include;

- Single fixed pulleys
- Single movable pulleys
- Block and tackle pulleys

Single fixed pulleys

A single fixed pulley is a pulley system where the wheel is held in one position. In these pulleys, it is the load and the effort that move.

In other words, this type of pulley doesn't increase the force that is applied to it. However, it does **change the direction of the force**. This allows you to use your weight to pull on one end of the rope and easily raise the load attached to the other end.

Characteristics of single fixed pulleys

- The wheel does not move.

- The effort applied is equal to the load.
- Single fixed pulleys change the direction of force.
- The mechanical advantage (M.A) of a single fixed pulley is one (1).

Note: Mechanical advantage of a machine is the ratio of load to the effort

Illustration of a single fixed pulley

M.A = L/E

M.A = 1

Reason. Work output is equal to work input. (Effort = Load)

Uses of single fixed pulleys

- They are used for hoisting (raising) flags.
- They are used to move window curtains.
- They are used to lift building materials on top of tall buildings.

Single movable pulleys

A single movable pulley is a pulley system where the wheel is attached to the load and moves with the load. The pulley is supported on two ropes and each rope shares a half of the force of the load. The effort needed is half the load. Therefore, the mechanical advantage and velocity ratio of a single movable pulley is two (2)

Illustration of a single movable pulley

$$\text{Mechanical Advantage} = \frac{\text{Load}}{\text{Effort}}$$

$$M.A = \frac{100N}{50N}$$

$$M.A = \underline{\mathbf{2}}$$

$$\text{Effort} = {}^{1}/_{2}\text{Load}$$

Uses of single movable pulleys

- In lifting water from deep wells.
- In carrying heavy materials in construction sites.

- They are used in break down cars.

Block and tackle pulleys

This is the pulley system where **a fixed block** and **a movable block** are joined together to do work. The load is attached to the movable block. The mechanical advantage is determined by the number of pulleys. A block and tackle system reduces the effort needed to overcome the load.

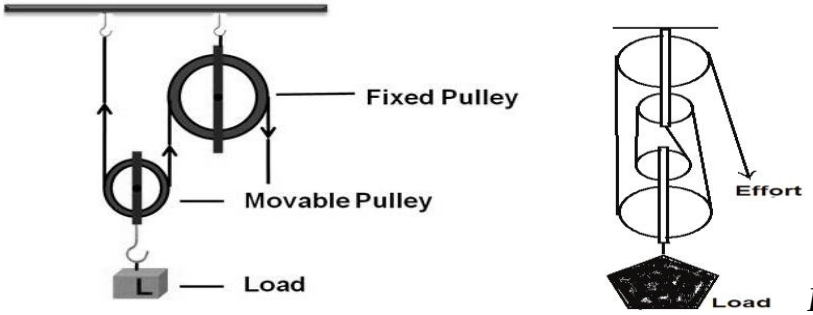


Fig: Block and tackle pulley

Uses (importance) of pulleys

- They are used for hoisting flags on flagpoles.
- Pulleys are used to move window curtains.
- They are used in cranes for lifting heavy loads during building.
- Pulleys are used for towing vehicles with mechanical problems.
- They are used in offloading heavy vehicles.
- Pulleys are used in scaffold to paint high rise buildings.

(a) Movable pulley (b) Single-fixed pulley (c) Block and tackle pulley

Different types of pulleys

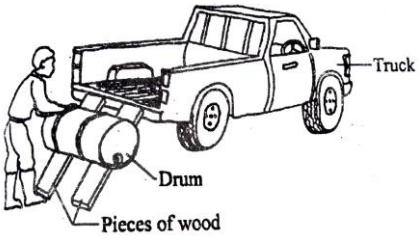
Mechanical Advantage of pulleys

In a pulley, the mechanical advantage is equal to the number of rope segments pulling up on the object. The more rope segments that are helping to do the lifting work, the less force that is needed for the job.

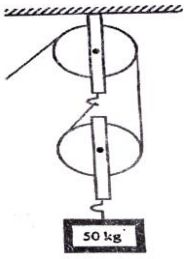
- In the single fixed pulley, only one rope segment pulls up on the load, so the mechanical advantage is **1**. In other words, this type of pulley doesn't reduce the force that is applied to it. However, it does change the direction of the force. This allows you to use your weight to pull on one end of the rope and more easily raise the load attached to the other end.
- In the single movable pulley, two rope segments pull up on the load, so the mechanical advantage is **2**. This type of pulley doesn't change the direction of the force applied to it, but it reduces the force applied.
- In a block and tackle pulley, two or more rope segments pull up on the load, so the mechanical advantage is **2** or greater than **2**. This type of pulley may or may not change the direction of the force applied to it—it depends on the number and arrangement of pulleys—but there is reduction in force applied.

Activity.

1. Which type of pulley is used for raising flags at school?
2. The diagram below shows a man using a simple machine to load a drum.



   a) What type of simple machine is the man using?
   b) How can the man improve on the machine above in order to make his work easier?
3. Why is a wheel of a pulley grooved?
4. How can friction be reduced in the wheel of a pulley?
5. Name any one force overcome when using a pulley.
6. The diagram below is of a pulley system. Use it to answer questions that follow.



   a) Use an arrow to show the direction of force.
   b) Name the type of pulley system shown above.
   c) If the mechanical advantage of the machine is 2 and the load being carried by the machine 50 kg, find the effort needed to raise that load.

Word list

Frictional force. The force that opposes motion.

Simple machine. A device that simplifies work.

Moment. The tendency of a force to rotate an object.

Lever. A stiff rod that turns freely at a fixed point called a pivot.

Pulley. A wheel with a grooved rim.

Screw. A machine with a thread wound around a cylinder.

Inclined planes. A slanting surface.

Load. The work to be done by the machine.

Effort. The work applied in a machine.

Lubrication. Reducing friction by applying grease and oil.

Mechanical advantage. The number of times a machine simplifies work.

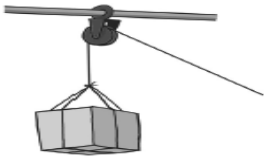
Pivot/fulcrum. The turning point of a machine.

Gravity force. The force that pulls an object towards the centre of the earth.

Wedge. A machine with a sharp pointed end.

Revision Exercise 4

1. What type of pulley is shown in the diagram below?



2. State the function of the pulley above in a school.
3. Apart from being used in a school, state any other use of pulleys to a society.
4. If the pulley above has a mechanical advantage of 1(one), find the effort needed to lift a load of 50N.
5. Use an arrow and letter E to show the direction of the effort.
6. Why is a hoe called a simple machine?
7. In which class of levers is a pair of tongs?
8. Why does oiling help to reduce friction in the moving parts of a machine?
9. Find the force needed to overcome the load of 50kgf using a single movable pulley.
10. In which class of levers does the one in the diagram belong?

11. Use letter P to show the position of the fulcrum on the above diagram.
12. How does the above machine simplify work?
13. Give any one example of a wedge used in the kitchen.
14. State any two uses of wedges to people.
15. Name one form of energy produced by friction.
16. What name is given to the turning point of a machine?
17. Give a reason why it is easier to use an inclined plane than a single fixed pulley.
18. Why is it easier to push a wheel barrow downhill than uphill?
19. Give a reason why the human arm is called a machine.

Topic 5: The excretory system

Introduction

If you exercise on a hot day, you are likely to lose a lot of water in sweat. Then, for the next several hours, you may notice that you do not pass urine as often as normal and that your urine is darker than usual. Do you know why this happens? Your body is low on water and trying to reduce the amount of water lost in urine. The amount of water lost in urine is controlled by the kidneys, the main organs of the excretory system.

These waste materials need to be removed from the body because when they are allowed to stay in our body for long, they can cause damage to the body organs or even poison our blood. The process of removing waste materials from the body is called ***excretion*** and the body system which removes waste materials is called ***excretory system***.

Importance of excretion in humans

- Excretion helps to keep the internal body temperature stable.
- Excretion prevents blood poisoning due to accumulation of wastes.
- Excretion prevents damage of body organs due to accumulation of wastes.

Excretory organs and excretory (wastes) products in the human body

Excretory organ	**Excretory products**
Lungs	Carbon dioxide, water vapour.
Kidneys	Urine (water, salts, nitrogenous wastes like urea and uric acids).
Skin	Sweat (water, salts and lactic acids).
Liver	Bile pigments.

We cannot refer to faeces as an excretory product. This is because it is not produced by the body. Not all the food we eat can be broken down and absorbed by the digestive system. Faeces is the part of the food that could not be digested and absorbed. And also, faeces are not produced in body cells like other wastes.

Summary

- Excretion is the process of removing wastes. It is one of the major ways the body maintains a stable internal environment.
- Organs of excretion make up the excretory system. They include the kidneys, liver, skin, and lungs.

Activity
1. Define the term excretion. *2. State any two importance of excretion to the human body.* *3. Give any one danger that may arise when wastes increase in the body.* *4. Apart from the kidney, name any other two excretory organs.* *5. Name the excretory organ which removes;* *i. urine* *ii. carbon dioxide and water vapour.* *iii. bile pigments.* *iv. sweat*

Human Skin

Introduction

The human skin is the sense organ for feeling. It covers almost all parts of the body except the eyes, toenails and fingernails. The skin is therefore the largest organ of the human body. The human skin removes sweat from your body. This helps your body to cool when the sweat evaporates from the skin surface. Sweat is formed by ***excess water, excess salts, urea*** and ***lactic acid.***

The skin has two layers, the upper layer is called ***epidermis*** and the inner layer is called ***dermis***. These layers are sometimes seen when a wound on your body is healing.

Epidermis

This is the outer most layer of the skin. The epidermis is made up of three layers.

The layers that make up the epidermis

- Cornified layer
- Granular layer
- Malpighian layer

Cornified layer

It is the tough outer most layer with dead cells.

- It prevents bacteria/germ invasion to the skin.
- It provides resistance to damage.
- It reduces excessive loss of water by evaporation.

Granular layer

It contains living cells and produces new cells which die continuously to form the cornified layer.

Malpighian layer

It is made up of young cells.
It contains melanin that determines skin colour and hair colour.
Melanin also protects the skin against strong radiation from the sun.

Note:

- When you lack melanin, you become an albino.
- On the finger nails are cells called keratin that helps to produce toes and finger nails.

Dermis

It is the inner layer of the skin. This layer is thicker than the epidermis

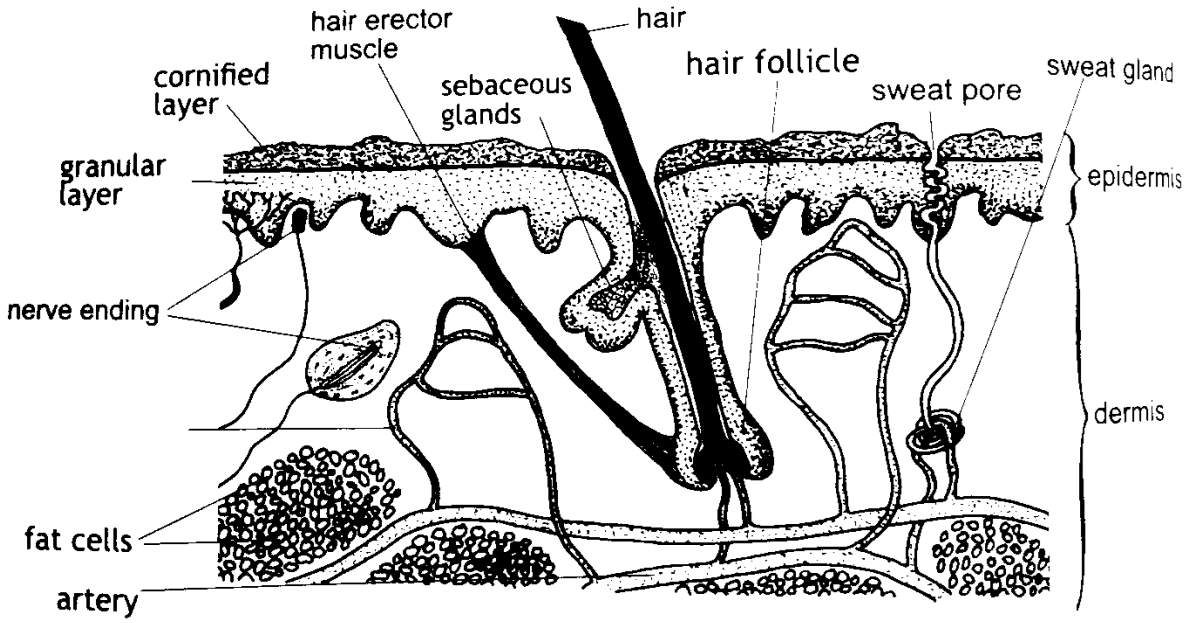
Parts of the dermis

Capillaries, sweat glands, Hair follicle, Sebaceous glands, sweat duct, Pore, erector muscles, Nerves, Subcutaneous fat.

Activity

1. *What is excretion?*
2. *State any one importance of excretion to the body.*
3. *State the excretory function of the skin.*
4. *Apart from excretion, state any other function of the skin.*
5. *Name the outer most layer of the skin.*
6. *Which excretory waste is removed from the body by the skin?*
7. *How is melanin important in the skin?*
8. *Name any two components of sweat.*
9. *How is sweating important to the body?*
10. *Apart from the skin, name two other excretory organs.*
11. *Give any one way sweat moves out of the body.*
12. *Which part of the skin helps in feeling?*

The structure of the human skin



Functions of the parts of the skin

- **Blood vessels** supply digested food and oxygen to the skin and transport waste products to their organs of excretion.
- **Sweat glands** produce, store and secrete sweat.
- **Sweat duct** transports sweat to the skin surface.
- **Sweat pores** let out sweat.
- **Hair follicles** produce body hair. Hair stands upright on cold days to trap escaping heat. This prevents heat loss from the body.
- **Nerves** transmit impulses for heat, touch and enable the skin to detect change in temperature.

Functions of the human skin

- The skin is the sense organ for feeling.
- The skin excretes sweat from the body.
- The skin regulates body temperature. When the body is too warm, sweat is released by the sweat glands and spreads over the skin surface. As the sweat evaporates, it cools the body. Blood vessels in the skin also dilate (widen), when the body is too warm. This allows more blood to flow through the skin, bringing body heat to the surface, where it radiates into the environment. When the body is too cool, sweat glands stop producing sweat, and blood vessels in the skin constrict (narrow), thus conserving body heat.

- It manufactures vitamin **D** by the help of sunlight energy.
- It protects the body against germ invasions and loss of water from the body.
- The skin stores fats which keep the body warm.

Summary

- The skin consists of two layers: the ***epidermis*** which is the outer most layer and the ***dermis***, which contains most of skin's other structures, including blood vessels, nerve endings, hair follicles and glands.
- Skin protects the body from injury, water loss, and microorganisms. It also plays a major role in maintaining a stable body temperature.
- The skin loses sweat by evaporation, radiation and conduction.
- Sweat is made up of water, salts and lactic acids.
- ***Skin cancer*** is a disease in which skin cells grow out of control; mainly caused by excessive exposure to UV light.

Activity

1. *Name the sensory organ for feeling in the human body.*
2. *What is the source of the energy used by the skin to make vitamin D?*
3. *In which way is sweating important to the human body?*
4. *Name the outer most layer of the skin.*
5. *How does the skin regulate body temperature during hot weather?*
6. *How does sweat move out of the body?*
7. *State the importance of hair on the skin.*
8. *State any one habit that may affect the normal working of the skin.*
9. *State the function of the sweat glands in the skin.*
10. *State any one function of fats in the body.*

Diseases and Disorders of the Skin

Some of these diseases are caused by different types of germs such as bacteria, fungi and viruses. Diseases harm our body and every organ of the human has its own diseases.

In this lesson, you are going to learn about different diseases affecting the human skin and the skin disorders.

The table below shows the common diseases affecting the human skin, their causes, ways through which they can be spread among people and the safety measures that we need to take to avoid getting them.

Disease	Cause(s)	How it spreads	Signs and symptoms	Prevention, control and treatment
Athlete's foot	Fungus	• Through sharing shoes or stockings with an infected person. • Wearing dirty stockings for long.	• Peeling of skin between toes. • Wounds between toes.	• Apply anti-fungal powder to absorb the fluid between toes. • Avoid sharing shoes and stockings. • Wash stockings regularly.
Ringworm infections	Fungus	• Through sharing clothes, beddings, sponges and combs with an infected person.	• Round white patches on the skin.	• Avoid sharing clothes, beddings and sponges with an infected person.
Impetigo	Bacteria	• Through body contact with an infected person.	• Red skin sores. • Yellowish brown crust.	• Early treatment of infected people using antibiotics. • Avoid body contact with infected persons.

Chicken pox	Virus	• Through body contact with an infected person. • Through sharing clothes, basins and beddings with an infected person.	•Small blisters on the skin.	• Avoid sharing clothes, basins and beddings with an infected person. • Avoid body contact with infected people.
Scabies	Tiny itch mites called *sarcoptes scabiei.*	• Close physical contact. • Sharing clothes with an infected person.	• Scaly swellings, usually between the fingers, on the wrists and genitals, and in the armpits. • Reddish lumps may appear on the limbs and trunk. • Intense itching, particularly at night. • Bumps under the skin near muscles.	• By not sharing clothes with an infected person. • By maintain proper personal hygiene. • Treatment is with an insecticide lotion.
Leprosy	Bacterium, *mycobacterium leprae*.	• Spread in droplets of nasal mucus.	• Reduced sensation and sweating.	• By early treatment. • Avoid contact with

		• Body contact with an infected person.	• Hands, feet, and facial skin become numb and muscles become paralysed, leading to deformity.	infected people. • Isolating people during treatment.
Scurvy	Lack of vitamin C.	• Lack of vitamin C	• Bleeding gums. • Soft and spongy gums. • Loosening of teeth.	• Feeding on foods rich in vitamin C. • Taking large doses of vitamin C supplement.

Disorders of the human skin

- **Albinism**: Lack of colour in the skin. When a person lacks melanin pigment, he or she becomes an albino.
- **Burns**. Skin injuries caused by dry heat.
- **Scalds**. Skin injuries caused by wet heat.
- **Cuts** and **wounds**. These are caused by sharp objects.
- **Acne.** Condition in which red bumps called pimples form on the skin; due to a bacterial infection.

Ways of caring for the human skin

- Bathing with clean warm water and soap regularly.
- Smearing the skin with Vaseline to keep it soft.
- Doing regular physical exercises.
- Do not bleach your skin. Chemicals for bleaching increase chances of getting skin cancer.
- Avoid sharing clothes, bed sheets, basins and sponges with other people.
- Avoid playing with sharp objects and fire.

Activity
1. *State the cause of athlete's foot in humans.* 2. *Apart from athlete's foot, name two other diseases which affect the human skin.* 3. *Give three ways of caring for your skin.* 4. *Which disease does a person get through wearing wet shoes and stocking?* 5. *What germ causes ringworm infection?* 6. *Which skin disease is caused by tiny itch mites?*

The Human Kidneys and the Urinary System

The major function of the kidneys is to filter blood. The kidneys also regulate the amount of water and salts in blood and produce a hormone which helps in production of red blood cells.

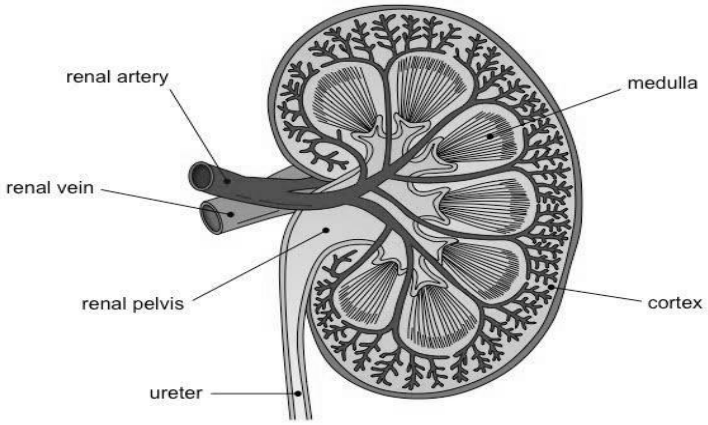
In this lesson, you are going to learn about the role of kidneys in removing waste materials from the body. The heart pumps blood which goes to other body organs as it carries other materials like food. However, the excess salts and excess water in food and protein wastes (e.g. urea and uric acid) need to be removed from the blood and also out of the body.

The kidneys together with other organs like the ureter and urinary bladder make up a system called the "***Urinary System***" which helps to remove these waste materials as urine.

