



## Supplementary Study Materials for Underperforming Schools

# Integrated Science JSS 3

March 2021



**NOT FOR SALE**



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## TEACHER'S GUIDE

Dear teacher,

The integrated science syllabus covers a wide range of science subjects such as physics, chemistry, biology, agricultural science, earth science, home economics and mathematics.

The approach to teaching this subject is more of demonstration, problem solving and analysis such as experiment and field work.

This material is divided into thirty (30) units which is a guide to problem solving, demonstrations, group work by the pupils and constant assessment in the thirty (30) units

The integrated science B.E.C.E paper is divided into three sections:

SECTION A- forty (40) objective questions to answer all

SECTION B- six (6) essay assorted questions from the various subject components to answer four (4)

SECTION C- test of practical work divided into three different parts- part 1, part 11 and part 111 to answer only four (4) question at least one question from each part.

Sample question papers are printed at the back to help the teacher visualize the nature of the B.E.C.E assessment. This material will help you as a supplement to your approach to the teaching syllabus.

The teaching learning process should be a child centered and environment friendly as your science laboratory is the environment.

Diagrams should be well drawn and labelled. The illustrations guide you the teacher and the pupil to achieve this objective.

A special feature of this work is that it contains a lot of worked examples and ample supply of exercises that will help the pupils to understand the concepts and principles underlying each topic.

Misprints are a plague to authors. Although every care has been taken to check mistakes and misprints, it is not too much to expect imperfections, especially when we are reminded of the phrase "to err is human". All such imperfections when brought to our notice will be duly incorporated in the next revised edition

We wish you and the children well.

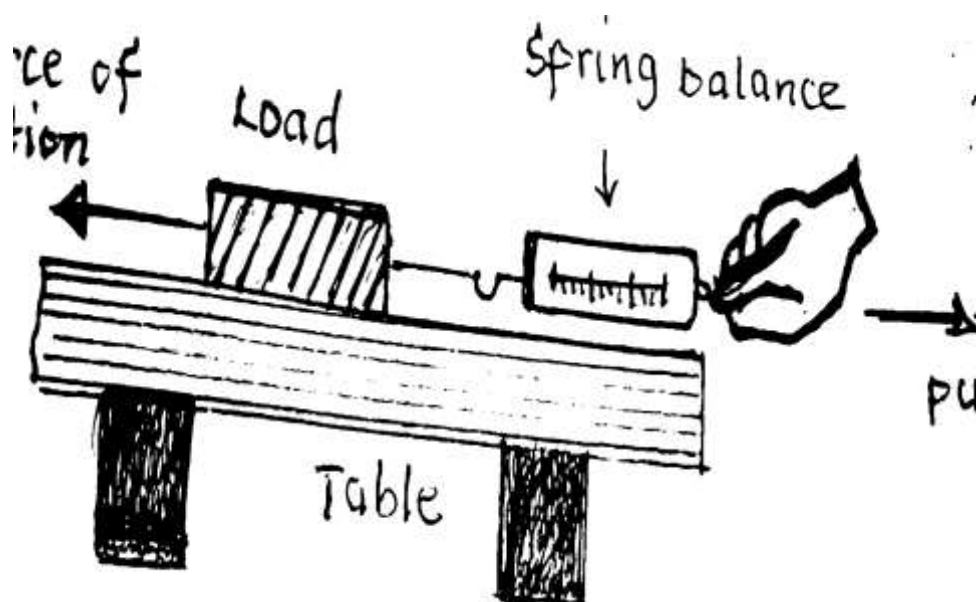
## INTEGRATED SCIENCE

### UNIT ONE (1) Force Work, Power and Energy

#### Learning Outcome

At the end of the lesson, pupils should be able to:

1. Explain what is meant by the terms Force, Work, Power and Energy
2. Describe the different types of force.
3. Demonstrate the effects of force on an object
4. Outline the advantages and disadvantages of friction
5. Calculate force, work, power and energy



#### FORCE, WORK, POWER AND ENERGY

Force can be defined as a push or pull of an object or body.

Anything which tends to change the state of an object or body in motion or at rest in a straight line.

#### Effects of force on an object or body

Force can

1. set an object into motion
2. change the speed of object
3. stop an object from moving
4. change the direction of a moving object



**Instrument:** spring balance  
S. I. Unit Newton (N)

**CALCULATION OF FORCE**

1. Calculate the force involved when a car of mass 250 Kg move with an acceleration of  $30\text{m/s}^2$

**Solution**

Force = Mass x Acceleration

$$\begin{aligned} F &= m \times a \\ &= 250\text{kg} \times 30\text{m/s}^2 \\ &= 7500\text{N} \\ \text{Force} &= 7500\text{N} \end{aligned}$$

2. Karim pushed a car of mass 500kg moving at a speed of 50m/s in 5 seconds. What force did Karim apply to move the car?

**Solution**

$$\begin{aligned} F &= \frac{\text{mass} \times \text{speed}}{\text{time}} \\ &= \frac{m \times s}{t} \\ &= \frac{500\text{Kg} \times 50\text{m/s}}{5\text{s}} \\ &= 5000\text{N} \end{aligned}$$

**Types of Force**

- |                        |                      |
|------------------------|----------------------|
| 1. Force of gravity    | 7. Tensional force   |
| 2. Compressional force | 8. Centripetal force |
| 3. Centrifugal force   | 9. magnetic force    |
| 4. Adhesive force      | 10. Cohesive force   |
| 5. Electrostatic force | 11. Frictional force |
| 6. Contact force       |                      |

**INERTIA** – is the tendency of body to resist being in motion or at rest



## **FRICTION**

Friction can be defined as

- A force which prevents one surface from moving over the other which is touching
- A force which opposes motion
- A force which retards motion

### **Two Types**

1. Static/Limiting friction
2. Dynamic/rolling/sliding friction

### **Advantages of Friction**

Friction

1. prevents falling whilst walking
2. is used in brakes of cars, lorries, bicycles etc
3. prevents skidding
4. is used in filing by gold smiths and carpenters
5. used in the sharpening of knives

### **Disadvantages of Friction**

Friction

1. causes heat and noise
2. causes wear and tear
3. smooth shoes cause falling
4. smooth tyres - causes accident
5. slippery hand s- causes breakages of clay and fragile materials

### **Way of reducing friction**

1. By lubrication (oiling or greasing)
2. Using rollers and bearing
3. Using ball and socket

### **Assignment**

1. a) Define force
- b) State three effects of force on objects
- c) List down any seven (7) types of force
2. a) Write down the mathematical expression of force
- b) Calculate the force need to pull a 5000g bag of rice with an acceleration of  $25\text{m/s}^2$
3. State two
- a) advantages



- b) disadvantages
- c) ways of reducing friction

## WORK, POWER AND ENERGY

### A. WORK

1. Work is said to be done when a force moves an object through a distance in the direction of the applied force.

OR

2. Work is the product of force and distance.

Mathematically

Work done (w)= Force(F) x distance(d)

$$W = F \times d$$

S.I UNITS

Force- Newton (N)

Distance- Metre (M)

Work done- Joule (J) or Newton metre (Nm)

### EXAMPLE

A force of 150N was applied to move a loaded wheelbarrow to a distance of 6m. calculate the workdone to move the wheelbarrow.

### SOLUTION

Work done= Force x distance

$$W = F \times d$$

$$= 150N \times 6m$$

$$= 900J$$

Work done = 900J

### B. POWER

Power can be defined as

- 1. The rate of doing work.
- 2. Work done per unit time.

Mathematically

Power=  $\frac{\text{work done}}{\text{Time}}$

Time

Power=  $\frac{\text{Force x distance}}{\text{Time}}$

Time

$$\text{Power} = \frac{F \times d}{T}$$



**S.I UNITS**

Force- Newton (N)

Distance- Metre (m)

Time- Second (s)

Work done- Joule (J)

Power- Watts (W) or Joule per second (J/s)

**EXAMPLE**

1. A wheelbarrow loaded with stones, does 320J of work in 4 seconds.

What is the power of the wheelbarrow?

**SOLUTION**

$$\begin{aligned} \text{Power} &= \frac{\text{Work done}}{\text{Time}} \\ &= \frac{320\text{J}}{4\text{ s}} \\ &= 80\text{ J/s} \\ &= 80\text{ Watts} \end{aligned}$$

2. What is the power expended by a mass of 80N moving up a staircase of distance 15m in 20s?

**SOLUTION**

$$\begin{aligned} \text{Power} &= \frac{\text{Force} \times \text{distance}}{\text{Time}} \\ &= \frac{80\text{N} \times 15\text{m}}{20\text{s}} \\ &= 60\text{ J/s} \end{aligned}$$

$$\text{Power} = 60\text{ Watts}$$

**C. ENERGY**

Energy is the ability or capacity to do work. S.I unit of energy is JOULE(J).

**SOURCES OF ENERGY**

1. Sun
2. Food
3. Electricity
4. Battery
5. Wind
6. Fuel



7. Fire
8. Biogas
9. Tidal waves
10. Geothermal
11. Nuclear waste

### FORMS OF ENERGY

1. Mechanical energy e.g Friction
2. Chemical energy e.g food, fuel
3. Solar energy e.g sun
4. Light energy e.g sun, electricity etc
5. Electrical energy e.g battery, electricity etc
6. Sound energy e.g flutes, drums etc
7. Heat energy e.g sun, fire, electricity etc
8. Nuclear energy e.g nuclear waste

### TYPES OF ENERGY

Two types exist

1. Potential energy
2. Kinetic energy

### POTENTIAL ENERGY

Potential energy is the energy a body or object possess by virtue of its position at rest or not moving. E.g

- a. A book on a table.
- b. A fruit about to fall.
- c. Water in a reservoir or dam.
- d. A stationary car.

Mathematically

Potential energy= mass x force of gravity x height

$$P. E = m \times g \times h$$

### EXAMPLES

A stone of mass 10 kg fell from a height of 80m if the acceleration due to gravity is

10m/s<sup>2</sup>. Calculate the potential energy of the stone.

### SOLUTION

Potential Energy= ?



Mass= 10kg

Height= 80m

Gravity= 10m/s<sup>2</sup>

P.E = m x g x h

$$= 10\text{kg} \times 80\text{m} \times 10\text{m/s}^2$$

$$= 8000 \text{ J}$$

P.E = 8000J

Potential energy depends on

- a. The mass or weight of an object.
- b. Acceleration due to gravity.
- c. Weight of the object

### 1. KINETIC ENERGY

Kinetic energy is that energy a body possess due to motion or when it is moving. E.g

- a. A moving car
- b. A rolling stone
- c. A flying bird
- d. A fired bullet
- e. A falling mango

The faster the object moves, the greater the kinetic energy.

Kinetic energy depends on

- a. The mass or weight of an object.
- b. The velocity or speed of the object.

Kinetic energy can be expressed as

1.  $K. E = \frac{1}{2} mv^2$  or  $K. E = \frac{mv^2}{2}$

2

2.  $Mass(m) = \frac{2 \times K. E}{v^2}$

v<sup>2</sup>

3.  $Velocity(V) = \frac{2 \times K. E}{M}$

M

#### EXAMPLE

- 1. A bullet of mass 10kg was fired from a gun and moved with a speed of 20 m/s. what was the kinetic energy of the bullet?

#### SOLUTION

K.E =?

Mass(m) = 10kg



$$\begin{aligned} \text{Velocity}(v) &= 20 \text{ m/s} \\ &= \frac{mv^2}{2} \\ &= \frac{10\text{kg} \times 20 \text{ m/s} \times 20 \text{ m/s}}{2} \\ &= 10 \times 10 \times 20 \\ &= 2000\text{J} \end{aligned}$$

$$\text{Kinetic Energy} = 2000\text{J}$$

2. A ball of mass 200g was released from a height with a velocity of 30m/s. find the kinetic energy of the ball.

SOLUTION

K.E =?

$$\text{Mass (m)} = \frac{200\text{g}}{1000} = 0.2 \text{ kg}$$

$$\text{Velocity (v)} = 30 \text{ m/s}$$

$$\begin{aligned} &= \frac{mv^2}{2} \\ &= \frac{0.2\text{kg} \times 30 \text{ m/s} \times 30 \text{ m/s}}{2} \\ &= 0.1 \times 30 \times 30 \\ &= 1 \times 3 \times 30 \\ &= 90\text{J} \end{aligned}$$

$$\text{Kinetic Energy} = 90\text{J}$$

B. E. C. E 1999 Q 6a

3. A ball of mass 400g is dropped from a height with a velocity of 40 m/s. find the kinetic energy.

SOLUTION

K.E =?

$$\text{Mass (m)} = \frac{400\text{g}}{1000} = 0.4 \text{ kg}$$

$$\text{Velocity (v)} = 40 \text{ m/s}$$

$$\begin{aligned} &= \frac{mv^2}{2} \\ &= \frac{0.4\text{kg} \times 40 \text{ m/s} \times 40 \text{ m/s}}{2} \end{aligned}$$



2

$$\begin{aligned} &= 0.4 \times 40 \times 40 \\ &= 2 \times 4 \times 40 \\ &= 320\text{J} \end{aligned}$$

Kinetic Energy = 320J

B.E.C.E 2001 Q5b

4. Calculate the velocity of a man whose mass is 180 kg has a kinetic energy of 4410 J and is moving at a constant velocity.

SOLUTION

Velocity (v) = ?

Mass (m) = 180 kg

Kinetic energy (K.E) = 4410J

$$V = \sqrt{\frac{2 \times KE}{M}}$$

$$= \sqrt{\frac{2 \times 4410}{180}}$$

$$= \sqrt{49}$$

Velocity = 7 m/s

### THE LAW OR PRINCIPLE OF CONSERVATION OF ENERGY

The law or principle of conservation of energy states that "energy can neither be created nor destroyed but can be changed or transformed from one form to another".

Example of energy transformation include

a. Switching on a television

Mechanical energy → Electrical energy → sound energy → Light energy → Heat energy

During photosynthesis

Light energy (solar energy) → chemical energy

a. Switching a torch light on

Chemical energy → Electrical energy → Light energy → Heat energy

b. A falling mango



Kinetic energy → potential energy

This principle or law means energy before reaction or change is equal to energy after reaction or change.

**Assignment**

1. Classify the following into potential or kinetic energy:
  - i. A stone from a catapult
  - ii. A mango that is about to fall
  - iii. A ball thrown by a goalkeeper
  - iv. A hammer on a table.
  - v. A player that is driven with a ball.
  - vi. A boy that is climbing a hill
  - vii. A book on a shelf
  
2. A body of mass 5g is lifted through a height of 10m. Calculate the potential energy of the body if the force of gravity is  $10\text{m/s}^2$ .
  
3. A body of mass 10g is moving with a speed of 2m/s. What is the kinetic energy of the body?

**UNIT Two (2) Measurement**

**Learning Outcome**

At the end of the lesson, pupils should be able to:

1. List some common physical quantities
2. identify and use appropriate instruments to measure different physical quantities
3. Identify and use the appropriate SI units for different physical quantities

**MEASUREMENT – S. I. UNITS**

- |                 |   |  |
|-----------------|---|--|
| 1. Force        | - | Newton (N)   |
| 2. Mass         | - | Kilogramme (Kg)  |
| 3. Acceleration | - | metre per second 2 ( $\text{Ms}^2$ or $\text{m/s}^2$ ) |
| 4. Speed        | - | metre per second ( $\text{ms}^{-1}$ or $\text{m/s}$ )  |
| 5. Time         | - | second (s)   |
| 6. Energy       | - | Joule (J)  |



- 7. Distance/Length/Height - metre (m)
- 8. Work done - (J)
- 9. Power - Watts (W)
- 10. Mechanical Advantage - No unit
- 11. Velocity Ratio - No unit
- 12. Efficiency - percentage (%)
- 13. Quantity of heat - Joule (J)
- 14. temperature - Kelvin (K)
- 15. Voltage - Volt (v)
- 16. Resistance - Ohm
- 17. Current - ampere/amps (A)
- 18. Density - Kilogram per metre cube (K/gm<sup>3</sup> or Kgm<sup>-3</sup>)
- 19. Volume - cubic metre/metre
- 20. Area - metre square (m<sup>2</sup>)

**INSTRUMENTS AND WHAT THEY MEASURE**

- 1. Spring - balance
- 2. Beam balance - mass
- 3. Clock/stop watch - Time
- 4. Metre rule/Tape rule - distance/height length
- 5. Thermometer - Temperature
- 6. Calorimeter - Heat
- 7. Ammeter - Current
- 8. Galvanometer - detect current
  
- 9. Voltmeter - voltage
- 10. Ohmmeter - Resistance
- 11. Rain gauge - Rainfall
- 12. Hygrometer - humidity
- 13. Barometer - Atmospheric pressure
- 14. Stethoscope - Blood pressure
- 15. Photometer - light intensity
- 16. Telescope - Observe distance object
- 17. magnifying glass - observe tiny object
- 18. Microscope - observe objects which cannot be seen by the naked eyes
  
- 19. Micrometer screw guage - diameter of wire/object
- 20. Vernier calipers - Inner/outer diameter of object
- 21. Measuring cylinder/calibrated beaker pipette/burette – volume of liquid
- 22. Wind vane – wind direction



- 23. Anemometer - wind speed
- 24. pH METER - Acidity/alkalinity/ pH of solution

### UNIT THREE (3) Density, Weight and Volume

#### Learning Outcome

At the end of the lesson, pupils should be able to

1. Measure weight, mass, volume and density
2. State the differences between mass and weight
3. Determine the volume of regular and irregular objects
4. Calculate the density, mass and volume of objects

**MASS** – Is the quantity of matter in an object.

The SI unit of mass is kilogramme (Kg) and the instruments used to measure mass is the beam balance, chemical balance, lever balance and electronic balance.

Mass is constant everywhere.

**WEIGHT** – Is the measure of the force of gravity

Weight is the gravitational pull on a body.

The force of gravity tends to pull objects towards the centre of the earth.

Weight is not constant. It can change from place to place

- a) An object weighs less on the north and south poles than at the equator because it is far farther from the centre of the earth.
- b) An object weighs less at sea level than down a deep well.
- c) Weighs more at sea level than up a mountain
- d) An object weighs less on the moon than on the earth
- e) An object weighs nothing in space because it is very far away from the gravitational pull of the earth.

The SI unit of weight is **NEWTON** and the instruments used to measure weight is **SPRING BALANCE**.

#### DIFFERENCES BETWEEN MASS AND WEIGHT

Mass	Weight
1. Is the quantity of matter in a body or substance	1. Is the gravitational pull on the body or object



2. Instrument used to measure mass is the beam balance	2. Instrument used to measure weight is the spring balance
3. SI Unit is kilogramme	3. SI Unit is Newton
4. Mass is constant	4. Weight varies from place to place
5. Is a scalar quantity – has only magnitude	5. Is a vector quantity – both magnitude and direction

**Density** – Is defined as the mass per unit volume of a substance. The symbol of density is

- a) Density =  $\frac{mass}{volume}$
- b) Volume =  $\frac{mass}{density}$
- c) Mass = density x volume

**SI Units**

Mass = Kilogramme (Kg)

Volume = mere cube (m<sup>3</sup>)

Density = Kilogramme per metre cube (Kg/m<sup>3</sup> or Kg m<sup>-3</sup>)

**Worked Examples**

1. A plank of wood has a mass of 75.6kg and a volume of 39m<sup>3</sup>. Calculate the density of the plank of wood

**Solution**

Mass = 75.6kg      Density =  $\frac{mass}{volume}$

Volume = 39m<sup>3</sup>      = 75.6kg

Density = ?      39m<sup>3</sup>

1.94 Kg/m<sup>3</sup>

Density of plank of wood – 1.94kg/m<sup>3</sup>

2. A piece of stone 60g was dropped in a measuring cylinder containing water. The level water increased from 50cm<sup>3</sup> mark to 78cm<sup>3</sup> mark. Find the density of the stone

**SOLUTION**

Mass of stone = 60g

volume of water displaced = (78 – 50)cm<sup>3</sup>  
= 28cm<sup>3</sup>

Volume of stone = volume of water displaced  
= 28cm<sup>3</sup>



$$\begin{aligned} \text{Density of stone} &= \frac{\text{mass of stone}}{\text{volume of stone}} \\ &= \frac{60g}{28\text{cm}^3} \\ &= 2.14\text{g/cm}^3 \end{aligned}$$

3. Calculate the mass of a book whose density is  $4.5 \text{ kg/m}^3$  and volume  $2.6\text{m}^3$

**SOLUTION**

$$\text{Density of book} = 4.5 \text{ Kg/m}^3$$

$$\text{Volume of book} = 2.6\text{m}^3$$

$$\text{Mass of book} = ?$$

$$\text{Mass} = \text{Density} \times \text{volume}$$

$$= 4.5 \text{ Kg/m}^3 \times 2.6\text{m}^3$$

$$= 11.7 \text{ kg}$$

4. What is the volume of iron bar whose density is  $1.5\text{g/cm}^3$  and mass of  $60\text{g}$ ?

**SOLUTION**

$$\text{Density of iron bar} = 1.5\text{g/cm}^3$$

$$\text{mass of iron bar} = 60\text{g}$$

$$\text{volume of iron bar} = ?$$

$$\begin{aligned} \text{Volume of iron bar} &= \frac{\text{mass}}{\text{density}} \\ &= \frac{60\text{g}}{1.5\text{g/cm}^3} \\ &= 40\text{cm}^3 \end{aligned}$$

**Determination of Density**

**A. REGULAR OBJECT**

- Find the mass of the object using the beam balance
- Calculate the volume of the object using its dimensions
- Use the formula: Density =

**B. IRREGULAR OBJECT**

- Determine the mass of the object using the beam balance
- Determine the volume of the object using the displacement of water in a measuring cylinder or overflow can.
- Use the formula: Density =  $\frac{\text{mass}}{\text{volume}}$



## IMPORTANCE OF DENSITY

1. Aeroplanes, moving parts of engines, bodies of buses, cars, boats and ships must be strong but not heavy
2. engineers making a bridge or tall building calculate the total height from the densities and volumes of the materials used.
3. Pure substances and mixtures can be distinguished.
4. A knowledge of density helps in the discovery of new elements.

## VOLUME

Volume is the amount of space that is occupied by a substance. Volume can also be defined as the internal space of an object such as cup, flask, pipe, box etc.

The SI unit of volume is metre cube/cubic metre ( $m^3$ ) other units may include cubic centimeter ( $cm^3$ ) cubic decimeter ( $dm^3$ ) or cubic millimeter ( $mm^3$ ).

A litre is not SI unit instrument used to measure volumes are:

- a) Liquid and Irregular solids
  - i. Pipette
  - ii. calibrated beaker
  - iii. measuring cylinder
  - iv. burette etc
- b) Solids (regular)

Metre rule

## Two Types of Solid

1. Regular solid
2. Irregular solid

1. How to measure the volume of a regular solid.

- a) Measure and record the length (L)
- b) Measure and record the breadth (B)
- c) Measure and record the height (H)
- d) Use the formula to find the volume

$$V = L \times B \times H \text{ (cm}^3 \text{ or m}^3\text{)}$$

2. How to measure the volume of an irregular solid

Two methods commonly used

- a) Using a measuring cylinder
  - i. Pour enough water into the measuring cylinder to cover the object (stone)
  - ii. Read the water level at the lowest point of the **MENISCUS** (curved line)
  - iii. Tie a string or thread round the object (stone)



- iv. Lower the object carefully into the measuring cylinder. The water will rise
- v. Leave some of the string hanging out of the cylinder
- vi. Shake it gently to remove the air bubble
- vii. Read the final water level at the lowest point of the meniscus find the volume

Volume = Final water level - Initial water level

b) Using an overflow can and a measuring cylinder

- i. Use a beaker and carefully pour some water into the overflow can until it is completely full (no water will flow out of the snout)
- ii. Wait until no more water flows or drops out of the snout
- iii. Tie a string or thread around the solid
  
- iv. Put a measuring cylinder under the snout
- v. Carefully lower the solid into the bottom of the water in the overflow can
- vi. Leave some of the string hanging out
- vii. Observe the excess water flowing into the measuring cylinder
- viii. Wait until no more water flows out and read the volume of water in the measuring cylinder.

This volume of water in the measuring cylinder is equal to the volume of the solid.

- Repeat twice and find the average volume of the solid

## UNIT FOUR (4) Machines

### Learning Outcome

At the end of the lesson, pupils should be able to

1. Explain the term machine
2. Identify simple machines
3. Name and describe some types of simple machines
4. Explain the terms Mechanical Advantage, Velocity Ratio and Efficiency of machines

### **Machine**

A machine is defined as

- a device by means of which work can be done easily and conveniently
- any device by which a force is applied at a point to overcome another force at another point.



## Types of machines

There are two types of machines

1. Simple machine made up of few parts simple machine includes
  - a. screw/car jack
  - b. pulleys
  - c. inclined planes
  - d. levers
  - e. wheel and axle
2. **Complex machines** are made up of many parts eg car, aeroplane bicycle ship etc

### SIMPLE MACHINES

#### **A. Screw jack**

- a simple machine that reduces the force needed to lift a car
- it takes less effort or force to push down on the jack than it would take to lift the car by hand

#### **B. Pulleys**

- is a wheel with a groove and a rope attached. Pulleys are used for lifting loads e.g.
- builders to move heavy loads to higher floors
- loading and offloading ship
- raising flags

Two types of pulleys exist:

1. Fixed pulley
  - Fixed at one place makes work easier by changing the direction of the force

### **Double pulleys are called Block and Tackle**

2. Movable Pulley
  - is not fixed but can move up and down with the load. It makes work easier by reducing the effort needed to lift the load.

#### **C. Inclined plane**

- a simple machine consisting of a slope strong plank, through which a load can be pulled
- a simple machine with a flat surface that is higher on one end

The less steep the slope the less effort required and less energy and force is used.



The longer the distance moved on an inclined plane, the less effort needed. This explains why roads are built around hills and mountains instead of straight up the sides since less effort would be needed to climb.

Examples of inclined planes are:

- sloping boards used to roll heavy objects such as barrel or drum of oil, bales of cloth onto lorry or truck
- slanting road
- path of a hill
- ramp
- staircase
- ladder used for climbing

**D. Levers:** A lever is

- a rod free to turn about a fixed turning point called pivot (fulcrum)
- a simple machine in which a force (EFFORT) is applied at one point to overcome a greater force (load) at the other end.

A lever has three (3) main parts. These are

- i. Load (weight to be lifted)
- ii. Effort (force applied)
- iii. Fulcrum (pivot-turning point)

## CLASSES OR ORDERS OF LEVERS

There are three (3) classes or orders of levers, depending on the relative position of the load fulcrum and the Effort.

These are:

### 1. First Class Lever

are levers in which the fulcrum is between the load and the Effort (E)

Example

Scissors crowbar hammer, pliers, pincers, see-saw etc

### 2. Second class Lever

are levers in which the load (L) is between Fulcrum (F) and the Effort (E)

Examples

wheelbarrow, nut cracker, bottle opener, paper cutter, oar used in canoe

### 3. Third Class Levers

Here, the effort is between the fulcrum and the load



Examples

Fishing rod, tweezers, tongs, forceps, human arm, spade, shovel etc

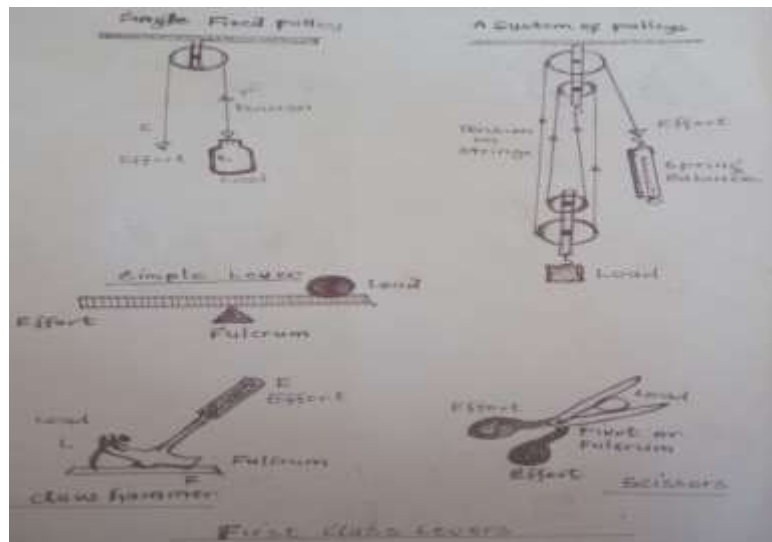
**E. Wedges**

- are two inclined planes fastened together back to back to form a sharp end. by large forces. It is used to push two objects apart. Examples
- a chisel blade used by carpenters
- an axe blade to split wood
- the blade of a knife, forks nails etc
- metal or wooden wedge to split fire wood or log etc.

**WHEEL AND AXLE**

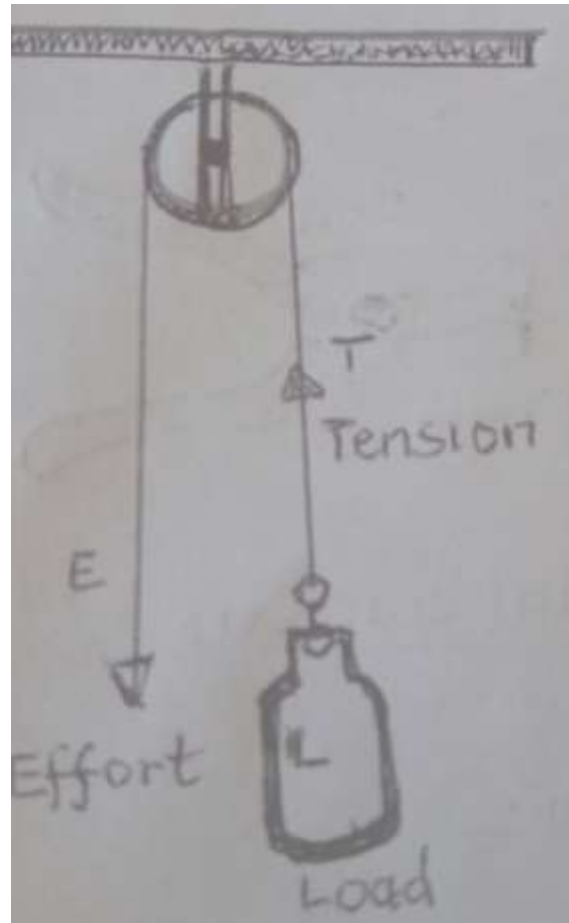
- is a simple machine consisting of two wheels of different sizes fixed together. A length of rope is wound around the larger wheel and a weight such as a bucket of water attached to a small wheel by another rope.

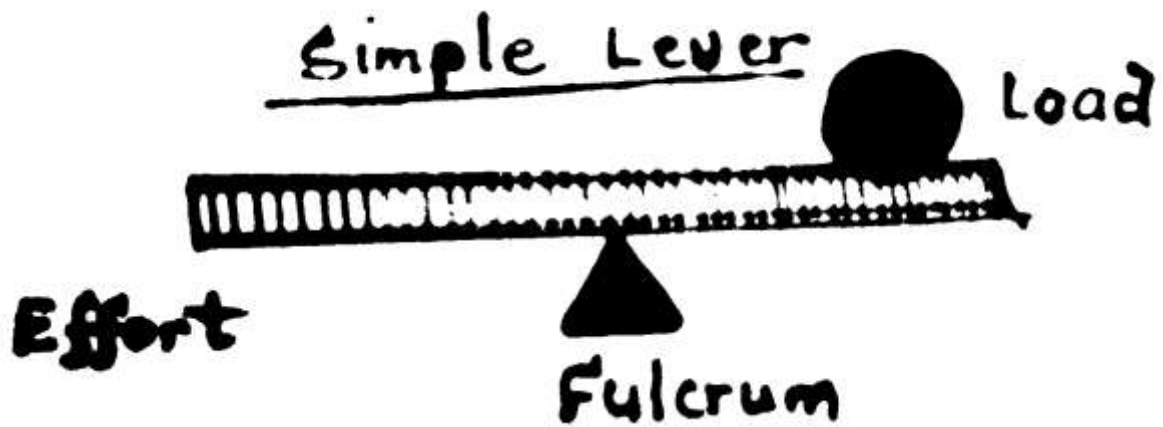
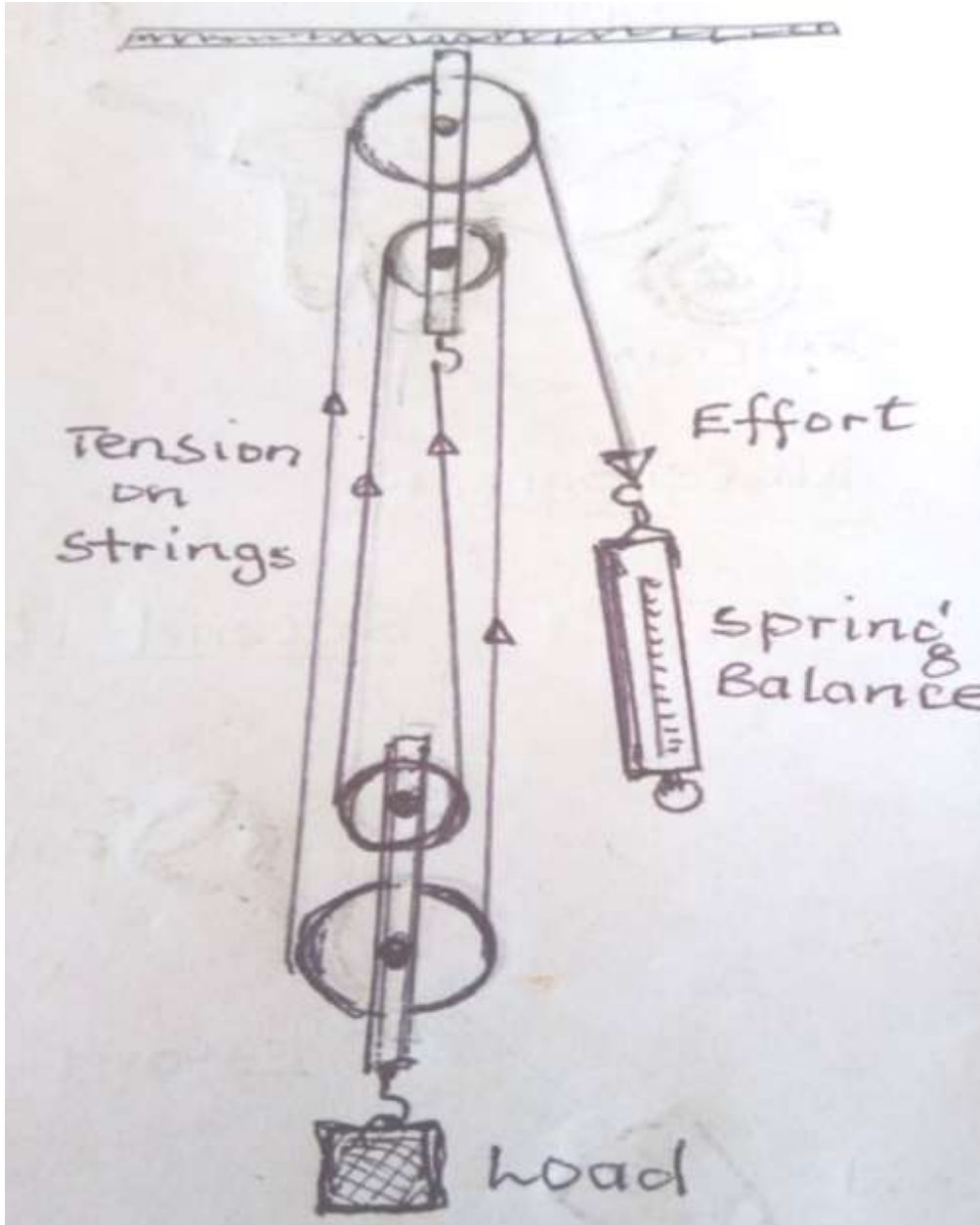
The smaller wheel or rod is called the **AXLE**.

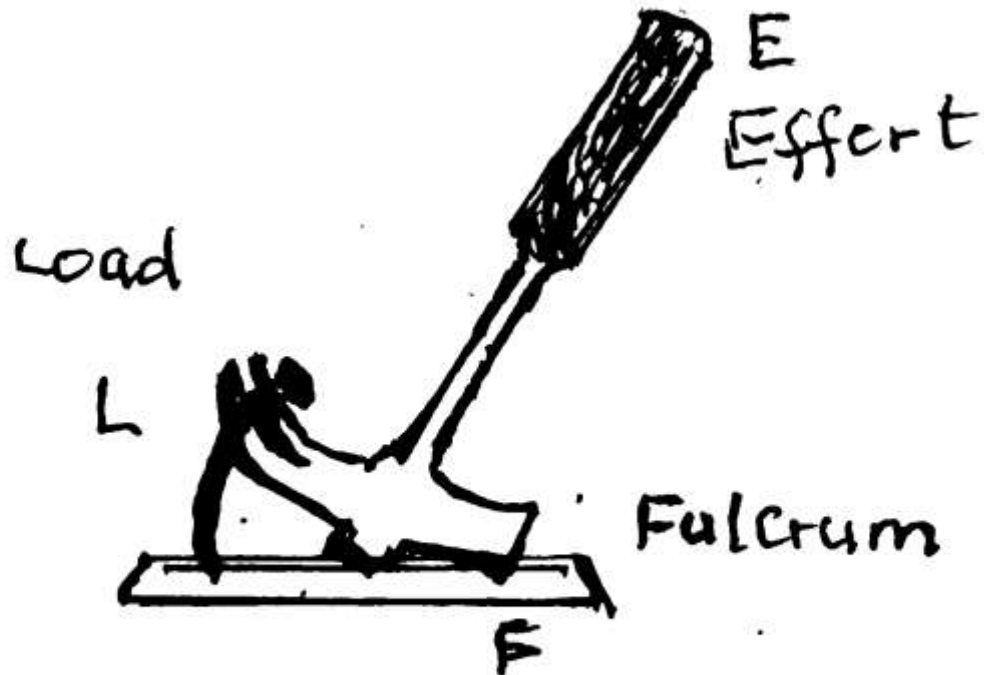




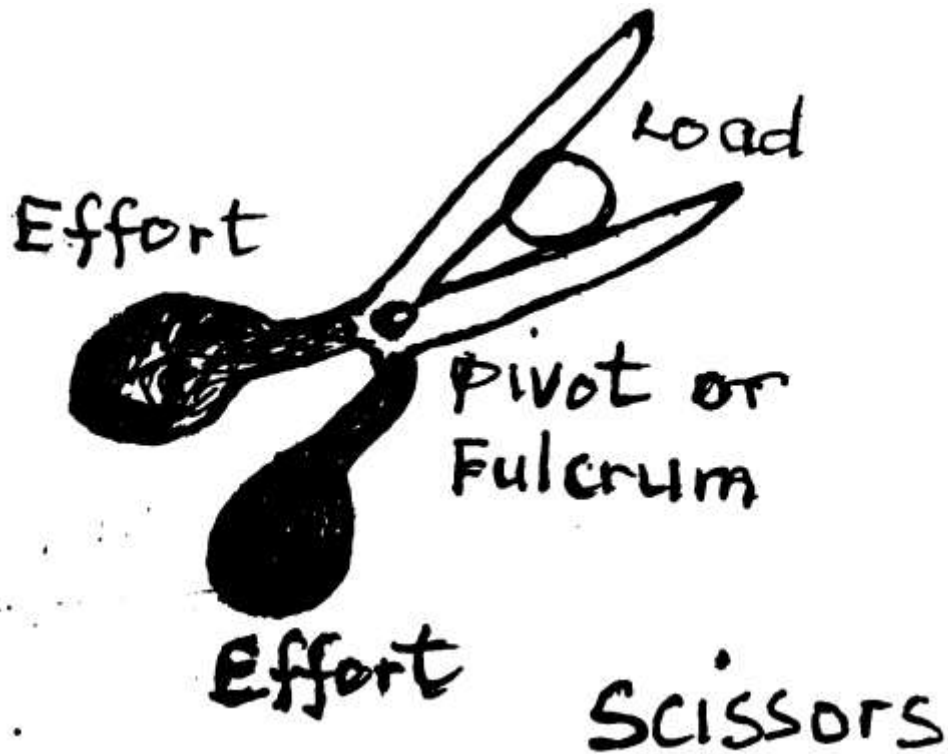
# The Sierra Leone Teaching Service Commission

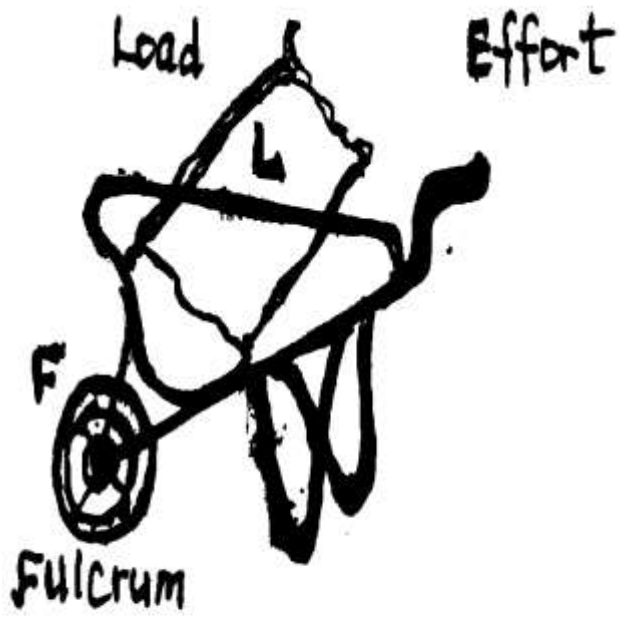




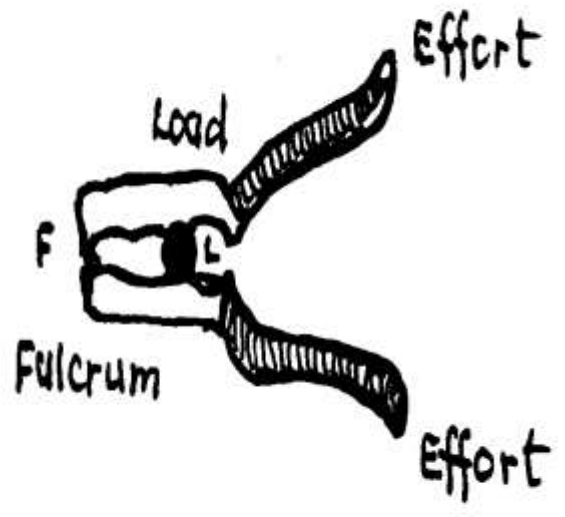


claw hammer

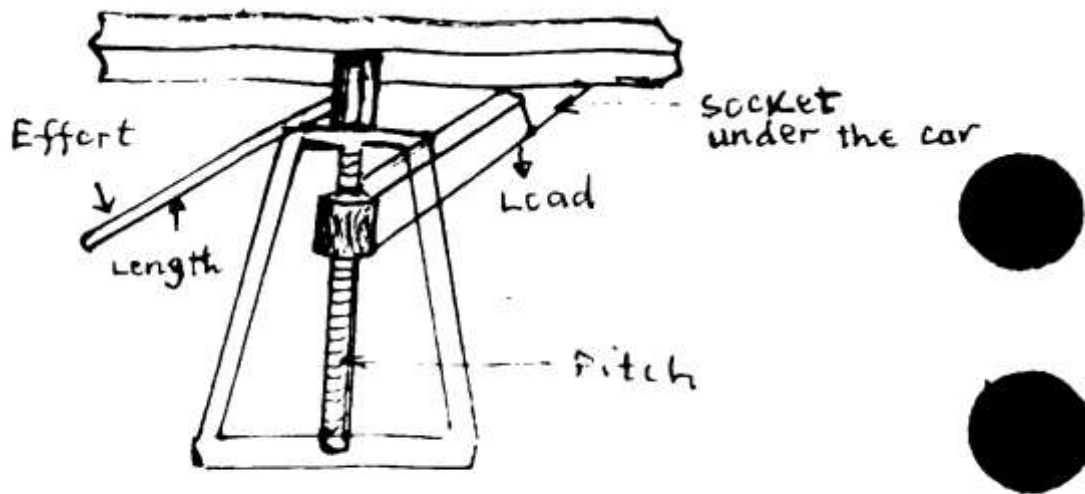
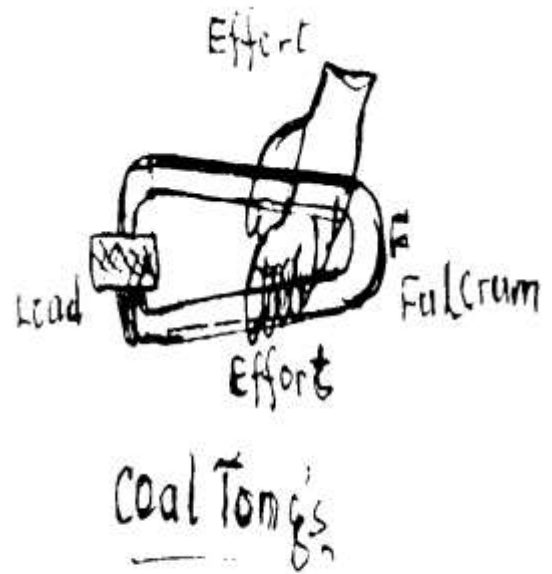
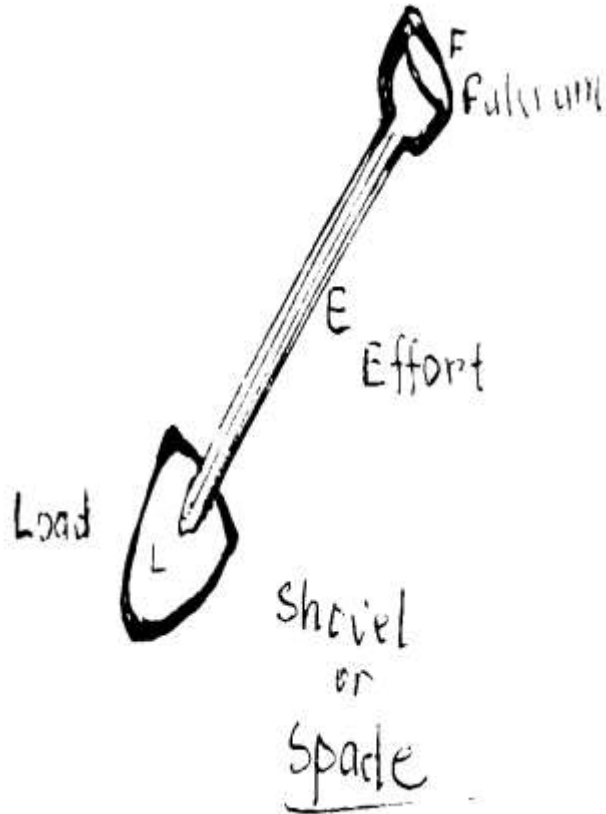




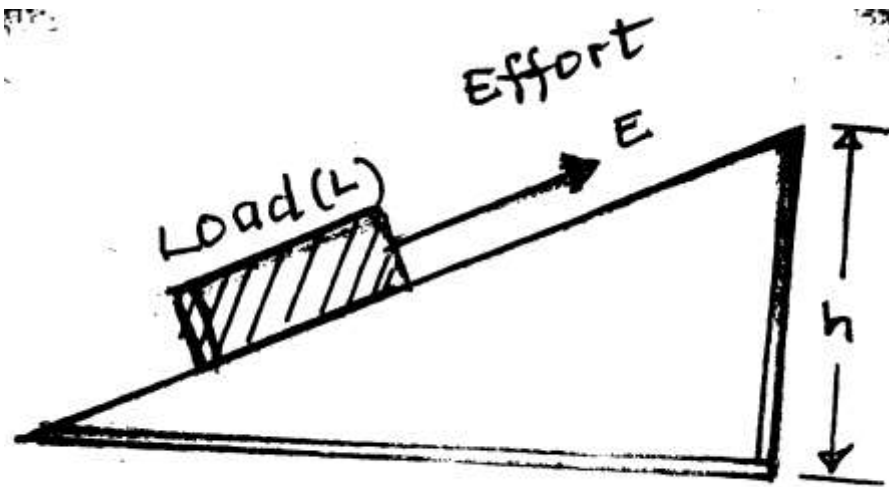
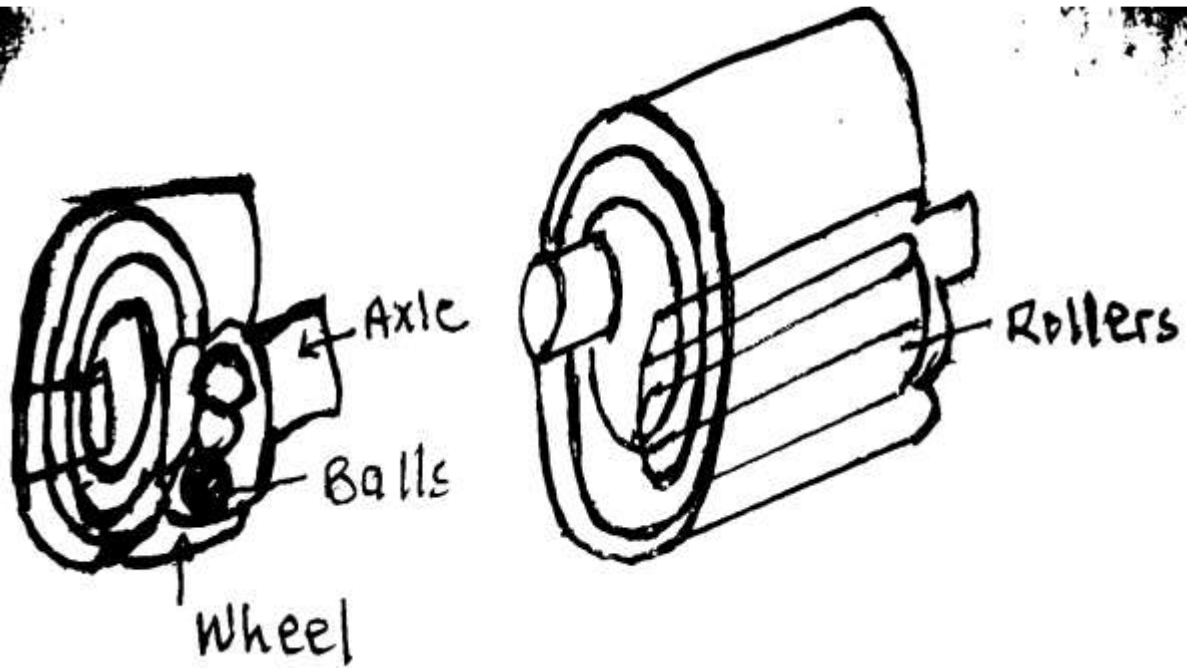
Wheelbarrow



Nutcrackers



The car Jack



Inclined Plane



Examples

windlass used to draw water out of a well, bicycle etc

**Mode of operation of a machine and its calculation**

The work of a machine is determined by the following

1. Mechanical advantage (M.A.)
2. Velocity Ratio (V.R.)
3. Efficiency of a machine

**1. Mechanical Advantage (M.A.)**

is the ratio of the load to the effort applied

$$M.A. = \frac{\text{Load (L)}}{\text{Effort (E)}}$$

Effort = E

**Mechanical Advantages has no unit**

- a. if the load is greater than the effort then the mechanical advantage is greater than 1 (MA>1)
- b. if the effort is greater than the load the mechanical advantage is less than 1 (MA<1)
- c. if the load equals the effort the mechanical advantage is 1 (MA = 1)

**Example**

A man uses a wheelbarrow with an applied effort of 20N to move a load 80N. what is the mechanical advantage of the machine?

$$M. A = ? \qquad M.A = \frac{\text{Load}}{\text{Effort}}$$

$$\text{Load} = 80N \qquad = \frac{80N}{20N}$$

$$\text{Effort E} = \qquad 20N$$



### 2. Velocity Ratio (V.R.)

If a machine is the ratio of the distance moved by the effort to the distance moved by the load.