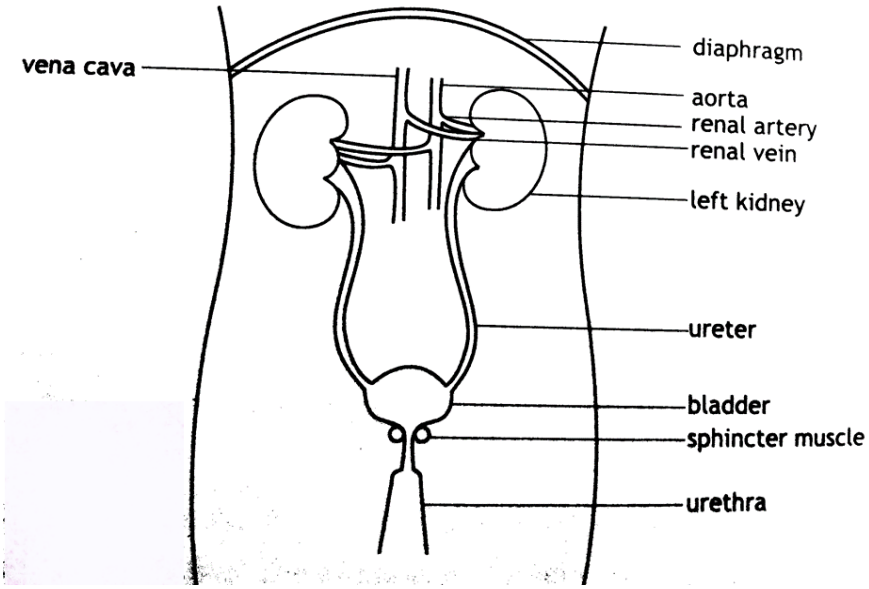
The Structure of the urinary system and a kidney

They are dark, red, bean-shaped and lie in the upper part of the abdominal cavity against the dorsal body wall. They are embedded in a protective layer of fat and connective tissue. The right kidney is slightly on a lower level than the left because of the position of the liver.

The cross section of the kidney



The position of the kidneys in the human body



Functions of the parts

- ***Renal artery*** carries oxygenated blood to the kidney.
- ***Renal vein*** carries deoxygenated blood away from the kidney.
- ***Cortex.*** Filters blood.
- ***Kidneys*** produce urine.
- ***Pelvis*** collects urine before it moves to the urinary bladder.
- ***Ureter*** transports urine from pelvis to the urinary bladder.
- ***Urinary bladder***. The bladder has an elastic wall and placed in the lower part of the abdominal cavity. It has sphincter muscles at its lower part and connected with both the ureters and urethra. Its function is to store urine before it is passed out of the body.
- ***Sphincter muscle*** controls the opening and closing of the urinary bladder.

Functions of the kidneys

- Kidneys also remove acid that is produced by the cells of the body.
- Kidneys maintain a healthy balance of water, salts and mineral such as sodium, calcium, phosphorus and potassium in blood.

- Kidneys remove wastes and extra fluid from the body.

  The kidneys remove various waste products and get rid of them in the urine.

  Some major compounds that the kidneys remove are:

  - urea, which results from the breakdown of proteins
  - uric acids from the breakdown of nucleic acids
  - drugs.
- Reabsorption of nutrients.

  The kidneys reabsorb nutrients from the blood and transporting them to where they will best support health. They reabsorb other products to help maintain homeostasis (stable internal environment).

  Reabsorbed products include:

  - glucose
  - amino acids
  - water
  - phosphate
  - chloride, sodium, magnesium and potassium ions.

Diseases of the kidneys and the urinary system

- **Kidney stones**

  In some cases, certain mineral wastes like calcium can form **kidney stones**, Stones form in the kidneys and may be found anywhere in the urinary system. Often, stones form when the urine becomes concentrated, allowing minerals to crystallize and stick together. They can vary in size, from small stones that can flow through your urinary system, to larger stones that cannot. Some stones cause great pain, while others cause very little pain. Some stones may need to be removed by surgery or ultrasound treatments.

Signs of kidney stones

You may have a kidney stone if you have pain while urinating, see blood in your urine and feel a sharp pain in your back or lower abdomen (the area between your chest and hips). The pain may last for a long or short time. You

may also have nausea and vomiting with the pain. If you have a small stone that passes on its own easily, you may not experience any symptoms. If you have some of these symptoms, you should see your doctor.

- **Kidney failure**

  Kidney failure happens when the kidneys cannot remove wastes from the blood. If the kidneys are unable to filter wastes from the blood, the wastes build up in the body. Kidney failure can be caused by an accident that injures the kidneys, the loss of a lot of blood, or by some drugs and poisons. Kidney failure may lead to permanent loss of kidney function. But if the kidneys are not seriously damaged, they may recover.

  Chronic kidney disease is the slow decrease in kidney function that may lead to permanent kidney failure. A person who has lost kidney function may need to get kidney dialysis. ***Kidney dialysis*** is the process of filtering the blood of wastes using a machine. A dialysis machine filters waste from the blood by pumping the blood through a fake kidney. The filtered blood is then returned to the patient's body.

- **Urinary tract infections (UTIs)**

  Urinary tract infections (UTIs) are bacterial infections of any part of the urinary tract. When bacteria get into the bladder or kidney and produce more bacteria in the urine, they cause a UTI. The most common type of UTI is a bladder infection. Women get UTIs more often than men. UTIs are often treated with antibiotics.

  Most UTIs are not serious, but some infections can lead to serious problems. Long lasting kidney infections can cause permanent damage, including kidney scars, poor kidney function, high blood pressure, and other problems. Some sudden kidney infections can be life threatening, especially if the bacteria enter the bloodstream, a condition called ***septicemia***.

What are the signs and symptoms of a UTI?

- A burning feeling when you urinate.
- Frequent or intense urges to urinate, even when you have little urine to pass.
- Pain in your back or side below the ribs.
- Cloudy, dark, bloody, or foul-smelling urine.
- Fever or chills.

Other diseases of the kidneys

- **Bilharzias** (**schistosomiasis)** A parasitic tropical disease, caused by any of 3 species of flukes called ***schistosomes***, and acquired from bathing in infested water. The larval form penetrates the bather's skin and develops in the body into adult flukes, which settle in the veins of the bladder and intestines. Eggs laid by adults provoke inflammatory reactions; there may be bleeding and ulceration in the bladder and intestinal walls, and the liver may also be affected. The first symptom is usually tingling and an itchy rash where the flukes have penetrated the skin. An influenza-like illness may develop weeks later, when the adults produce eggs. Subsequent symptoms include blood in the urine or faeces, abdominal or lower back pain, and enlargement of the liver or spleen. Complications of long-term infestation include liver *cirrhosis*, *bladder tumours*, and *kidney failure*.
- **Nephritis**. Inflammation of one or both *kidneys*. Nephritis may be caused by an infection, abnormal responses of the *immune system*, or metabolic disorders, such as gout caused by accumulation of uric acids in blood and synovial fluid.
- **Kidney cancer**.

  Kidney cancer -- also called renal cancer -- is **a disease in which kidney cells become malignant (cancerous) and grow out of control, forming a tumour**. Almost all kidney cancers first appear in the lining of tiny tubes (tubules) in the kidney.
  Some risk factors include: being obese, prolonged use of pain killers and smoking. Signs include: blood in urine, weight loss, fatigue and anaemia.

Ways of caring for the human kidney

i) Exercising regularly to keep fit. Maintain a healthy weight according to your age to avoid putting excess strain on all bodily systems.

ii) Avoid taking too many drugs especially pain killers. Stick to prescriptive drugs from a qualified medical officer.

iii) Visit a doctor (urologist) regularly to check the health of the urinary system.

iv) Eat healthy by avoiding junk food. Eat more fresh fruits and green vegetables. Choose foods low in sodium, sugar and fats but high in fiber content.

v) Be informed about the causes and prevention methods of kidney diseases and urinary tract infection causes.

vi) Avoid smoking and alcohol intake.

Fig. A boy exercising by running.

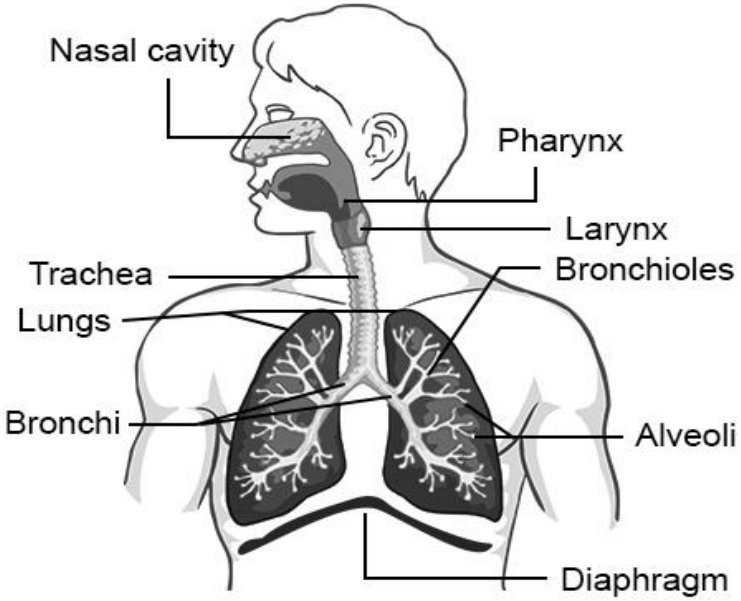
Summary

- Kidneys help in filtering blood and producing urine.
- The kidneys are also involved in maintaining the water level in the body and regulating red blood cell levels and blood pressure.
- They also reabsorb materials into blood like water, salts and glucose.
- Urine consists of substances like urea, uric acids, water and salts.
- Filtration of blood takes place in the part of the kidneys called the ***cortex***.
- Water intake, physical exercise and temperature will always determine the amount of urine passed out.
- It's always a good idea to drink plenty of fluids, especially when you have been exercising. Drinking plenty of water helps to flush away materials that might form kidney stones. Staying hydrated is the best way to prevent kidney stones.
- ***Kidney dialysis*** is the process of filtering wastes from the blood using a machine.

The lungs

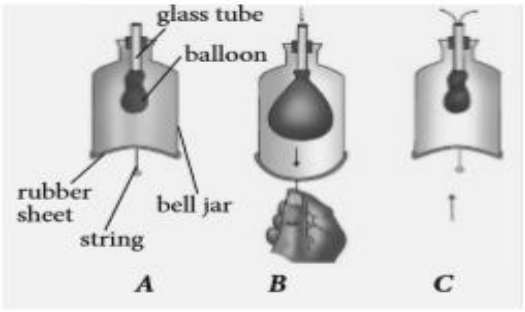
Cellular respiration occurs in every living cell in your body. It is the reaction that provides energy for cell activities. If respiration stops, the cell no longer has energy for cell activities, and the cell dies. As respiration occurs ***carbon dioxide*** is produced as a waste product. As the carbon dioxide accumulates in body cells, it eventually diffuses out of the cells and into the bloodstream, which eventually circulates to the lungs. In the alveoli (air sacs) of the lungs, carbon dioxide diffuses from the blood, into the lung tissue, and then leaves the body every time we breathe out. Some ***water vapour*** also exits the body during breathing out.

- Lungs are both **excretory** and **respiratory organs.**
- As air goes through the nose it is warmed, moistened and cleaned. (filtered)
- When we breathe through the mouth, we take in cold air which may affect our lungs.
- Gaseous exchange takes place in the alveoli (air sacs)

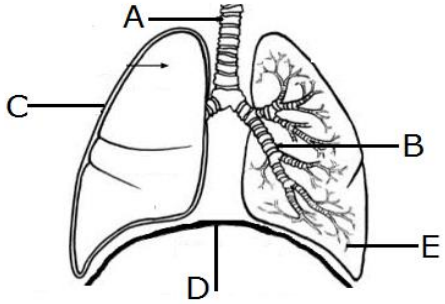


Activity

1. Describe what is happening in each of the diagrams A, B and C.



2. Use the diagram below to answer questions that follow.



   a) Name parts marked: A, B, C, D
   b) State the function of part marked E
   c) Use letter P to show on the diagram the position of the heart.

3. Give a reason why a person breathes a lot after an exercise.

Parts of the respiratory system and their functions

Part	Description	Function
Nose	The outer part of the respiratory system with two systems.	To allow in and out air during breathing. It has mucus and cilia that filters dust in the air breathed in.
Trachea	Made up of rings of cartilage to keep it open all the time.	Acts as passage for air from the nose to the lungs.
Bronchus	The trachea divides into two branches called bronchi. Each bronchus enters into the lungs.	They connect bronchi to bronchioles. Acts as the passage for air to the lungs.
Bronchioles	Divide into smaller air sacs (alveoli)	They connect bronchioles to air sacs.
Air sacs	Tiny sacs of air in each lung.	They help in gaseous exchange.
Lungs	The two lungs are enclosed in the chest cavity and protected by the rib cage.	Helps in gaseous exchange.
Rib cage	Set of ribs that enclose and protect the lungs.	They regulate the size of the chest during breathing.
Diaphragm	Sheet of muscle that separates the chest cavity from the abdomen.	Pulls in air during breathing in. Pushes out air during breathing out.

Diseases of lungs

The respiratory system is affected by many diseases and disorders. Some of these are caused by micro-organisms while others are genetic. The most common respiratory diseases are:

Tuberculosis, Asthma, Pneumonia, Bronchitis, Whooping cough, Common cold Influenza.

1. **Asthma** This is a disease that comes about when the air passages in the lungs suddenly narrow as a result of contraction of their smooth muscles. It is also

characterized by an inflow of mucus which clogs the narrow passages even more. Some substances can trigger an asthma attack. They are called allergens. They include pollen grains, some type of proteins in milk, pet hairs, dust and even flavours in food. It can also be caused by stress and anxiety. In some families the disease is inherited.

Symptoms of asthma

- Difficulty in breathing. Breathing can feel so difficult or quick that the patient can faint.
- Wheezing sounds when breathing.

Prevention and treatment

Asthma is treated by two types of medication: long-term control and quick-relief medicines that help reduce airway inflammation and prevent asthma symptoms.

• Quick-relief medicines relieve asthma symptoms that flare up.

• People with asthma should avoid an environment that is likely to bring on asthmatic attack. This is by avoiding contact with allergens.

• Asthma patients are advised to carry inhalers that contain a drug which pacifies the condition.

A boy using an inhaler.

2. **Bronchitis** This is an infection of the inner walls of the bronchi. It is caused by bacteria or air pollutants such as smoke in inhaled air. The infection causes the mucous membrane in the respiratory tract to produce excess mucus. This causes the cells lining the bronchi and bronchioles not to function properly. As a result, the air passage to the alveoli becomes blocked with mucus. Severe coughing occurs in an attempt to get rid of the excess mucus. Breathing also becomes difficult. Bronchitis may be acute or chronic.

   Acute bronchitis starts quickly and stops after a few days. The symptoms of acute bronchitis are like those of a cold.

   Chronic bronchitis starts slowly and lasts for a long time. It is a more serious kind of infection. It is commonly caused by smoking and air pollution.

Symptoms of bronchitis

- Secretion of excess mucus.
- Coughing

- Difficulties in breathing.

Prevention and treatment

- Acute bronchitis is treated by simple measures that include: getting plenty of rest, drinking lots of fluids and taking a cough syrup.
- People with chronic bronchitis should take antibiotics every time they have a cold with a fever.
- A doctor should be consulted at the early stages of bronchitis.
- Avoid smoking whether actively or passively.
- Avoid polluted air.

3. **Emphysema** This results from long untreated bronchitis where the bronchioles in the lungs become blocked. This causes damage to delicate walls of the alveoli due to high pressure when coughing. This leads to reduced surface area for gaseous exchange. The lungs become distended and inelastic that gases cannot be exchanged efficiently. The patient becomes weak due to insufficient oxygen supply to tissues. Running and walking can prove to be hard when one has this condition.

Prevention and treatment

- Emphysema is treated according to the severity of symptoms. Bronchodilators are normally given to help relieve coughing, shortness of breath and breathing problems.
- Early treatment of bronchitis with antibiotics to prevent secondary infection can help to prevent emphysema.

4. **Pneumonia** is an infection of the lungs. It is caused by bacteria called Pneumococcus that spreads through the air. It can also be caused by a virus or a fungus. Infection proceeds from the mouth down into the lungs. As a result of the infection, a fluid is produced which collects in the alveoli. The lungs become solid and have no air. This prevents exchange of gases in the lungs.

Signs and symptoms

- Sudden chills and high fever.
- Rapid shallow breathing and sometimes wheezing.
- Cough with yellow, greenish colour or mucus with some blood.
- Chest pains.

Prevention and treatment

- Overcrowded places should be avoided and good ventilation in living rooms should be provided.
- Treatment of pneumonia involves curing the infection and preventing complications. It also depends on the causative agent: bacterial, viral or fungal.

- Bacterial and fungal pneumonia are treated with drugs while viral pneumonia clears by itself.

5. **Tuberculosis** (TB) is caused by bacteria called Mycobacterium tuberculosis. The source of infection may be droplets containing bacteria sprayed from the air passages during breathing or sneezing. It can also be caused by infected dry sputum in particles of dust. Tuberculosis bacteria may attack any part of the body, but they usually invade the lungs, causing pulmonary tuberculosis. Another source of infection is by drinking raw milk from a cow suffering from bovine tuberculosis.

Severe coughing may be a sign of TB

Signs and symptoms

- Tuberculosis of the lungs starts with a dry cough followed by the spitting of blood, fever and sweating at night as the infection proceeds.
- If there is no treatment, loss in weight occurs and finally death of the patient.

In addition to tuberculosis of the lungs, there are other forms of the disease in which bacteria attack the lymphatic glands, bones and other parts of the body.

Prevention and treatment

- The patient should consult a doctor for adequate treatment. Treatment for TB will usually involve a long course of antibiotics lasting 6-9 months.
- Overcrowding increases the risk of spread of tuberculosis.
- Avoid taking raw milk. Boil all milk or drink pasteurized milk.
- Immunisation with B.C.G. vaccine in children.
- Isolating patients.

6. **Whooping cough** is caused by bacteria called Bordetella pertussis. The mode of infection is from one person to another through inhalation of infected droplets.

Signs and Symptoms

Whooping cough starts like a cold with fever, running nose and cough.

Two weeks later, the whooping begins. The patient coughs rapidly many times without taking a breath, until one coughs up a mass of sticky mucus, and the air rushes back into the lungs with a loud whoop sound. After the "whoop", the patient may vomit. Between coughing bouts, the patient seems fairly healthy.

Prevention and treatment

1. Patients should consult a doctor for adequate treatment. Treatment for whooping cough involves taking antibiotics early before coughing fits begin.
2. Patients should be isolated from contact with other people.
3. Immunisation with DPT vaccine against whooping cough. In infants, the vaccine against whooping cough is usually combined with those against diphtheria and tetanus.

7. Common cold is an illness caused by a virus infection located in the nose. Colds also involve the sinuses, ears and bronchial tubes. Colds last on average for one week. Mild colds may last only 2 or 3 days while severe colds may last for up to 2 weeks. A cold is a milder illness than influenza.

Nasal secretions containing cold viruses contaminate the hands of people with colds as a result of nose blowing, covering sneezes and touching the nose. Cold viruses may contaminate objects and surfaces in the environment of a patient.

Note: Young children are prone to colds.

Cold virus, which is expelled into the air in coughs and sneezes, may land in the nose or eye of another person and cause infection. Hence transmission.

Signs and symptoms

- Sneezing
- Runny nose
- Nasal obstruction
- Sore or scratchy throat
- Cough
- Mild general symptoms like headache, feverishness, chilliness, and not feeling well in general.

Prevention and treatment

Colds is caused by a virus; therefore, it will clear after several days. Treatment is mainly to lessen the symptoms. If a cold persists seek medical advice.

- To prevent catching a cold, limit contact with known cold patients, especially during the first three days of their illness.

Practice preventive measures which keep cold virus from entering the nose:

- Wash hands after contact with cold sufferers and objects and surfaces they may have contaminated.
- Keep fingers out of the eyes and nose.
- Avoid having cold patients cough and sneeze on you or in your direction.

8. **Influenza** or 'the flu' is a highly contagious disease caused by infection from influenza type A or B (or rarely C) virus. These viruses infect the upper airways and lungs. The flu is highly contagious.

Flu is not the same as a common cold and can be a serious illness. For some people, such as the elderly and those with underlying medical conditions, the flu can cause serious complications which require hospitalisation. It can sometimes lead to death.

Flu is usually spread through infected people coughing and sneezing, which temporarily contaminates the surrounding air and surfaces with infected droplets.

Signs and Symptoms

Symptoms usually appear 1–3 days after being infected. A person can spread flu to others 1–2 days before they become unwell and up to 5 days after symptoms develop. The symptoms of influenza can include:

- Fever
- Dry cough.
- Muscle and joint pain.
- Tiredness or extreme exhaustion.
- Headache
- Sore throat.
- Stuffy nose.

Prevention and treatment

1. Generally, uncomplicated flu is managed by simply resting in bed, drinking plenty of fluids (particularly water) and taking over-the-counter medication to help relieve the symptoms.
2. Antiviral medications reduce the length of time symptoms last and help people infected return to their daily routines earlier.
3. Good hygiene is essential to protect yourself and others.
4. You can reduce the risk of infection by getting vaccinated.

Health Check!

It is unhygienic to cough and spit carelessly in public places. This can easily spread diseases. It exposes other members of the public to infections. Besides it is also ugly.

Disorders of the lungs

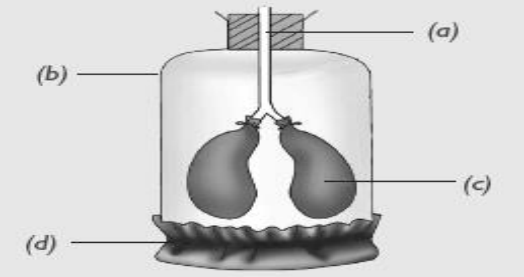
- Choking
- Hiccups
- Yawning

Ways of taking care of the respiratory system include:

- Avoiding **smoking** to ensure healthy lungs.
- Eating a **vitamin- rich diet.**
- Seeking immediate medical care in case of a respiratory problem.
- Exercising regularly to strengthen respiratory muscles.
- Drinking plenty of water.
- Avoid refined sugar, pasta or dairy products.
- Avoiding inhaling unknown or dangerous substances or chemicals.
- When spraying chemicals in the house or any other place, always wear protective clothing, for example, a gas mask.

Activity

1. The diagram below shows a modal of the breathing system. Use it to answer the questions that follow.



   i) What do the parts represent on the actual respiratory system?
   ii) State what happens to part marked (d) when the balloons are filled with air.
2. Name the two wastes removed from the body by the lungs.
3. Why are lungs grouped under both respiratory and excretory systems?

The liver

The liver is a large, important organ in our bodies. Its numerous functions make it "part" of the circulatory, digestive, and excretory systems. The liver as an excretory organ acts to breakdown some proteins and other nitrogenous compounds by a process called ***deamination***. As a result of these reactions, a nitrogenous waste called ***urea*** is formed. The liver as well helps in excreting toxic substances, drugs and their derivatives; bile pigments and cholesterol.

Circulation to and from the liver

- **Hepatic artery**: It supplies oxygenated blood to the liver.
- **Hepatic portal vein**: It supplies blood with digested food from the stomach and intestines to the liver.
- **Hepatic vein**: Caries deoxygenated blood from the liver to the vena cava.

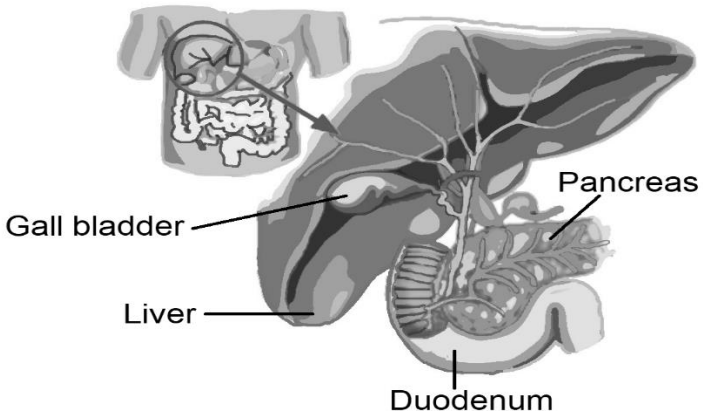


Fig: Location of the liver in the body.

Function of the liver

- The liver breaks down excess amino acids and toxins in the blood.
- Regulation of blood sugars.
- Produces bile salts which aid absorption of fats.
- Stores iron.
- It reduces on excess amino acids in the body (deamination).
- Manufacture of plasma proteins.
- It burns fats to forms glucose and release energy.
- It converts poisonous compounds into less harmful substances (Detoxication).
- The liver stores the fat-soluble vitamins A, D, E, and K, and the water-soluble vitamin B_{12}.
- It produces heat.

Diseases of the liver

- **Hepatitis:**
  Hepatitis is inflammation of the liver caused by any of several viruses. The most common of these hepatitis viruses have been designated A, B, and C, although there are others. Symptoms of hepatitis include anorexia (loss of appetite), nausea, fatigue, and possibly jaundice. Severity of disease ranges from very mild (even asymptomatic) to fatal. Hepatitis A is spread through faecal contact while B and C through contact with infected body fluids like blood.
- **Cirrhosis:** Hardening of liver tissue as a result of alcoholism.
- **Abscesses** There are pus filled sacs on the liver.

Word list

Alveoli. Sacs in the lungs where gaseous exchange takes place.

Bronchus. A tube that connects from the trachea and it is a passage for air.

Trachea. A tube through which air passes to and from the lungs.

Cilia. The hair like cells in the nose and trachea that filters the air we breathe in.

Filtration. The process of removing wastes from a liquid.

Homeostasis. The state of steady internal, physical, and chemical conditions maintained by living systems.

Kidney failure. A disease in which the kidneys are over worked, common in people who drink alcohol.

Deamination. The process of breaking down amino acids into less poisonous substances.

Respiration. The making of energy in living body cells.

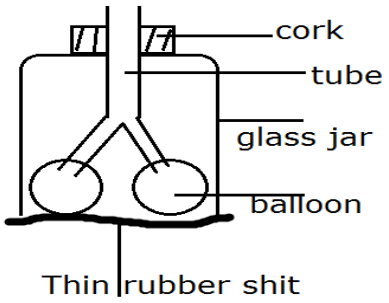
Excretory system. The system that removes wastes from the body.

Urinary system. The system that removes urine from the body.

Revision Exercise 5

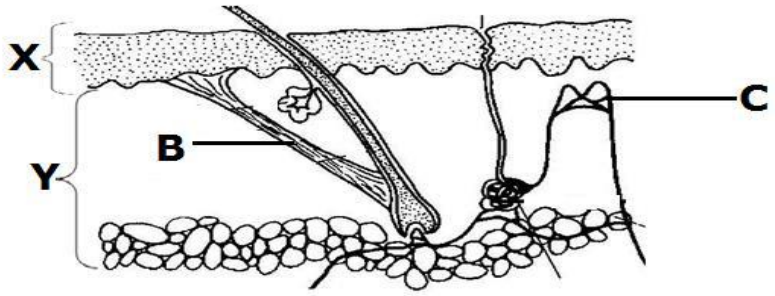
1. Why does air breathed out contain less oxygen than air breathed in?
2. Give a reason why the heart of a person who has been scared beats faster.

The diagram below shows an experiment carried out.

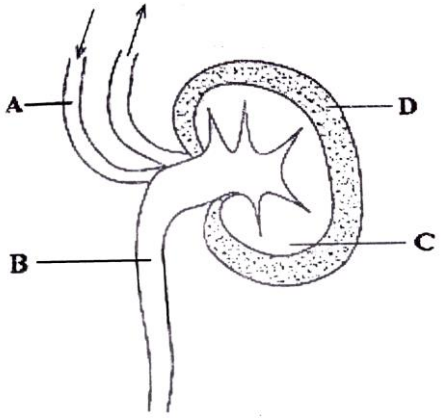


3. What is the experiment about?
4. State what happens to the balloon when air moves out.
5. Name any **one** infectious disease of the lungs.
6. Which organ removes urine from the body?
7. To which system of the body does the organ that removes urine from the body belong?
8. Where does urine collect before it is removed from the body?
9. Name any one substance found in urine.
10. Apart from the kidneys, mention any other excretory organ.
11. Mention any **one** waste removed from the body by the kidneys.
12. State the function of the kidneys during blood circulation.
13. How is the function of the kidneys similar to that of the skin?
14. Which human body organ balances the amount of water needed in the body?
15. Apart from skin, name any other respiratory organs.
16. State any **one** importance of cilia in the nose.
17. How important are rings of cartilage that make up the trachea?
18. Which human body organ regulates body temperature?
19. Why does a person urinate a lot on a cold day than a sunny day?
20. How does smoking affect the proper functioning of the lungs?

21. ***Use the diagram below of the human skin to answer questions that follow.***



a) Name part marked **B**.
b) State the function of part marked **C**.
22. What germ causes leprosy?
23. Give any ***one*** way leprosy can be spread from one person to another.
24. Mention any **one** sign of leprosy.
25. Apart from being spread through air, give any other way tuberculosis is spread in humans.
26. Give any **one** sign of Tuberculosis in humans.
27. What communicable disease has similar signs as tuberculosis?
28. Name the outer most layer of the skin.
29. Apart from removing wastes, mention **one** other function of the human skin.
30. The diagram below is a section of a human kidney. Use it to answer the questions that follow.



31. Name the parts marked with letters B and C.
32. What happens to blood in part marked with letter D?
33. How is part A important to the kidney?
34. State the function of the hair on the skin.
35. Apart from producing bile, state any other function of the liver.
36. Which organ of the body is affected by Hepatitis B?

Topic 6: Light energy

Introduction

Light is a form of energy that enables us to see. Light is the only form of energy that can be seen.

Sources of light

You can see an object only if light from it enters your eyes. Some objects such as the Sun, electric lamps and candles make their own light. We call these **luminous** sources. Most things you see do not make their own light but reflect it from a luminous source. They are **nonluminous** objects. Papers, planets and the Moon are examples.

Uses of light

- **Light enables us to see objects using our eyes.**
  All animals are able to see the objects around them due to the presence of eyes. But without light, these eyes might be of no use. Because of light, the eyes can receive the image of the objects and send the information to the brain. From this visual information, we comprehend (understand) the objects. Hence, we can notice that in darkness we could see nothing. So, light makes us able to see objects around.
- **Plants use sunlight to carry out photosynthesis.**

  Almost all living things depend on light for their food and energy.

  Plants synthesize (make) their own food by the use of sunlight energy. The sunlight energy which falls on the leaves and other greenish surfaces on plants is trapped by chlorophyll, this trapped energy is converted to reserve energy in the form of carbohydrates.

  The carbon dioxide and water are used up to form carbohydrates in the presence of sunlight.
- **For Vitamin D synthesis**: Vitamin-D is a type of vitamin which is needed to be supplied from the external source. When the light falls on the skin, the cells below the skin converts it to vitamin-D. So, if someone stays away from sunlight for long, he tends to develop the vitamin-D deficiency. Also, to get a regular dose of vitamin D, it is important to expose to sunlight every day. The best time would be in the mornings and evenings (before dawn).

Properties of light

- Light travels in a straight line.

Practical work

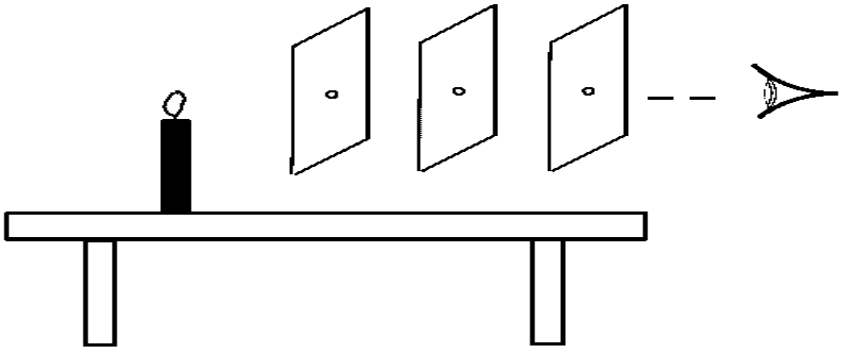
To demonstrate that light travels in straight lines

Apparatus (materials needed):

You will need a candle, matches and three sheets of paper.

Method:

- Make a small hole in the middle of each of the three sheets of paper.
- Light the candle.
- Look at the burning candle through the hole in the first sheet of paper.
- Place the second sheet of paper between you and the candle so that you can still see the candle through the holes.
- Now do the same with the third sheet so that you can still see the candle. The sheets of paper must not touch each other.
- What do you notice about the holes in the paper?



Conclusions:

In the investigation you will notice that the holes in the paper need to be in a straight line. This shows that light travels in a straight line. We cannot see around corners. This also proves that light does not bend around a corner but travels straight.

Speed of light

Proof that light travels very much faster than sound is provided by a thunderstorm. The flash of lightning is seen before the thunder is heard.

Rays and beams of light

The path along which light travels is called "a ray of light". A ray of light is represented using an arrow. The head of the arrow shows direction of light.

A ray of light.

Beams

A group of light rays travelling in the same direction is called a beam. This can be ***parallel beam***, ***divergent beam*** and ***convergent beam.***

- In **parallel beam,** the light rays do not meet and have the same distance apart.
- **Divergent beam** is where light rays from the same source spread into different directions.
- In **convergent beam**, light rays from different sources meet at the same point.

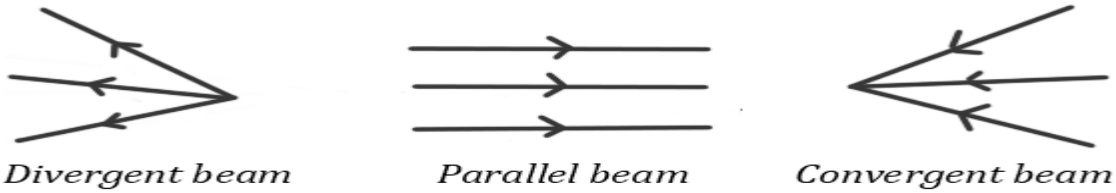


Fig: Types of beams.

Effect of light on different objects

You are aware that there are different objects in your environment. Some of them allow all the light to pass through them, others allow only less light to pass through and some block all the light.

Objects that allow light to pass through completely are called ***transparent objects.***

Examples of transparent materials

- Clear glass
- Clean still water
- Air

Objects that allow light to pass through but you cannot see clear images through them are called ***translucent objects.***

Examples of translucent materials

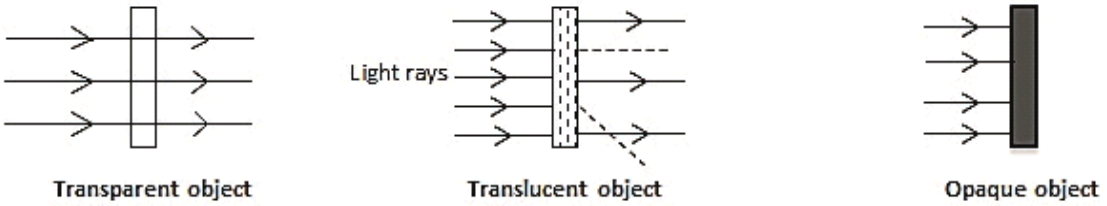
- Frosted glass
- Tissue paper
- Coloured glass
- Oiled paper
- Smoky air
- Thin cloth
- Tracing paper

Objects that allow no light to pass through them are called ***opaque objects***. No image can be seen through an opaque object.

Examples of opaque objects

- A hard paper
- Wood
- Stones
- Human Body
- Metals

Diagrams showing effects of different materials on light



Activity
1. *Define the term beam of light.* 2. *Name any two types of beams of light.* 3. *Briefly explain the difference between opaque objects and transparent objects.* 4. *How is a beam of light different from a ray of right?* 5. *State what happens when light strikes an opaque object.* 6. *In this activity, you will flash light towards the objects in the table, one after the other, and record whether the light passes completely, partially (less light passes) or light is blocked (doesn't pass)*

No.	Object	Can light pass through.	Can clear images be seen through.	Type of materials.
1.	Clear glass.			
2.	Colourless polythene bag.	All light passes through.	Clear images are seen through.	Transparent
3.	Piece of iron.			Opaque
4.	Piece of wood.	No light passes through.		
5.	Stone			
6.	Coloured polythene bag.		No clear images are seen through.	
7.	Oiled paper.	Light can pass through.		
8.	Light cloth.			
9.	Piece of rubber.	No light can pass through.		

How Shadows and Eclipses are Formed

Practical work

You will need the following materials

Burning candle or torch, white sheet of paper, lemon fruit, stick, a tin (you can make your tin by cutting plastic water bottle

Steps to follow

- Fill the tin with soil.
- Fix the lemon fruit onto a stick and fix the free end of the stick into the tin with soil.
- Pin the white sheet paper to the wall at the same height of the stick holding the fruit.
- Move the tin with the lemon fruit near to the paper on the wall.
- Flash light direct onto lemon fruit as you observe what is formed on the paper.
- Repeat the steps while using other opaque objects.

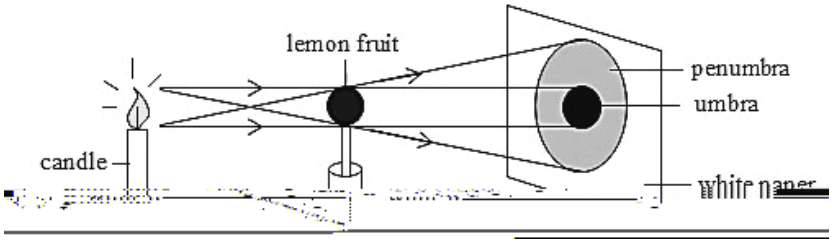
Summary

From the above activity, the lemon fruit blocks light and forms a dark region on the paper. This dark region is called a ***shadow***. A ***shadow is the region of darkness formed when an opaque object blocks light***. The size of the shadow formed depends on the size of the source of light and the distance of an object from the source of light. A shadow has ***two*** parts; the dark inner part of a shadow is called ***umbra*** while the light outer part is called ***penumbra***. **Shadows** are formed for two reasons. First, because some objects, which are said to be **opaque**, do not allow light to pass through them. Secondly, light travels in straight lines. The sharpness of the shadow depends on the size of the light source. A very small source of light, called a **point source**, gives a sharp shadow which is equally dark all over.

Questions

1. *Why are shadows formed?*
2. *Shadows are formed because light travels in a straight line.*
3. *Shadows are formed because some objects are opaque.*
4. *What determines the sharpness of a shadow?*
5. *The sharpness of a shadow depends on the size of the light source.*

Parts of a shadow



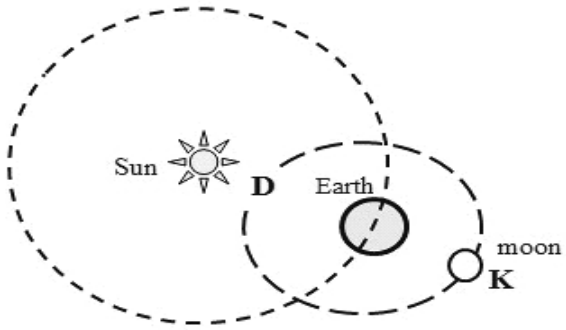
Umbra is formed by total blockage of light while ***penumbra*** is formed when light is partially blocked.

Eclipses

Total blockage of light forms umbra while partial blockage of light forms penumbra. In nature, the earth revolves around the sun while the moon revolves around the earth. At a certain time in a year, the moon passes between the sun and the earth such that all the three bodies are in a straight line. The moon will block the sun's light and its shadow is formed on the earth. This condition is called ***solar eclipse*** or eclipse of the sun.

There are also periods in some years when the earth passes between the sun and the moon. The earth being opaque will block the sun's light and form a shadow on the moon. This is called ***lunar eclipse*** or eclipse of the moon.

The diagram below shows how the moon and the earth revolve to form eclipses.



When the moon revolves and reaches point **D**, a solar eclipse is formed. When the moon revolves and reaches point **K**, a lunar eclipse is formed. ***An eclipse*** is the partial or total blockage of sunlight by either the moon or the earth. Full shadow is ***umbra*** while partial shadow is ***penumbra***.

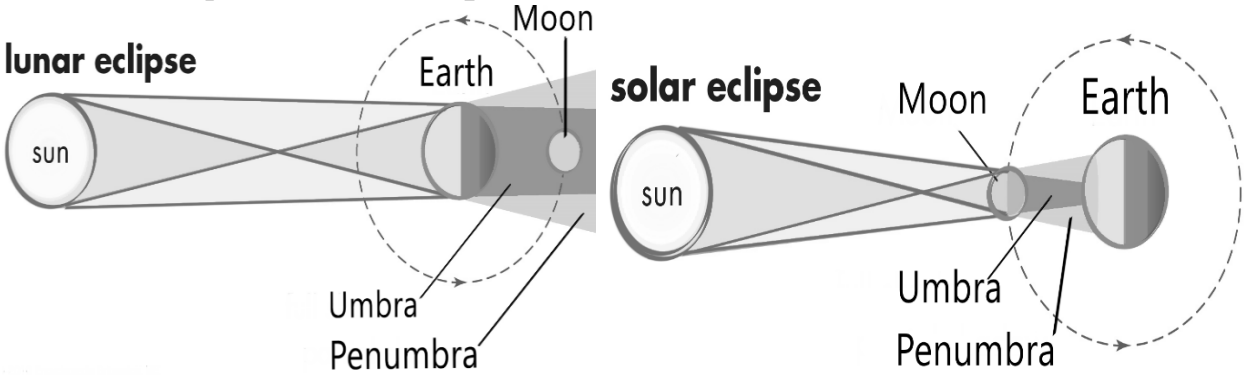


Fig: Eclipses

Reflection of Light

Introduction

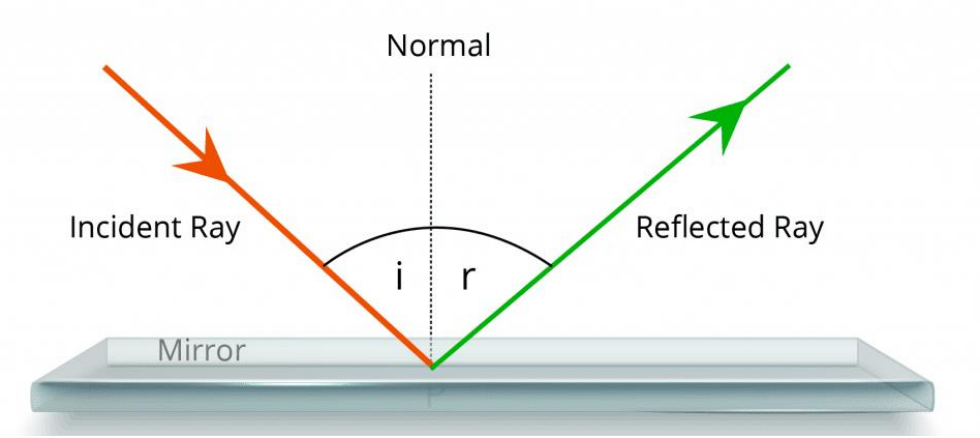
When light rays fall on an object;

- They may pass through that material or get blocked.
- They may bend as they pass through that material.