Velocity ratio has no unit

$$c) \text{ V.R.} = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

$$d) \text{ V.R.} = \frac{\text{Length of plane}}{\text{Height of plane}}$$

$$e) \text{ V.R.} = \frac{\text{Length of handle}}{\text{Radius of axle}}$$

Examples

- a) Calculate the velocity ratio of a machine when an effort moves at a distance of 6m moved a load to 10m.

**Solution**

$$\text{V.R.} = ? \qquad \text{V.R.} = \frac{\text{distance effort}}{\text{distance load moved}}$$

length of plane = 30m

$$\text{Height of plane} = 6m \qquad = \frac{30m}{6m}$$

$$\text{V.R.} = 5.0$$

- b) Calculate the velocity rate of an inclined plane of length 30m used to roll a load into a truck of 6m from the ground.

**Solution**

$$\text{V.R.} = ? \qquad \text{V.R.} = \frac{\text{Length of plane}}{\text{Height of plane}}$$

Length of plane = 30m

$$\text{height of plane} = 6m \qquad = \text{V.R.} = \frac{30m}{6m} = 5$$

$$\text{V.R.} = 5.0$$



c) Find the velocity ratio of a crank whose hand is 44cm from the axis and has an axle of radius 11cm

V.R = ?

$$V.R. = \frac{\text{Length of plane}}{\text{Radius of axle}} = \frac{44\text{cm}}{11\text{cm}} = 4$$

$$= \frac{2\pi \times 4}{2\pi \times 4} = 4.0$$

**EFFICIENCY**

- is the ratio of useful work done by the machine to the total work put into the machine expressed as a percentage
- is the ratio of the work output to the work input expressed as a percentage?
- is the ratio of the mechanical advantage to the velocity ratio expressed as a percentage

$$\text{Efficiency} = \frac{\text{work output}}{\text{work input}} \times \frac{100}{1}$$

$$\text{Efficiency} = \frac{M.A}{V.R} \times \frac{100}{1}$$

Efficiency is expressed as a percentage

**Note** No machine is 100% efficient as the machine has to overcome friction between parts of the machine

**Examples**

1. The work input of a machine is 100J. If the work output is 800J, calculate the efficiency of the machine

work out put = 800J                      Efficiency =  $\frac{\text{work output}}{\text{work input}}$

work input = 1000J

$$\text{Efficiency} = ? \qquad = \frac{800J}{1000J} \times \frac{100}{1} = 80$$

Efficiency = 80.0%



2. In machine an effort of 100N moved through a distance of 20m in order to lift a load of 250N through a distance of 5m. Calculate the
  - a. Mechanical advantage
  - b. Velocity ratio
  - c. Efficiency of the machine

$$M.A = \frac{\text{load}}{\text{Effort}}$$

$$b. V.R. = \frac{\text{Effort distance}}{\text{Load distance}}$$

$$= \frac{250}{100}$$

$$\frac{20}{5}$$

$$= 2.5$$

$$= 4.0$$

$$\text{Efficiency} = \frac{M.A}{V.R.} \times \frac{100}{1} = \frac{2.5}{4} \times \frac{100}{1}$$

$$= \frac{250}{4}$$

$$\text{efficiency} = 62.5\%$$

## UNIT FIVE (5) Heat and Source of Heat

### Learning Outcome

At the end of the lesson, pupils should be able to

1. Explain the terms heat and energy
2. Demonstrate the modes of heat transfer

### Heat can be generated

1. mechanically eg by friction
2. Chemically such as burning of fuel food etc
3. by sun rays
4. by electricity
5. by biomass or biogas
6. nuclear change

### Effects of Heat on Substance

1. Heat can cause an increase or change in temperature
2. It can cause a change of state eg. melting, boiling, evaporation, sublimation, freezing etc
3. Heat can cause burning
4. Heat can cause expansion of a substance
5. It assists chemical reaction



### Factors which affect the Heat change of a Body

1. The mass of the body
2. The surrounding temperature
3. The type or nature materials the body is made up of
4. The specific heat capacity of the body

### Transfer of Heat

There are three main ways by which heat is transferred from one body to the other.

#### **Conduction**

Is the transfer of heat through solids without any visible movement of heated particles eg, when one end of a metal is hold in a pore the other can become heat after a while.

Dripping a metal spoon on a hot soup. The heat from the soup travels through the spoon to the handle.

#### **Convection**

Is the transfer of heat through liquid or fluidly with visible movement of the heated particles. eg. heating a beaker of water with some crystal of potassium permanganate, thread like stream of colour will rise from the bottom of the beaker to the top

1. Land and sea biceps
2. Ventilation of building
3. Cooling system of an engine
4. Formation of clouds

#### **Radiation**

Is the process by which heat energy is transferred through vacuum which required no materials medium but in the form of waves form the sun eg. heat energy form the sun reaches the earth surface by the radiation. Radiation requires no material medium

### Good Conductors and Insulators

**Conductor** – Are materials in which heat can move through easily eg metals, iron, copper, aluminium, lead, zinc, tin etc

**Insulators** – Are substance in which heat cannot move through they are referred to as poor or bad conductors. Examples plastic, rubber, paper, wood, wool.

#### **Sample Questions**

1. a) State three effects of heat on a substance
- b) Give two (2) factors which affect the heat change of a body
2. a) Distinguish between conduction and convection



- b) give two (2) examples of
- (i) Good conductor
  - (ii) insulators

## UNIT SIX (6) Measurement of Heat

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. determine the quantity of heat in an object
2. define heat capacities and latent heat

### Heat capacity and specific that capacity

Heat capacity of a substance or a body is the evantity of heat required to raise its temperature through  $1^{\circ}\text{C}$

Speific heat capacity of a substance or body is the heat required to raise the temperature of 1g or 1kg of a substance through  $1^{\circ}\text{C}$

### Latent Heat

Is the heat that is given off or absorbed during a change of state of a substance without a corresponding increase in temperature

### Latent Heat of Fusion

is the heat required to change a solid to liquid without a corresponding increase or change in temperature.

### Latent Heat of Vapourization

Is the heat required to change or liquid to gas (vapour) without a corresponding increase or change in temperature

### Specific Latent Heat

Is the heat absorbed or evolved when 1g or 1kg of substance undergo change of state without a corresponding increase or in temperature

### Specific Latent Heat of Fusion

Is the heat absorbed or evolved when 1g or 1kg of a substance change form solid to liquid without any corresponding increase or change in temperature

### Specific Latent Heat of Vapourization

Is the heat absorbed or evolved when 1g or 1kg of a substance change form liquid ot gas (vapour) without any corresponding increase or change in temperature



Temperature

1. Is the degree or amount of hotness or coldness body or substance
2. Is the measure of how hot or cold a substance is.

Convert 68°F to °C

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

$$= \frac{5}{9} (68 - 32)$$

$$= 5 \times 4$$

$$= 20^{\circ}\text{C}$$

Convert 45°F to °C

$$^{\circ}\text{F} = \left(^{\circ}\text{C} \times \frac{9}{5}\right) + 32$$

$$= \left(45 \times \frac{9}{5}\right) + 32$$

$$= (9 \times 9) + 32$$

$$= 81 + 32$$

$$= 113^{\circ}\text{F}$$

**Difference between Heat and Temperature**

<b>Heat</b>	<b>Temperature</b>
Heat is a form of energy	Temperature is the amount of degrees of hotness or coldness of body substance
Heat cannot be measured directly	Temperature can be measured
Heat is measured in Joules (J)	Temperature is measured in Kelvin (K)
The instrument used to measure heat is the calorimeter	The instrument used to measure temperature is the thermometer

Work Examples

What quantity of heat is required to change the temperature of 4kg of water from 2°C TO 100°C. (The specific heat capacity of water is 4.200 JKg-1K-1)

$$Q = mc\Delta T$$

$$Q = mc (T_2 - T_1)$$

$$4 \times 4.200 \times (100 - 2)$$

$$= 16.8 \times 98$$

$$\underline{1646.4 \text{ J}}$$



## UNIT Seven (7) Electricity

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. describe static and current electricity
2. mention the various components of electric circuits and their functions
3. differentiate between primary cells and secondary cells

Electricity is a form of energy generated when electric charges (electrons) move for one point to another in a conductor.

### SOURCES OF ELECTRICITY

Electricity energy is generated by

1. chemical energy
2. Air/wind
3. Water (tidal waves)
4. Nuclear energy
5. Sun/solar energy
6. Geothermal

### Electric circuit

An electric Circuit is the path through which electric currents flows. it has four component

- a) Source-cell or battery
- b) Wires (cables) – path or lines through which electric current flows
- c) Switch (tapping key\_ - Device which opens or closes the circuit
- d) Electrical appliance – An object which uses the electric current eg
  - When all the four components are present we have a complete circuit
  - The circuit is incomplete when all the component are not present
  - A closed circuit s one in which the switch is closed that is to allow current to flow.
  - It is an open circuit when the switch is not closed that is not on and thereby not allowing current ot pass



## BATTERY AND CELL

A battery – A battery is a collection of several cells. It is a device that charges chemical energy into electrical energy due to the chemical reaction which takes place inside the body.

### Examples

1. Lead acid accumulator or car battery
2. Alkaline accumulator or NiFe

### CELLS

- A cell is a simple unit device found in a battery
- Is a device that stores energy in the form of chemical the energy being released when a current is conducted between the terminals of two cells.
- Is the chemical device that converts chemical energy into electrical energy.

### There are two types of cell

1. Primary cell
2. Secondary cell

### A Primary Cell

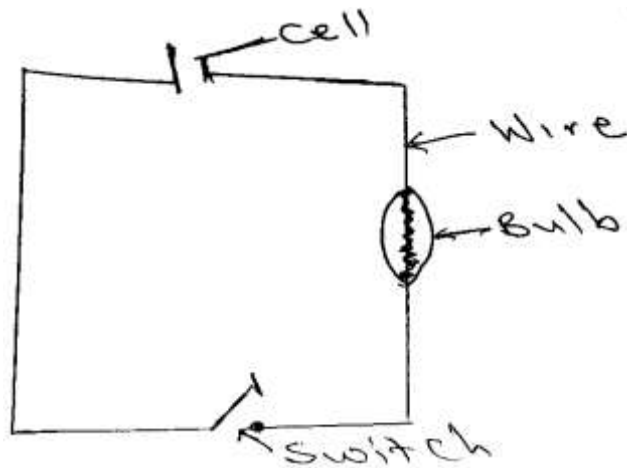
A primary cell charges chemical energy directly into electrical energy. They cannot be recharged

Examples of Primary cells are

- i. Daniel cell
- ii. Simple Voltaic cell
- iii. Wet Le Clanché cell
- iv. Dry Le Clanché cell

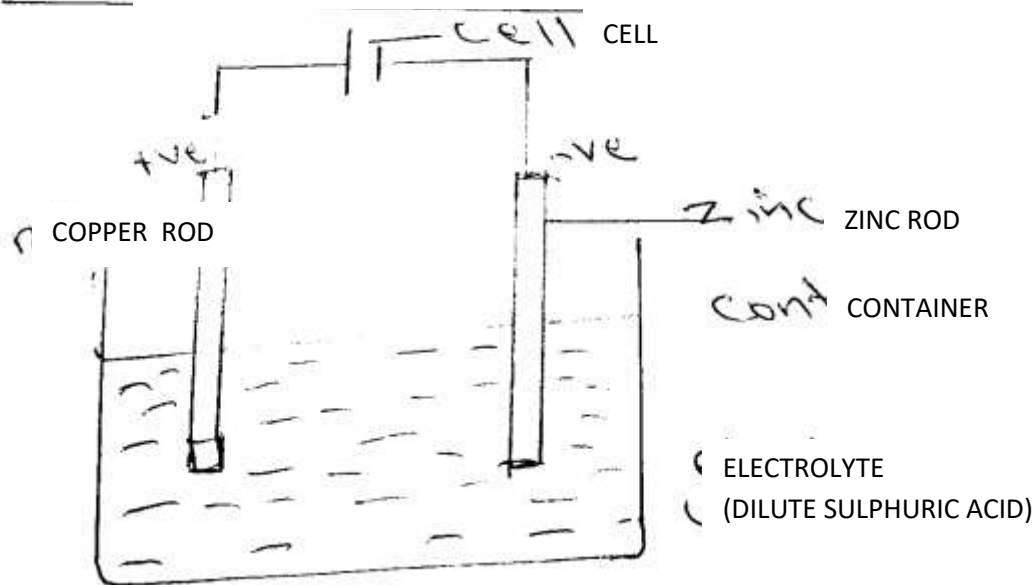
### Sample questions

1. Give two (2) examples of cell battery
2. a) What is an electric circuit?  
b) Draw a diagram of a complete electrical circuit with all the four component presents
3. a) State three (3) sources of electricity.  
b) What is a circuit



ELE

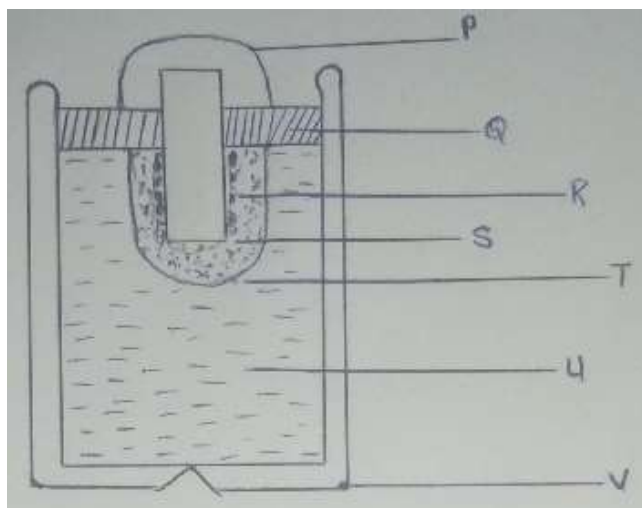
ELECTRICAL CIRCUIT



SIMPLE PRIMARY CELL

Effects of simple primary cells are

- local action
- polarization



## UNIT EIGHT (8) Matter

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. explain matter
2. describe the nature and state of matter
3. outline the characteristics of the states of matter
4. demonstrate how matter is changed from one state to another

**MATTER** – Anything that has mass or weight and can occupy space

### PROPERTIES OF MATTER

1. Has mass/weight
2. Has volume/size
3. Can occupy space

### State of Matter and their properties

Solid	Liquid	Gas
Has a definite volume	Has a definite volume	Has no definite volume
Has a definite shape	Has no definite shape Take the shape of the container	Has no definite shape



Cannot be easily compressed	Can be compressed	Can be easily compressed
Particles are closely packed	Particles are a bit free to move about	Particles are free to move about
Has very high density	Has high density	Has low density
Examples: stone, chalk, table, blackboard, stick etc	Water, petrol, kerosene, oil, milk	Oxygen, nitrogen, carbon, dioxide, chlorine, helium

### CHANGING THE STATE OF MATTER

Is the conversion of one state of matter to another by means of heat or force.

melting - is the process by which a solid is changed into a liquid by heating

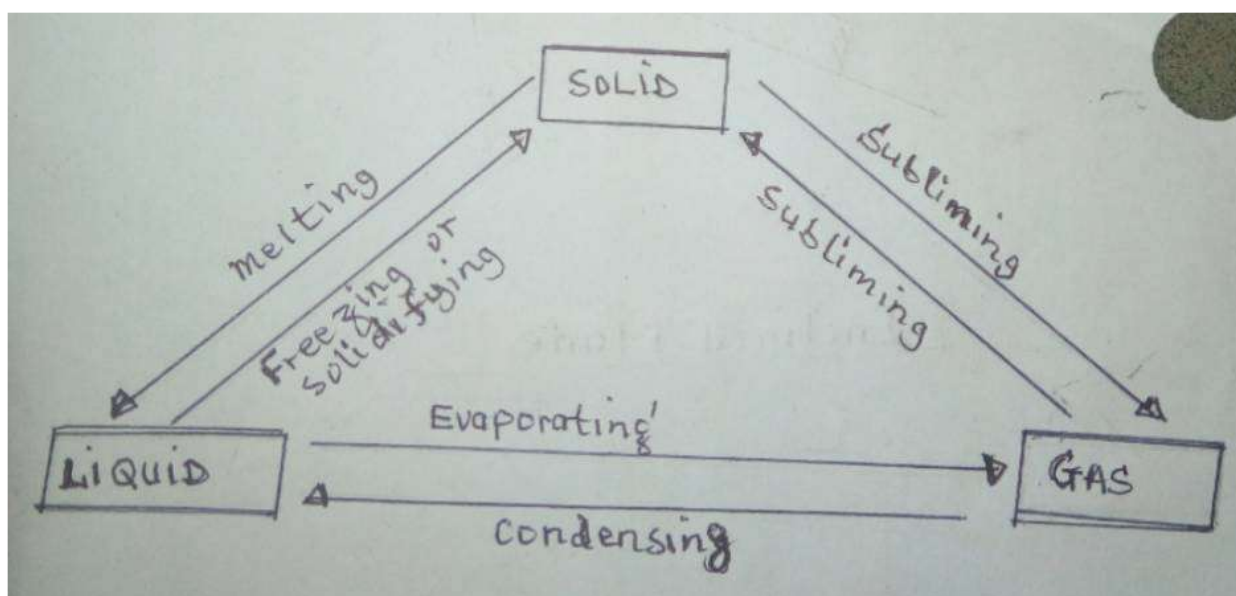
**Boiling/evaporation** - is the process by which a liquid changes into gas (vapour) by heating.

Condensation/cooling – is the process by which a gas changes to a liquid by cooling

Freezing/solidification - is the process by which a liquid changes to a solid by cooling

**Sublimation** - is the process by which a substance changes from the solid state directly to other gaseous state when heated without forming the liquid state e.g. iodine, camphor balls, ammonium chloride

**De-sublimation** - is the process by which a substance changes from gas directly to solid when cooled forming the liquid state.





## PHYSICAL AND CHEMICAL CHANGES

**PHYSICAL CHANGE** – is a change in which no new substances are formed and the change is reversible.

Examples

- Dissolving common salt in water
- melting of ice
- Freezing of water
- Melting of candle
- Magnetization of iron

**CHEMICAL CHANGE** – is a change in which new substances are formed and the change is irreversible

Examples

- Burning of charcoal
- Digestion of food
- Fermentation
- Rusting of iron
- Burning of paper

### Differences between Physical and Chemical changes

Physical change	Chemical change
Non new substances are formed	New substances are formed
Easily reversible	Not easily reversible
Produce no change in mass	Produces changes in mass
Not accompanied by great heat change	Usually accompanied by great change in mass

## ELEMENT, COMPOUND AND MIXTURE

**Element** is a substance which cannot be split up into two or more substances by any known chemical means

Examples: Hydrogen – H, lithium – Li, Beryllium – Be, Magnesium – Mg, Copper – Cu, Iron – Fe, zinc – Zn, Aluminium – Al, Boron – B Carbon – C, Phosphorus – P, Iodine, I, Fluorine – F, oxygen-O, Nitrogen-N, Helium-He, Neon-Ne, Argon-Ar etc

**Compound** - is a substance which is made up of two or more substances that are chemically combined together.

Examples

1. Water (hydrogen and oxygen) –  $H_2O$
2. Common salt (sodium and chlorine) - NaCl



- 3. Carbon dioxide (carbon and oxygen) -  $\text{CO}_2$
- 4. Ammonia (nitrogen and hydrogen) –  $\text{NH}_3$

**Mixture** is a substance which is made up of two or more substances (elements or compounds) that are not chemically combined together.

Examples

- Sand and water - sand and rice
- salt and water - Alcohol and water
- Sand and cement - iodine and common salt

**Differences Between Compound and mixtures**

<b>Compounds</b>	<b>Mixtures</b>
1. The composition of elements present in a compound is fixed	1. The composition of elements present in a mixture is not fixed
2. The properties of a compound are different from those of its constituents	2. The properties of a mixture are the same as that of its constituents
3. The constituents can be separated only by chemical means	3. The constituents can be separated by physical means
4. Definite chemical formula for compounds	4. No definite chemical formula for mixtures

**Assignment**

- 1. a) Define
  - i. Element ii. compound iii. mixture
  - b) Give two (2) examples of each in (a) above
- 2. Write 10 elements with their symbols
- 3. Give 2 differences between an element and a compound



## UNIT NINE (9) Separation of Mixture

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. distinguish between elements, compounds and mixtures
2. list and explain some methods of separating mixtures

As already stated, mixture can be separated by physical means that is by methods which do not involve chemical reaction separation by physical method depends on:

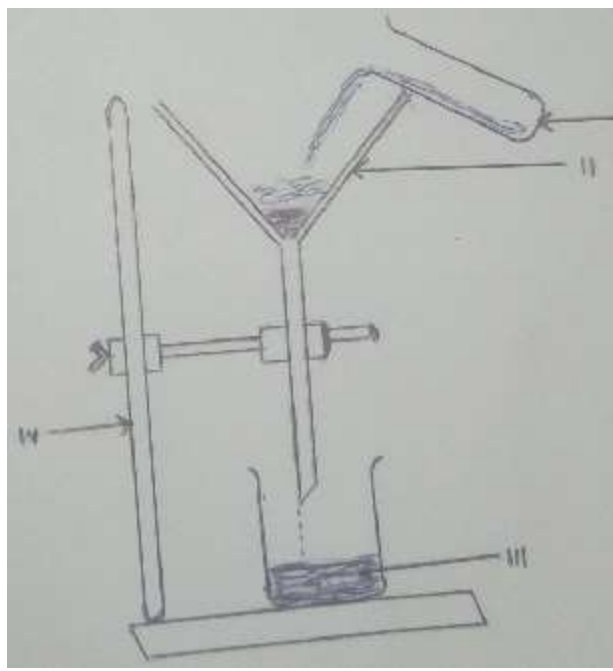
- a. the properties of the substance that is their state whether they are solid, liquid or gas their sizes
- b. their solubilities
- c. their melting and boiling point

### FILTRATION

Filtration is the method used in separating insoluble solids from liquid.

Example: sand can be separated from water by filtration. The sand and water mixture is poured on a filter paper inserted in a funnel with a beaker underneath the set-up.

The liquid (water) that passes through space in the filter paper is the filtrate while the solid (sand) left behind on the filter paper is known as the residue.





### SEDIMENTATION

This method can be used when the solid settles at the bottom and then the clear liquid at the top

### DECANTATION

This method involves the pouring of the clear liquid from the settled solid.

### SOLIDS SOLUBLE IN LIQUID

Example: Salt and water

Acid water to dissolve the salt (dissolution). This forms solutions of salts and water. The “solute” dissolving and the water is the solvent (dissolving medium)

**A solution** is a uniform mixture two or more substances . Example sand and water.

**A suspension** is a mixture of two or more substances in which the particles are seen clearly.

Example: starch in water, chalk powder and water

### EVAPORATION TO DRYNESS

With a mixture of salt and water the solution can be separated by evaporation or dryness method of separation. This method can be used to get back the salt from the salt and water solution.

The mixture is heated until the liquid vaporizes.

**Indirect heating** – this method is used when the liquids is volatile or flammable. To avoid the liquid from catching fire, a water bath is used.

Example: separating alcohol and water

### DISTILLATION

This method can also be used to separate salt from water. The water can be recovered by condensation of the liquid to form distillate.

### LIQUID – LIQUID MIXTURE



**Immiscible liquid** Example, palm oil and water

The two liquids cannot mix. The denser liquid sinks at the bottom, while the less denser floats.

This mixture can be separated using the separating funnel. All the water is drained down the beaker leaving the palm oil in the separating funnel.

### **SIMPLE DISTILLATION**

This method is used to separate two miscible liquid that can mix. The two miscible liquids will have different boiling points eg alcohol and water. The alcohol boils at  $28^{\circ}\text{C}$  to water boils at  $100^{\circ}\text{C}$ . Distillation involves vaporizing the liquid and condensing the vapour to liquid. The alcohol first vaporizes and is condensed using the condenser. The liquid which is collected in a beaker after distillation is called distillate.

### **FRACTIONAL DISTILLATION**

Used to separate miscible liquids with several components in the mixture having different boiling points.

Crude oil into various components - petrol, kerosene, diesel, lubrication oil and coal tar.

In this method a FRACTIONAL COLUMN is used containing beads and thermometer. The glass beads in the column after large surface area for vapourization at different temperatures. The thermometer shows the temperature range of the different components.

### **SOLID – SOLID MIXTURES**

Chromatography colour separation

This method is used to separate various colours components in ink, dykes, leaf extracts etc.

Three types exist based on the mixture to be separated.

- a. Paper chromatography
- b. Column chromatography
- c. Gas chromatography

**Paper Chromatography** – a mark is made at the centre of he strip of filter paper and allow to dry. The strip is then placed in a suitable solvent just 2cm above the mark. As the solvent rises, it carries with it dissolved substances



which are deposited substance as various bands showing the number of substances (colours) present in mixtures

### Sublimation

A mixture of two solid in which one changes directly to vapour (gas) on heating and back to solid on cooling without forming the liquid state.

Solid  $\xrightleftharpoons{\text{Gas}}$

Iodine  $\xrightleftharpoons{\hspace{1cm}}$  Iodine

Examples of substances that are sublime are A mixture of ammonium chloride and common salt can be separated by this method. The ammonium chloride sublimes and cool down on the inverted funnel.

### MAGNETIC SEPARATION OR MAGNETIZATION

This method is used to separated magnetic substance form non-magnetic substance fillings and Sulphur. The magnetic substance (iron filling) is removed from the mixture using a bar magnet. The iron fillings cling to the bar magnet while the Sulphur is left out. Another examples is sand and razor blade.

### Assignment

1. Draw and label the following apparatus for the method of separation of
  - a) Filtration
  - b) Evaporation
  - c) Distillation
  - d) Fractional distillation
  - e) Separating funnel
  - f) Sublimation
2. Draw any ten laboratory equipment and give their uses.



UNIT TEN (10) Air

**Learning Outcome**

At the end of the lesson, pupils should be able to:

1. explain the components of air and their relative percentages
2. demonstrate rusting and how to prevent rusting
3. explain the preparation/properties and uses of some of the gases in air

**AIR**

Air is a mixture of gases. The blanket of air which completely covers the earth is called atmosphere

<b><u>Component (constituent)</u></b>	<b><u>Percentage Volume</u></b>
Nitrogen (N <sub>2</sub> )	78.1%
Oxygen (O <sub>2</sub> )	21%
Carbon dioxide (CO <sub>2</sub> )	0.003%
Inert/Rare/Noble gases	about 1%
Water vapour	Varies
Dust particles	Varies

**Differences between Inhaled and Exhaled Air**

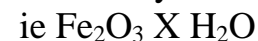
<b><u>Inhaled Air</u></b>	<b><u>Exhaled Air</u></b>
Dust particles present	Dust particles absent
Large amount of oxygen present (21%)	Small amount of oxygen present (16.17%)
Low percentage of carbon dioxide (0.03%) present (3% to 4%)	High percentage of carbon dioxide present (3% to 4%)
Low water vapour present	High water vapour present

**Rusting**

Rusting occurs when iron is exposed to ordinary air and moisture (water) the iron becomes coated. With a reddish brown substance known as rust.

Rust is a brown substance that coats an iron after exposure to ordinary air and moisture

rust is a hydrated iron (IV) oxide



Rusting is an oxidation process like burning but it is very slow compared to burning. The condition necessary for rusting are air, moisture (water).



**Prevention of Rusting**

- Oiling or greasing
- Painting
- Electroplating
- Alloying
- Enamel
- Galvanizing
- Coating with tar

**Uses of Oxygen**

1. It is used in oxy-acetylene flame for welding and cutting steels
2. It is used in respiration in plants and animals
3. It is used as breathing aid by mountain climbers, sea divers astronauts and patients in hospitals
4. Liquid oxygen is used in expensive and also as rocket fuel
5. Oxygen is used in the production of steel

**Uses of Carbon dioxide**

1. It is used as dry ice (solid CO<sub>2</sub>) in making ice cream
2. It is used in fire extinguishers since it does not support combustion
3. It is used in mineral drinks such as coca cla, sprite, soda water and medical salt such as Epsom salt
4. It is used in preventing fruits
5. It is used in baking powder which is responsible for the puffy nature of bread and cake

**Assignment**

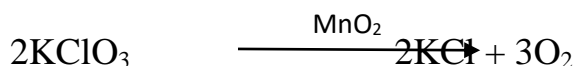
1. a) State the constituents and composition of the three major gases in Air.
- b) Give three ways by which rusting can be prevented
  2. State two uses of each
    - i. Oxygen
    - ii. Carbondioxide
  3. State three differences between inhaled air and exhaled air.

**OXYGEN GAS (O<sub>2</sub>)**

**Laboratory preparation of oxygen O<sub>2</sub>**

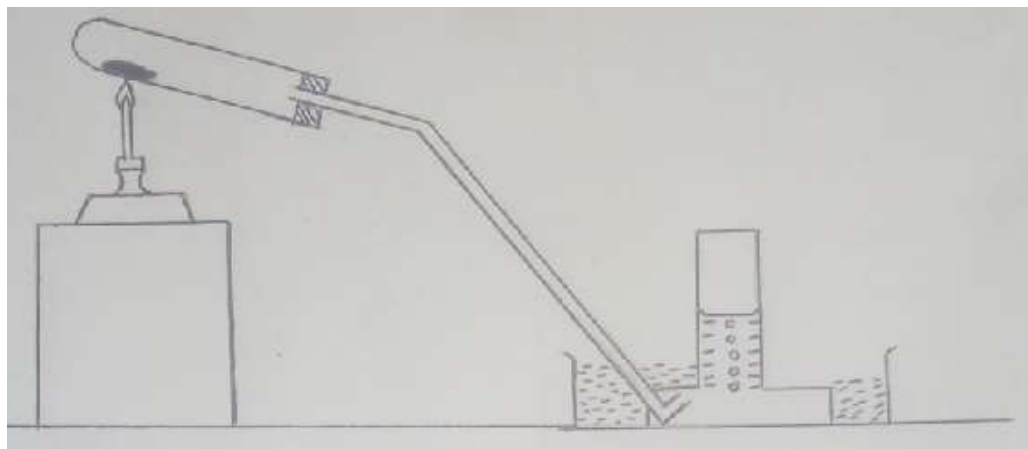
Oxygen is prepared in the laboratory by heating a mixture of potassium chlorate and manganese dioxide acting as a catalyst.

A catalyst is a substance which alters the rate of a chemical reaction by remains unchanged at the end of the reaction. The manganese dioxide as a speed boat to speed up the reacting but does not appear to take part in the reaction.





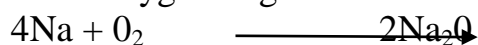
The gas oxygen (O<sub>2</sub>) is given off and collected over water by downward delivery.



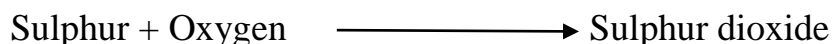
**PROPERTIES OF OXYGEN**

- Oxygen is a tasteless odourless and colourless
- It supports combustion (burning) and therefore relights/rekindles a glowing/lighted splint
- It is neutral to litmus paper
- Metals burn in oxygen to form basic oxides

Sodium + oxygen to give sodium oxide



Calcium oxygen to give Calcium Oxide



**TEST FOR OXYGEN**

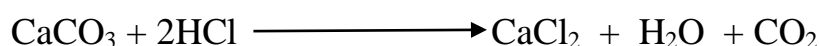
Oxygen relights or rekindles a glowing lighted splint when the lighted splint is lowered into a gas jar containing oxygen.

**CARBON (IV) OXIDE (CO<sub>2</sub>)**

**LABORATORY PREPARATION OF CARBON OXIDE**

Carbon dioxide is prepared in the laboratory by the action of dilute hydrochloric acid on marble or limestone (calcium carbonate )

Effervescence bubbling occurs and gas is produced, passed through the delivery tube and collected over water, since it is insoluble in water





The carb dioxide can be collected by downward delivery or upward displacement, since carbon dioxide is dense than air.

### PROPERTIES OF CAROB DIOXIDE

- CO<sub>2</sub> is a colourless and odourless gas
- CO<sub>2</sub> is denser than water
- IT is slightly soluble in water to give an acid solution
- it turns damp blue litmus paper faint red.
- It do not support combustion (burning) and therefore can put a glowing splint
- CO<sub>2</sub> turns lime water Ca(OH)<sub>2</sub> milky.

### TEST FOR CARBON DIOXIDE (CO<sub>2</sub>)

When carbon dioxide (CO<sub>2</sub>) gas is passed through lime water (calcium hydroxide Ca(OH)<sub>2</sub>, the lime water turn milky due to the formation of calcium carbonate - CaCO<sub>3</sub>

## UNIT ELEVEN (11) Water

### Learning Outcome

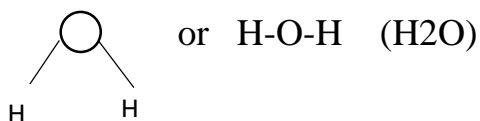
At the end of the lesson, pupils should be able to:

1. mention the sources and uses of water
2. describe the properties of water
3. explain how water is treated for public consumption
4. differentiate between hard water and soft water

Water is a stable compound with the chemical formula H<sub>2</sub>O meaning two atoms of hydrogen and one atom of oxygen.

The ratio of hydrogen to oxygen in water is 2:1

- Water is a basic necessity of life.
- It occupies about 75% of the earth
- Water is a universal solvent, that is it can dissolve most substances.
- The molecules have the structure:



Water is commonly referred to as hydrogen oxide, the only liquid at room temperature.



### Sources of Natural Water

The main natural sources of water include

- Rain water
- Wells
- Spring
- Streams
- Ocean/Sea
- Pond

The purest form of natural water is rain water and the impurest form is the sea.

### Purification of Water

#### Domestic means

- a. Filtration
- b. Boiling
  
- c. Distillation
- d. Addition of chemical (alum, camphor, chlorine, naphthalene)
- e. Sedimentation/Decantation

### **Town Water Supply**

The purification of water for a town or community involves several stages.

These are as follows:

Water from lakes/streams → screening → filtration → sedimentation → Exposure to sunlight → Addition of alum → Chlorination → Addition of lime → storage tanks → homes

#### Screening

Water from the river or lake is screened or strained to remove suspended materials such as rags, sticks, solid organic matter which may interfere with the purification step.

#### Filtration

Water is passed over sand filter beds since they water consists of gravels and coarse sand are arranged at the bottom of the filter bed and fine sand at the top. Large particles such as leaves, soil, dead animals etc can be removed from the water.



### **Sedimentation and decantation**

Water is pumped into a sedimentation tank to allow suspended fine material that escaped the screening and filtration to sink to the bottom. The water is poured off the other tank.

### **Exposed to sunlight/Aeration**

The filtered water is brought into contact with the atmospheric air which removes the taste and odour caused by organic matter. Exposing the water to sunlight kills anaerobic bacteria that may be present in the water. It also changes dissolved iron and manganese compounds into soluble hydrated oxide of the metal which may then be readily settled out.

### **Addition of Alum**

Addition of alum causes smaller particles to coagulate, that is the smaller particles stick together and settle at the bottom.

The water is then filtered to remove the coagulate materials (sediments). This method does not remove dissolved chemicals and micro-organisms.

### **Chlorination**

Chlorine is then added to the water that has been exposed to kill any bacteria that may still be in the water.

### **Addition of Lime**

Calculated amount of calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) is added to the water to give the required pH that is acidity or alkalinity.

### **Storage Tank**

The chemically treated water is then poured into tanks for storage which is later on transported to our homes, schools, industries through pipes.

### **Physical Properties of Water**

- Pure water is odourless, colourless and tasteless
- Pure water has no suspended particles
- Pure water boils at  $100^\circ\text{C}$  ( $212^\circ\text{F}$ )
- Pure water is free from germs
- Pure water has a pH OF 7
- Pure water is neutral to litmus
- Pure water expands on heating
- Pure water has high surface tension



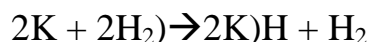
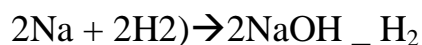
- Pure water freezes at 0°C (32°F)

### Chemical Properties of Water

#### 1. Action of water on metals

Active-metals/sodium (Na), Potassium (K), Calcium (Ca)

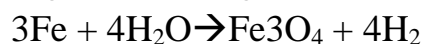
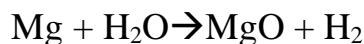
Water reacts violently with Na, and Ca to form metal hydroxide and hydrogen gas.



#### 2. Semi-Active metals

Examples: Magnesium (Mg) Aluminium (Al), Zinc (Zn), Iron (Fe) Lead Pb are semi-active metals

Semi-active metals are not very reactive with cool water however they react with hot water or steam to form the metal oxide and hydrogen gas.



#### 3. In-Active Metals

Silver (Ag), Gold (Au)

they have no reaction with water.

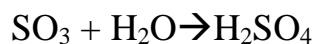
### Action of water on non-metal oxides

Oxides of non-metals are acidic and dissolve in water to form acids

Non-metal oxides are also referred to as Acid ANHYDRIDE

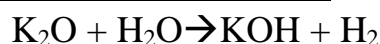


(Carbonic acid)



(sulphuric acid)

### Action of Water on Metal Oxides



- Water reacts with anhydrous copper sulphate to give blue hydrated copper sulphate crystal
- Water reacts with blue cobalt (II) chloride to give pink hydrated cobalt chloride



### **Types of water**

1. Hard water – Water that does not easily lather readily with soap because of the present of salt.
2. Soft water – Water that is easily lather with soap, because of the absence of salt.

### **Hardness of water**

Hardness of water is caused by the presence of dissolved mineral salt found in the water. Such salts as Calcium ( $\text{Ca}^{2+}$ ), Magnesium ( $\text{Mg}^{2+}$ ) and Iron ( $\text{Fe}^{2+}$ ) of each sulphate ( $\text{SO}_4$ ), chloride (Cl) or hydrogen carbonate ( $\text{HCO}_3$ ).

### **Types of Hard water**

#### **I. Temporal hardness**

Temporal hardness is caused by the presence of soluble calcium hydrogen carbonate of magnesium hydrogen carbonate.

This types of hardness can be removed easily by boiling.

#### **II. Permanent Hardness**

Permanent hardness is caused by the presence of sulphate or chloride or calcium magnesium and iron.

- a. Calcium sulphate –  $\text{CaSO}_4$
- b. Magnesium chloride –  $\text{MgCl}_2$
- c. Magnesium sulphate –  $\text{MgSO}_4$
- d. Iron sulphate –  $\text{FeSO}_4$
- e. Calcium chloride –  $\text{CaCl}_2$

Permanent hardness cannot be removed by boiling

Removal of hardness of Water

#### **i. Boiling**

Boiling only removes temporary hardness, the hydrogen carbonate of calcium and magnesium decomposes to give a precipitate of their corresponding carbonates.

#### **ii. Distillation**

Water s vaporized leaving behind calcium magnesium and Iron ions ( $\text{Ca}^{2+}$   $\text{Mg}^{2+}$   $\text{Fe}^{2+}$ ). Distillation can remove both temporal and permanent hardness



**Addition of Calcium Hydroxide slaked lime**

Slaked lime can remove both temporary and permanent hardness by precipitating the insoluble carbonate chloride and sulphate.

**Addition of Sodium Carbonate or Washing Soda**

Adding of sodium carbonate (washing soda) to hard water can remove both hardness. This addition removes calcium ions.

The calcium ion form a precipitate which is filtered off.

**Advantages of Hardwater**

1. Hard water is essential for the function of strong bones and teeth because it contains calcium ion.
2. Hard water does not dissolve lead and therefore it can be supplies in lead pipes to prevent lead poisoning.
3. Hard water prevents heart diseases.
4. Hard water has a pleasant taste hence extensively used in brewery industries for the preparation of alcoholic drinks.
5. The calcium in hard water helps in blood clotting

**Disadvantages of Hard water**

1. Hard water wastes a lot of soap when used in washing to form a scum.
2. Hard water produces fumes and in knittle boilers hot water pipes and radiators.
3. Hard water interferes with dyeing and tanning and it is therefore not suitable for industrial purposes.
4. Hard water tends to make white clothes turn grey when used in laundry

**Differences between Hardness and Soft Water**

<b>Hard water</b>	<b>Soft water</b>
Presence of salt	No presence of salt
Does not easily lather with soap	Easily lather with soap
Has a pleasant taste, thus used in the production of alcohol	Has no taste, thus is not used in alcohol product
Not used in dyeing and tanning industries	Used in dyeing and tanning industries
Produces fur and scales in kettles and boilers	Odes not produce fur and scales in kettles and boilers



Does not dissolve lead

Dissolves lead which is lead poison

**Uses of Water includes for**

1. domestic purposes
2. drinking, cooking, bathing and washing
3. Industrial purposes
4. Generation of electricity (hydro electric power)
5. Irrigation of crops
6. Cooling of engines and nuclear reaction

**UNIT TWELVE (12) THE PERIODIC TABLE**

**Learning Outcome**

At the end of the lesson, pupils should be able to:

1. explain the periodic classification
2. average common elements into groups and periods
3. distinguish between the families of elements on the periodic table

**THE PERIODIC TABLE**

A list of elements arranged in increasing order of atomic number displayed in groups and periods.

**GROUPS**

The periodic table of the first 20 elements has 8 groups

**GROUPS** – are vertical rows showing elements with similar physical and chemical properties having the same number of electrons in their outermost shells.

**PERIODS**

The period table has 4 periods. A period is the horizontal row of the elements on the table. There are the same number of shells in elements of the same period.

GROUP	ELEMENTS	PERIOD	ELEMENTS
1	H, Li, Na, K	1	H, He
2	Be, Mg Ca		
3	B, Al	2	L, Be, BC, NO, Fe Ne
4	C, bi		



5	N P	3	Na, Mg, Al, bi, P, S, cl, Ar
6	O, S		
7	F, cl	4	K, Ca
8	He Ne Ar		

**PERIODIC TABLE**

GROUPS	GROUP I	GROUP II	GROUP III	GROUP IV	GROUP V	GROUP VI	GROUP VII	GROUP VIII
PERIOD 1	H 1							H 2
2	Li 3	Be 4	B 5	C 6	N 7	O 8	F 9	Ne 10
3	Na 11	Mg 12	Al 13	Bi 14	P 15	S 16	Cl 17	Ar 18
4	K 19	Ca 20						

**GROUP I – Elements – H, Li, Na, K - ALKALI METALS**

**Properties**

1. They have one electron in their outermost shells
2. They are called Alkali metals
3. They dissolve in water to form Alkali solution
4. They are soft metals and can easily be cut with a knife
5. They are very reactive
6. They react with oxygen to form oxides or easily tarnish in air
7. They form Hydrogen gas when dissolved in water

**GROUP II – Elements – Be, Mg, Ca – ALKALINE EARTH METALS**

**Properties**

1. They are called Alkali earth metals
2. They form basic Alkali solution with water
3. They have two electrons in their outermost shells
4. They are harder than group one (1) metals
5. They form oxides when react with oxygen
6. They form Alkali solution when dissolved in water
7. They give off Hydrogen gas when react with water



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**GROUP III – Elements – B, Al**

## **Properties**

1. They have three electrons in their outermost shells
2. They are hard and cannot be easily cut



**GROUP I** – Elements – H, Li, Na, K - ALKALI METALS

**Properties**

1. They have one electron in their outermost shells
2. They are called Alkali metals
3. They dissolve in water to form Alkali solution
4. They are soft metals and can easily be cut with a knife
5. They are very reactive
6. They react with oxygen to form oxides or easily tanish in air
7. They form Hydrogen gas when dissolved in water

**GROUP II** – Elements – Be, Mg, Ca – ALKALINE EARTH METALS

**Properties**

1. They are called Alkali earth metals
2. They form basic Alkali solution with water
3. They have two electrons in their outermost shells
4. They are harder than group one (1) metals
5. They form oxides when react with oxygen
6. They form Alkali solution when dissolved in water
7. They give off Hydrogen gas when react with water

**GROUP III** – Elements – B, Al

**Properties**

1. They have three electrons in their outermost shells
2. They are hard and cannot be easily cut

**Properties**

1. They have eight electrons in their outermost shells
2. They can be called ~~Z~~ero, inert, stable or noble gasses
3. They are used to fill balloons in air ships and light bulbs



## UNIT THIRTEEN(13) ATOMIC STRUCTURE

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. distinguish between atomic number and mass number
2. describe how the particles are arranged in the atom

### **ELECTRONIC CONFIGURATION**

ELEMENT	SYMBOL	ATOMIC NUMBER	ELECTRONIC STRUCTURE				
			SHELL				
			K	L	M	N	
Hydrogen	H	1	1				
Helium	He	2	2				
Lithium	Li	3	2	1			
Beryllium	Be	4	2	2			
Boron	B	5	2	3			
Carbon	C	6	2	4			
Nitrogen	N	7	2	5			
Oxygen	O	8	2	6			
Fluorine	F	9	2	7			
Neon	Ne	10	2	8			
Sodium	Na	11	2	8	1		
Magnesium	Mg	12	2	8	2		
Aluminium	Al	13	2	8	3		
Silicon	Si	14	2	8	4		
Phosphorous	P	15	2	8	5		
Sulphur	S	16	2	8	6		
Chlorine	Cl	17	2	8	7		
Argon	Ar	18	2	8	8		
Potassium	K	19	2	8	8	1	
Calcium	Ca	20	2	8	8	2	



### THE ARRANGEMENT OF ELECTRONS

	SHELL	Total Number Of Electron Electronic Config							
1	1st. Shell = K		2					2	
2	1st. Shell = L		8					2, 8	
3	2nd. Shell = M		8					2, 8, 8	
4	3rd. Shell = N		8					2, 8, 8	

### CONFIGURATION

This refers to the arrangement of electrons on the shells around the nucleus of an atom

### STRUCTURE

Display the diagrammatic representation of electrons around the shells.

Inside each structure is a nucleus into which the protons and Neutrons are found.

The electrons are found moving around the nucleus

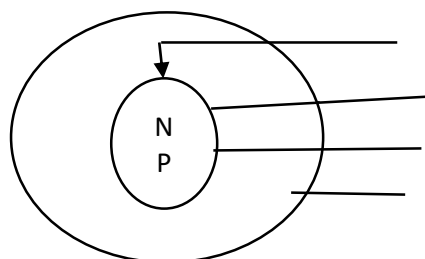
Each atom contains

Electron

Proton – P

Neutron – N

Nucleus



Nucleus

Neutron

Proton

Electron

Electrons are Negatively Charged

Protons are Positively Charged

Neutrons are Nutrally Charged

Proton = Atomic number = Electron number

Neutron = Atomic mass – Proton Number

### Example

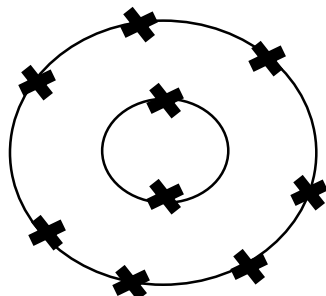
Configuration of Neon (Ne) =  $Ne$   $\begin{matrix} 20 \text{ Atomic Mass} \\ 10 \text{ Atomic Number} \end{matrix}$

1. Atomic number = 10



- 2. Number of electrons = 10
- 3. Atomic mass = 20
- 4. K shell = 2 electron
- L shell = 8 electron
- 5. Neutron = atomic mass – Atomic Number

### Structure



Element	Proton	Election	Atomic Mass	Neutron Neutron	Calculation
H	1	1	1	1 – 1	0
He	2	2	4	4 – 2	2
Li	3	3	7	7 – 3	4
Be	4	4	9	9 – 4	5
B	5	5	11	11 – 5	6
C	6	6	12	12 - 6	6
N	7	7	14	14 – 7	7
O	8	8	16	16 – 8	8
F	9	9	19	19 – 9	10
Ne	10	10	20	20 – 10	10
Na	11	11	23	23 – 11	12
Mg	12	12	24	24 – 12	12
Al	13	13	27	27 – 13	14
Sl	14	14	28	28 – 14	14
P	15	15	29	29 – 15	14
S	16	16	32	32 – 16	16
Cl	17	17	35.5	35.5 – 17	17.5
Ar	18	18	40	40 -18	22
K	19	19	39	39 – 19	21
Ca	20	20	40	40 – 20	20



**Electronic structures from the table**

1	Hydrogen (H) Protons = 1 Electron = 1 Mass = 1 Neutron = 1 - 1 = 0	$H_1^1$	
2	Helium (He) Protons = 2 Electron = 2 Mass = 4 Neutron = 4 - 2 = 2	$He_2^4$	
3	Lithium (Li) Protons = 3 Electron = 3 Mass = 7 Neutron = 3 - 7 = 4	$Li_4^7$	
4	Beryllium (Be) Protons = 4 Electron = 4 Mass = 9 Neutron = 9 - 4 = 5	$Be_5^9$	
5	Boron (B) Protons = 5 Electron = 5 Mass = 11 Neutron = 11 - 5 = 6	$B_5^{11}$	
6	Carbon (C) Protons = 6 Electron = 6 Atomic Mass = 14 Neutron = 12 - 6 = 6	$C_6^{12}$	
7	Nitrogen (N) Protons = 7 Electron = 7		



Atomic Mass = 14	<b>X</b>
Neutron = $14 - 7 = 7$	

## UNIT FOURTEEN (14) CHEMICAL FORMULA

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. write chemical formula and chemical equation
2. state the symbols of the first 20 elements and other common element



Meaning

Is a sign representing molecules of elements, radicals or compounds comprising a combination of symbols and valencies.