- They may be absorbed or bounced back. The bouncing back of light rays is called ***reflection***.

Reflection of light usually takes place when light rays fall on shiny objects or surface. A ray of light which hits the shiny surface is called ***incident ray*** and when it bounces off, it is called ***reflected ray***. There is also an imaginary line in the centre of the reflecting surface at an angle of 90^0 called the ***normal.***

Diagram showing how light can be reflected



Key

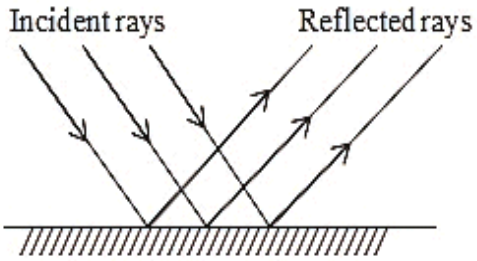
- ***i*** is called angle of incidence. It is the angle between incident ray and the normal.
- ***r*** is angle of reflection. It is the angle between the reflected ray and the normal.
- The glancing angle is the angle between the incident or reflected ray and the reflecting surface.
- The point of incidence is the point where the incident ray meets the reflected ray.

Note. The incident ray and the reflected ray are on the opposite sides of the normal.

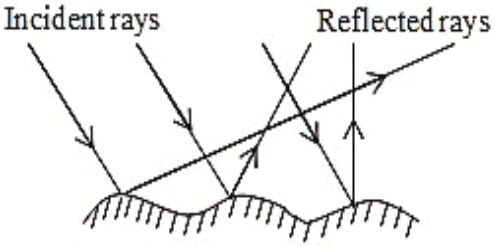
Types of reflection

Regular reflection occurs on smooth shiny surfaces such as a plane mirror and clear water. Light rays are reflected at the same angle and in parallel form.

Irregular reflection occurs on rough shiny surfaces like cracked mirror and muddy water. Light rays are scattered and reflected at different angles. This is why irregular reflection is also called ***diffuse reflection***.



Smooth shiny surface
produces regular reflection



Rough shiny surface
produces irregular reflection

Laws of reflection of light

- The angle of incidence is equal to the angle of the reflection.
- The incident ray, the reflected ray and the normal ray at the point of incidence, all lie in the same plane. Point **o** at the centre of the reflecting surface shows the point of incidence.

Note: The point of incidence is the point where the incident ray touches the reflecting surface.

Calculating simple problems on reflection of light

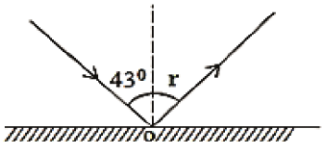
We can find one angle when the other is given using the first law of reflection of light.

If the angle of incidence is 30^0, the angle of reflection is also 30^0 since they are equal. Remember the angle of incidence or angle of reflection and the glancing angle add up to 90 degrees.

Worked Examples

Find the size of angle ***r, i*** and ***g*** in the diagrams below.

(a)



Solution

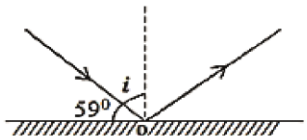
(a)

$\angle i = 43^0$

Since $\angle i = \angle r$

Therefore $\angle r = 43^0$

(b)



Solution

(b)

$\angle i = 59^0$

$\angle g + i = 90^0$

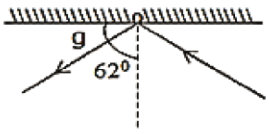
$59^0 + i = 90^0$

$59^0 - 59^0 + i = 90^0 - 59^0$

$i = 90^0 - 59^0$

Therefore $\angle i = 31^0$

(c)



Solution

(c)

$\angle r = 62^0$

$\angle r + g = 90^0$

$62^0 + g = 90^0$

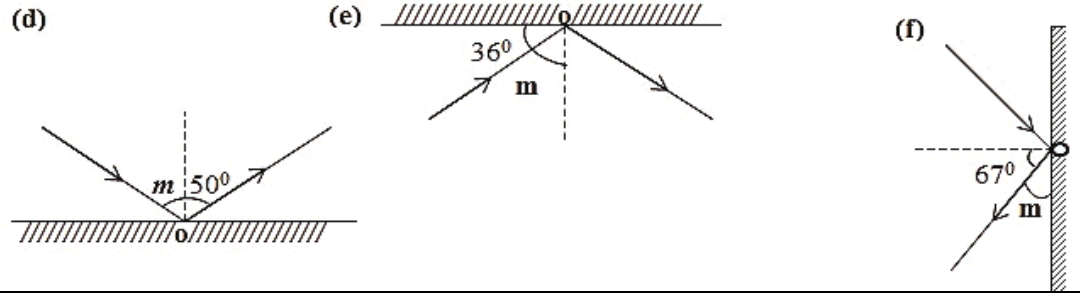
$62^0 - 62^0 + g = 90^0 - 62^0$

$g = 90^0 - 62^0$

Therefore $\angle g = 28^0$

Activity

1. *Define the term reflection of light.*
2. *State one law of reflection.*
3. *In each of the diagrams d, e and f, find the value of m in degrees.*



Plane Mirrors

Activity

In this activity, you will find out the characteristics of images formed by plane mirrors.

Materials needed

Plane mirrors (dressing mirror), pen, pencil and exercise book, ruler

Steps to follow

- Ask a friend to hold the plane mirror upright on a table or a flat surface.
- Use the pen to write the word plane in capital letters on a piece of paper.
- Hold the piece of paper upright with the word facing the mirror. The paper should be 15 cm away from the mirror.
- Observe how each letter of the word appears in the mirror.
- Ask your friend to raise the mirror to the level of your face, touch on your left ear and observe inside the mirror**.**
- Now hold the mirror and follow the steps again for your friend to see what happens.

Summary

A mirror is a piece of glass which reflects light. Due to reflection, mirrors form images of objects in front of them. An ***image*** is the light picture formed by reflection of light.

There are two types of images;

- **Real images;** images which are formed (that can be cast) on the screen.
- **Virtual images** are not formed on the screen or the film. They are formed behind the mirror or lens. Virtual images are cast by ***plane mirrors*** *and* ***lenses***.

Characteristics of images formed by plane mirrors

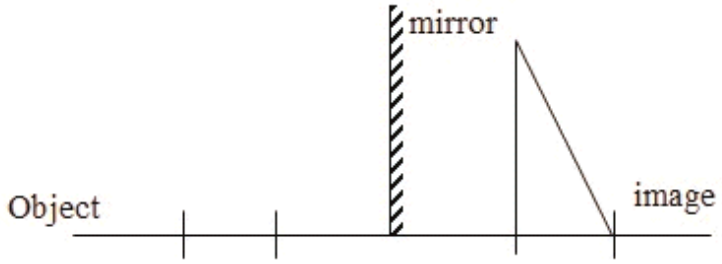
- The images are upright /erect.
- The image distance is equal to the object distance from the mirror.
- The image has the same size as the object.
- Images are laterally inverted. This means that the right side of the object appears to be the left of the image in the mirror.
- The image is virtual (not formed on the screen).

Uses of plane mirrors

- They are used as dressing mirrors.
- They are used by dentists to see damaged parts of the teeth.
- They are used in salons when working on hair.
- They are used in periscopes.
- They are used to see our backs.
- They are used in supermarkets for security.

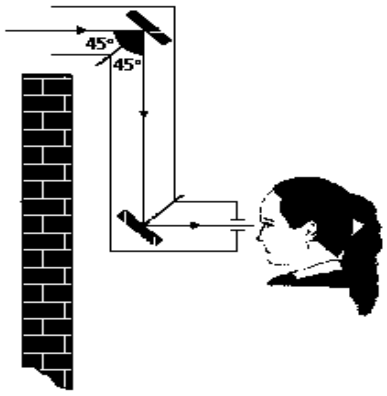
Activity

1. *Name the type of reflection produced by plane mirrors.*
2. *Describe any three characteristics of images formed by a plane mirror.*
3. *List any two uses of plane mirrors to people.*
4. *In the diagram below, draw the object which forms the image.*



Periscope

A simple **periscope** consists of a tube containing two plane mirrors, fixed parallel to and facing each other. Each makes an angle of 45° with the line joining them (Figure below). Light from the object is turned through 90° at each reflection and an observer is able to see over a crowd or over the top of an obstacle.



Uses of periscopes

- They are used by soldiers to see enemies around corners.
- They are used in submarines to see the surface of water.
- They are used by spectators to see over crowds.

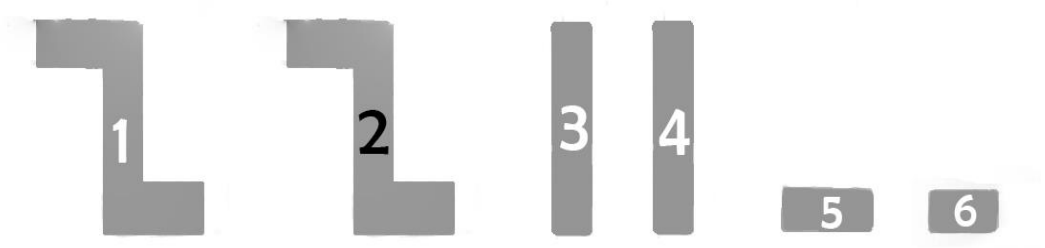
Practical work: Making a periscope.

Materials needed

- 2 small plane mirrors.
- Pair of scissors.
- A shoe box
- Pencil
- Cello tape/glue

Steps

1. Draw the outline diagram of a telescope to be made on a large box.
2. Make cut outs from the drawn telescope as shown below.



3. Join the cut outs 2,3,4,5,6 and form the shape at the sides.
4. Use glue to fix the two plane mirrors in the corners, these mirrors must be facing each other and inclined at an angle of 45°.
5. Test the telescope and finally cover with cut out 1 to complete the periscope.
6. The telescope will be ready to work.

Practical work: Making a pinhole camera

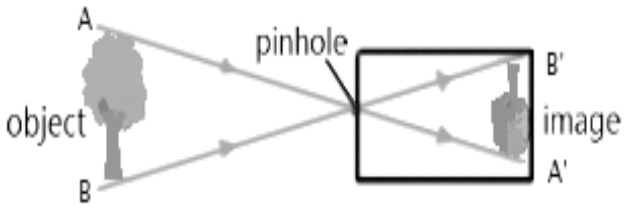
Materials needed

A small pin, a small box/tin, a waxed paper (screen), source of light, a rubber band.

Steps

- Make a small hole in the centre of the black box using a pin.
- Tie a waxed paper with a rubber band on the open side of the box/tin.
- Take the camera in a dark room. Hold the camera box at arm's length so that the pinhole end is nearer to the source of light. Look at the **image** on the screen (an image is a likeness of an object and need not be an exact copy).

A pinhole camera



Can you see ***three*** ways in which the image differs from the object?
What is the effect of moving the camera closer to the object?
Make the pinhole larger. What happens to the

1. Brightness,
2. Sharpness,
3. Size of the image?

Make several small pinholes round the large hole and view the image again.

Characteristics of images formed in a pinhole camera

- The image is diminished i.e. smaller than the object.
- The image is inverted i.e. formed upside down.

- The image is real i.e. formed on the screen.

Activity

1. *What determines the nature of image formed in a pinhole camera?*
2. *How does the size of the pinhole affect the image formed in a pinhole camera?*
3. *Why should the inside of a pinhole camera be painted black?*
4. *On what principle of light does a pinhole camera work?*
5. *Why are images in a pinhole camera formed upside down?*

Refraction of Light

Practical work

- Pour clean water in the glass cup and place it under an open source of light.
- Allow the water to settle and gently dip the pencil or the wooden rod in it.
- Observe it from one side through the glass. How does the pencil appear when dipped into glass containing water?
- Also fill the basin/bowel with clean water and place the coin in it.
- Stand and observe the coin. What have you observed?

Summary

You will notice that the pencil appears to be broken or bending in the water. This is due to ***refraction of light***. Air which surrounds the glass cup is less dense than water, when light moves from a less dense medium to a denser medium (e.g. from air to water), its speed reduces and when light moves from a denser medium to less dense medium (i.e. from water to air, its speed increases. These ***changes in speed of light*** cause the light rays to bend. The bending of light rays as they move from one medium to another is called ***refraction*****.**

Facts about refraction

- *A ray of light is bent **towards** the normal when it enters an optically denser medium at an angle, for example from air to glass as in Figure. The angle of refraction r is less than the angle of incidence i.*
- *A ray of light is bent **away from** the normal when it enters an optically less dense medium, for example from glass to air.*

- *A ray emerging from a parallel-sided block is **parallel** to the ray entering, but is **displaced sideways**, like the ray in Figure below.*
- *A ray travelling along the normal direction at a boundary is **not refracted.***

Note 'Optically denser' means having a greater refraction effect; the actual density may or may not be greater.

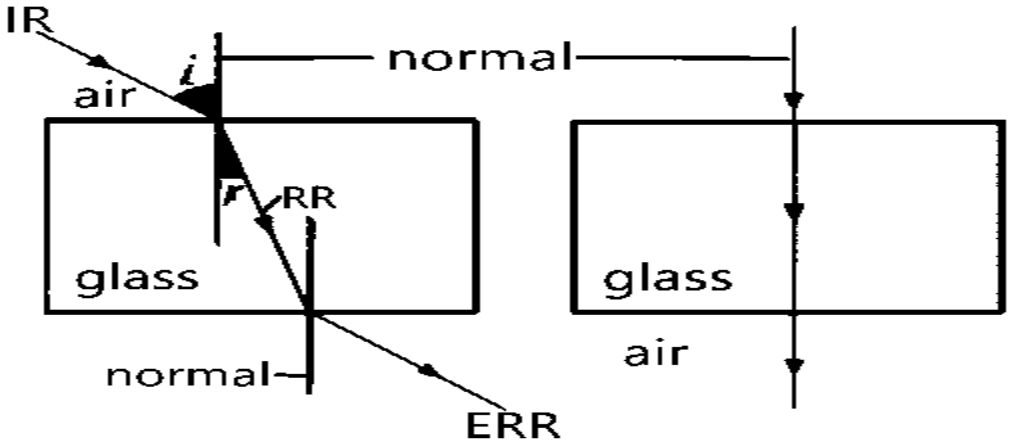
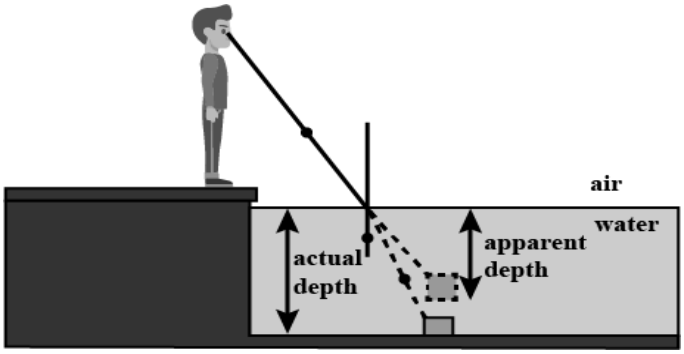


Fig: Refraction of light through a glass block.

Principle / law of refraction:

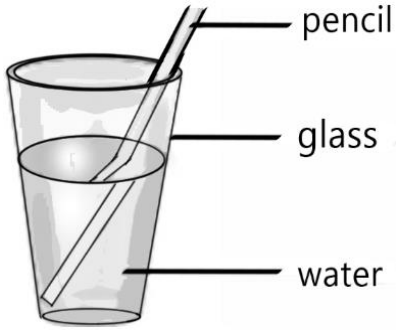
The incident ray, the refracted ray and the normal all lie in the same plane.

Effects of refraction of light



- Refraction produces colours e.g. a rainbow occurs when white light from the sun is refracted through rain drops and split into seven colours. The band of seven different light colours is called ***spectrum***.
- Refraction causes real and apparent depth i.e. objects placed in a basin containing water appear to be nearer than their actual depth.

- Refraction makes objects dipped in water to appear bent or broken.



Activity
1. Define the term refraction of light. *2. State any one effect of light refraction* *3. State the law of refraction.* *4. Briefly explain how a rainbow is formed.* *5. What causes refraction of light?* *6. Why does a coin dropped in water appear raised?* *7. Why does a stick placed in water appear broken?*

Optical Instruments

Optical instruments are the devices which process light to enhance an image for a clearer view. The use of optical instruments, such as a magnifying lens or any complicated device like a microscope or telescope, usually makes things bigger and helps us to see in a more detailed manner. The use of converging lenses makes things appear larger, and on the other hand, diverging lenses always get you smaller images.

Examples of optical instruments

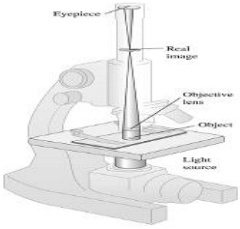
- **Microscope**

A microscope has two converging lenses. And is used to see germs like bacteria and virus that are very tiny.

- **Telescope**

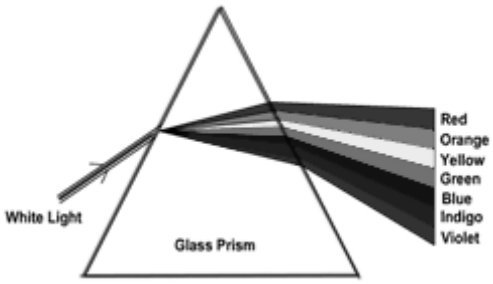
We use a telescope to view an object that is at a very distant place like the moon, stars and other heavenly bodies, a telescope uses two lenses a convex and a concave lens.

- **Human eye**
- **Binoculars**
- **Lens camera**

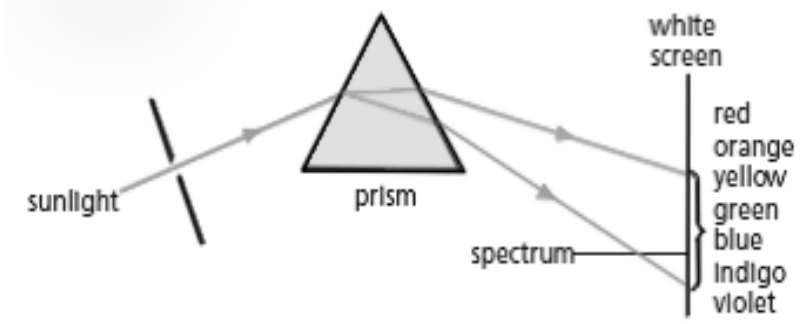
		
Telescope	Microscope	Binoculars

Prism and light spectrum

Dispersion



When sunlight (white light) falls on a triangular glass prism (Figure below), a band of colours called a ***spectrum*** is obtained. The effect is termed **dispersion**. It arises because white light is a mixture of many colours; the prism separates the colours because the refractive index of glass is different for each colour (it is greatest for violet light).



For memorizing, Richard Okello Your Girl Betty Is Vomiting.

Summary

Spectrum is a band of seven colours. Dispersion is the splitting of white light into seven colours, dispersion is caused due to the fact that light travels at different speeds in different materials.

The rainbow

A rainbow is a spectrum formed when sunlight is dispersed by water droplets in the atmosphere. Sunlight that falls on a water droplet is refracted. Because of ***dispersion***, each colour is refracted at a slightly different angle, as shown in **Figure**. A second rainbow outside of the first is sometimes formed, this is fainter, and has the order of the colours reversed. Light rays that are reflected twice inside water droplets produce this effect.

Lenses

A magnifying glass

Introduction

A lens is transparent glass or plastic material with smooth, curved surfaces that refract light passing through it. When light is refracted it changes direction due to the change in density as it moves from air into glass or plastic. Lenses are used in cameras, telescopes, binoculars, microscopes, spectacles and magnifying glasses

Types of lenses

There are two types of lenses; ***convex lenses*** and ***concave lenses.***

A convex lens is thicker at the centre and thin at the edges. When light passes through a convex lens, its speed reduces and the light rays bend to form convergent beam (bends light inwards) This is why a convex lens is also called a ***converging lens.***

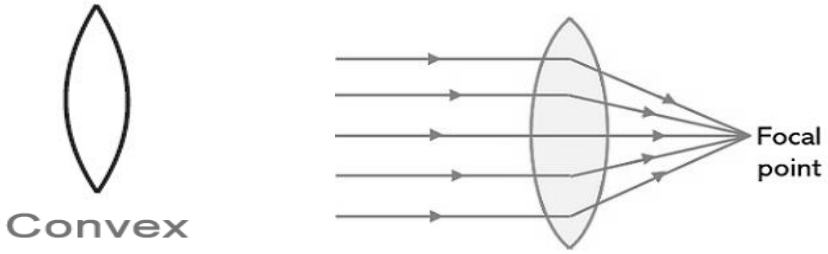


Fig: convex lens and its effect on light.

A concave lens is thin at the centre and thicker at the edges. When light meets a concave lens, the light rays bend to form divergent beam (spreads light out) and this is why a concave lens can also be called a ***diverging lens***.

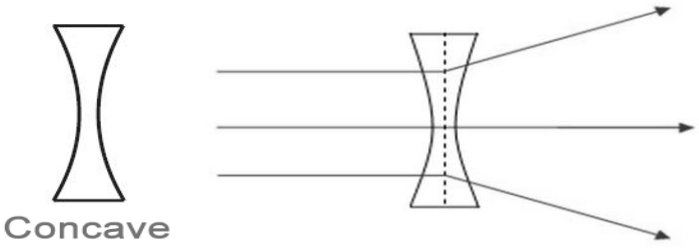
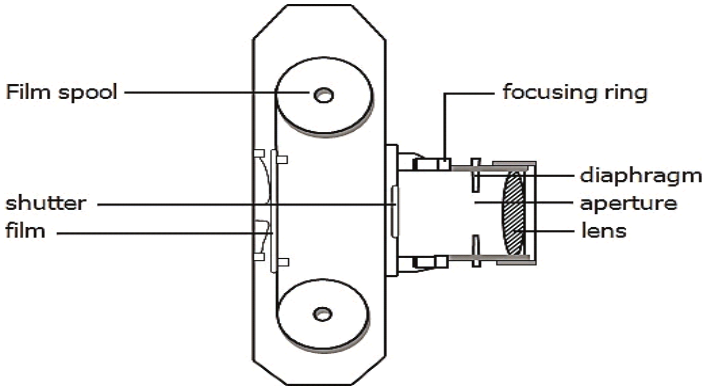


Fig: concave lens and its effect on light.

Uses of lenses

- Lenses are used in telescopes, cameras, microscopes and film projectors.
- They are used in spectacles to correct eye defects and also in magnifying glasses.
- Convex lenses are used to inspect cars by security persons.

The lens camera



How the lens camera works

- Light enters the camera through the ***aperture***; the ***lens*** refracts and focuses the light rays on the ***film*** where inverted images are formed.
- The ***diaphragm*** controls the amount of light entering the camera. The ***focusing ring*** is used to increase or reduce the distance between the lens and the film.
- When the camera is not in use, the shutter closes to keep out light.
- Images formed by the lens camera are real, upside down (inverted) and smaller than the object (diminished).

Activity

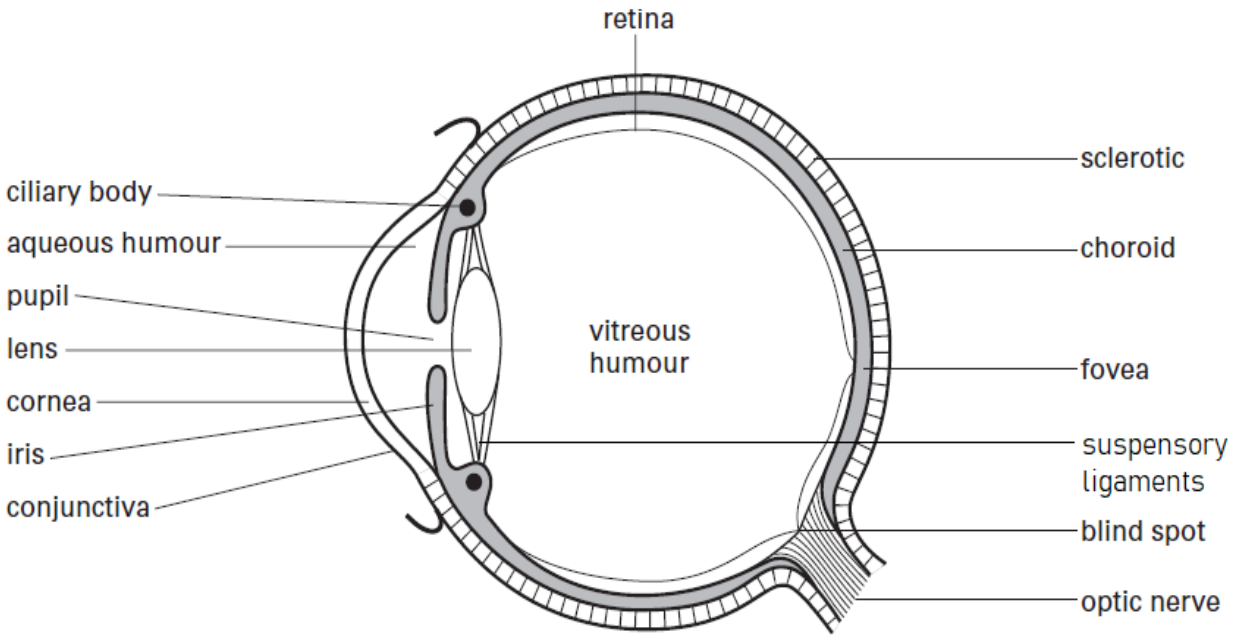
1. *Mention any one type of lens.*
2. *Name two optical instruments that use lenses.*
3. *State any two characteristics of images formed by a lens camera.*
4. *Use a pencil to draw a convex lens and a concave lens in your note books the spaces below.*

The Human Eye

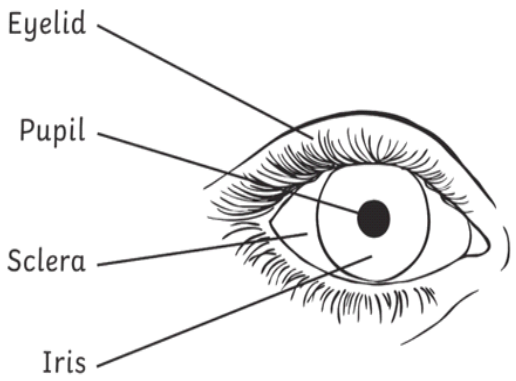
Introduction

Did you know that the human eye is the part of our body which works in the same way as a photographic camera? The human eye is the sense organ for sight. It is an optical organ because it uses light to function. Mirrors, microscopes, telescopes, binoculars, lens cameras and periscopes are examples of optical instruments because they use light to function. The complete shape of the eye is called eyeball and it is protected by the eye socket or orbit in the skull.

The cross section through the human eye



The front view of the human eye



How the does the eye work?

Light rays from an object enter the eye through the pupil. The ***cornea*** refracts the light rays onto the lens**.** The ***lens*** focuses the light rays onto the retina where images are formed upside down. The ***ciliary muscle*** allows the eye to focus light from objects near and far by changing the shape of the ***lens.***

The ***optic nerves*** connected to the retina send this information to the brain as light (vision) impulses**.** The brain interprets these impulses to produce a correct image of the object (what we see). Images formed in the eye are inverted, real and diminished.

The ***iris*** controls the amount of light entering the eye by changing the size of the pupil. ***Aqueous humour*** and ***vitreous humour*** are fluids which maintain the shape of the eyeball and also refract light.

Eyelids close to keep out light when not needed in the eye while the ***eyelashes*** trap dust particles from entering the eye.

Suspensory ligament. *It holds the lens in position.*

Choroid. To prevent internal reflections in the eye. Also supplies the eye with digested food.

Fovea. to give an accurate interpretation of the image.

Retina. Is where an inverted image is formed.

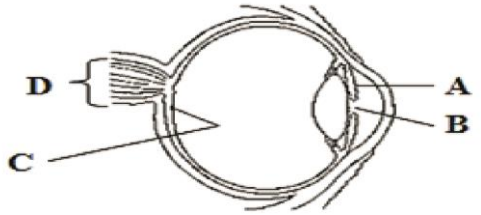
Sclerotic. To protect the internal parts of the eye.

Note

Blinking spreads the tears and allows them to wash the eye. Composed mostly of water, tears also contain an enzyme called ***lysozyme***, which prevents bacteria from reproducing on the eye's surface.

Activity

1. *Give any **two** examples of optical instruments.*
2. *The diagram below is of a human eye. Use it to answer questions that follow:*



*i) Identify the parts labelled **A** and **B**.*
*ii) Give the function of part **C** and **D**.*

Differences between the eye and the lens camera

Human eye	**Lens camera**
Iris controls amount of light entering the eye	Diaphragm controls amount of light entering the camera
Eyelids block light when not needed	Shutter blocks light when not needed
Pupil allows light into the eye	Aperture allows light into the camera
Lens focuses light on the retina	Lens focuses light on the film
Images are formed on the retina	Images are formed on the film

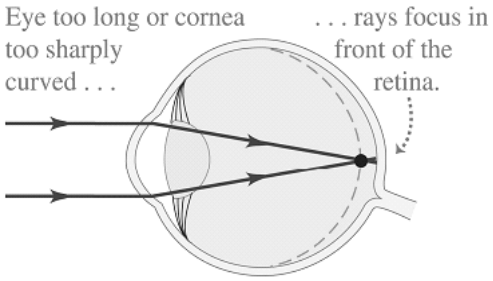
Eye Defects/Disorders

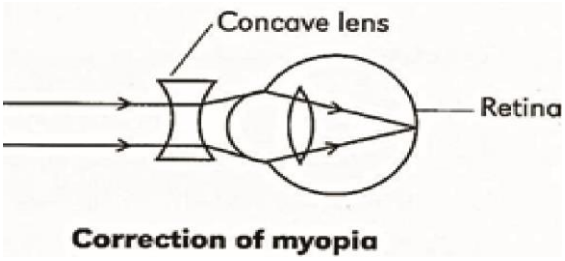
Introduction

There are certain conditions that may prevent eyes from functioning properly. This may affect only a certain part of the eye or even sometimes the whole eye. These conditions are called eye defects or disorders. ***Eye defect*** is where a person cannot see certain distances clearly. Below are the common eye defects.

Short sightedness (myopia)

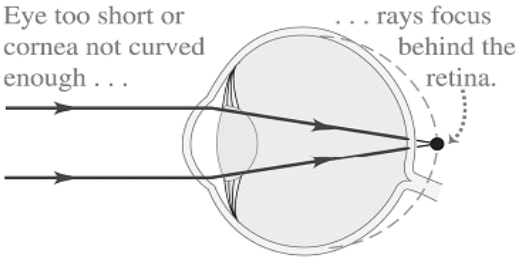
A person suffering from short sightedness sees near objects clearly but not objects which are far away from him/her. This eye defect is caused by too ***large eyeball*** and too ***thick eye lens***. In short sightedness, the light rays from far objects are focused in front of the retina. The images are also formed in front of the retina. Short sightedness is corrected by wearing spectacles with ***concave lens***. Concave lenses ***diverge light rays*** to focus images on the retina.

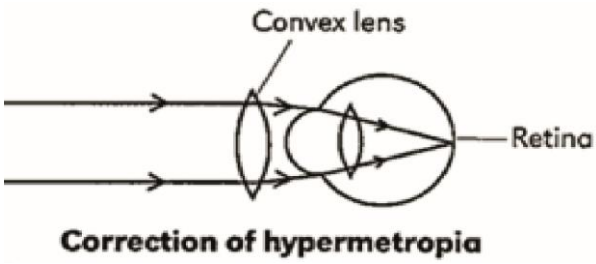




Long sightedness (Hypermetropia)

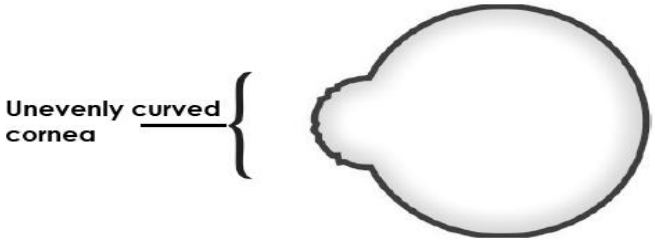
A person with hypermetropia sees objects that are far but cannot see nearby objects clearly. This is caused by too ***small eyeball***, too ***thin eye lens*** and loss of flexibility by the eye lens. In long sightedness, the light rays from nearby objects are focused behind the retina. The images are also formed behind the retina. Long sightedness is corrected by wearing spectacles with ***convex lenses***. Convex lenses ***converge light rays*** to focus images on the retina.





Astigmatism

This is the inability to see objects both vertically and horizontally clearly at the same time. It is caused by having irregular cornea (cornea that is not evenly curved). This unevenly curved cornea causes the images formed on the retina to be unclear (blurred). Astigmatism is corrected by wearing spectacles with special cylindrical lenses.



Diseases of the human eye

Eye disease and cause	How it spreads	Signs and symptoms	Prevention, control and treatment
Trachoma *Caused by chlamydia bacteria.*	• Through body contact with infected people. • By houseflies • Through sharing handkerchiefs and face towels with infected people.	• Red eyes • Swollen eyelids. • Watery discharge from the eyes.	• Avoid sharing handkerchiefs and face towels. • Washing the face with clean water and soap. • Treat infected people using antibiotics.
Conjunctivitis *Caused by bacteria or virus.*	• Through shaking hands with infected people. • Sharing face towels and handkerchiefs.	• Eye turns pink. • Watery discharge from the eyes. • Itching of the eyes.	• Avoid shaking hands with infected people. • Isolating the infected people. • Avoid sharing face towels and handkerchiefs.
River blindness *Caused by protozoa called onchocerca volvulus.*	• Through bites of black fly or Jinja fly.	• Swelling of the skin near the eyes. • Itching of the eye. • Swollen nodules under the skin.	• Spray breeding places for black flies using insecticides. • Early treatment of infected people.
Night blindness *Caused by lack of foods rich in Vitamin A.*	• It is non-communicable since it does not spread from one person to another.	• Poor night Vision.	• Feeding on foods rich in vitamin A e.g. carrots, pawpaw, onions, Liver.

Care for the human eye

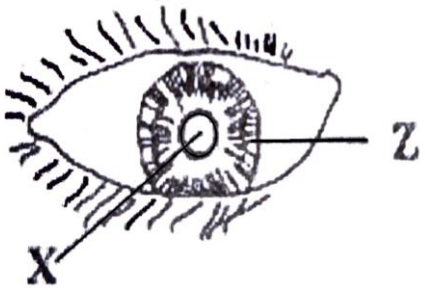
- Washing the face with clean warm water and soap.
- Going for regular medical eye check-up.
- Not touching or rubbing your eyes with dirty hands.

- Feeding on a balanced diet.
- Avoid reading under dim light or too bright light. This habit strains the eye and leads to damage of the retina.
- Avoid playing rough games or playing with sharp objects.

Activity

1. *Give any two diseases that affect the eyes.*
2. *Which disease of eyes is spread by a housefly?*
3. *What germ causes trachoma?*
4. *Name one deficiency disease of the eyes.*
5. *State two ways of caring for the eyes.*
6. *Why is it dangerous to look under direct sunlight?*
7. *Of what importance are sun glasses to a person?*
8. *How can short sight be corrected?*

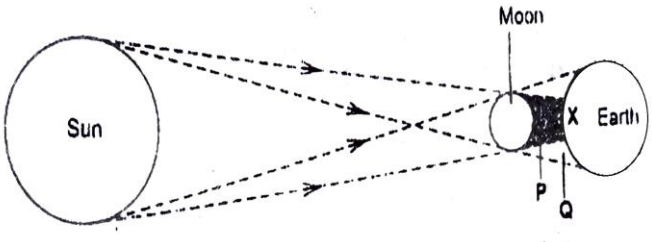
   The diagram below is of a human eye. Use it to answer the questions that follow.



   a) *Name the part marked with letter X.*

   b) Give the use of the part marked with letter Z.

9. *Which part of the human eye has the same function as the diaphragm of a lens camera?*
10. *The diagram below shows a type of eclipse. Use it to answer the questions that follow.*



    a) Name the type of eclipse shown in the diagram.

    b) Name the shadows marked p and Q.

    c) What happens to a person who would be in part X during the eclipse?

11. *State any one cause of short sightedness.*

Word list

Light energy. The form of energy that enables us to see.

Reflection. The bouncing of a ray of light as it strikes a shiny material.

Refraction. The bending of a ray of light as it passes from one medium to another.

Dispersion of light. The splitting of white light into seven distinct colours.

Lens. A material with two curved sides capable of refracting light.

Plane mirror. A flat mirror.

Luminous objects. Are objects that produce their own light.

Non-luminous objects. Are objects that reflect light from luminous objects.

Shadow. A region of darkness formed by obstruction of light by an opaque object.

Eclipse. A natural shadow formed by obstruction of light from the sun by either the moon or the earth.

Eye defect. A condition when a person cannot see certain distances clearly or normally.

Solar eclipse. An eclipse formed when the moon is in between the sun and the earth.

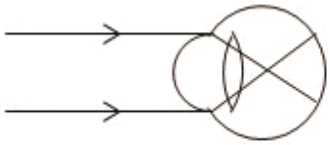
Lunar eclipse. An eclipse formed when the earth is in between the sun and the moon.

Spectrum. A band of seven colours.

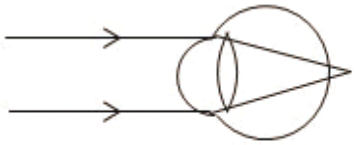
Optical instruments. Instruments that process light to make distant and tiny objects seen clearly.

Revision Exercise 6

1. State the cause of night blindness.
2. Give any **one** way through which the spread of trachoma can be controlled among people.
3. The diagrams **P** and **Q** are of eye defects. Use them to answer the questions that follow.



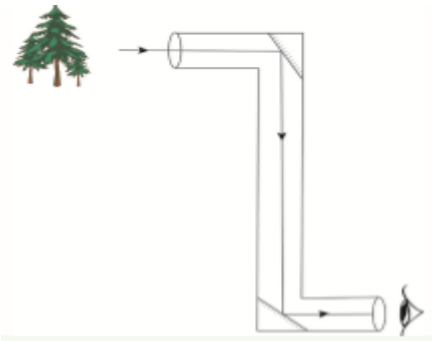
P



Q

   i) Identify eye defect **P**.
   ii) Give any **one** cause of eye defect **Q**.
   iii) Which type of lens is used to correct eye defect **P**.

4. Write any **two** ways of caring for the human eye.
5. What causes refraction of light?
6. Explain how a rainbow is formed.
7. Why are images formed in a pinhole camera inverted?
8. How is refraction different from reflection of light?
9. Give any one way a shadow is different from an image.
10. How are virtual images different from real images?
11. Why is a convex mirror used as a driving mirror?
12. Give any one characteristic of images formed in a lens camera.
13. On which principle of light does the instrument below work?



Topic 7: Interdependence of Things in the Environment

How Components of the Environment Benefit from Each Other

Brain teaser

Look at the pictures below. Can you identify the types of relationships exhibited?

What do the activities in the pictures tell you about how organisms in the environment benefit from one another?

As a human being, you need other people to stay with, water for drinking and bathing, food from plants and animals to eat and keep healthy, air to breathe in so that your body gets oxygen. All plants and animals too need water, air and food. This means that things in the environment benefit from each other. The way in which things benefit from each other is called **interdependence.**

Activity: Identifying things in the environment.

In your groups guided by a teacher, take a walk around your school compound. Record all the things that you see.

What did you see?

Record your information in a table similar to the format below.

Living things	Non-living things
1. Mango tree 2. 3.	1. Buildings 2. 3.

Environment

Environment refers to things surrounding people.

Components of the environment

- Animals
- Plants
- Water bodies
- Air
- Soil

Interdependence of plants and animals

Plants and animals depend on each other in a number of ways, in this kind of interdependence both plants and animals benefit from one another.

How animals depend on plants

- Animals depend on plants for food. E.g. bees get nectar from flowers.
- Animals depend on plants for shelter / habitat. E.g. birds make their nests in trees.
- Animals depend on plants for herbal medicine.
- Animals depend on plants for oxygen. Plants release oxygen during photosynthesis which animals use for respiration.

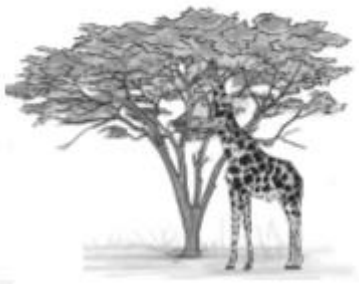


Fig: A giraffe feeding.

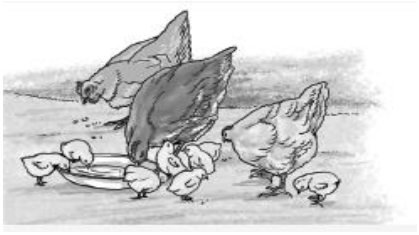
Fig: A monkey eating a fruit.