Valency

- a. This refers to the combining power of atoms.
- b. The valency of an element or radical is the number of Hydrogen atoms which will combine or displace one atom of the element or one group of the radical.

Radical

An atom mole or ion that has an unpaired valence electron making them highly chemically reactive.

Examples

Radical	Valency
HCO <sub>3</sub>	1
OH	1
NO <sub>2</sub>	1
CLO <sub>3</sub>	1
NH <sub>4</sub>	1
NO <sub>3</sub>	1
MnO <sub>4</sub>	1
SO <sub>4</sub>	2
CO <sub>3</sub>	2
PO <sub>4</sub>	3
SO <sub>3</sub>	2

**VALENCIES OF THE FIRST 20 ELEMENTS**

	ELEMENT	VALENCY
A	Argon	0
	Helium	0
	Neon	0
B	Hydrogen	1
	Lithium	1
	Fluorine	1
	Sodium	1



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	Chlorine	1
	Potassium	1
C	Beryllium	2
	Oxygen	2
	Sulphur	2
	Calcium	2
	Magnesium	2
D	Boron	3
	Iron	3
	Nitrogen	3
	Phosphorous	3
	Aluminium	3
E	Carbon	4
	Silicon	4
F	Nitrogen	3
	Phosphorous	
G	Sulphur	2

Other valencies of elements outside the first 20 elements

Zinc = Zn = 2

Copper = Cu = 1, 2

Iron = Fe = 2, 3

Tin = Sn = 2, 4

Lead = Pb = 2, 4

CHEMICAL FORMULAE	
CaO	Calcium oxide
Na <sub>2</sub> O	Sodium oxide
H <sub>2</sub> O	Water
MgCl <sub>2</sub>	Magnesium Chloride
NaCl	Sodium Chloride
MgO	Magnesium Oxide
KCl	Potassium Chloride



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$\text{Al}_2(\text{SO}_4)_3$	Aluminium sulphate
$\text{Ca}(\text{OH})_2$	Calcium Hydroxide
$\text{Fe}_2(\text{SO}_4)_3$	Iron (V) Sulphate
$\text{Mg}(\text{OH})_2$	Magnesium Hydroxide
$\text{CaCO}_3$	Calcium Carbonate
$\text{FeS}$	Iron Sulphate
$\text{CO}_2$	Carbonate (IV) Oxide
$\text{Fe}_2\text{O}_3$	Iron (III) Oxide
$\text{CaCl}_2$	Calcium Chloride
$\text{FeO}$	Iron (III) Oxide
$\text{PbO}$	Lead Oxide
$\text{CuO}$	Copper Oxide
$\text{H}_2\text{SO}_4$	Sulphuric acid
$\text{ZnO}$	Zinc Oxide
$\text{ZnCl}_2$	Zinc Chloride
$\text{H}_3\text{PO}_4$	Phosphoric acid



HNO <sub>3</sub> – Nitric acid	Al <sub>2</sub> (OH) <sub>3</sub>
H <sub>2</sub> CO <sub>3</sub> – carbonic acid	Mg (OH) <sub>2</sub>
NH <sub>4</sub> – Ammonium	NH <sub>4</sub> NO <sub>3</sub>
NH <sub>3</sub> – Ammonium	2KCO <sub>3</sub>
ClO <sub>3</sub> – chlorate	NaCl
PO <sub>4</sub> – phosphate	Zn NO <sub>3</sub>
NO <sub>3</sub> – Nitrate	CuSO <sub>4</sub>
NH <sub>3</sub> (OH) <sub>2</sub> – Ammonium hydroxide	Na <sub>2</sub> CO <sub>3</sub>
KOH – Potassium hydroxide	H <sub>2</sub> SO <sub>4</sub>
K <sub>2</sub> O – Potassium oxide	ZnCl <sub>2</sub>
Al <sub>2</sub> O <sub>3</sub> – Aluminium oxide	CuCO <sub>3</sub>
NaO – Sodium oxide	

### WRITING CHEMICAL FORMULAE

#### Steps

- 1st. Represent the elements and radicals in symbols.
- 2nd. Write the valencies underneath the symbols.
- 3rd. If the valencies are the same divide both with one of the valency for each.
- 4th. Inter change the valencies of each symbol by a cross sign
- 5th. Match down the symbols with the-inter changed valencies.
- 6th. Write out the formula derived.

#### Example

##### 1) Magnesium Oxide (MgO)

NH<sub>4</sub> – Ammonium

1st. Mg + O

2nd. 2                      2

3rd.  $\frac{2}{2}$                        $\frac{2}{2}$

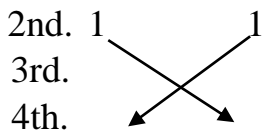
4th. 1                              1

5th. Mg<sub>1</sub>                      O<sub>1</sub>

MgO: One atom of magnesium combines with one atom of oxygen

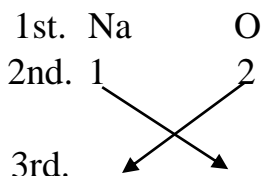
##### 2) Sodium chloride (NaCl)

1st. Na                      Cl



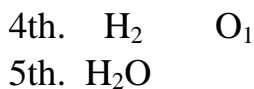
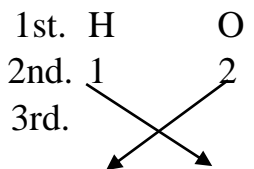
NaCl: one atom of sodium reacts with one atom of chlorine

**3) Sodium Oxide (Na<sub>2</sub>O)**



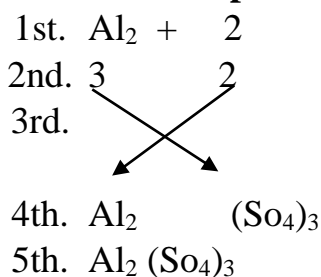
Na<sub>2</sub>O: Two atoms of sodium react with one atom of oxygen.

**4) Water (H<sub>2</sub>O)**



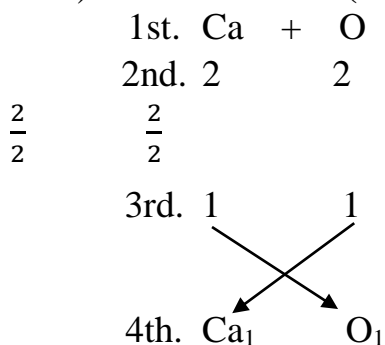
Two atoms of Hydrogen react with one atom of oxygen.

**5) Aluminium sulphate Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**



Two atoms of Aluminium react with 3 atoms of sulphate.

**6) Calcium oxide (CaO)**

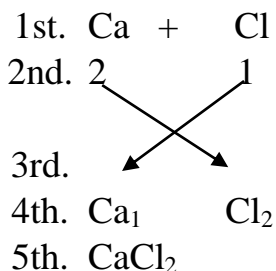




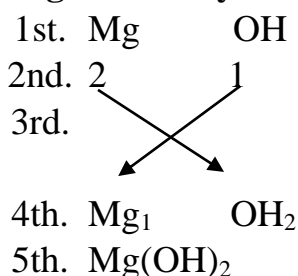
5th. CaO

One atom of Calcium reacts with one atom of oxygen.

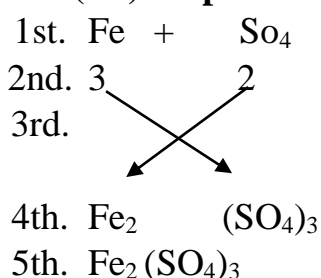
**7) Calcium Chloride (CaCl<sub>2</sub>)**



**8) Magnesium Hydroxide Mg(OH)<sub>2</sub>**



**9) Iron (III) Sulphate Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**



CaO	One atom of calcium reacts with atom of oxygen
NaCl	One atom of sodium reacts with one atom of chlorine
H <sub>2</sub> SO <sub>4</sub>	Two atoms of Hydrogen reacts with one atom of sulphur and four atoms of oxygen radical
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	Two atoms of Aluminium reacts with three atoms of sulphur and twelve (12) atoms of oxygen radical
Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	Two atoms of iron reacts with thee atoms of sulphur and 12 atoms of oxygen radical
CaCl <sub>2</sub>	One atom of calcium reacts with two atoms of chlorine



H <sub>2</sub> O	Two atoms of Hydrogen reacts with one atom of oxygen
------------------	--

**Atoms of Radicals**

- 1) (SO<sub>4</sub>)<sub>3</sub>  
 3 × Sulphur = 3 Sulphur atoms  
 3 × Oxygen = 12 oxygen atoms
- 2) (OH)<sub>2</sub>  
 1 × 2 oxygen = 2 oxygen atoms  
 1 × 2 Hydrogen = 2 Hydrogen atoms

**CHEMICAL EQUATION**

A short – hand form of expressing what happens in a chemical reaction.

A chemical reaction equation is divided into reactants and products.

**Example**

- 1. H<sub>2</sub> + O<sub>2</sub> → H<sub>2</sub>O  
 Reactants      Products
- 2. Na + Cl → NaCl  
 Reactants      Products

**STEPS**

- 1. Write out the chemical Equation  
 Example = magnesium oxide MgO  
 Mg + O      MgO
- 2. Check to find out if the equation is balanced or not by counting the number of atoms on either sides of the reactants and products one after the other.
- 3. Always write small whole number in front of symbols when balancing making sure that they are equal on either sides.

In balancing chemical equations the total number of atoms on the reactants must be equal to the total number of atoms of the product. It teaches that during chemical reactions, atoms are neither created nor destroyed (Rule of conservation of mass)

**Example**

1	H <sub>2</sub> + O <sub>2</sub> → H <sub>2</sub> O Not balanced
	2H <sub>2</sub> + O <sub>2</sub> → 2H <sub>2</sub> O = Balanced
2	Fe + Cu SO <sub>4</sub> → Fe SO <sub>4</sub> + Cu Balance
3	CaC + H <sub>2</sub> O → Ca (OH) <sub>2</sub> Balance



4	$Fe + S = \text{—————} FeS$ Balance $= Fe + S = \text{—————} FeS$ Balance
5	$P + O_2 \text{ —————} P_2 O_3 = \text{Not balanced}$ $4P + 5O_2 \text{ —————} 2P_2 O_5 = \text{Balance}$
6	$Mg + O_2 \text{ —————} MgO = \text{Not balanced}$ $2Mg + O_2 \text{ —————} 2MgO = \text{Balance}$
7	$Zn + O_2 = \text{—————} ZnO + \text{Not balance}$ $2Zn + O_2 \text{ —————} 2ZnO = \text{Balanced}$
8	$SO_2 + H_2O \text{ —————} H_2 SO_4 = \text{Not balance}$ $2Zn + O_2 \text{ —————} 2ZnO = \text{Balanced}$

## UNIT FIFTEEN

### ACIDS, BASES AND SALTS

#### Learning Outcome

At the end of the lesson, pupils should be able to:

1. explain the terms acids, bases and salts
2. distinguish between an acid and a base
3. classify substance as acids, bases and salts.

#### **ACID**

A compound that turns blue litmus paper red

Types of ACIDS

1. Organic Acid
2. Inorganic Acid

#### **ORGANIC ACID**

They are acids which occur naturally. They are found in plants and animals.

Organic acids are weak and less harmful to man.

	ORGANIC ACID	SOURCE
1	Bee Stings	Bees
2	Lactic	Milk
3	Citric acid	Un-ripe Lemon and Grape Fruit
4	Palmitic acid	Palm oil



5	Amino acid	Protein
6	Acetic acid	Vinegar
7	Methanoic acid	Red ants
8	Salicylic acid	Aspirin
9	Tartaric acid	Graps
10	Ascorbic acid	Rancid butter

## PROPERTIES OF ACIDS

### A. Physical Properties

1. Dilute solutions of acids are sour
2. Dilute solutions of acids turn blue litmus paper red
3. Concentrated acids are corrosive

### B. Chemical properties

1. Strong acids conduct electricity in aqueous solution
2. They react with bases to form salt and water.

**Example,** 
$$\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$$
  
*acid            Base            Salt            Water*

3. Dilute acids react with metallic salts (Carbonates) to form salts water and carbon oxide.

**Example.**

- $\text{H}_2\text{SO}_4 + \text{CuCO}_3 \rightarrow \text{CuSO}_4 + \text{H}_2\text{O} + \text{CO}_2$
- $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

4. They react with metals to produce Hydrogen gas.

**Example.**

- i.  $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
- ii.  $\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$

## IN ORGANIC ACIDS

These are acids that are chemically produced in the laboratory.

**Example**

- $\text{H}_2\text{SO}_4$  – Sulphuric acid
- $\text{H}_2\text{CO}_3$  – Carbonic acid
- $\text{HCl}$  – hydrochloric acid

## USES OF ACIDS

1. To manufacture fertilizers, detergents (Cleaning agents)
2. To manufacture dyes drugs and plastics.



3. Used as electrolytes in lead acid batteries.
4. Use as dehydrating agent
5. Used in petrol refinery
6. Manufacture explosives
7. Soap making
8. Fuel in rocket
9. Food preservation
10. To remove rust.

## **BASES**

These are compounds that turn red litmus paper to blue.

### **Types of base**

1. Organic bases
2. In Organic bases

### **Organic Bases**

These bases that occur naturally in plants and animals.

### **Examples**

1. Petre
  2. Wood ash
  3. Cocoa peels
  4. Wasps stings
- i. Note that the above organic bases produce KOH – Potassium Hydroxide
  - ii. The composition organic matter produces  $\text{NH}_3$  – ammonia

## **INORGANIC BASES**

They are bases prepared in the Laboratory.

### **Example.**

- KOH – Potassium hydroxide
- $\text{NH}_4\text{OH}$  – Ammonium hydroxide
- $\text{Ca(OH)}_2$  – Calcium hydroxide

## **CLASSES OF BASES**

1. Metallic bases
2. Soluble bases
3. Insoluble bases

### **Metal Bases**

They react with oxygen to form bases.



- CaO – Calcium oxide
- K<sub>2</sub>O – potassium oxide
- NaO – Sodium Oxide
- Al<sub>2</sub> O<sub>3</sub> – Aluminium Oxide

**Soluble Bases**

Hydroxides dissolve in water to form Alkaline solution.

NaOH –Sodium hydroxide

KOH – Potassium hydroxide

NH<sub>4</sub>OH – Ammonium hydroxide

Ca(OH)<sub>2</sub> – Calcium hydroxide

**Insoluble bases**

They do not dissolve in water to form solution.

Mg (OH)<sub>2</sub> – magnesium hydroxide

Al (OH)<sub>3</sub> – Aluminium hydroxide

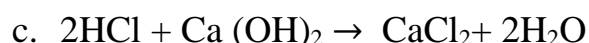
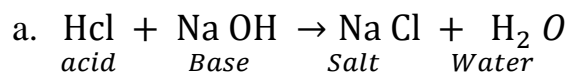
**Physical properties of Bases**

Taste	Bitter
Feel	Slippery
Odour	Odourless
Litmus paper	Turns Red to blue

**Chemical Properties of Bases**

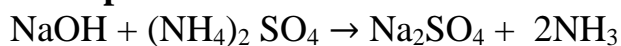
1. Bases react with acids in neutralization reaction of form salt and water.

**Example.**



2. Bases conduct electricity when dissolved in water.
3. Bases and Alkalis react with ammonium salt on heating to produce ammonium gas.

**Example.**



**SALTS**



Substances (Compounds) which contain the negative ions of acids and positive ions of bases.

A salt is a compound formed when an acid reacts with a base.

### Example of Salts

1.  $\text{Cu SO}_4$  – Copper Sulphate
2.  $\text{Zn NO}_3$  – Zinc nitrate
3.  $\text{NaCl}$  – Sodium chloride
4.  $\text{K}_2\text{CO}_3$  – Potassium carbonate
5.  $\text{Fe}_2(\text{SO}_4)_3$  – iron (III) sulphate
6.  $\text{NH}_4\text{NO}_3$  – Ammonium nitrate

### Types of Salts

1. Normal salt
2. Acid salt
3. Basic salt
4. Double salt
5. Complex salt

### Properties of salts

- a. **Salt on Water:** soluble salts dissolve in water to form solutions
- b. **Salt on Acids:** strong acids react with salt to form salt, water and carbon dioxide.  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
- c. **Salt on Alkalis:** Alkalis react with salt to form salt, water and ammonia.  $\text{NH}_4\text{Cl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{NH}_3$
- d. **Action on Heat:** Salt decompose on heating to form oxygen gas.  $2\text{NaNO}_3 \xrightarrow{\text{Heat}} 2\text{NaNO}_2 + \text{O}_2$
- e. Salts have no effect on Litmus paper.

### **NEUTRALIZATION**

Reaction: this the reaction between acids and bases to form salt and water.

- $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$
- $2\text{HCl} + \text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$

### **PH SCALE**

This refers to the power of hydrogen ion.

It is a measure of hydrogen concentration in a solution





## UNIT SIXTEEN(16) METALS AND NON-METALS

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. classify elements into metals and non-metals
2. state the properties of metals and non-metals
3. describe the composition of alloys and their uses

About 3/4 of the elements known are metals found in free states. They are present in earth as ores.

Ores – solid materials containing a metal or its compound mixed with other impurities.

Most elements in group I, II, III are pure metals excluding Hydrogen as non-metal and carbon as metalloid.

METALS	NON-METALS	METALLOID
Lithium Beryllium Sodium Magnesium Aluminium Potassium Calcium	Hydrogen Helium Nitrogen Oxygen Fluorine Neon Phosphorous Sulphur Argon	Silicon Carbon Boron
Zinc – Zn Lead – Pb Iron – Fe Mercury – Hg Silver – Ag Tin – Sn Copper – Cu Manganese – Mn Nickel Ni Gold – Au		Metalloids are elements that display both properties of metals and non-metals.

### DIFFERENCES BETWEEN METAL AND NON-METALS

METALS	NON-METALS
--------	------------



1	Good conductors of heat and electricity except copper	Poor conductors of heat and electricity except carbon in graphite
2	Strong and tough	They are not strong and tough
3	Shiny or bright and can be polished	Not shiny and bright and cannot be polished
4	They can be hammered (malleable) into thin sheets	Cannot be hammered (Not malleable) into thin sheets
5	Have high melting point except mercury with low melting point	Have low melting point except carbon with high melting point
6	Have high boiling point	Have low boiling point
7	Have high density except sodium and potassium with low densities	Have low density
8	Ring when hot (sonorous)	Do not ring when hit (Not sonorous)

## ALLOYS

An alloy is a mixture of two or more metals to form a single uniform solid object that undergoes a change in physical properties.

	ALLOY	COMPOSITION	USE
1	Solder	Lead and Tin	Joining pieces of metals like electrical wires
2	Bronze	Copper and Tin	Making copper coins
3	Typing metal	Lead, Antimony Tin	Printing books
4	Stainless steel	Chromium Nickel	Making cutting tools – knives, Saws, Scissors ...
5	Magnet	chromium Nickel, Cobalt	Attracting metallic substances
6	Galvanized Iron	Iron, Zinc	Making buckets tanks, tubes wire fence barbed wire, roofing materials metals, nails, nuts
7	Brass	Copper, Zinc	Making tubes, rods, screws, nuts, bolts, ornaments
8	Duralumin	Aluminium, magnesium, copper	Making bodies of planes, Buses, Lorries, Railways, Trains, Tankers



# The Sierra Leone Teaching Service Commission





## UNIT SEVENTEEN (17) CONTINUITY AND CHANGE

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. differentiate living from non-living things
2. classify living things

Biology is the study of living things that is plants and animals. The study of plants is known as BOTANY and the scientists who study plants is a Botanist. The study of animal is ZOOLOGY, and the scientist is a zoologist.

### Characteristics of Living Things

1. **Movement** – Is the change of position of parts or the whole of the living organism. Animals move from place to place locomotion. Plants do not move from to place but move part of their body eg plants can bend towards light
2. **Respiration** – Is the breakdown of food within the cells of living organism with or without oxygen to release energy.
3. **Nutrition/Feeding** – Is the process by which living organism obtain or take in food. Green plants manufacture or make their own food by the process of Photosynthesis. Plant take in simple food animals feed on read-made food that is complex food.
4. **Irritability/Sensitivity** – Is the process by which living things respond to stimulus or external change in their environment. Animals respond faster to stimulus while plants respond slowly to stimulus.
5. **Growth** – Increase in size and height resulting in change in their body shape and functions. Plants grow at their roots or short tips and definite regions apical growth. Growth in plants is continuous. Animals grow throughout the body INTERCALARY growth. growth in animals stop at maturity.
6. **Excretion** – Is the process by which living things remove metabolic waste form their body. Metabolic waste includes sweat, urine, carbon dioxide etc.
7. **Reproduction** – Is the process by which living organisms give rise to young ones called offspring. The acronym – MR. NIGER put together from the first letter of each process gives the seven characteristics of living things. MOVEMENT, RESPIRATION, NUTRITION, IRRITABILITY, GROWTH, EXCRETION AND REPRODUCTION



**DIFFERENCES BETWEEN PLANTS AND ANIMALS**

<b>Plants</b>	<b>Animals</b>
Don't move from place to place no locomotion	Move from place to place locomotion
Respond slowly to external stimulus	Respond faster external stimulus
Growth in plants take place at definite regions called apical growth	Growth in animals occur in all part of body intercalary growth
Growth is continuous	Growth stops maturity

**Assignment - I**

1. State any two other differences between plants and animals.
2. State 5 difference between living things and non-living things
3. Give any 5 similarities between plants and animals

**UNIT EIGHTEEN (18) LIVING CELLS**

**Learning Outcome**

At the end of the lesson, pupils should be able to:

1. explain what a living cell is
2. describe the structure and functions of plant and animal cells

A living cell is the basic structural and functional unit a living organism.

Organisms with one cell are called unicellular organisms eg amoeba, paramecium, euglena etc

Organisms with two or more cells are called multicellular eg man, mango tree, rat, spirogyra etc

**Parts of a Cell and their functions**

1. Cell membrane – selectively permeable serves as a barrier allowing certain substances and others not

It protects the cell

2. Cellwall – In plant cells only
  - give strength and support to other cell
  - give shape to the cell
3. Nucleus – controls lie activities of other cell
  - responsible for cell division (reproduction)



- determines the shapes and functions of the cell
4. Cytoplasm – contains cell organelles – minute cell structures organelles – minute cell structures that carries out specific functions.

**Cell Organelles include:** mitochondrion, ribosome, lysosome, Golgi bodies, cell membrane, chloroplasts etc

### **FUNCTIONS**

**Cytoplasm** - Facilitate the movement of substances in and out of the cell.

It is also the site for most chemical reactions in the cell

**Mitochondrion** – Is the site for the oxidation of food substance concerned with the release of energy. It is referred to as the “power” House” of the cell

**Ribosome** – Is the site for protein synthesis

**Lysosome** – Found in animal cells but not in plant cells

It aids in the disintegration of dead cells and also to help in the digestion of food on the cells.

**Vacuoles** – Are fluid filled cavities in the cytoplasm. They are small humorous and unreliable in animal cell while in plant cell, they are usually large few and occupy a greater space of cell.

the fluid found in the vacuole is known as cell sap which contains mineral salts, sugar and pigment dissolved in water.

### **Functions**

- Acts as storage organ
- It controls the amount of water which moves into and out of the all (osmo-regulation)

**Golgi bodies** are coiled and thread like. It is secretory in function.

**Cell Membrane** – Encloses the cell and serves as a barrier and a link between the cell and its surroundings. The cell membrane is partially or selectively permeable ie allow substances depending in size and nature to pass through it.

### **Functions**

- Contain the cell content
- Controls the transfer of food and waste substance into and out of the cell.



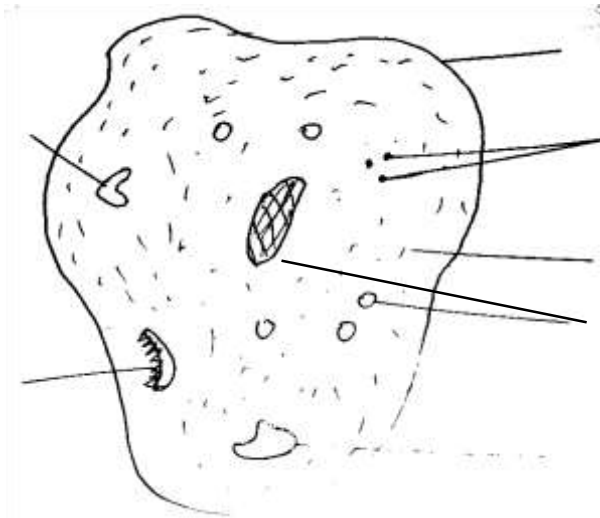
- Cellwall – Found only in plant cells. It is a thick rigid wall lying just outside the cell membrane. the cell is non-living and is made up of CELLULOSE

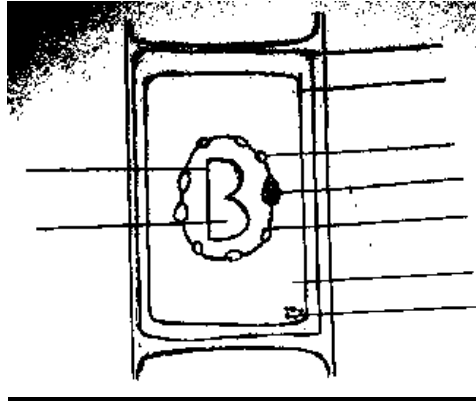
### Functions

- Give shape and rigidity to the cell.
- Is permeable to gases, water and other substances
- Prevent or protect the cell by the entrance of bacteria

**Chloroplast** – Found in plant cells only, they contain the green pigment called chlorophyll used to manufacture food by the process known as photosynthesis. The main function of the chlorophyll is to capture sunlight energy or trap sunlight energy from the sun for photosynthesis.