How animals depend on other animals

- Animals depend on other animals for protection. E.g. for those that move in herds, a dog at home provides protection to people.
- Some animals get food from other animals. e.g. scavengers and predators, adult animals provide milk to their young ones.
- Some animals use other animals for transport. E.g. camel, donkey and horse are all used for transport.

- Parasites get food from their hosts.

Fig: A lioness hunting.



Chicks feeding

Oxen ploughing

How plants depend on animals

- Plants get carbon dioxide from animals.
- Plants obtain manure from animals.
- Animals help in pollination of plants.
- Animals help in seed and fruit dispersal.
- Some plants feed on some animals. E.g. insect eating plants (Venus fly trap).
- Plants get care from animals. People provide care to crops.

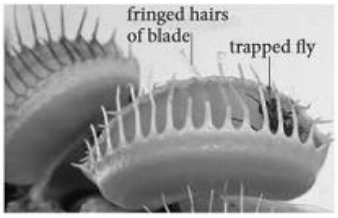


Fig: Venus Fly trap

How plants depend on other plants

- For support. Plants with weak stems climb others to get support. E.g. a passion fruit plant gets support from other plants.
- Some plants provide shade to other plants.
- Leguminous plants fix nitrogen in the soil which is used by other plants.
- Some plants also get manure from other plants.

Interdependence of living things and non-living things

How animals depend on non-living things

1. Air

Air is a mixture of gases. Such gases include nitrogen, oxygen, carbon dioxide and rare gases.

i) Oxygen

Oxygen occupies 21% in the atmosphere and very useful on earth. Life is possible on earth because of oxygen. Oxygen is useful to animals in the following ways;

- Oxygen is used for respiration i.e. making energy in body cells.
- Oxygen is used for gaseous exchange (breathing).
- Oxygen supports burning.

ii) Nitrogen

Nitrogen occupies 78% in the atmosphere and it is used in the following ways;

- Liquid nitrogen is used to preserve semen used for artificial insemination.
- Nitrogen is also used in electric bulbs, as it is inert (non-reactive).
- Nitrogen is used to make fertilizers.

iii) Carbon dioxide

Carbon dioxide occupies 0.04% in the atmosphere and it is useful to animals in the following ways;

- Carbon dioxide is used to preserve soft drinks like sodas, as it does not support the life of microorganisms like most bacteria.
- Carbon dioxide is used to stop fire as it does not support burning.

iv) Rare gases

These occupy 0.96% in the atmosphere and they include; argon, neon, krypton, helium and radon. These are useful in the following ways.

- Argon is used in electric bulbs as it is non-reactive.
- Rare gases are also used to make atomic weapons.

2. Wind

Wind is the air in motion. It is useful to animals in the following ways;

- People use wind for winnowing.
- Wind helps people to sail on water using small boat.
- Wind is also used for flying kites and balloons.
- Wind is used to dry people's clothes.

Fig: Wind helps to sail boats.

3. Water

Water occupies almost 70% of the entire earth, this means it is plenty. It is useful to animals in the following ways;

- Marine animals use water as their habitat. Such animals include; Mammals like seals, dolphins, whales and porpoises. Fish like tilapia, Nile perch and sharks. Invertebrates like molluscs such as water snails, squid, clams, oyster, mussels and octopus. Crustaceans like crabs, lobster, shrimp and prawns. Coelenterates and echinoderms all use water as their habitat and feeding places.

- People use water for generation of electricity. Hydro electricity, steam energy, tidal energy are all forms of electricity generated from water.
- People use water for irrigation. This supports farming during drought and in very dry places.
- Water is used for recreation activities like swimming, bungee jumping and rafting.
- People also use water as a raw material for industries.
- People also use water for domestic use like drinking, washing, bathing, cooking and many others.

Fig: How animals use water.

4. Soil

Soil is the top layer of the earth's surface. It is useful to animals in the following ways;

- Habitat. Animals like rodents, earthworms, termites, ants use soil as their habitat.
- Agriculture. People use soil for growing crops and grazing of animals. Crops need soil with humus to grow well.
- Construction. People also use soil for construction of their houses, factories, roads and many other projects.
- Ceramics and pottery. Soil is used for making ceramics.

Fig: A woman digging.

Fig: A banana plantation.

How plants depend on non-living things

1. Water

- Water helps in seed germination. Seeds need water to soften their testas (seed coats) during germination, this eases the bursting of the testa and so the embryo (plumule and radicle) move out.
- Photosynthesis. Plants make their own food by the help of water which is the raw material that provides hydrogen gas for the process to occur.
- Dissolves mineral salts. Water dissolves mineral salts in the ground for the plants to use them.
- Water also helps to cool plants.
- Water also softens the ground for the crops to grow well.
- Mineral salts. Water has useful mineral salts that help crops to grow well.
- Pollination and dispersal. Some flowers are pollinated by water, some plants are also dispersed by water e.g. coconuts.

2. Air

- Plants use oxygen for respiration.
- Plants use carbon dioxide for making their food. Carbon dioxide is also a raw material just like water. Carbon dioxide provides carbon which is essential for the formation of starch.
- Plants use nitrogen to make proteins. Such plants include the legumes, legumes have root nodules that store nitrogen fixing bacteria. These bacteria trap nitrogen and convert it to nitrates that they fix in the soil.
- Plants also use nitrogen to make their chlorophyll. Chlorophyll is a green pigment found in leaves of plants, it helps plants to trap sunlight energy.

3. Soil

- Soil provides nutrients and minerals required for plant growth.
- Soil holds the plants firmly in the ground.

4. Wind

- Wind helps in seed dispersal. Here wind scatters seeds in the environment which increases on their population.
- Wind helps in pollination. Different crops undergo different forms of pollination and one of the ways in through wind.

How non-living things depend on living things

- For protection against soil erosion (plants) protect soil against erosion.
- Bacteria help in soil formation.

- Plant materials help to improve on soil fertility.

Food chain

Different habitats and ecosystems provide many possible food chains that make up a food web. ***A food chain*** is the way organisms in an environment get their food. A food chain represents the flow of energy from one organism to another.

A food chain can also be the feeding relationship between organisms in the environment.

In a grassland ecosystem, a grasshopper might eat grass, a ***producer.*** The grasshopper might get eaten by a rat, which in turn is consumed by a snake. Finally, a hawk—an apex predator—swoops down and snatches up the snake. Such is an example of a food chain.

Another example may be in a pond where a mosquito larva eats the algae ***(producer),*** and then perhaps a dragonfly (***primary consumer***) larva eats the young mosquito. The dragonfly larva becomes food for a fish (***secondary consumer)***, which provides a tasty meal for a raccoon (***tertiary consumer***).

Components of a food chain

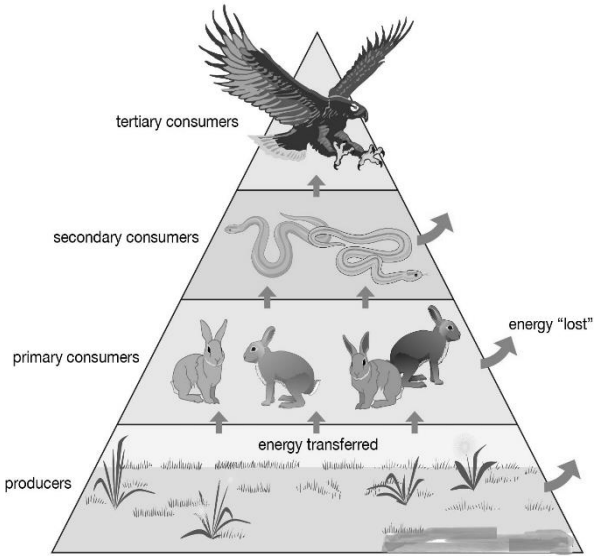


Fig: A food chain pyramid

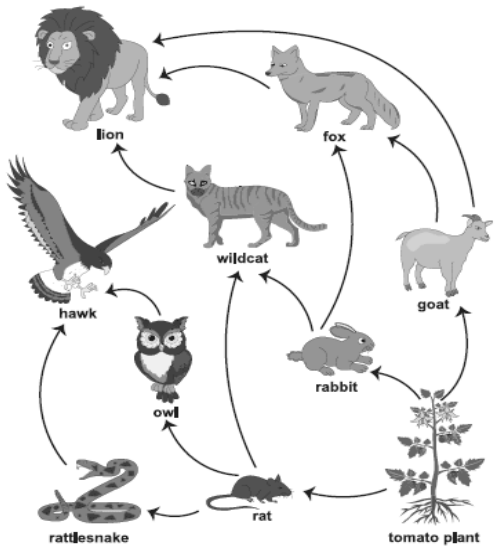


Fig: A food web

Producers

A food chain always starts with a **producer.** This is an organism that makes its own food. Most food chains start with a green plant, because plants can make their food by **photosynthesis.** These organisms make their own food by the help of sunlight energy.

Primary consumers

The primary consumers are herbivores (vegetarians), these organisms feed on vegetation. Such animals include cows, rabbits, goats, antelope, grasshoppers and many other. Organisms in this group are many in number.

Secondary consumers

The secondary consumers are living organisms that feed on primary consumers. These are majorly **carnivorous** animals and some omnivores. Carnivorous feed on meat while omnivorous feed on both meat and vegetation.

Tertiary consumers

These are living organisms that feed directly on secondary consumers. These include all the large cats like lions, cheetah, leopard, tiger and dogs like hyenas, wolves, and foxes. Other organisms like humans, eagles and owls also belong here.

Decomposers

Decomposers are organisms that break down and feed on the remains of dead organisms and other organic wastes such as dead plants, dead animals, animal wastes and many more. These organisms feed on decaying matter, such organisms include bacteria and fungi.

Fig 1: fungi on wood

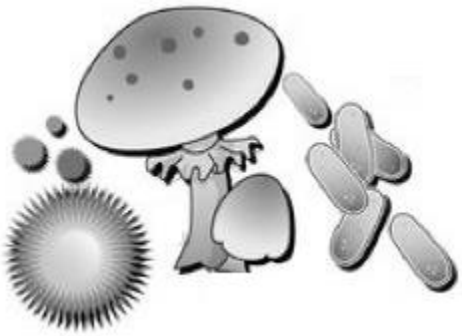
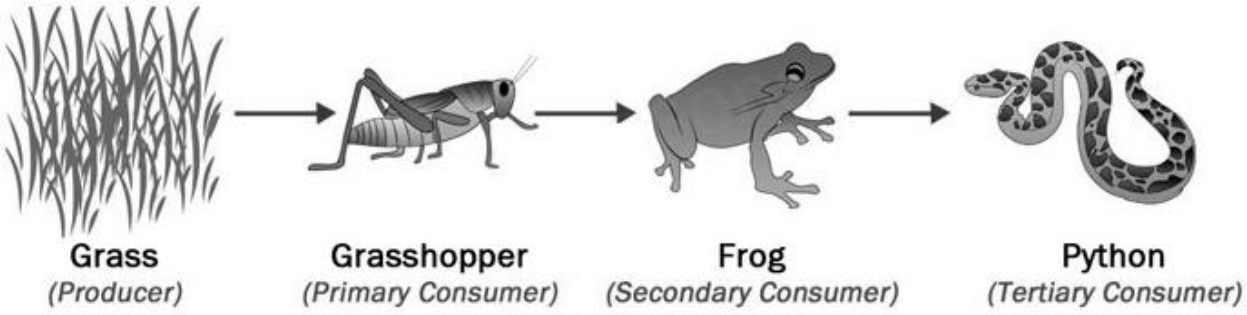


Fig 2: bacteria and fungi

Example of a food chain



Summary of interdependence of things in the environment

Components	**Ways in which they depend on each other**
How animals benefit from plants.	• Animals get food from plants. • Trees are habitats to some animals. • Trees give shade to animals.
How animals benefit from other animals.	• Some animals eat other animals as food. • Young animals get care from their parents. • Some animals provide security to others.
How plants benefit from animals.	• Plants get manure from animal dung, urine and poultry droppings. • Plants get carbon dioxide from animals and use it to make food. • Some insects and birds pollinate flowers on plants.
How plants benefit from other plants.	• Big trees provide shade to young plants. • Plants with weak stems climb others for support. • Big trees protect others from strong wind and heavy rain drops.
How animals and plants benefit from soil.	• Some animals live in the soil, *e.g. earthworms, millipedes.* • Plants get water and mineral salts from soil.
How animals and plants benefit from water.	• Animals drink water. • Water is a habitat for some animals. • Plants use water as a raw material for photosynthesis.

Agroforestry

Agroforestry is the practice of growing trees alongside other crops on the same piece of land. Agroforestry can also be defined as the practice of growing trees alongside other crops and rearing of animals on the same farm.

Growing trees and crops together

Crops and trees benefit from each other when they are grown together. There are very many ways in which crops and trees benefit from each other. Besides that, the famer also gets double income i.e. from the crops and the trees.

Factors to consider when selecting trees to grow with crops

- High maturity rate. Consider trees that grow first.
- They should have deep roots to prevent the competition of mineral with the crops.
- Multipurpose. The trees should be able to serve more than one use.
- They must have a good coppicing ability that they can easily regrow when harvested.
- Pest resistant. The trees should have the ability to resist pests.
- The trees should not have a canopy so that the crops can get access to enough sunlight.

Common local trees grown

There are very many common local (indigenous) trees that are grown in our locality together with crops. These include;

Musizi, mvule tree, mahogany tree, acacia and many others. These trees have a number of uses to people, they provide wood fuel, timber e.t.c

Common exotic trees grown

These trees were introduced in from different countries across the world. They produce soft wood and mature faster. They include conifers like pine, cypress and spruce.

Starting a tree nursery bed

Nursery bed. This is a place/area where seeds are first planted before taken to a well-prepared garden.

Reasons for growing crops in a nursery bed

- Crops are protected from harsh weather.
- Crops get enough care.
- It also enables good selection of seedling for the main garden.

Quality of good seeds for planting.

- The seeds should have a high germinating rate.
- They should be free from pests.
- They should be free from diseases.

- They should not be broken.
- They should be obtained from healthy parent tree.
- They should be of reasonable size depending on the variety.

Materials needed in starting a nursery bed

- Poles
- Hoes
- Watering can
- Polythene papers.
- Dry grass.
- Water source.
- String/tape measure.
- Seeds or cuttings.

Steps taken in starting a nursery bed

- Dig the land to break down the big lumps of earth.
- Form a mound/raise the soil above the ground level.
- Add manure to the soil. This should be well mixed with the soil.
- Level the soil with a rake.
- Put a shade using sticks, grass and banana fibre.
- Pour water to make the soil wet.
- Make holes in the soil, after the seeds can then be planted.

Care for seedlings in a nursery bed

At this time, seedlings are so fragile that they need much care for them to grow well. The following can be done in caring for seedlings;

- Watering: This should be done in order to prevent seedlings from drying up.

Fig: A girl watering crops.

- Weeding: Weeding involves removing weeds, it can be done in a number of ways but the most common one in a nursery bed is uprooting. Weeds should be removed in order to prevent the competition for nutrients, and also control pests that may be attracted by the weeds.
- Mulching: Mulching involves covering of the soil with dry plant materials, this is done majorly to keep moisture in the soil.
- Thinning: Thinning involves the removal of excess and poor growing seedlings from the nursery bed, this increases space for the proper growth of the seedlings.
- Controlling pests and diseases: Very many pests attack the seedlings when in a nursery bed and so they need constant spraying to reduce on the effects that may be caused by the pests.

Transplanting

Transplanting is the transfer of seedlings from the nursery bed to the main garden. This is always done using a trowel. Transplanting is done in the evening because of the following reasons.

- Reduce the rate of transpiration.
- Give roots time to set in and start absorbing water.
- Reduce evaporation of water from the soil.

Importance of growing crops and trees together

- Trees provide shade to crops.
- Some trees which are legumes fix nitrogen in the soil.
- Trees reduce the strength of rain drops/ hail stones hitting the crops.
- Trees act as wind breaks against strong wind.
- Trees provide wood fuel and poles.
- Trees also provide timber when harvested.
- Trees support crops with weak stems.

Rearing animals and growing crops on the same farm

Some farmers who have animals also grow crops and they have benefited from this practice in a number of ways.

- The crops provide food for the animals.
- The farm yard manure from animals is collected and used in gardens. This helps to reduce on the costs of buying fertilizers.
- The farmer earns income from both animals and plants on a farm.

Rearing and caring for animals, growing crops and trees on the same farm

Caring for animals

Animals can be cared for in the following ways;

- Giving enough feeds and water to animals.
- Treating sick animals.
- Vaccinating and deworming them.
- Building houses for domestic animals.
- Enforcing strict laws against poaching wild animals.
- Protecting habitats of wild animals.

Fig: Different ways of caring for animals.

Importance of agroforestry

- The animals, crops and some trees provide food to the farmer.
- Trees provide shade to animals and the crops.
- Animal dung and urine rot to form manure for trees and crops.
- Crops can also be prepared and used as feeds for animals.
- Trees in agroforestry help in rain formation by carrying out transpiration.

- The farmer gets wood fuel from trees. This can be in form of firewood and charcoal.

Activity
1. Define the term interdependence. *2. State any two ways plants benefit from animals.* *3. Describe any two ways in which some animals depend on other animals.* *4. List any two ways through which we can care for wild animals.* *5. What is hardening off?*

Care for trees in agroforestry

- Controlling pests and diseases.
- Weeding
- Mulching
- Pruning: this involves cutting of excess branches from a plant. This can be done to reduce the hiding places for pests.

Pests and diseases in trees and crops

A pest is a living organism that attacks and destroys plants.

Examples of pests include;

Pest	Crop affected	Damage done
Mealy bug	Pineapples, coffee	Leaves turn yellow.
Aphids	Oranges, coffee, cabbages	Wilting of crops.
Weevils	Bananas, maize, beans	Leaves turn yellow.
Codling moth	Citrus fruit	Fruits fall off
Thrips	Bananas	Premature ripening
Rodents like rats, squirrels and mice.	Cereals, potatoes, cassava	Rotting of roots
Army worms, locusts, caterpillars.	Cereals and trees	Leaves turn yellow.

Fig: Stem borer, moth and caterpillar

Diseases of crops and trees

Disease	Cause and Crop affected	Signs
Powdery mildew	Fungi, citrus fruit	Powdery patches on leaves.
Green mould	Fungi, citrus fruit	Drying of stems.
Tomato blight	Fungi, Tomatoes, potatoes	Yellow leaves.
Bacterial wilt	Bacteria, Bananas, tomatoes	Rotting of stems.
Rust	Fungi, cereals	Black spot on leaves.
Leaf spot	Fungi, maize, potatoes, cassava	Yellow leaves.
Cassava streak disease	Virus, cassava	Wilting
Cassava mosaic	Virus, cassava	Wilting

Control of pests and diseases of trees and crops

- Early planting.
- Spraying using pesticides.
- Use of insect predators. Insect predators like lady birds are used to kill larvae of insect pests like aphids.
- By crop rotation. This method of controlling pests breaks the life cycle of pests.
- By weeding.
- By uprooting infected crops.
- By spraying using fungicides to kill fungi that grow on crops.

Disadvantages of pests

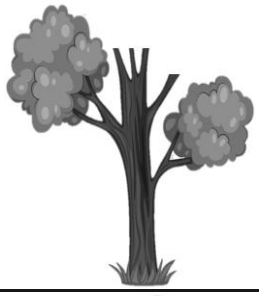
- Some pests eat and destroy the trees.
- Some pests spread the diseases to crops.
- Pests reduce the quality of yields.
- Pests reduce the speed at which the trees grow.

- They increase the cost of production since pesticides are bought to control them.

Proper harvesting of trees in agroforestry

During harvesting of trees, a right method should be used, this must ensure continuity of the tree growth.

Methods of harvesting trees in agroforestry

Method	How it is done	Illustration
Coppicing	Cutting of a tree at stump level above the ground. This encourages new shoots to grow from the stump.	
Pollarding	This is the cutting off of the top part of a tree leaving some side branches to grow. This encourages thicker growth of side branches.	
Lopping	Cutting off the side branches of a tree leaving the top part to grow.	

Activity

1. *Define the term agroforestry.*
2. *Give any two ways in which crops benefit from trees when they are grown together.*
3. *Name the method of harvesting trees for timber.*
4. *Name any one garden tool used to harvest trees.*
5. *State any one advantage of harvesting trees using coppicing method.*

6. *Give any two pests that attack trees on a farm.*
7. *State any two ways of controlling pests and diseases that attack trees.*
8. *How does weeding help to control pests in a garden?*
9. *State any one way a farmer can benefit from growing crops and rearing of animals.*

Starting and Managing a School / Home Woodlot

Introduction

An area of land used for growing trees is called ***woodlot***. In this lesson, you will know how to start and manage your own woodlot project.

Importance of a wood lot project

- Trees provide firewood for cooking.
- Trees provide timber for building and making furniture.
- Trees are a habitat for many insects, birds and small mammals.
- Trees help to conserve soil.
- Trees are also sources of income after selling wood and timber.
- Trees help to purify air. Trees take in carbon dioxide during photosynthesis and release oxygen that purifies the air.