**Endoplasm Reticulum** – Transport materials within the cytoplasm. It transport materials from the cytoplasm to the nucleus. Example of cells includes root cell, nerve cells, red blood cells, white blood cells, epithelial cells, sperm cells, egg cells, spongy cells, epidermal cells, palatable cells etc





## UNIT NINETEEN (19) AMOEBIA PROTEUS

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. describe the structure of amoeba
2. state the function of the various parts of amoeba
3. explain the living processes in amoeba

Amoeba proteus is a unicellular, microscopic aquatic organism. It lives in ponds, ditches and stagnant pools. It belongs to the group called Protozoa.

### Structure of Amoeba

Amoeba is irregular in shape ie has no definite shape. It keeps changing its shape all the time.

Amoeba is bounded by an outer membrane known as the cell membrane. The cell membrane protects the cell content and acts as a boundary.

Below the cell membrane is a clear outer layer – the ectoplasm and in inner darker layer the endoplasm. The ectoplasm and the endoplasm forms the Cytoplasm. The endoplasm contains the nucleus at the centre, the contractile vacuole and the food vacuole. The pseudopodia (false feet) bulges outside the cell membrane.

### Mode of Life of Amoeba

**Movement** – Amoeba moves by means of the false feet known as pseudopodia  
**Feeding** – Amoeba feeds on microscopic organisms such as diatoms, desmids etc. Amoeba encircles the food by means of the pseudopodia, engulfs the food and forms the food vacuole. digestive enzymes chemicals are secreted to speed up the digestion.



**Respiration** – amoeba being aquatic obtains oxygen from the water through the cell membrane and also releases carbon dioxide into the water, this exchange of gases occur by simple diffusion through the cell membrane.

**Excretion** – The removal of metabolic wastes and excess water from the cytoplasm is done by the contractile vacuole, the process known as Osmo-regulation

**Reproduction** – Amoeba reproduces by asexual means involving only one organism

Amoeba divides into two, a process known as Binary Fission. The nucleus divides into two parts; the cytoplasm also divides to make two individual daughter cells. The original amoeba forms two new amoeba which will grow to maturity.

**Encystment** – Under unfavourable conditions, amoeba forms a protective coat known as **Cyst**. The amoeba will carry out life processes and reproduces several times. When conditions become favourable in the pond, the Cyst is blown off to release many new cells. This process is known as encystment

**Key Words**

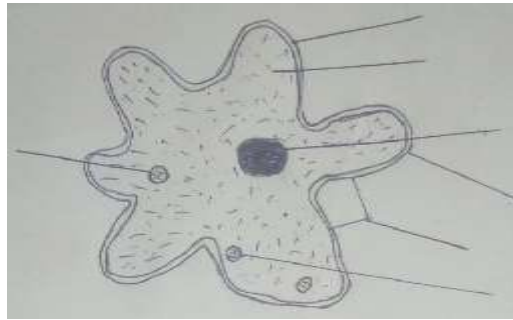
Amoeba	Cell membrane
Microscopic	Ectoplasm
Unicellular	Endoplasm
Aquatic	Cytoplasm
Ponds	Nucleus
Ditches	Food vacuole
Diatoms	Contractile vacuole
Desmids	Pseudopodia
Engulf	Osmo-regulation
Stagnant pools	Diffusion
Binary fission	Cyst
Encystment	Asexual

**Assignment**

1. Name the parts associated with the following life processes in Amoeba
  - a) Movement
  - b) Respiration
  - c) Feeding
  - d) Reproduction
2. Draw reproduction in Amoeba
3. What is:
  - a) Binary fission
  - b) diffusion
  - c) Aquatic
  - d) Microscopic



e) Encystment



**UNIT TWENTY (20) Flowering Plants**

**Learning Outcome**

At the end of the lesson, pupils should be able to:

1. describe the structure of a flowering plant
2. state the functions of the parts of the plant

A typical flowering plant consists of two main systems; root system – found below the ground surface consisting of the root, root cap and root hairs

There are two main types of roots

- I. Tap root system and
- II. Fibrous system

**The main function of the root are**

1. To absorb water and mineral salt form the soil
2. to fix the plant firmly in the soil
3. to transport water and mineral salts to the stem

**Shoot Stem**

Consists of the stem, leaves and flowers. It is the aerial part of the plant

**The Stem**

The stem is an aerial part of vascular plant which bears the leaves, buds, nodes and reproductive structure

Eg flowers and fruits.

**The main Functions of the Stem are**

1. Holds leaf in a position in order to receive sunlight
2. Transports manufactured food down to the roots
3. Transports water and mineral salts to the leaves

**The Leaf**

The leaf consists of three (3) main parts – They are

- a) leaf blade or lamina
- b) Leafstalk or petiole
- c) Leaf base

The parts of the leaf are apex, leaf blade, midrib, leaf, margin, leaf vein, leaf stalk and leaf base.



Leaves of Dicotyledons are network venation eg orange mango etc while those of monocotyledons are parallel venation eg maize, grass etc

**The main functions fo the leaf are**

Functions of the leaf

- a) Site for photosynthesis – manufacture of food
- b) The leaf carry out respiration – exchange of gases
- c) used as support for plants eg climbing plants

**Assignment**

- 1. State two other functions of
  - i. roots, ii. Stem, iii. Leaf
- 2. Give three differences between monocot plan and dicot plants
- 3. Draw and label the external structure of a monocot plant

**Internal Structure of the stem**

The stem is made up of

**Epidermis** – Is the outer most layer of the stem. It withstands the pressure of all the turgid cells and acts as a protective layer. It has no stomata and no guard cells.

**Cortex** – Just behind the epidermis moving towards the stem centre,. It is used to store food (starch)

**Vascular Bundle**

**Xylem Tissues** – Main functions is the conduction of water and mineral salts up the plant to the leaf

Phloem – Responsible for the transport of manufactured food form the leaves to the roots and the various parts of the plant for storage

**Cambium** – Responsible for the growth, thickness strengthening the stem and giving its toughness

Pith – is a wide opening which occupies the whole centre of the stem and can be used for storage of food

**Internal structure of leaf**

The leaf consists fo three (3) main parts

Epidermis – It is covered by a cuticle which renders on the lower side of the leaf are minute openings called stomata (stoma)

The stomata regulate the exchange of gases(oxygen, carbon dioxide and water vapour) into and out of the leaf.

The bean-shaped cells which regulate the opening and closing of the stoma is known as the guard cell.

Mesophyll – Ae mainly concerned with photosynthesis. the mesophyll consists of

- i. the palisade layer and
- ii. the spongy layer of tissue. The sell consists of chloroplasts and have a space between them



The palisade cells are cylindrical while the spongy cells have regular shape

**Vascular Bundle** – The vascular bundle consists of the Xylem and Phloem tissues. The extensive network of vein supplies water to the mesophyll and carries the products of photosynthesis from them

**Assignment**

1. State three differences between the internal structure of a monocot stem and that of dicot stem
2. Where in the internal structure of the leaf does photosynthesis take place?

**UNIT 21**

**FLOWERS**

**Learning Outcome**

At the end of the lesson, pupils should be able to:

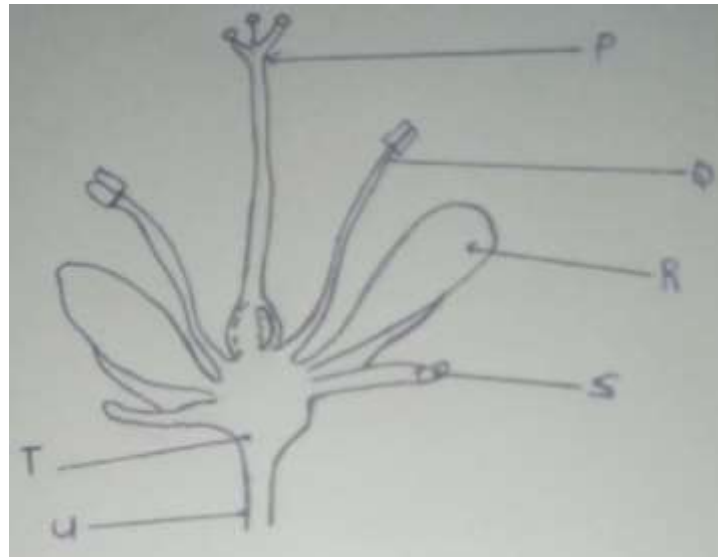
1. identify the floral parts and variation in flower structure
2. describe how flowers are pollinated and fertilized
3. identify the agents of dispersal of fruits and seeds

**STRUCTURE OF A FLOWER**

**A FLOWER:** Is the reproductive organ of a flowering plant. It produces seeds and fruits. It consists of flower stalk or pedicel, the end of which is swollen to form the receptacle.

There are four kinds of floral leaves arranged in circles or whorls around the receptacle: Calyx, corolla, androecium and gynaecium.

1. **CALYX** - is the outer most whorl made up of sepals. Usually green and function to protect the flower in bud. When coloured, they are petals.  
**COROLLA** – it is made up of petals, brightly coloured to attract insect for pollination.
2. **ANDROECIUM (STAMENS)** – it is the male part of the flower and consists of stamens. A stamen is made up of a stalk called filament and a head called anther. The anther contains the pollen grains, which contain male gametes.
3. **GYNAECIUM OR PISTIL** – these consist of the female part of the flower, and consist of one or more carpels. A carpel is usually made up of three parts which are STIGMA which receives the pollen grains, STYLE which connect the stigma to the ovary and ovary which contain the ovules, and ovules contain the ovum or the female sex cell.
4. **THE NECTARY** – secretes nectar, a food for insects. This plays an important role in pollination



### **FUNCTIONS OF THE FLOWER**

1. **FORMATION OF SEX CELL:** It is also called gametes. These are both male and female gametes thus the flower undergoes, sexual reproduction.
2. **POLLINATION:** Is the process where pollen grains are transferred to the stigma of the same flower or a flower of the same plant.
3. **FERTILIZATION:** is the union of the male and female gametes to form a zygote. Since the male and female gametes are haploid when the two unite the zygote is diploid.
4. **FRUIT DEVELOPMENT:** the ovary becomes fruit. The wall of the ovary becomes the wall of the fruit called the pericarp. The fruit protects the developing seeds and plays an important role in seeds dispersal.
5. **DEVELOPMENT OF THE EMBRYO SAC:** this is the green structure at the top of the diagram is the ovule.
6. **GERMINATION:** The embryos will germinate from the seed if the proper germination conditions are present. When this occurs the seed resumes its growth.

### **POLLINATION AND FERTILIZATION**

1. **POLLINATION** – Is the transfer of pollen grains from the anther to the stigma of the same flower or flower of another plant of the same kind. The pollen grains are transferred by insects or by wind. There are two types of pollination, and these include:
  - a. **SELF POLLINATION** – This involves transfer of pollen grains from the anther of a flower to the stigma of the same flower or to flower on the same point.



- b. **CROSS POLLINATION** – This involves transfers of pollen grains from the anther of a flower of one plant to the stigma of the anther plant on the same kind (species).
2. **FERTILIZATION** – This is the union of male and female gametes or sex cell to form a zygote. This process follows pollination in plant in animals fertilization is either internal takes place inside the female organism or external (outside the body of the female organism).

## UNIT TWENTY TWO (22) NUTRITION

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. classify food items based on their nutrients
2. state the importance of food nutrients
3. test for starch and proteins

Nutrition is the process whereby living things obtain and use food.

### **FOOD AND CLASSES OF FOOD**

**FOOD:** is any substance taken in by living things to nourish their bodies. The different of food we eat daily form our *DIET*.

### **CLASSES OF FOOD**

Food items are classified according to the main function of the food in the body. The main classes are energy-giving foods, body-building foods and protective (maintenance) foods.

- a) **ENERGY-GIVING FOODS-** Energy-giving foods are the food items that provide the body with the energy. These foods are carbohydrates and lipids (fats and oil)
- b) **BODY-BUILDING FOODS-**Body-building foods provide the body with the substances it requires to grow and to repair and replace worn-out parts. They are mainly proteins.
- c) **PROTECTIVE FOODS-**Protective foods are foods that regulate metabolism and keep our bodies healthy.

### **WHY DO WE NEED FOOD?**

- As a fuel (source of energy)
- As body building materials (building and repair of body tissues).
- To maintain a healthy body (protection against diseases)



In our diets, we need seven essential components of food. These are called **NUTRIENTS**. A nutrient is a substance that provides nourishment. The food nutrients are; **carbohydrates, fats and oils, vitamins and water.**

A roughage is an important component of our diet but it is not a nutrient.

### **CARBOHYDRATES**

Are the major sources of energy needed in the body to perform any activity. The main elements present in carbohydrates are carbon ( C ), Hydrogen ( H ) and Oxygen ( O ) are in the ratio of 2:1. Carbohydrates are obtained from starchy food such as cereals, and roots and tubers. Cereal include cassava, potato, sweet potato and yams. End product of carbohydrate digestion id **GLUCOSE**.

#### **FUNCTION OF CARBOHYDRATES**

1. They provide energy
2. Carbohydrate help in the maintenance of the structure of the cell walls
3. They are food storage components
4. Provide fibre that makes food move smooth through the gut
5. Serve origin of other organic molecules like amino acids

#### **Effects and dangers of excess or lack of carbohydrates are**

Excess carbohydrates can cause obesity (over weight)  
overweight or obesity can lead to heart (over weight) too much sugar can cause tooth decay

#### **Test for carbohydrates**

##### **Test for starch**

- put a little food substance into a test tube
- add a few drops of iodine solution

##### **Solution**

Formation: A blue-black indicates the presence of starch in food substance

##### **Test for reducing Sugar**

put a little food substance into a test tube add a little benedict's solution or Fehling's solution A and B to the food substance in the test tube

Formation of orange or brick-red precipitate shows the presence of reducing sugars in the food substance.

##### **Proteins**

Proteins are the food substances that contain carbon, hydrogen, oxygen and nitrogen. Some proteins contain sulphur and phosphorus

Major sources of proteins include meat, milk, eggs, fish and legumes



### **Functions of proteins in the diet**

- Proteins make up hormones, enzymes and co-enzymes
- They help us grow
- They are responsible for repair of damaged or worn-out tissues
- Proteins give energy but not as important as carbohydrates
- Control the rate of metabolism
- The end product of protein digestion is Amino Acids

### **Test for Proteins**

Two tests in the laboratory

#### **Million's Test**

- Place some quantities of mashed food substance in a test tube and add some water and shake well.
- Add few drops of Million's reagents and heat for about 1 minute
- A *white curdy* precipitate formed which turns deep red on heating is an indication of proteins in the food substance

#### **Biuret Test**

- Put a sample of the food in to a test tube
- Add water
- Add few drops of biuret solution sodium hydroxide and copper

Sulphate solution dropwise and shake well.

The formation of a violet colouration indicates the presence of proteins in the food substance

Lack of proteins lead to diseases like kwashiorkor and Rickets.

### **Assignment**

1. Why do we need food?
2. What is a balanced diet?
3. Give 3 (three) functions of  
a) protein    b) carbohydrates
4. State one test for  
a) starch    b) protein    c) lipids

## **UNIT TWENTY THREE (23) NUTRITION**

### **Learning Outcome**

At the end of the lesson, pupils should be able to:



1. classify items based on their nutrients
2. state the importance of food nutrients
3. test for fats and oils
4. describe a balanced diet and state its importance

### LIPIDS (FATS AND OILS)

Fats and oils are generally called lipids. Lipids are esters of long chain-fatty acids and glycerol. They contain carbon, hydrogen and oxygen.

Fats and oils are obtained from;

3 animals. For example, mutton fat, beef fat and chicken

4 plants, for example, ground nut oil, palm kernel, palm oil etc

### DIFFERENCES BETWEEN FATS AND OILS

FATS	OILS
Are solids at room temperature	Are liquids at room temperature
Are obtained from animals	Are obtained from plants
Contain more saturated by fatty acids	Contain more unsaturated fatty acids

### FUNCTIONS OF LIPIDS

- Lipids produce twice more energy to the body than carbohydrates
- They insulate the body. That is, they prevent or reduce heat losses
- They act as energy store.
- They serve as structural material. For example, they form part of the components of cell membrane
- Fats dissolve fat-soluble vitamins.
- They protect internal organs such as intestines, kidney and heart.
- They form fatty sheath around nerve impulses.
- Fats make aquatic animals buoyant
- Lipids makes some body parts water-proof. Examples are waxes on plant leaves and exoskeleton of arthropods
- They are used to make hormones

### TEST FOR LIPIDS

Lipids can be identified by using **sudan111 test**, spot test and emulsion test.

#### USING SUNDAN 111 SOLUTION

4. Half-fill a test tube with any cooking oil, eg, peanut oil or coconut oil.
5. Add 3 to 5 drop of Sudan 111 solution
6. Shake the mixture well

**Observation: the reagent stains the oils red.**

#### Sport test



Release a drop of oil any plain paper (e.g, filter paper). Leave the paper to dry in the sun hold the paper to light and look at the light via the spot where the oil was dropped. The spot becomes translucent.

### **Emulsion test**

- a) Put about 2ml of ethanol into a test tube
- b) Add 1 ml of any oil.
- c) Shake the mixture thoroughly
- d) Transfer the mixture into another test tube containing about 2 ml of water.

**Observation: the mixture forms a milky emulsion.**

### **ASSIGNMENT**

1. Why do we need food?
2. Give two uses of each of the following nutrients in the body
  - a) Carbohydrate
  - b) Protein
  - c) Fats and oils
3. A) list any four reagents used to test for food.  
B) For each of the reagents named above, give the food it tests for and the final colour change.

## **UNIT TWENTY FOUR (24) DIGESTION**

### **Learning Outcome**

At the end of the lesson, pupils should be able to:

1. describe the structure of the digestive system
2. give he function of the parts of the digestive system

**Digestion** is the process by which the body breaks down complex food substance into simple soluble forms by means of enzymes so that they can be absorbed into the body to release energy.

The food that is digested or broken down is transported by the blood lymprn into the cells of the body. This process is called absorption.

**Absorption** is the passage of digested food into the cell of other body. The cell then make use of the absorbed food and this process is called Assimilation.



Assimilation is the use of absorbed food by the cells of the body. when digested food is assimilated into the cells fo the body, energy is produced. **Egestion** is the removal of undigested food materials from the body.

### The Digestive System in Humans

The digestive system consists of the mouth, oesophagus, stomach, small intestine,, large intestine, anus and other organs such as liver, stomach pancreas etc.

The oesophagus, stomach, small intestine, large intestine and anus are all part of the alimentary canal

### Functions of the parts of the Digestive System in Human

**Buccal cavity (mouth)** – Contains teeth and tongue. Teeth break down solid food into smaller pieces. Tongue rolls the chewed food into a bolus (a form of ball) before it is swallowed. carbohydrate digestion begins in the mouth

**Salivary gland** – It produces saliva. Saliva moistens and binds chewed food – enabling it to be formed into a bolus and also lubricates he bolus for easy swallowing. Saliva creates an optimum pH (slightly alkaline) for salivary amglase.

**Gullet** or oesophagus – It is a muscular tube through which food (bolus) passes before it gets to the stomach. The lining of the oesophagus secretes mucus to lubricate the ball of food.

**Stomach** – It is a sac-like structure that receives chewed food from the buccal cavity. The walls of the stomach contain gastric gland. The gastric gland secretes gastric juice. The gastric juice contains hydrochloric acid and protein-digesting enzymes called proteases. These are pepsin and rennin protein digestion begins in the stomach.

**Small Intestine** – It consists of the duodenum and the ileum. IT is in the small intestines that absorption of digested food occurs.

**Pancreas** – It produces a juice called pancreatic juice. Pancreatic juice contains three digestive enzymes namely pancreatic amylase, trypsin and lipase pancreas also secretes a hormone known as insulin that helps in the conversion of excess sugar to glycogen for storage in the liver.

**Liver** – It produces bile. Bile is not an enzyme but salt to break up fats into smaller droplets for easy digestion by enzymes.

**Gall bladder** – It store the bile that is produced by the liver

**Larger Intestine** – It consists fo the colon and return. It is here that undigested food substances are stored. It also absorbs water



anus – It serves as an opening allowing undigested material to be removed from the body

### End Products of Digestion

Carbohydrates	-	Glucose
Protein	-	Amino Acids
Lipids	-	Fatty acids and glycerol

### **Assignment**

1. What is
  - i. Digestion
  - ii. Egestion
2. State four structures associated with human alimentary canal
3. Give one main function for each
  - i. mouth
  - ii. gullet
  - iii. stomach
  - iv. large intestine

## **UNIT TWENTY FIVE (25) THE CIRCULATORY SYSTEM**

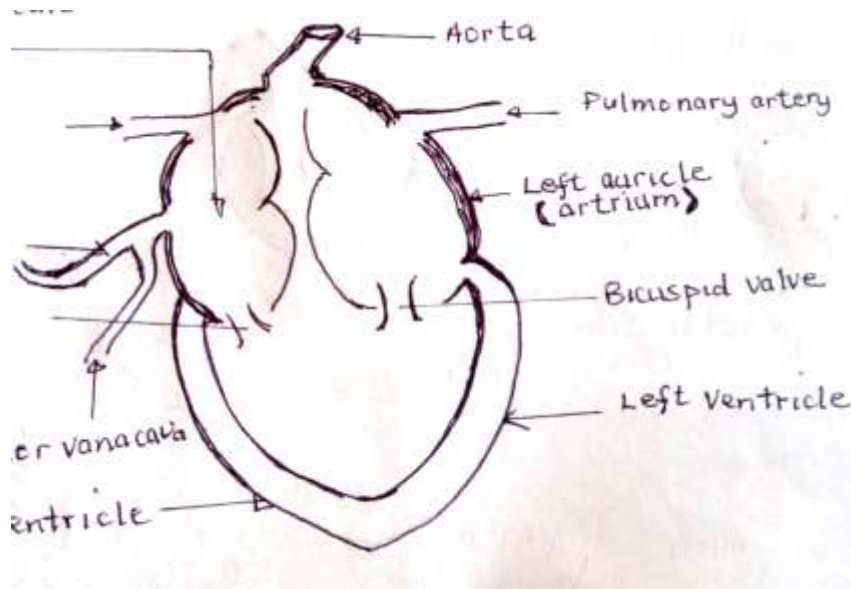
### **Learning Outcome**

At the end of the lesson, pupils should be able to:

1. describe the structure of a circulatory system
2. state the functions of the parts of the circulatory system
3. give the functions of blood and the heart
4. explain how the circulatory system work

The circulatory system is made up of blood vessels that carry blood away from and towards the heart. The arteries carry blood away from the heart and the veins carry blood back to the heart. The circulatory system carries oxygen, nutrient, and hormones to the cells, and removes waste products like carbon dioxide. The two sub division of the circulatory system are: pulmonary circulation and systematic circulation

**HEART** – It a large muscular organ found in the chest cavity. It controls the circulation of blood, by pumping the blood to other parts of the body.



### **FUNCTIONS OF THE HEART**

1. It controls the circulation of blood by pumping the blood to other part of the body
2. It pumps oxygenated blood to the body to the other part of the body
3. It pumps hormones and other vital substances to different parts of the body
4. It's received deoxygenated blood and carry metabolic waste products from the body and pumping it to the lungs for oxygenation.
5. It maintain pressure

**BLOOD** – Is a body fluid that transports oxygen and nutrients to the cell and carries away carbon dioxide and other waste products.

### **FUNCTIONS OF THE BLOOD**

1. The blood transport dissolve food substances blood cells and blood platelets
2. The blood is fluid connective tissues
3. The blood provides the body's cell with oxygen and removes carbon dioxide
4. The blood regulate body temperature
5. The blood platelets clot blood at sites of injury
6. The blood brings waste products to the kindness and liver
7. The red blood cell are the most numerous living cells in blood



8. The white blood cell protect the body from pathogens

### **TYPES OF BLOOD CELLS**

**PLASMA** – The liquid component of the blood in which the following blood cells are suspended

**RED BLOOD CELLS** – These carry oxygen from the lungs to rest of the body

**WHITE BLOOD CELLS** – These help fight infections and aid the immune process. The types of white blood cells include:

- Lymphocytes
- Monocytes
- Eosinophils
- Basophils
- Neutrophils

**PLATELETS** – These help in blood clotting

### **TYPES OF CIRCULATION**

The two sub-division of the circulation are:

**PULMONARY CIRCULATION** – is the contraction of the right ventricle forces blood past the semi-lunar valves into the pulmonary artery, which carries it to the lungs.

**SYSTEMIC CIRCULATION** – is the contraction of the left atrium forces blood past the bicuspid valve into the left ventricles.

### **Parts of the heart and their functions**

**Learning Outcome:** At the end of the lesson, pupils should be able to

- List down the types of circulatory system
- Draw and describe the human heart
- Give the functions of the various parts of the human heart

What are the main transport systems in humans

There are two main transport systems in humans.

These are the

- blood circulatory system
- lymphatic system

The organ which control the blood circulation in mammals is the heart

### **The Heart – Structure**

This is the organ that controls the circulation of blood in mammals. It is a large muscular organ, shaped and lies in the thorax between the lungs but shifted slightly in the left.



The longitudinal section of the heart reveals four chambers namely

- right auricle/atrium
- right ventricle
- left auricle/atrium
- right ventricle

Separating the left auricle and the left ventricle is the bicuspid valve on the other hand, the tricuspid valve separates the right auricle and right ventricle

### **Parts of the circulatory system of mammals and their functions**

- aorta

aorta carries oxygenated blood from the heart to all parts of the body

- Vena cava

Vena cava brings into the heart deoxygenated blood from all parts of the body

- Pulmonary vein

Pulmonary vein transports oxygenated blood from the lungs to the heart

- Pulmonary artery

Pulmonary artery transports deoxygenated blood from the heart to the lungs

- Right atrium/auricle

Right atrium/auricle relaxes and expands to receive blood from the vena cava. Contracts to pump blood under pressure into the right ventricle

- Right ventricle

Right ventricle relaxes and expands to receive blood from the left auricle contracts to pump blood under pressure into the lungs through pulmonary artery.

- Left auricle/atrium

Left auricle/atrium relaxes and expands to receive oxygenated blood from the lungs through the pulmonary vein

- Left ventricle

Left ventricle relaxes and expands to receive blood from the left auricle contracts to pump oxygenated blood under pressure to all parts of the body through the aorta.

- Tricuspid valve

Tricuspid valve prevents the flow of blood back from the right ventricle into the right auricle.

- Bicuspid valve

bicuspid valve prevents the back flow of blood from the left ventricle into the left auricle



## **MAMMALIAN BLOOD CIRCULATION – FLOW OF BLOOD THROUGH THE HEART**

For every circuit that the blood takes, it passes through the heart twice thus in mammals there is double circulation which means that blood flows through the heart twice in ne circulatory path the process is described as follows

blood which enters the right auricle of the heart via the two vena cavae under oxygenated from the right ventricle, it is pumped into the pulmonary artery and the travels to the lungs where it is oxygenated. oxygenated blood returns to the heart through the left auricle via pulmonary veins. It then passes through the bicuspid valve into the left ventricle where it is forced into the aorta and around the body where it is used for tissue respiration. The bold vessels which carry blood away from the heart are called arteries and those that carry blood into the heart are called veins.

### **Sequences of blood flow through the heart from the tissue**

Below is the sequence through which the blood enters the heart and various organs it passes through before finally leaving he heart.

Red blood cells form the tissues → arteria or superior vena cava → right auricle → tricuspid valve → right ventricle → pulmonary artery → lungs → pulmonary → left auricle → bicuspid valve → left ventricle → aorta → to all parts of body

### **Key Words**

auricle	atrium
ventricle	bicuspid
tricuspid	pulmonary
vena cava	oxygenated
valve	arteries

### **Assignment**

Draw and label the mammalian heart

Give the functions of the

- a) pulmonary artery    b) pulmonary vein    c) right ventricle    d) left ventricle



## UNIT TWENTY SIX (26) ECOLOGY

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. explain the basic ecological term
2. define the term ecosystem
3. list the man components of an ecosystem

**ECOLOGY** - Is the study of the inter-relationship between organism and their environment. Plants and animals depends on their environment to derive their food. Living organisms need such things as water, air, food or sunlight and therefore rely much on their environment.

### Basic Concepts in Ecology

**Environment** – Refers to the surrounding or all the conditions in which the organism lives, e.g. the surrounding soil, water, air, climate, physical features fo the landscape, other organisms, etc

**Habitat** – Is any locally within an environment in which an organism can successfully survive i.e. the place where the organism lives. Habitat includes

**Aquatic habitat** – Life on land, including all the ground and underground

**Arboreal habitat** – living on trees and in the air (aerial)

**Species** – Are group of individuals which form an ecological and structural unit that are capable of breeding together to produce a fertile young.

**Organism** – Is the fundamental functional unit of ecology. It includes both plants and animals.

**Population-** Is a group of individual or species or genetically similar individuals living in the same habitat at the same time or at a particular time e.g.



the mango tree in a school compound, grasshopper in a field. Population may tend to change over a period of time, such changes are called “fluctuation.”

**Community** – Are group of population of organism of different species that are occupying the same area but not necessarily sharing the same resource material.

**Ecosystem** – Refer to an area (habitat) composed of plants and animals (biotic) interacting with each other and with the non-living (abiotic or physical) factors of the environment eg a pond

#### **The components of the Ecosystem**

An ecosystem comprises of the Living components (biotic) and the non-living or physical component (abiotic)

**Biotic Component** – Are all the living organisms associated with an environment. This consist of producers, consumers, decomposers.

**Producers** – Mainly green plants which manufacture their food from simple inorganic raw materials with the aid of sunlight and chlorophyll, because community depends on them

**consumers** – Refers to all animals which bring food directly or indirectly from plant. Three kinds exist

**Primary Consumers** – herbivores which feed directly on plants e.g. grasshoppers, cows, etc

**Secondary Consumers** – Carnivores that feed on herbivores e.g. toads, lizards

**Tertiary Consumers** – Which eat the secondary consumers e.g. man, lion, snake

**Decomposer** – Are mainly non-green plants, bacteria and fungi that break down plant and animal remains to obtain energy. They help in nutrient recycling  
Photosynthesis



## UNIT TWENTY SEVEN (27) ECOSYSTEM

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. describe how the components interact to make the ecosystem
2. list ways in which animals depend on plants and plants depend on animals

### **Interactions between individuals in a community**

Apart from the relationship between producers, consumers and decomposers, there are other interactions between the individuals in the community. This includes:

**Predation:** the killing of another animal for food. The predator is usually larger than its prey (organism it kills for food). E.g the fox kills the rabbit. The fox is the predator and the rabbit is the prey.

**Parasitism** – A feeding relationship between two organisms in which only one partner (the parasite) benefits at the expense of the other. A parasite is an organism which only live on or in the body of other organism (the host) from whose tissues it derived its nourishment and harm the organism. Eg. bed bugs, mites, ticks, lice etc (ectoparasites) and tapeworm, ascaris, plasmodium, trypanosome, (endoparasites).

**Saprophytes** - Are organisms (plants) that derived their nutrients from dead organic matter e.g. bacteria and fungi. They lack chlorophyll and cannot therefore photosynthesis. They obtain their nutrients by extra cellular digestion.

**Symbiosis** (mutualism) is an association between two different organisms in which both organisms benefit eg bacteria in the intestine of termites, bacteria in root nodules of legumes, bacteria in the rumen of ruminants.

**Commensalism** – An association between two different species of living organism in which only one (the commensal) benefit and the other neither benefits nor harm. eg. cattle and cattle egret, shark and sucker fish, sea anemone and hermit crab

### **Food Chain and Food Web**



One of the ways in which the organism of a community interact is by feeding or providing food for each other

**Food chain** – Refers to a line of organisms in a feeding relationship in which lower one is used as food source. It is also the linear feeding relationship in which one organism uses the other as source of food. By this, food or energy is passed from producers to consumers and to decomposer. All food chains begin with green plants (producers). Example

grass → grasshopper → lizard → snakes → hawks

The grass is the producer, the grasshopper is the primary consumer, the lizard is the secondary consumer and the hawk is the tertiary consumer (top predator). Another example of a food chain is spirogyra → mosquito → small fish → water snakes.

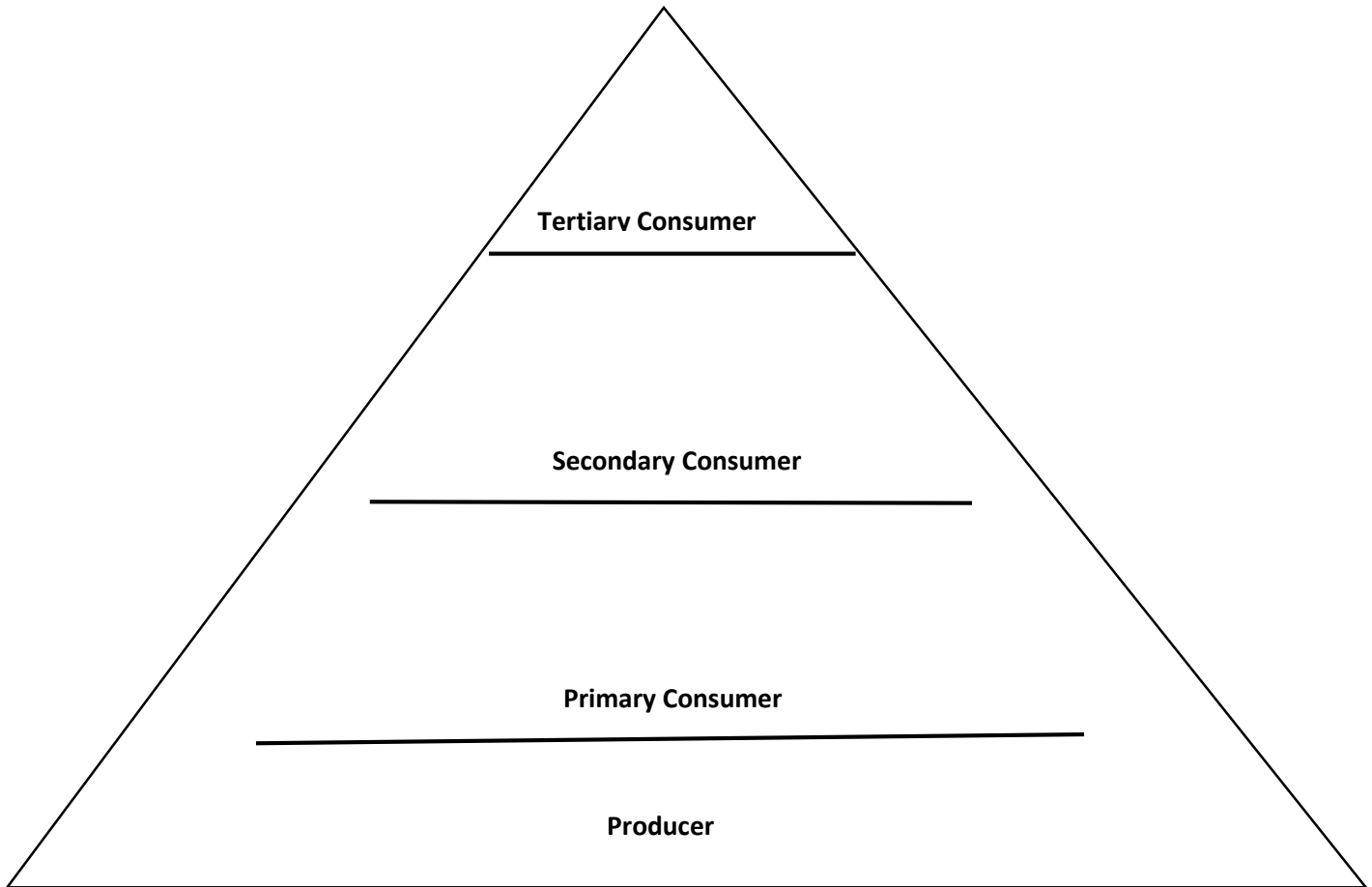
**Food Web** – Is the complex feeding relationship in which an organism has more than one source of food. It is a confused feeding relationship in which one organism feeds on and is being fed by many other organisms.

**Differences Between A Food Chain and a Food Web**

<u>Food chain</u>	<u>Food web</u>
Is a simple linear feeding relationship	Is a complex feeding relationship
Contains consumers feeding on one kind of food	Comprises consumers that feed on different kinds of foods
Involves fewer organism in the community	Involves many organisms in the community

**Pyramid of Numbers**

The number of individual organisms present at each stage of a food chain generally decreases. A pyramid or number is a way of representing the relationship between the number of individuals at each stage of the food chain.



**Assignment**

1. Give three examples of a food chain
2. What is
  - a) Parasite
  - b) Host
  - c) Predator
  - d) Prey
  - e) Commensals
3. Give two examples of
  - a) Endoparasites
  - b) Ectoparasites



## UNIT TWENTY EIGHT (28) POPULATION CHANGES

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. define the term population, migration, immigration and emigration
2. list the factors that will increase or decrease population in the school
3. give the problems of population growth
4. describe the movement of people

The number of people in a place or Country does not always remain the same it changes every day, month or year. The size of the population can be smaller or larger as a result of these changes. I.e. increase or decrease in population. The factors that will increase population in the school community are:

1. Increase in birth rate
2. Decrease in death rate
3. Immigration
4. New admission

Factors that can decrease or reduce population in the school community are:

1. High death rate
2. Low death rate(mortality)
3. Emigration
4. Wars
5. Expulsion
6. Graduation
7. Transfer

Basically changes in population of people within the Country depend on three factors;

1. Birth rate-number of babies born in a year
2. Death rate- number of people who died in a year
3. Migration rate- number of people coming in or leaving

**MIGRATION:** Is the number of people moving into or out of a country. The main types of migration exists.

**IMMIGRATION:** Is the movement of people into a country. The people who come are called immigrants and they add to the total population.

**EMIGRATION:** Is the movement (going)of people out of a country. The people who move out of a country are called **EMIGRANTS** and they reduce the total population. Other forms of migration include;

**RURAL-URBAN MIGRATION-**Movement of people within the same country from the rural area (village or towns) to the Urban areas (cities and large towns) this reduces the population in the rural areas.

**URBAN-URBAN MIGRATION:** This is an internal movement of people from one urban area to another urban area e.g. BO to Freetown.

### **REASONS FOR MIGRATION**



1. In search of food
2. Jobs or employment opportunity
3. Educational opportunities
4. Health facilities
5. Security facilities(war)
6. Agricultural facilities

## **PROBLEMS OF POPULATION GROWTH**

**Major problems are over-crowding and sanitation which lead to;**

1. Many infectious diseases such as cholera, diarrhoea, T.B, can spread easily.
2. More waste and poor sanitation causing pollution. No proper disposal of refuse.
3. Increase crime rate. E.g. Stealing, fighting, prostitution, etc.
4. Poor housing and social facilities
5. Odd jobs (employment)

## **MAN AND HIS ENVIRONMENT**

There are different types of environment;

**PHYSICAL ENVIRONMENT:** Including the soil, land, forest, ocean, sea, air, etc, when this environment is changed by man, two other types of environment are known.

**NATURAL ENVIRONMENT:** Has not undergone any changes e.g. sea, ocean, sky, rivers, etc. The earth is man physical environment.

**ARTIFICIAL ENVIRONMENT:** Environment made by man. It is not in its original state swimming pools, dams, houses, lakes, etc.

## **NATURAL RESOURCES IN THE ENVIRONMENT**

Natural resources are anything from the material or environment man can use in some useful ways.

These includes plants, animals, land, water, minerals, rocks, wild life, livestock, fishes, fossils, forest trees, etc. These materials provide man with basic necessities of life, such as food, clothing, shelter and energy.

**1. RENEWABLE RESOURCES:** The resources that the environment can replace or recycle at the same time

we use them. E.g. water, tree, wild life, crops, fish, etc.

**2. NON-RENEWABLE RESOURCES:** The resources that are not replaced at the same time we use them. They need several years to even replace themselves. E.g. minerals, metals, fossils, fuels, (crude oil), coal, biofuel (biogas).

## **MANS ACTIVITIES AND THE CHANGES IN THE ENVIRONMENT**

Man's activities have greatly influence and brought changes in the environment. This includes;



**1. AGRICULTURE:** Over cultivation, over grazing, land cleaning, burning, tilling, killing, etc, leads to the destruction of trees, exposure of the soil to erosion and killing of large animals and soil micro-organisms. Indiscriminate use of chemicals (pesticides and fertilizers) can kill other animals. cause of soil toxicity

**2. DEFORESTATION:** Cutting down of forest trees for timber, fuel, wood or farming without replacing them. This can cause soil erosion and lost forever of some forest trees, vegetation and animals (wild life). The exposure of the soil can cause leaching of the soil nutrients.

**3. MINING:** Involve the removal of minerals such as diamonds, rutile, iron Ore, etc, buried down in the earth crust. Destroys drinking water systems treatment and fertile agricultural land.

**4. FISHING:** Can destroy would-be bigger fishes, pollutes the water and sometimes the chemicals use can destroy the lives of many fishes and other organisms.

**5. HUNTING:** This may lead to the extinction or complete disappearance of many important animals.

**6. POLLUTION:** The accumulation or addition of harmful wastes into the environment. The harmful substances are called **POLLUTANTS. E.g.**

- a) Carbon dioxide (burning)
- b) Smoke (factories and burning)
- c) Carbon monoxide (factories and garages)

## **7. INDUSTRIALISATION AND URBANISATION**

Construction of roads, building dams, recreation centres, etc, have led to deforestation, pollution reduction in fertile agriculture lands.

### **POLLUTION**

**POLLUTION:** Is the release, addition or accumulation of harmful wastages into the environment. Pollution can be air pollution water pollution or land pollution depending on the part of the environment affected.

**1. AIR POLLUTION:** Mainly caused by the discharge of gases or particles from domestic fires, motor vehicles, generating stations, factories, city roads, building sites, discos, etc. Air pollution include dust carbon dioxide, carbon monoxide, Sulphur dioxide, noise, etc. Air pollution can cause asthma, acid rain to corrode metal, bricks and mortar, eye irritation, suffocation, global warming (greenhouse effect) and death. Air pollution may be prevented or controlled by;

- a) Siting factories away from residential areas.
- b) Building tall chimney so that waste gases are discharged high up in the air.
- c) Passing waste gases from factories through filters and absorbers which remove the polluted air before they are discharged.
- e) Halls to be sited away from residential areas.



**2. WATER POLLUTION:** Caused by the discharged of untreated sewages, industrial waste, oil spillage and agricultural waste materials. Water pollution can cause contamination of drinking water, fish or other animals such as food, by pathogen, death of humans who eat contaminated food, death of sea birds, flooding due to blockage of rivers or streams, etc.

Water pollution can be controlled by:

- a) Treating sewages before being discharged.
- b) Industrial materials should be recycled or treated in controlled amount.
- c) Farmers should avoid using excessive amount of chemical and fertilizers

**3. LAND POLLUTION:** Polluted by discarded objects like old cars and lorries, tins, cans, bottles, plastics and industrial wastes.

Land pollution can be controlled by:

- a) Recycling of metal and other materials from old motor vehicles
- b) Proper disposal of refuse

## UNIT TWENTY NINE (29) EARTH SCIENCE

### Learning Outcome

At the end of the lesson, pupils should be able to:

1. describe the components of the universe
2. state the importance of the sun and the star
3. explain the star patterns in Sierra Leone

The universe means the whole world. The universe includes the sun, moon the planets, comets, galaxies and other heavenly bodies

### **The Solar System**

- The solar system is a small part of the universe called the milky way galaxy.
- The solar system is made up of the sun the planets the moons, comets, asteroids (planetoids) meteors and stars.

### **The Sun**

- The sun is a ball like object that is made up of hot gases
- The sun is the centre of the solar system
- The sun is a star with a great amount of energy



- The sun is 150 million (One hundred and fifty million) kilometres or 93 million (ninety three million) miles away from the earth and that is why we feel or receive very little of the energy it radiates

### **Importance of the sun**

- Green plants absorb light from the sun which they use to manufacture food for themselves and for other animals
- The energy (heat) from the sun is used to operate solar equipment (eg, watches, calculators)
- It is a source of vitamin D which is needed in our bodies
- The rotation of the earth helps to provide an even distribution of the radiant energy from the sun because the rotation of the earth exposes different parts of the earth to the sun at different times

### **The Stars**

- The stars we see on a clear night are very big spheres of gases which release much radiant energy
- The temperature of the stars is usually very high, but fortunately it is a very great distance away from us and protects us from its violent energy it radiates
- stars form part of the "milky way galaxy and they are always moving as the earth moves
- Stars are of different shapes and sizes and they are also far away from each other
- The only star that is nearer to the earth (besides the sun) is called Proxima centauri
- Some stars are brighter than others



- The brightness of a star depends on its size and its distance from the earth (a large star is brighter than a smaller star)
- Stars exist in groups called galaxy.

### **The Importance of stars**

- Stars give us light and heat on earth
- Stars are used to determine time and direction
- People use stars to predict the weather
- Astrologist use stars to predict the future of people by using life circle of stars.

### **Star Constellations**

Star constellations are a group of stars that form different patterns in the sky

Some of the star constellations around the earth are

Pisces	Sagittarius
Leo	Libra
Aquarius	Gemini
Cancer	Taurus
Capricorn	Aries

### **Star Constellations that can be seen in Sierra Leone**

Four star constellations that can be clearly seen in Sierra Leone are

1. **Orion** - It is seen in the months of January, February, March and April
  - It resembles a hunter
  - It is named after a famous Greek hunter called Orion



2. **Plough** - It is seen in the months of January, February, March, April, May and June

It resembles a great bear

3. **Pegasus** - It is seen in the months of September, October, November and December

- It resembles a winged horse

4. **Scorpius** - It is seen in the months of May, June, July and August

- It resembles a scorpion
- Some stars exist in pairs that revolve around each other These are called Double stars
- A band of twelve constellations around the earth is called Zodiac

### Assignment

1. Define the following:  
i. universe, ii. solar system, iii. sun iv. galaxy
2. State the distance of the sun from the earth in kilometres
3. List five (5) stars constellations around the earth
4. Name the four star constellation that can be seen in Sierra Leone.

**TOPIC: THE MOON**

**SUBTOPIC:**

**1: The Phases Of The Moon**

**2: The importance Of The Moon**



### 3: Satellites

#### LEARNING OUTCOME:

By the end of the lesson, Pupils should be able to;

- 1: Identify and draw the phases of the moon
- 2: List the importance of the moon
- 3: Define and give the types of satellite
- 4: State the importance of satellite

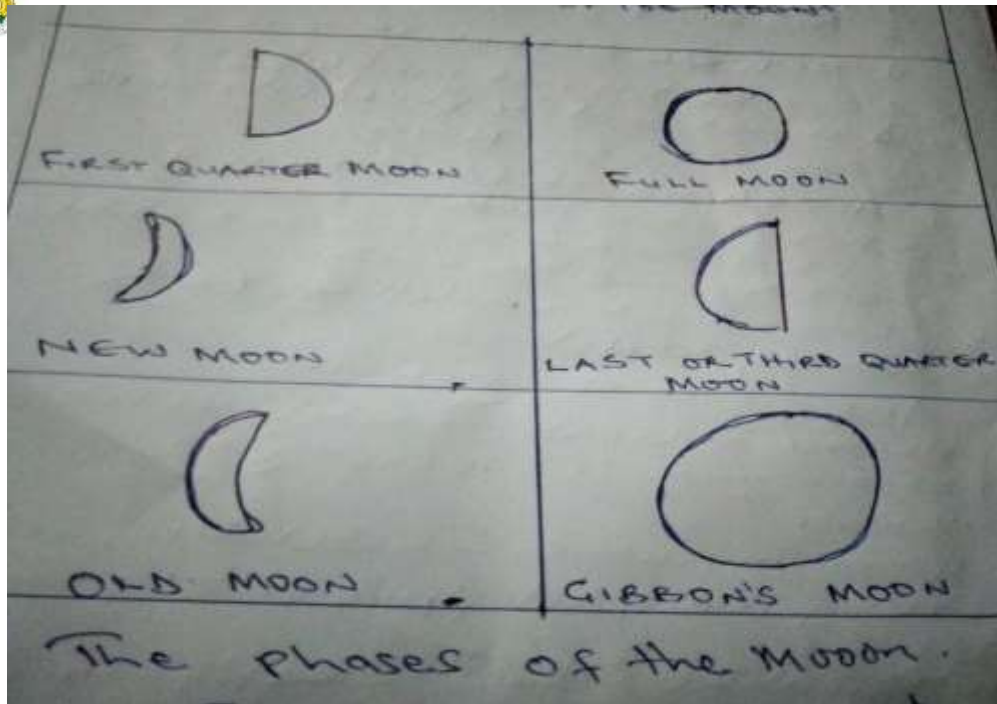
#### THE MOON

- The moon is the closest heavenly body of the earth in the sky.
- It is so close that we can see it. The moon was the first heavenly body that scientists landed a rocket and Astronauts
- The first astronauts to land on the moon were two American astronauts called **Neil Armstrong** and **Edwin Aldrin** on the 20th July 1969.
- The space craft they used was code named **Apollo**
- The moon is much smaller than the earth
- It has a diameter of **12,800 km** and it is four hundred thousand kilometres (**400,000 km**) away from the earth.
- The moon does not produce its own light. The moon light is caused by the sunlight that is reflected from the surface of the moon
- There is no life in the moon (ie no grass, no soil, no wind, no sound and very little air)
- The moon takes twenty nine (29) days to complete a revolution around the earth. (This is known as a lunar month)
- As the moon revolves round the earth, it undergoes some changes at different times in the month.