Preparing wood for different purposes and proper storage

When trees have been cut, they can be used for different purposes like burning them to obtain charcoal, for firewood, for timber, getting poles for electricity wires and for income. So, they can be prepared in different ways for all those purposes.

Wood for firewood

It is split, dried and then kept in a shed. The purpose of splitting is to make them easily dry.

Fig: A man splitting wood.

Wood for poles

After a tree has been cut, its bark is removed and then soaked in chemicals and other wood preservatives. This prevents the wood from being attacked by pests like wood lice.

Wood for timber

The trees are cut into different sizes, the pieces are then kept in a shed for slow drying. This process is called wood seasoning.

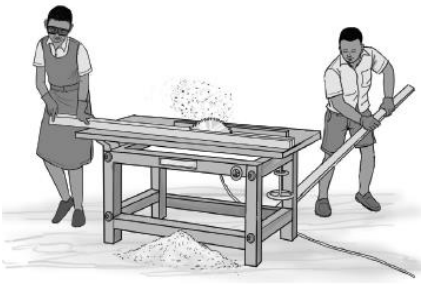


Fig: splitting wood using an electric saw.

Seasoning

This is the putting of timber in a shed to dry at a slow pace. If timber is left under direct sunshine it may get over twisted (move out of shape) this lowers its quality. The twisting of the pieces of timber is called ***warping***. So, seasoning prevents timber from warping.

Record keeping

Records are written information on activities carried out on a farm.

Activity

Prepare a simple record about the activities in your home woodlot project; include information about preparing the land, setting a nursery bed, planting, watering, spraying, transplanting, applying manure, weeding, mulching the garden and pruning. In your notebook, state the;

- Type of trees you have chosen to grow.
- The purpose of the trees you are growing.
- The different activities you have carried out when growing the trees.

Note: Remember the woodlot project may take more than one year but not one day or just weeks. Continue managing it until the trees are fully grown.

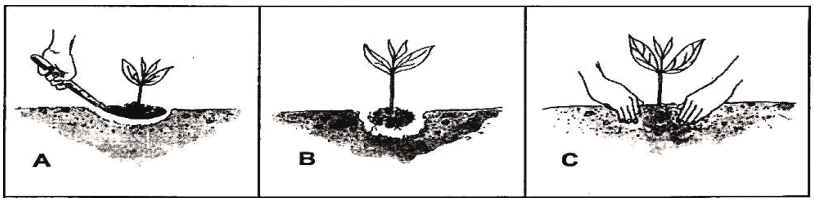
Project: My home woodlot project

Make sure you record the date for every activity below. You can prepare a table using the example shown below for recording the activities.

Date	**Activity**	**Comment**
1/Jan/2020	Buying or collecting the seeds	Activity done

- From your environment, collect the seeds of trees you would like to plant. These could be seeds of mangoes, oranges, jackfruit, eucalyptus, avocado, paw paws etc.
- Identify a small piece of land where to plant the trees, plough or dig through it.
- Make a nursery bed for planting the seeds, you can ask your parent or an elder to guide you how to make a good nursery bed.

- Make sure you put shade on the nursery bed and water the nursery bed regularly.
- When the seedlings are ready, select the healthier ones and transplant them. Your parent/guardian may still guide you on how transplanting is done. See the diagram below for more guidance.



Word list

Agroforestry. The growing of crops together with trees on the same farm.

Warping. This is the twisting of timber out of shape.

Seasoning. This is the putting of timber in a shed to dry at a slow pace.

Axe. A garden tool used for cutting and splitting wood.

Food chain. A way organisms in the environment get their food.

Food web. A combination of many food chains in an ecosystem.

Ecosystem. A community of living organisms in the environment.

Interdependence. This is the way organisms in the environment benefit from one another.

Wood lot. An area of land set aside for growing trees for wood.

Nursery bed. A place where seedlings are first planted before taken to a well-prepared garden.

Transplanting. This is the transfer of seedlings from the nursery bed to a well-prepared garden.

Trowel. A garden tool used for transplanting seedlings.

Hardening off. This is the making of seedlings get used to garden conditions.

Revision Exercise 7

1. State the meaning of the term interdependence.
2. Give any two ways animals depend on plants.
3. What is agroforestry?
4. Apart from fish, name any other animal whose habitat is water.
5. State any two importance of agroforestry.
6. Give any two ways in which plants benefit from other plants in the environment.
7. Define the term “plant staking.”
8. Write down any one crop propagated by grafting.
9. How does mulching improve on soil fertility?
10. In which way does crop-rotation help to control crop-pests?
11. State one value of bush fallowing as a farming method.
12. How do trees planted in a school garden prevent soil erosion?
13. State the importance of shade on a nursery bed.
14. List down any two activities done to care for trees in a nursery bed.
15. Write down any one method of planting crops.
16. State one reason for weeding crops.
17. Mention any one method of harvesting wood.
18. Which method is best for harvesting wood for timber?
19. Why do some fruit trees need pollarding?
20. Why is hardening off important?
21. Give any one importance of gap filling in crop growing.
22. Give any one reason why people plant trees in their compounds.
23. Of what use is a secateur important in tree growing?
24. Name any one disease of crops.
25. Use the organisms below to make a food chain. Goat, grass, leopard, fungi.
26. Of the above organisms, name the producer.

Topic 8: Population and Health

Community health and social problems

Population

Population is the total number of organisms in an area.

Human population

This is the total number of people living in an area.

Community

This is a group of people living together. For example, a school, a home, a town and a village.

Health

This is the state of complete physical, mental and social well-being.

Community health

This refers to the essential health conditions in which individuals and families within a community live.

Common sickness in a home

- Diarrhoea
- Dysentery
- Cholera
- Malaria
- Kwashiorkor
- Typhoid
- Relapsing fever
- Poliomyelitis

Causes of common sickness at home

- Poor sanitation.
- Poor personal hygiene.
- Poor nutrition (malnutrition) or inadequate food supply.
- Inadequate water supply.

- Lack of enough physical exercise.
- Alcoholism and drug abuse.
- Living in polluted areas**.**
- Ignorance about some health practice (habit).

Type of sickness	Example of sickness	Prevention
STDs	AIDS, syphilis, gonorrhoea, chlamydia, trichomoniasis, candidiasis, genital herps, genital warts	Abstaining from sex, being faithful and condom use.
Immunisable diseases	Tuberculosis, pertussis, diphtheria, poliomyelitis, measles, haemophilus influenza B, hepatitis B, meningitis, cervical cancer, tetanus, rubella pneumonia, diarrhea.	Immunization
Diarrheoal diseases	Diarrhea, dysentery, typhoid, cholera	Maintaining proper sanitation, drinking boiled water.
Air borne diseases	Tuberculosis, influenza, leprosy, ebola, Marburg, pertussis, diphtheria, pneumonia	Immunization, isolating infected people, quarantining infected people.
Water borne diseases	Cholera, typhoid, bilharziasis, dysentery, diarrhea.	Proper sanitation, drinking boiled water.
Tick borne diseases	Relapsing fever, lyme disease, anaplasmosis, African tick bite fever.	Spraying ticks.
Insect borne diseases	Malaria, sleeping sickness, elephantiasis, river blindness, yellow fever, zika fever, west Nile fever, relapsing fever, bubonic plague, typhus fever	Spraying insects using insecticides, sleeping under treated mosquito nets.
Deficiency diseases	Kwashiorkor, goitre, marasmus, rickets, anaemia, beriberi, scurvy, pellagra,	Feeding on a balanced diet.

	sterility, night blindness, poor blood clot	
Self-inflicted diseases	Lung cancer, kidney failure, emphysema, bronchitis, heart stroke, throat cancer.	Avoid smoking and alcoholism.
Food borne illnesses	Food poisoning, diarrhoea, peptic ulcers, cholera, typhoid, dysentery.	Proper handling of food.
Hereditary diseases	Asthma, sickle cell anaemia, blood cancer (leukemia)	Testing before marriage.

Inadequate water supply

It refers to a condition when water is not enough to meet people daily domestic needs.

Causes of poor water supply

- Drought
- Floods
- Wars
- Overpopulation
- Silting

A flooded home.

Pollution of water

Water associated diseases

Categories of water associated diseases.

Water borne diseases

These are diseases spread through drinking contaminated water.

Examples of water borne diseases

- Cholera
- Typhoid
- Bilharzia

- Polio
- Dysentery
- Hepatitis
- Diarrhoea

Water contact diseases

These are diseases which spread when our bodies get into contact with contaminated water.

Examples of water contact diseases

- Bilharzia
- Swimmer's itch
- Ear, eye and nose infections

Water cleaned diseases

These are diseases we get when we don't have enough water to use.

Examples of water cleaned diseases

- Scabies
- Impetigo
- Trachoma
- Conjunctivitis

Water habitat vector diseases

These are diseases which spread by vectors which spend part of their life cycle in water.

Examples of water habitat vector diseases

- Malaria
- Bilharzia
- River blindness
- Dengue fever
- Yellow fever

Ways of making dirty water safe for drinking

- Boiling
- Treating using chemicals like chlorine, calcium chloride, potassium permanganate.

Solutions / how to overcome inadequate water supply

- Government should provide clean safe water.
- Protection of wetlands and water catchment areas.
- Educating people about the importance of protecting water sources.

Effect

- Leads to spread of water cleaned and diarrhoeal diseases.

Poor sanitation

This refers to the improper disposal of wastes in places where we live or stay.

Causes of poor sanitation

- Poor disposal of human wastes.
- Poor disposal of rubbish.
- Sharing a house with domestic animals.
- Poor drainage in a home.
- Blockage and bursting of sewerage system.
- Over-crowding in a home.
- Poor ventilation of houses.

Diseases associated with poor sanitation

- Diarrhoea
- Dysentery
- Malaria
- Cholera
- Typhoid
- Bilharzia

Solution / How to control poor sanitation

- Constructing and using latrines and toilets to dispose human wastes.
- Proper disposal of rubbish.
- Constructing well ventilated houses.
- Draining stagnant water.
- Treatment of sewage before being disposed of.
- Animals should be kept in separate house with people.
- Slashing grass around our homes to destroy the hiding places for vectors and snakes.

Container where wastes are dumped in town

Effects of poor sanitation

- Easy spread of diarrhoeal diseases.
- Multiplication of vectors and germs.
- Easy contamination of water sources.
- Bad smell in the environment.

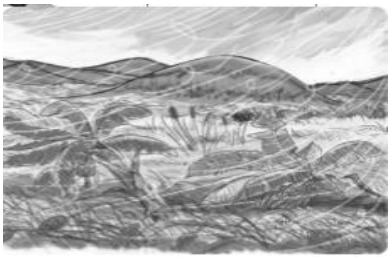
Inadequate food supply (Food insecurity)

Is a condition when the food available is not enough to meet the daily nutritional needs of the people in an area.

Causes of inadequate food supply

- High population.
- Laziness
- Poverty
- Low level of technology.
- Ignorance of good modern farming methods.
- Prolonged drought.
- Floods
- Wars
- Poor soils (infertile soils).
- Poor attitude towards farming.
- Crop pests and diseases.

Drought kills animals and plants.



Strong storms destroy crops.

Food security

Food security is a condition when the food available is enough to meet the daily nutritional needs of people in an area. Here people should have access to enough and nutritious food.

Solutions to inadequate food supply (ways of promoting food security)

- Promotion of family planning.
- Provision of soft loans to farmers to increase productivity.
- Giving irrigation facilities to people.
- Protection of wetlands to control floods.
- Growing crops which are resistant to crop pests and diseases.
- Growing crops which are resistant to harsh weather conditions (drought).
- Sensitizing school children on the value of agriculture.
- Hold workshops to sensitize people on better methods of farming.

Malnutrition

The food an animal eats every day is called ***diet***. Humans need 7 types of nutrients in their diet: carbohydrates, proteins, fats, water, fibre, vitamins and minerals. The amount of energy needed is provided mainly by our ***carbohydrate*** and ***fat*** intake. Your dietary requirements depend on your age, sex and activity.

- ***Age***: The energy demand increases until we stop growing. While children are growing they need more protein per kilogram of body weight than adults do.

- ***Sex***: Generally, males use up more energy than females.

- ***Pregnant women*** need extra nutrients for the development of the foetus.

When the body lacks food or the right type of food a person becomes ***malnourished***. A person can become malnourished if he/she eats;

- Wrong amount of food: too little or too much.
- Incorrect proportion of main nutrients.
- Lacking in one or more key nutrients.

Causes of malnutrition

- Poverty
- Ignorance about good ways of feeding.
- Alcoholism in adults.
- Sickness
- Prolonged drought and floods.
- Wars

Effects of Malnutrition

- **Coronary heart disease.** Too much saturated/animal fat in the diet results in high cholesterol levels. Cholesterol can stick to the walls of arteries, gradually blocking them. If coronary arteries become blocked, the results can be angina and coronary heart disease.

- **Obesity.** This is when a person eats too much food (carbohydrate, fat or protein).

Diseases caused by poor feeding (malnutrition)

Deficiency diseases

Fig: A child with marasmus. ***Fig: A child with rickets.***

These are diseases caused by poor feeding or lack of some nutrients in the diet.

Deficiency disease	Deficiency (lack of)
Kwashiorkor	Proteins
Marasmus	Carbohydrates
Rickets	Vitamin D

Scurvy	Vitamin C
Night blindness	Vitamin A
Pellagra	Vitamin B_3
Beriberi	Vitamin B_1

Activities to address inadequate food

- By use of improved farming methods.
- Use of family planning methods.
- Growing crops which are resistant to diseases.
- Avoid the draining of wetlands.
- Introducing irrigation farming.
- Constructing of valley dams to trap water for irrigation.

Controlling common sicknesses in a home and in the community

- Practicing proper sanitation.
- Controlling air pollution.
- Providing proper nutrition.
- Controlling air pollution.
- Ensuring proper ventilation of houses.
- Ensuring adequate water supply.
- By immunization.

Summary of Causes of Common Sicknesses in a Home and the Community.
Fill in the table below

Conditions that lead to common sicknesses	List the examples	Ways of preventing / controlling
Poor feeding (deficiency diseases)	Kwashiorkor …….. …….. ……..	• Feeding on balanced diet. • Having meals regularly.
Smoking, alcohol and drug abuse (self-inflicted diseases).	Lung cancer …….. …….. ……..	
Drinking contaminated water (Water borne diseases).	Dysentery …….. …….. ……..	
Poor sanitation and food Hygiene.	…….. …….. …….. ……	
Having unprotected sexual intercourse with infected people (Sexually Transmitted Diseases).	AIDS …….. Candidiasis …….. Syphilis	

Community health and social problems

Anti-Social Behaviour

A behaviour which is not acceptable to the members of the community is called an ***anti-social behaviour***. Such behaviour in most cases is punishable by the law. Below are some examples of anti-social behaviour, and their meaning.

Anti-social behaviour	Meaning (description)
Truancy	Act of refusing to attend school without permission.
Disobedience to authority	Refusing to abide by laws of a given society.
Stealing /theft	Taking away someone's property in their absence.
Robbery	Taking away someone's property by use of force.
Arson	Burning houses or property belonging to other people.
Murder	Killing other people.
Rape	Act of forcing a person into having sex.

Other antisocial behaviour include; defilement, bullying, alcoholism, drug abuse, violence, lying, abortion.

Causes of anti-social behaviour

- Over strictness by parents or teachers.
- Pampering of children.
- Failure to enforce rules in a community.
- Poor social environment.
- Peer influence.
- Ignorance of society rules / laws.
- Unfulfilled expectations.

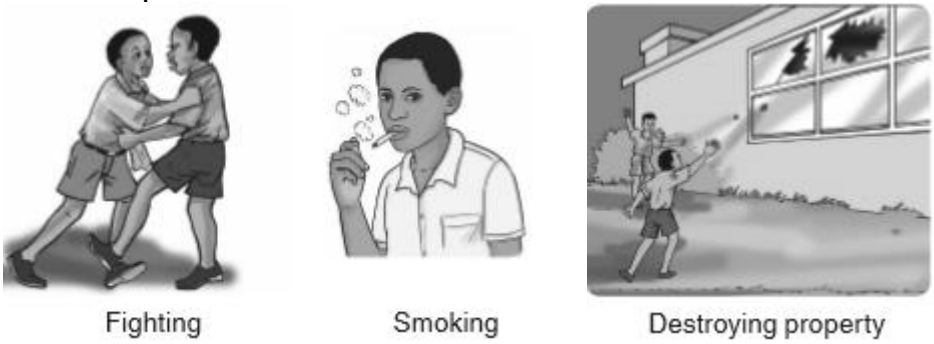


Fig: forms of anti-social behaviour.

Sexual deviations

A sexual deviation is any sexual relationship or practice which is not accepted in a society. The following are forms of sexual deviations.

- ***Bestiality*** is sexual relationship with other animals other than human beings.
- ***Homosexuality*** is sexual relationship between persons of the same sex. e.g. man and a man.
- ***Masturbation*** is stimulating one's sexual organs to fulfil sexual desire within oneself.

- ***Incest*** is sexual intercourse between close relatives.

Other sexual deviations include;

1. ***Lesbianism;*** sex between females.
2. ***Oral sex****;* sex in the mouth.
3. ***Anal sex****;* sex in the anus.

Causes of sexual deviations

- Peer influence.
- Exposure to pornography.
- Poverty
- Ignorance on dangers of sex deviations.
- Drug abuse
- Poor social environment.
- Child abuse

Effects of anti-social behaviour and sexual deviations

- They may lead to death.
- May lead to body pain or injuries.
- Leads to school dropout.
- Sexual deviations may lead to spread of STDs.
- Some forms of sexual deviation can result into complications in reproduction.
- Embarrassment and being a social misfit.

Ways of avoiding anti-social behaviour and sexual deviations

- Avoid bad peer groups.
- Educating children about body changes.
- Through guidance and counselling.
- Joining good social and health clubs.
- Punishing wrong doers.
- Avoid watching and reading pornographic materials.
- Encouraging sex education to youth in school and at home.
- Avoid giving learners harsh punishments.

Activity
1. Define the following terms: *i. Anti-social behaviour.* *ii. Sexual deviations.* *2. Mention any two causes of anti-social behaviour.*

3. State two effects of anti-social behaviour.
4. Give two ways through which you can avoid sexual deviations.

Activities to Address Health Concerns

Introduction

As people stay in the community, there are common issues which affect their health. This can be outbreak of diseases, poor sanitation, lack of clean water in the community and food shortage. These issues which affect the health of people in the community are called ***health concerns***.

Below are some of the activities carried out to address these issues:

1. Care for homes:

This can be done by;

- Proper disposal of wastes.
- Draining stagnant water.
- Providing good nutrition.
- Treating of the sick.
- Supply of clean water.

2. Health surveys: A health survey is a process of finding out the health status of people in a society. The information collected enables the leaders to identify the problems of people and plan for solutions.

Information gathered during a health survey

- Kind of food people eat.
- Kind of houses people use.
- The health facilities in an area.
- Sanitation in the area.
- Immunization coverage.
- Food security in the area.

Importance of health surveys

- They help in planning by finding out what health facilities are in the area.
- They help to find out the sanitation and latrine coverage in an area.
- They help to find out the immunization coverage of the population in an area.
- They help to find out if people have safe water in the area.
- They help to find out information on food security in an area.

3. **Health Education:** Educating the community on matters concerning health. This can be through radios, newspapers, TV stations, etc. Issues addressed during health education may include, proper sanitation, importance of

immunization and good feeding. This is the knowledge which deals with the health concern and general being of individuals, families and communities. Health education is very important because it helps people, families and communities to address health concerns.

Importance of health education

- It helps one to value the importance of good health.
- It helps people to maintain good health through personal, family and community hygiene.
- It helps people in preventing the spread of simple diseases which would affect the society.
- It helps people to be easily mobilized in case of disease outbreak e.g. cholera.
- It reduces poor traditional beliefs about diseases.

4. **Health parades:** A health parade is an assembly organised to check on the health and hygiene of school children. Children's teeth, hair, uniforms and fingernails are checked by teachers or health prefects.
5. Other activities include immunization, feeding on balanced diet, observing proper personal hygiene, promoting family hygiene, among others.

Collecting Information on population

Kind of information gathered about population.

- Demography
- Housing information.
- Immunization
- Available health services.
- Food security

1. Demography

Demography is the study of the changing population characteristics in a given area. It involves studying the changing numbers of birth, death and diseases in a community. This study provides information about overall health of people and helps the government to plan for services needed by people.

Importance of demography

- To plan for the community services e.g. health centres, markets and water.
- The government is able to know the general health of people.

2. Housing information

This is the finding out of the number of people who sleep in permanent or temporary houses to estimate the poverty line of the people.

3. Available health services

The government needs information on these services to be able to deliver medical services quickly and monitor the health of its population.

Information available on health services include

- Immunization
- Family planning.
- Treatment of infections.
- Provision of water.
- Control of epidemic diseases.

Advantage of collecting information on available health services

- It helps in quick delivery of medical services.
- Control of epidemic diseases.
- It helps the government to monitor the health of people.

4. **Immunization**

   The introduction of vaccines into the body to produce anti bodies against certain diseases.

   Collecting information on immunization

   Information includes;

   - Number of immunization centers.
   - People involved in carrying out immunization.
   - Days and time on which immunization is done.
   - Number of children immunized.

Importance of immunization

- To protect children against the childhood immunisable diseases.
- Reduce the rate at which children die / reduces infant mortality rate.

Activity

Move around your community and record your findings about the following.

	Family Identity (home name)					
Item checked	A	B	C	D	E	F
Latrine/toilet						
Bathrooms						
Rubbish pit						
Kitchen						
Plate stand (rack)						
Clean compound						
Clean water source						

Key

(√) **For item found (x) For item not found.**

- Find out the health problems which are likely to affect families which do not have the above items.

Word list

Sanitation. The general cleanliness of the environment.

Malnutrition. A state of poor feeding.

Sexual deviation. A sexual act that is not acceptable in the community.

Immunization. The introduction of vaccines in the body to cause immunity.

Water borne disease. A disease that is spread through drinking contaminated water.

Deficiency disease. A disease that is caused by lack of certain food values in the body.

Health. A state of mental, spiritual and physical well-being.

Population. The total number of people living in an area.

Antisocial behavior. An act that is not allowed in a community.

Truancy. The act of absenting or refusing to go to school.

Arson. The crime of setting a fire with intent to cause damage.

Bullying. The act of intimidating a weaker person to do something.

Also, the act of making life unpleasant for another person.

Teasing. The act of making annoying remarks/ fun of someone.

Health concern. Health problems in a given community that need immediate attention.

Revision Exercise 8

1. Define the term human population.
2. Write down any four health concerns common in your area.
3. Identify any three human activities that can lead to poor sanitation.
4. Suggest one reason why water sources should be protected.
5. Give any two activities which can improve sanitation at home.
6. State any two health dangers which can result from poor sanitation in the community.
7. Mention any three examples of anti-social behaviour common in a school.
8. Identify any three ways one would avoid anti-social behaviour.
9. Give any two natural changes which can result into poor water supply in the community.
10. How has the government of Uganda tried to improve on provision of clean water supply in your community?
11. What health problems can result from poor water supply in your area?
12. List down any two natural changes that can result into inadequate food in a community.
13. Suggest any two ways government can encourage and promote adequate food supply in the community.
14. Outline two ways we can promote health in a community.
15. Give any two values of budgeting in a family.
16. State any two values of health surveys in an area.
17. Define the term demography as used in health education.
18. Identify any one health danger of staying in over-crowded areas.
19. Give any two reasons why immunization of children is important.
20. State the importance of a child health card to a parent.
21. Why should expectant mothers be immunized with Tetanus Toxoid?
22. How is a health centre important to people in the community?

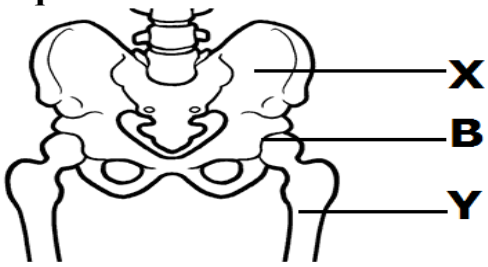
Sample Test Paper

SECTION A: 40 MARKS

Questions 1 to 40 carry one mark each.

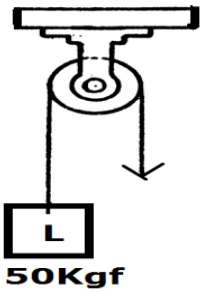
1. Give any **one** example of a scavenger bird.
2. What are the standard units for measuring mass?
3. Which type of lens is used to correct short sightedness?
4. State any **one** cause of silting of water bodies.
5. Give a reason why sound is not able to pass through a vacuum.
6. Which type of bee is commonly seen around flowers?
7. Name any **one** permanent birth control method in females.

Use the diagram below to answer questions 8 and 9.



8. Name the bone of the skeleton marked **X.**
9. What type of joint is indicated by letter **B**?
10. How does sound travel from its source?
11. Give a reason why sound travels fastest in solids.
12. State any **one** danger of taking unprescribed drugs.
13. Give any **one** effect of alcohol to an individual.
14. Name any **one** substance that makes up urine.
15. Which body organ regulates the level of water in the body?
16. State any **one** importance of sweating to the body.
17. What is the similarity between the function of anthers and testis?
18. Which secondary sex characteristic is common in both adolescent boys and girls?
19. Which part of a flower produces ovules?
20. Give a reason why the injured part of a person with a burn should be dipped in cool water for 10 minutes.

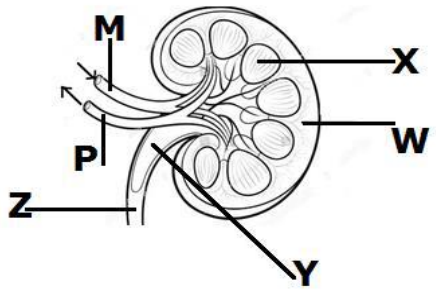
Use the diagram below to answer the questions 21, 22 and 23.



21. Which type of pulley is shown in the diagram?
22. In which class of levers is the above machine?
23. How is the above pulley useful in a school?
24. Which force enables rain to fall from the sky?

25. Convert 30°C to °F.
26. In the space below, draw a compound trifoliate leaf.
27. State any **one** way of maintaining a VIP latrine.
28. Give any **one** example of a fungi.
29. State the role of chlorophyll during photosynthesis.
30. Apart from boiling water, give any other way water can be made safe for drinking.

Use the diagram below to answer questions 31, 32 and 33.

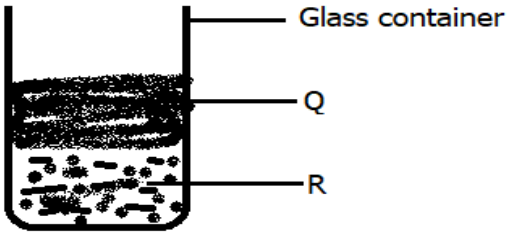


31. Name part marked **Y**.
32. State the function of part **W**.
33. How is the function of blood vessel **M** different from that of **P**?
34. Which part of the human skeleton protects the spinal cord?
35. State any **one** cause of fever.
36. Give any **one** example of a flat bone in the body.
37. How is pitch of sound different from volume of sound?
38. Give any **one** difference between drug abuse and drug misuse.
39. Apart from the skin and the liver, name any other excretory organ.
40. How are echoes prevented in a music theater?

SECTION B: 60 MARKS

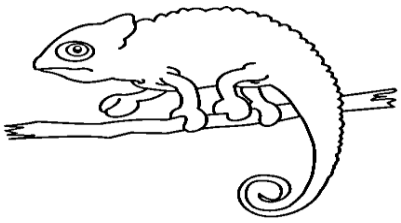
Questions 41 to 55 carry four marks each.

41. a) Name the outermost layer of the human skin.
    b) State any **one** waste product removed by the skin.
    c) Apart from removing wastes, mention **two** other functions of the human skin.
42. The diagram below shows a glass container into which water and cooking oil were poured. The two liquids settled as shown. Study and use it to answer the questions that follow.



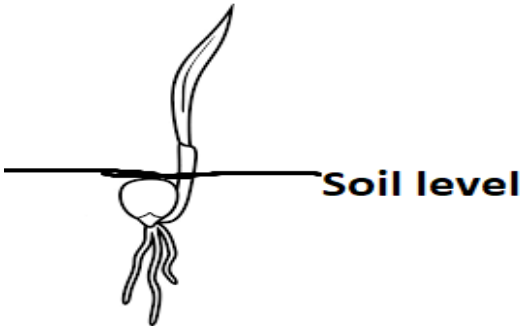
a) Which of the two liquids is represented by:
b) State any **one** method that can be used to separate the two liquids.
c) Why has the liquid **Q** settled on top of liquid **R**?

43. The diagram below shows an animal commonly found in the school surrounding. Use it to answer the questions that follow.



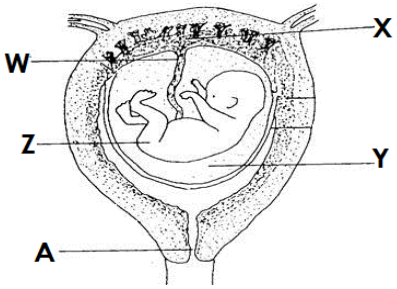
a) To which group of animals does this animal belong?
b) Name any **one** other animal that belongs to the same group as the above.
c) How does the animal protect itself from its enemies?
d) How is the above animal useful to the environment?

44. The diagram below shows a germinating seed. Use it to answer the questions that follow.



a) State the type of germination shown above.
b) Where does the seed above store food used during germination?
c) Give an example of a crop with the same type of germination.
d) Apart from moisture, state any other condition necessary for seed germination.

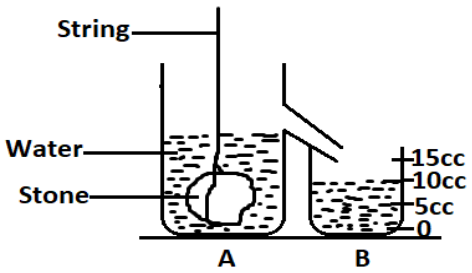
45. The diagram below shows a human foetus in the uterus. Study and use it to answer the questions that follow.



a) Name parts marked **Y** and **Z**.
b) State the importance of parts **X** and **W**.

46. a) How does heat travel through the following?
i) Solids
ii) Vacuum.
b) State any **two** importance of heat transfer by convection.

47. An irregular object was lowered into container **A** containing water. The water it displaced was collected in container **B** as shown below.



a) Name the containers **A** and **B**.

b) What is the volume of the irregular object?

c) Calculate the density of the irregular object if its mass is 60g.

48. a) State the method that can be used to separate:

i) Fruit seeds in juice.

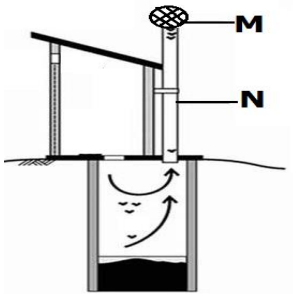
ii) Millet seeds mixed with its husks.

b) Give the importance of the following steps in cleaning clothes at home:

i) Sorting.

ii) Soaking.

49. The diagram below is of a Ventilated Improved Pit (VIP) latrine. Use it to answer the questions that follow.



a) Name parts marked **M** and **N**.

b) Give the function of part marked **M**.

c) What do the arrows in the diagram show?

50. a) What causes fainting?

b) State any **two** conditions that can lead to fainting.

c) Why are the legs of a person who has fainted raised higher than the legs when giving first Aid?

51. a) What is soil erosion?

b) Give any **one** type of soil erosion

c) Give **two** ways erosion can be controlled in hilly areas.

52. a) Give any **two** properties of magnets.

b) State any **two** uses of magnets to people.

53. Use the diagram below to answer the questions that follow.

a) What name is given to the above equipment?
b) Why is the above equipment always painted with bright colours?
c) Why is such equipment recommended to be in schools?
d) What gas is contained in the above equipment?

54. a) Give **two** sources of direct current electricity.
b) What causes static electricity.
c) Name any **one** example of static electricity.

55. a) What germ causes dysentery?
b) Give any **two** signs of dysentery.
c) State any **one** type of dysentery.

Sample PLE paper 2012

SECTION A: 40 MARKS
Questions 1 to 40 carry one mark each.

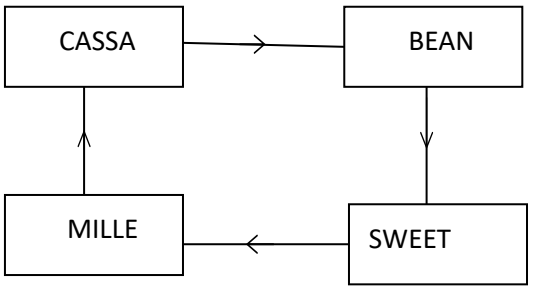
1. Give any one example of a root tuber.
2. State one disadvantage of keeping finger nails long.
3. What is the importance of including calcium in chicken feed?
4. What is the use of a wedge as a simple machine?
5. Name the type of lens used to correct long sightedness.

The diagram below shows a person with an injury. **Use it to answer question 6**

6. How useful is the structure marked **M** to the injured person?
7. Apart from mosses, give one other example of a spore bearing non-flowering plant
8. Name any one mammal that lives in water.
9. Give a reason why people keep cats in their homes.
10. Why does a farmer cut off leaves of a banana sucker before planting it? To reduce the rate of transpiration
11. Apart from pasteurizing, give any one way milk can be prevented from going bad.
12. Why is it important for a husband and his wife to be treated together if they have got gonorrhea?

13. Why do farmers carry out debeaking in poultry farms?
14. State any one habit which helps to promote oral health.
15. State one use of soil to earthworms.

The diagram below shows a crop rotation cycle

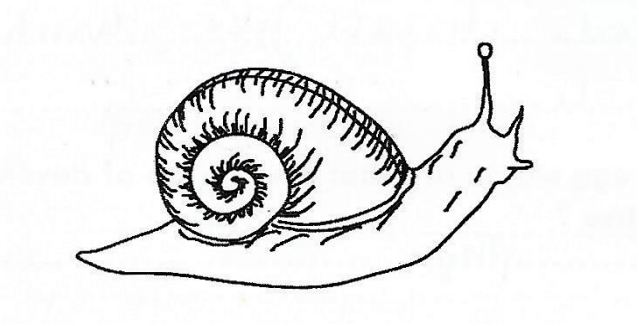


16. What is the importance of beans in this cycle to the rest of the crops?
17. Which communicable disease in human affects both the skins and the skeletal system?
18. Apart from carbohydrates, name one other class of food that gives the body energy.
19. In which way is the sun important in the formation of rain?
20. State any one method used to make dirty water clean.
21. How does a sweater help to keep a person warm during cold days?

The diagram is a head of a bird. Use it to answer question 22

22. What does a bird with this type off beak eat?
23. Give any one effect of poor disposal of human wastes in the environment.
24. Apart from the egg stage, at what other stage of development is a housefly not active?
25. Why does a clay-made charcoal stove use less charcoal than a metallic one?
26. Apart from production of eggs (ova), mention one other use of the ovaries in the human body.
27. State one way in which a child gets natural immunity
28. State the injury that results from tearing of muscles.
29. Which gas is used by food manufacturers for preserving drinks like sodas?

The diagram below is of a common animal. Use it to answer question 30



30. Which disease does the above animal spread humans?
31. Why are the legs of a person who has fainted raised higher than the

head as a way of giving first aid?

32. What name is given to a place where seedlings are grown before transplanting?
33. Which part of the human ear equalizes pressure in and outside the ear?
34. Name one other disease caused by fungi in human s apart from ring worm.
35. What class of food is digested in the stomach?
36. Give any one advantage of castrating farm animals.
37. In the space below draw a simple diagram of a fibrous root system.
38. How are plastics and glass materials dangerous to soil?
39. Apart from liquids, name one other state of mater through which heat is transferred by convection.
40. In which human body organ does gases exchange take place?

SECTION B: MARKS 60 MARKS

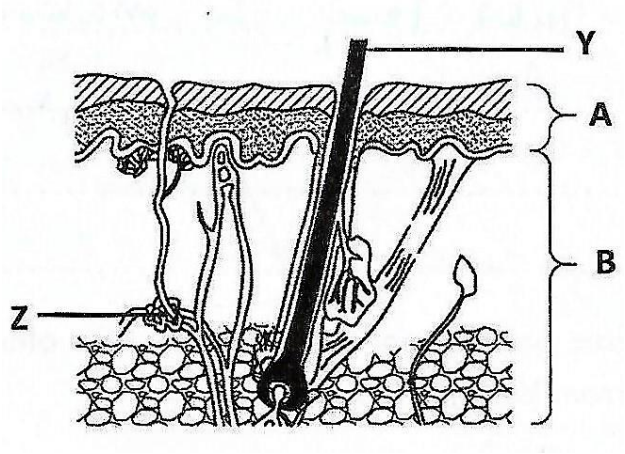
Questions **41** to **55** carry four marks each

A	B
Chameleon Toad Bat Ostrich	Mammals Birds Reptiles Amphibians

41(a) Gives any two examples of a physical change

(b) State two characteristics of a chemical change

The diagram below of a human skin. Use it to answer questions 42



42.(a) Name the layers A and B

(i) A

(ii) B

(b) Give the function of the part labeled Y and Z

(i) Y

(ii) Z

43. (a) Name the two types of pollination in flowering plants

(b) Write any two agents of pollination

44. (a) Give any two disadvantages of keeping local breeds of poultry

(b) Apart from getting money, give any two ways a farmer benefits from keeping poultry.

45. Match each animal in A with the correct group to which it belongs in B

(a) Chameleon

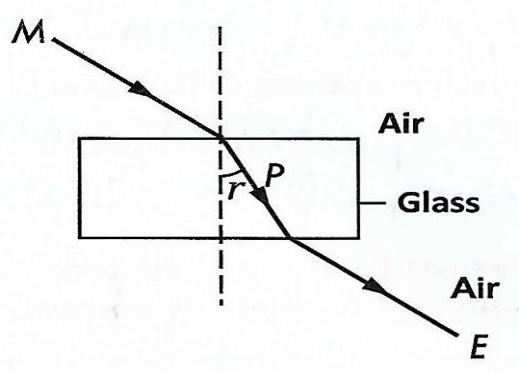
(b) Toad

(c) Bat

(d) Ostrich

The diagram below shows how light passes through a glass block**.**

Study and use it to answer question 46.



46. (a) Name the rays M and P

(i) M

(ii) P

(b) Name the angle marked ***P***

(c) Give a reason why ray ***P*** bends as shown in the diagram.

47(a) Give one reason why dehydration is dangerous to humans

(b) In which way is oral rehydration solution (ORS) a good treatment for diarrhea?

(c)Apart from taking ORS, how else can one prevent dehydration?

(d) How can a person preparing ORS prevent it from contamination?

54. (a) Name the type of joint found in each of the following parts of the human body

(i) Shoulder.

(ii) Wrist.

(b) What advice would you give to a person to keep the skeletal system in a healthy working condition?

48. The table below, shows source of food, the food nutrients in it and the related deficiency disease. Complete it correctly.

Source of food	**Food nutrient**	**Deficiency disease**
Fruit	Vitamin C	----------
Beans	----------	Kwashiorkor
----------	vitamin	Night blindness
Iodized salt	Iodine	----------

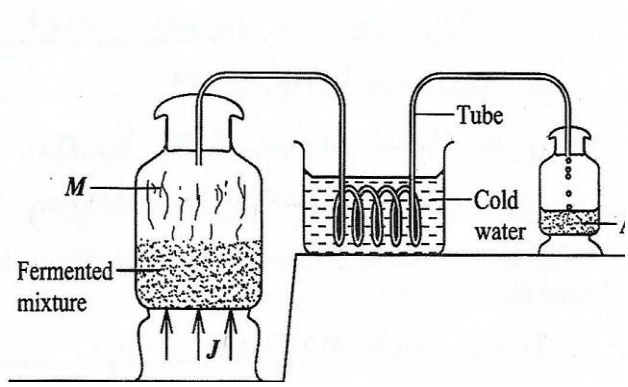
49. (a) Which type of blood vessels return blood to the heart?

(b) What is the function of valves in the blood vessels during blood circulation?

(C) What type of blood is carried by most blood vessels with valves?

(d) Give any one waste materials carried by blood.

The diagram below shows one of the methods of preparing alcohol. Study and use it to answer questions 50.



50(a) Name the methods used in the diagram

(b) What do the arrows labeled ***J*** represent?

(c) Why is the tube passes through cold water?

(d) What process forms ***M?***

51(a) Apart from ante –natal care, give two other ways of caring for pregnant women.

(b) In which one ways should pregnant women protect their unborn babies from malaria?

(c) Why are pregnant women advised not to smoke?

52. (a) Name the force that brings down all objects thrown up.

(b) (i) When a piece of paper and as rubber are dropped from the same height, which one reaches the ground first?

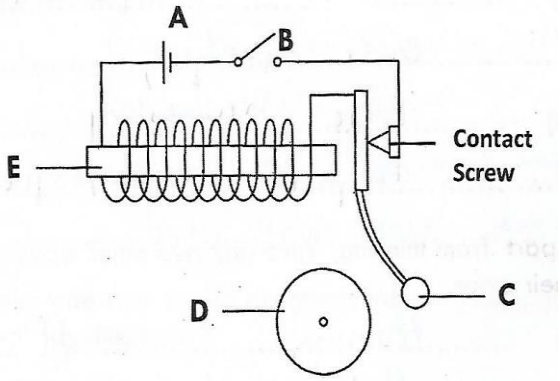
(ii) Give a reason for your answer in (b) (i) above.

(c) Why do some objects float on water?

53. (a) State any two reasons why farmers thin their crops.

(b) Apart from thinning, give two other ways farmers care for their crops.

Study the diagram of an electric bell below and use it to answer question 55.



55. (a) Name the part marked A and C

(i) A

(ii) C

(b)What will happen to E when B is closed?

(C) How useful is part D on the electric bell