#### THE PHASES OF THE MOON.



As



the  
moon

revolves round the Earth, it undergoes some changes at different times of the month.

This is called the phases of the moon.

The moon is a natural satellite .

### SATELLITES



A Satellite is a body that orbits or revolves round another heavenly body.

Two types of Satellites exist:

These are ;

- 1: Natural Satellites
- 2: Artificial Satellites

1: Natural Satellites: is a Satellite that is not made by man and is not sent up or placed into space by any man e.g moon.

2: Artificial Satellites: is a Satellite that is made by man and sent up or placed into space so that they can orbit round the Earth. e.g. communication satellites, Earth Satellites, Rocket etc.

### **IMPORTANCE OF SATELLITES**

- 1: Weather forecast: Satellites assist meteorologist in fore casting the weather.
- 2: Communication: Satellites pick up and relay radio, telephone or television message.
- 3: For Science Research: Supply information about radiation, magnetism etc..

### **The Importance of the Moon**

1. The moon gives light at night
2. It causes ocean currents and tides
3. It can help to determine the time, month and date

### **Assignment**

- ❖ Name the first astronauts to land on the moon.
- ❖ What is the distance of the moon form the earth (in kilometres
- ❖ What are the four phases of the moon?
- ❖ State two more importance of Satellites apart from those stated above.



**TOPIC: ECLIPSE**

**SUB-TOPIC:**

1. **ECLIPSE-TYPES**
2. **SOLAR AND LUNAR ECLIPSE**
3. **RAINBOW**
4. **SOME HEAVENLY BODIES**

**LEARNING OUTCOME**

By the end of the lesson, pupils should be able to;

1. Define and give the types of eclipse
2. Describe solar eclipse and lunar eclipse
3. Illustrate the formation of rainbow
4. Show the colours of a rainbow
5. Define and give examples of some heavenly bodies

**ECLIPSE**

The sun is a large luminous body that sends light onto earth and the moon. Because of the movement of the earth and the moon, it is possible for one of them to cover the other from the sun.

**TYPES OF ECLIPSE**

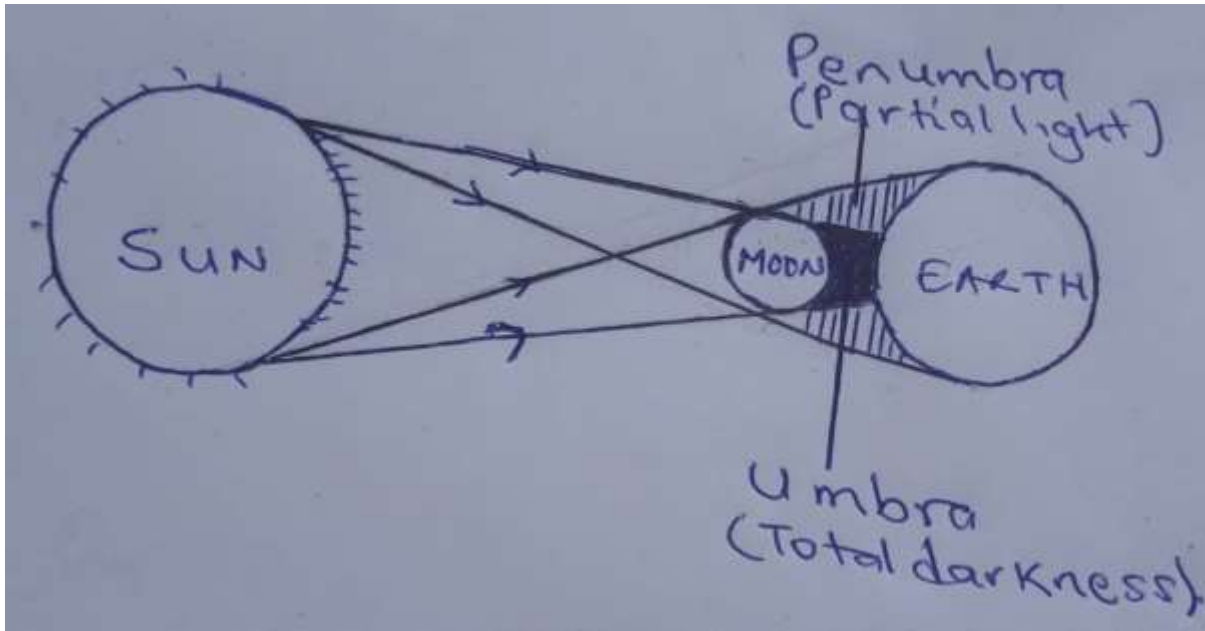
There are two types of Eclipse:

1. SOLAR ECLIPSE
2. LUNAR ECLIPSE

1. **SOLAR ECLIPSE:** Solar eclipse or the eclipse of the sun occurs when the moon passes directly between the sun and the earth. The shadow of the moon will fall on some parts of the earth because the earth is much bigger than the moon.

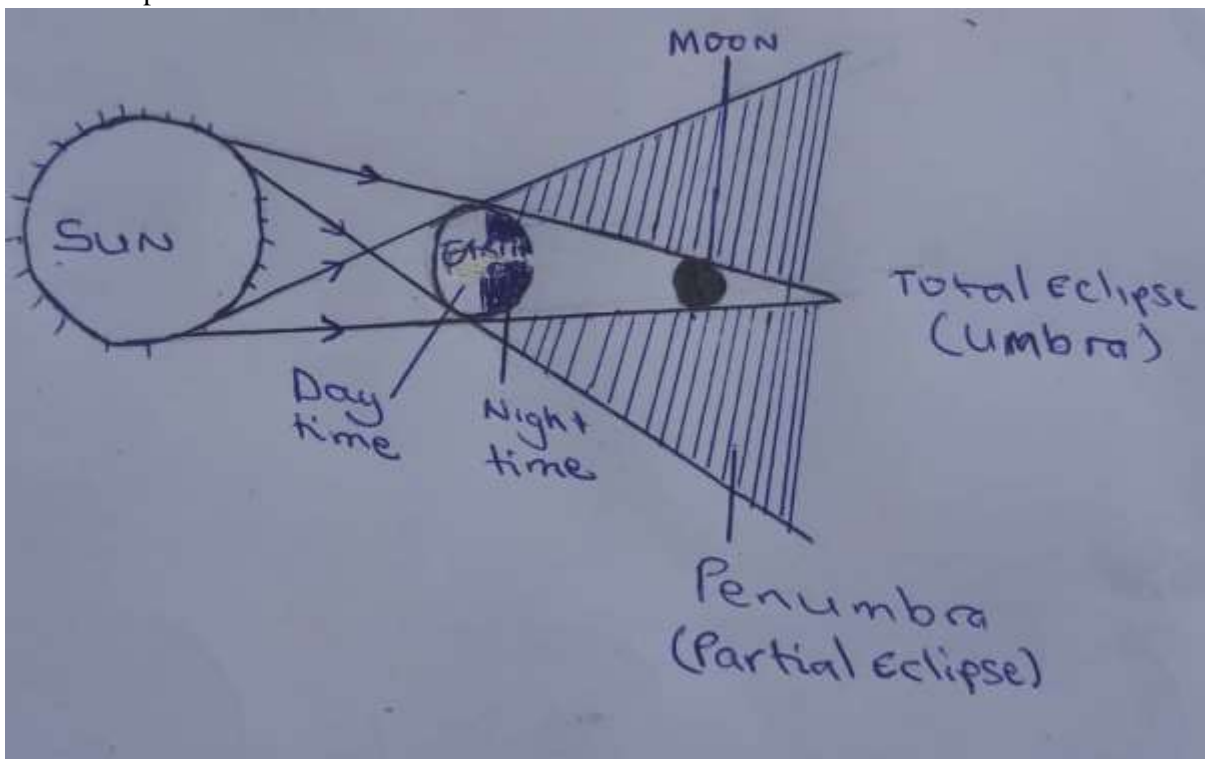
Regions of total shadow (*umbra*) and partial shadow (*penumbra*) will fall on the earth. This will cut off the sunlight or moonlight on some parts of the earth's surface.

This total or partial darkness may last for many days or hours. At times the moon is too far away from the earth that no region of shadow will fall on the earth. This is called annular eclipse.



**Solar eclipse**

- 2. **LUNAR ECLIPSE:** (or eclipse of the moon): lunar eclipse occurs when the earth comes between the sun and the moon. The shadow of the earth thrown on the moon cause the lunar eclipse.



**Lunar eclipse**

**RAINBOW**





- (a) meteors
- (b) meteoroids
- (c) asteroids
- (d) comets
- (e) umbra
- (f) penumbra

**TOPIC: PLANETS**

**SUB-TOPIC:**

- 1. THE EIGHT (8) PLANETS
- 2. THE CHARACTERISTICS OF PLANETS
- 3. DISTANCES OF THE PLANETS FROM THE SUN

**LEARNING OUTCOME**

**By the end of the lesson, pupils should be able to;**

- 1. Define a planet
- 2. List down the eight (8) planets
- 3. Give the characteristics of the planets
- 4. Show the distances from the sun, time to complete a revolution and the number of moon (s) each planet has.

**THE PLANETS**

A planet is a non-luminous heavenly body that revolves round the sun in an elliptical path known as orbit.

There are eight common planets in the solar system. These are listed in the order of their distance from the sun.

- |            |             |
|------------|-------------|
| 1. Mercury | (6) Saturn  |
| 2. Venus   | (7) Uranus  |
| 3. Earth   | (8) Neptune |
| 4. Mars    |             |
| 5. Jupiter |             |

**POINTS TO REMEMBER**

- 1. The orbit of the planets (except pluto) is almost in one plane
- 2. The planets revolve in the same direction (the nearer a planet is to the sun, the faster its speed).



- 3. The four planets nearest to the sun are made up of rocky materials. Whilst the two most distant (Neptune and Pluto), consist mainly of gases (hydrogen and helium).
- 4. Pluto is no longer a planet but a dwarf planet because its orbit is not clear.

**ACRONYM- My Very Educated Mother Just Serve Us Nuts.** The first letters stand for the planets and the whole sentence is for the eight (8) planets.

**NOTE:** Pluto is a longer planet because its orbits is not clear and is obscured. Pluto has been reduced to a **DWARF PLANET**.

All the planets can be grouped into two. The first four plants-*Mercury, Venue, Earth* and *Mars* are known as the Inner Planets and are closed to the sun. they are made mainly of rock and iron.

The last four Planets-*Jupiter, Saturn, Uranus* and *Neptune* are known as the Outer Planets and are far from the sun. they are mainly made up of gas (*Hydrogen* and *Helium*).

**INNER PLANETS**

- 1) Mercury
- 2) Venus
- (3) Earth
- (4) Mars

**OUTER PLANTS**

- 1) Jupiter
- 2) Saturn
- 3) Uranus
- (4) Neptune

**POINTS TO REMEMBER**

- 1. The orbit of the planet is almost in one place and is cleared.
- 2. The planets revolve in the same direction. The nearer the planet is to the sun, the faster its speed.

**THE CHARACTERISTICS OF PLANETS**

- 1. Planets travel in elliptical path known as ORBIT round the sun.
- 2. Planets are non-luminous. i.e. they do not produce light on their own. They get light from the sun’s reflection.
- 3. All planets are spherical in shape or round in shape.
- 4. Most planets have their own moon or natural satellites which travel around them

**DIFFERENCES BETWEEN THE PLANETS AND THE SUN**

PLANET	STAR
1. Does not produce light and heat	1. Produces light and heat
2. Does not twinkle	2. Usually twinkles



3. Moves round a star (star)	3. Does not move
4. It is solid in nature	4. It is made up of burning gases
5. It is smaller in size than the star	5. It is bigger in size than the planet

Below is table of planets; their distance from the sun (in km), time spent to complete a revolution and the number of moons each has.

PLANETS	DISTANCE FROM THE SUN	TIME TO COMPLETE A REVOLUTION	NUMBER OF MOON
Mercury	58 million km	88 days	0
Venus	108 million km	225 days	0
Earth	105 million km	365 days	1
Mars	228 million km	687 days	2
Jupiter	778 million km	2, 380 days	12
Saturn	1, 921 million km	10, 445 days	10
Uranus	2, 890 million km	30, 260 days	5
Neptune	4, 497 million km	388, 426 days	2

### ASSIGNMENT

1. (a) What are planets?  
(b) Name the four planets that are gases in nature
2. a) what is an orbit with respect to the solar system  
b) give the shape of the orbit of the planets
3. Name the:
  - a) The largest planet
  - b) Smaller planets
  - c) Hottest planet
  - d) Coldest planet
  - e) Planet where life is possible
4. Why is Pluto no longer considered as a planet?



## UNIT THIRTY(30) SOIL AND ROCKS

**TOPIC:                STRUCTURE OF THE EARTH**

### **ROCKS**

**SUB TOPIC:**        1. External structure of the earth

2. Internal structure of the earth
3. Rocks and their composition
4. Types of rocks and their characteristics
5. Importance of rocks

### **LEARNING OUTCOME**

At the end of the lesson, pupils should be able to:

1. name the external and internal structure of the earth.
2. describe the various layer of the earth's structure
3. define the term rock
4. describe how the major types of rocks are formed and give their characteristics
5. mention some uses or importance of rocks

### **SOIL**

Soil is a medium for plant growth or the outer most layer of the earth crust.

**SOIL SUPPORT LIFE:** There are various living and non-living substance in the soil. Examples of some living things in the soil which includes: Earthworm, lizard, millipedes, snail, ants, rats, frogs, plants termites, micro-organisms (Bacteria, amoebas) etc.

The non-living substances includes: Rocks, Diamonds, coal, iron ore, gold, rutiles, sands, etc. They are found in or on the soil.

### **SOIL TYPES**

On the basis of the particles which make up the soil, soil may be divided into the following types;

Sandy Soil

Clay Soil

And Loamy Soil

1. **SANDY SOIL:** It contain mostly sand, some silt, stone and gravel. Sandy soil gritty to touch and feel. Water passes through quickly, and they dry out easily. Sandy soil contains low amount of humus.



### CHARACTERISTICS OF SANDY SOIL

- I. Sandy soil is coarse and gritty
- II. Sandy soil is not sticky when wet
- III. Sandy soil has high percolation while capillarity is very low
- IV. Sandy soil is well operated and cannot hold water
- V. Sandy soil has large pore spaces.

2. **CLAY SOIL:** It contain mostly clay, some silt and sand. Clay soil contains very small particles which stick together. They are sticky to touch. Water does not easily pass through a clay soil.

### CHARACTERISTICS OF CLAY SOIL

- I. Clay soil is lightly packed with little pore spaces
- II. It is poorly aerated and can hold water
- III. It is fine grained and smooth
- IV. It is sticky when wet and hard when dry
- V. Percolation is how but capillary is high

3. **LOAMY SOIL:** It contains silt, a small amount of clay a good amount of humus, some gravel and sand. Loamy soil is crumbly to touch, fertile and supply air, water and nutrient for healthy plant growth. Loamy soil is the best soil for agriculture because all of the constituents of the good soil are present.

### CHARACTERISTIC OF LOAMY SOIL

- I. It contains a lot of organic matter
- II. It is loose and moist in nature
- III. It is well aerated and can hold water
- IV. It does not support erosion and water logging

**SILT:** This consists of very small quartz particles. They are micro sand grains but have more surface area than sand.

**LATERITE:** This is leached soil and it is not very suitable for agricultural purpose.

### COMPARISON OF SANDY AND CLAY SOIL

SANDY SOIL		CLAY SOIL	
1	Low water hold capacity	1	High water capacity
2	Have large air space	2	Have small air space
3	Have large particle size	3	Have small particle size
4	Drainage is rapid	4	Drainage is slow
5	Feel gritty	5	Sticky to feel
6	Can't be moulded into shape on wetting	6	Can be moved into shape



## SOIL CONSERVATION

It is no grain saying soil erosion has rendered millions of acres of land highly unproductive. If the world is to meet up with adequate provision of food for the daily increase in the population, and to avert famine and diseases, then measures must be taken to check the ravages of excessive erosion.

### TYPES OF SOIL CONSERVATION

- a. By terracing hill sides to prevent soil erosion: This method is commonly practised in part of Monsoon Asia, Java, Japan etc.
- b. Through contour ploughing whereby the furrows in which the crops are planted create narrow and banked up terraces round hill sides.
- c. By strip-cropping: This is when grasses are planted in strips, soil-binding leguminous crops and yearly cereals. At right angles to the prevailing winds.
- d. By offering hill slopes
- e. Conversion of crop land into pasture
- f. Replacing furrow with suitable crop rotation
- g. By dividing up large field into smaller ones surrounding by hedges and walls that act as wind breaker
- h. Limiting the amount of animals on a farm to the actual holding capacity of the pasture

### IMPORTANCE OF SOIL

1. Soil provides the only medium through which agriculture is practised to provide food for man
2. Soil serves as the source of all minerals used by man
3. Soil provides the habitat for most organisms especially bacteria
4. Soil provides plants with all the needed nutrients for their continuous existence
5. Soil act as reservoir for air and water needed by soil-living organisation to survive
6. All vegetation types form their basis of soils. Without soil, plants cannot get support and nutrient for growth
7. All forms of construction works are carried out on soil

**SOIL FORMATION** – Soil is formed by a process called weathering.

Weathering involves the breaking of rock , resulting into them changing to soil.

**WEATHERING** Is caused by agents such as temperature, winds, water, living organisms, chemicals and chemical process, plants and animals.

**HUMUS – (ORGANIC MATTER)** Is the component of the soil that support life. It refers to the dead and decaying plants and animals. Humus is a source of



food for plant and some animals living in the soil. Humus helps in retaining water in the soil and ensures good aeration. It also inhibits erosion.

### COMPONENTS OF THE SOIL

There six (6) major constituents of a fertile soil and these include: rock particles, water minerals salts, air, humus (organic matter) and macro and micro-organisms.

**ROCK PARTICLES:** these include stones and gravels of different sizes. These are three (3) main types of rocks. Igneous rocks, Sedimentary rocks, and Metamorphic rocks.

### ROCKS

A rock is any solid substance that forms part of the earth’s crust. This solid substance maybe hard, like granite or may even be soft like mud.

ROCK	MINERALS
Limestone	Quartz, feldspar, micas
Sandstone	Quartz, calcite, feldspar
Granite	Feldspar, agate
Basalt	Calcite, dolomite
Shale	Quartz, micas, feldspar

**SOIL FORMATION** – Soil is formed by a process called weathering. Weathering involves the breaking of rock , resulting into them changing to soil. **WEATHERING** Is caused by agents such as temperature, winds, water, living organisms, chemicals and chemical process, plants and animals.

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### The external structure of the earth

The earth is divided into three external structures.

1. Lithosphere
2. Hydrosphere
3. Atmosphere

#### 1. The Lithosphere

It is the solid part of the earth (land) that makes up the continents, rocks, soil and minerals. All land plants and animals are found on this layer, 25% of the entire earth is dry land, and forms the lithosphere



## **2. Hydrosphere**

This is the body that consists of water and includes oceans, seas, rivers, lakes, springs, streams etc. The aquatic (water) plants and animals are found in the water about 75% of the earth surface is made of water.

## **3. Atmosphere**

It is made up of gases such as oxygen, nitrogen, carbon dioxide, pure gases etc. The oxygen in the atmosphere is used by plants and animals for respiration

### **The crust**

This is the outer most layer of the earth found below the oceans and continents. It is 82 kilometres thick and consist of chemical elements such as silicon, iron, sodium, potassium

### **The Mantle**

- It is found beneath the crust and it is about 2,900 km.
- It is made up of mainly solid rocks and from about 655 of the mass of the earth.
- It is believed that the mantle is very hot with a temperature of 3,000°C.

### **The Core**

- It forms the centre of the earth
- It is the inner most layer and about kilometres thick.
- The centre of the core is very hot with a temperature as high as 41000°C
- The core is divided into two parts

### **The Inner Core**

- It is made up of iron and nickel
- The Outer Core
- It is made of liquid

### **Rocks and their Composition**

A rock is a naturally occurring solid aggregate that consists of one or more mineral materials. Examples of rocks are granite, diorite, slate, conglomerate, coal and sandstone.

Many rocks comprise several minerals such as feldspar, quartz and mica. Some rocks contain only one mineral. For example, limestone contains only calcium



carbonate ( $\text{CaCO}_3$ ). Other rocks lack minerals. For example, coal and peat are formed from remains of plants and animals

### **Types of rocks and their characteristics**

Based on their mode of formation, rocks are classified into the following types

#### **Igneous Rocks**

Igneous rocks are massive, shiny rocks formed from magma (molten rock) which cools and solidifies either below or above the soil level. They consist mainly of primary minerals such as quartz and feldspar. Examples of igneous rocks are gabbro, diorite, scoria, pumice, basalt, felsite, rhyolite and andesite.

#### **Characteristics of Igneous Rocks**

- Igneous rocks are crystalline in structure
- They are heavy, shiny and hard
- They are fossil-free
- Igneous rocks are non-stratified
- They are resistant to erosion and other weathering conditions

#### **Sedimentary Rocks**

Sedimentary rocks (stratified rocks) are rocks formed when organic materials and weathered products of other pre-existing rocks accumulate and harden together into strata. The weathered products and the organic materials are called sediments.

Sedimentary rocks are composed of secondary minerals such as dolomite, gypsum, calcite and clay minerals. These rocks contain fossil or organic matter, examples of sedimentary rocks are sandstone, conglomerate, breccia, chalk, dolomite, limestone, peat and coal. Peat and coal are formed from only plant and animal remains. Thus, they are free of minerals

#### **Characteristics of Sedimentary rocks**

- Sedimentary rocks lie in layers (strata)
- They contain secondary minerals
- They have lines of weakness in between the strata
- They contain fossils (harden remains of prehistoric plants and animals)
- They are susceptible to erosion and other agents of weathering.
- They are non-crystalline coarse or fine-grained.



## **Metamorphic Rocks**

Metamorphic rocks are rocks formed when pre-existing rocks are transformed by intense heat and pressure. Examples are slate, schist, gneiss, marble and quartzite.

### **Characteristics of metamorphic rocks**

- Metamorphic rocks are dull and rough in appearance
- They are non-crystalline
- They are either soft or hard. For example, gneiss is hard but graphite is soft.
- They may contain fossil.
- They may be foliated. That is they may occur in separable layers

### **Importance or Uses of Rocks**

- Rocks weather to produce parent material which forms soil. They produce the mineral matter in soils. For example, sandstone weathers to produce sandy soils.
- Rocks contain plant nutrients which are released into the soil as they weather. Some rocks are used directly as fertilizers. For example, limestone is applied to add calcium or magnesium to the soil.
- Rocks contain useful minerals such as gold aluminium and diamond. The minerals are mined and extracted from the rocks.
- They decorate the surroundings or are used to decorate the environment. For example, rocks are placed in the flower beds in most roundabouts in urban centres
- They are quarried and used to construct roads to build houses and to cover the ground as ballast.
- Sedimentary rocks such as coal are used as fuel to generate electricity and to produce heat for cooking.
- Permeable rocks are aquifers from which groundwater is extracted as borehole and well water.
- Porous rocks serve as deposits of crude oil

## **EXPERIMENTS TO STUDY SOIL SAMPLE**

### **A. EXPERIMENT TO SHOW THAT AIR IS PRESENT IN GARDEN SOIL**

**METHOD:** Fill container with soil and pour water onto the soil



**OBSERVATION:** Bubbles of air are given out from the soil particles. The bubbles is as a results of air present.

**CONCLUSION:** Air is present in a garden well

**B. EXPERIMENT TO SHOW THAT MICRO-ORGANISMS ARE PRESENT IN A GARDEN SOIL**

**METHOD:** Fill two containers with soil, one with fresh garden soil and the other with heated garden soil. Label A and B and enclose under a bell jar with a Beaker of lime water. Observe after 2-3 days. Smear the edge of the bell jar with Vaseline to make it air tight.

**OBSERVATION:** Lime water enclose with fresh garden soil turn milky, while lime water enclosed with heated garden soil remain unchanged.

Micro organisms contained in the fresh garden soil give out carbon dioxide which turns the lime water milky

**CONCLUSION:** Micro organisms are present in a garden soil. Microorganism are living organism that cannot be seen make eye, unless by used of an instrument called MICROSCOPE.

**THE ROLE OF LIVING ORGANISMS IN THE SOIL**

The role of living organisms in the soil includes:

1. They help us to clear away dead bodies from the earth surfaces
2. They help to make soil loose by burrowing holes and mixing the top soil with the sub-soil
3. They help to enrich the soil examples earthworm, bacteria
4. Termites damage crop and wooden part building

**C. EXPERIMENT TO COMPARE THE PROPORTIONS OF SAND AND CLAY IN SOIL (SEDIMENTATION)**

**METHOD:** Shake up a handful of soil with water in 500ml measuring jar and leave it to settle.

**OBSERVATION:** The heavy, coarse gravel and sand settle first then the silt and final the clay. The proportion of each type of particles in the soil can be estimated by measuring the depth of earth layer and relating it to the total depth of the layers

**CONCLUSION:** The proportion of sand and clay can be determined by measuring the depth of each layer, after settling.

**D. EXPERIMENT TO COMPARE THE WATER AND DRY SANDY AND CLAY SOIL AND POROSITY OF CLAY AND SANDY SOIL**

Sand two filter funnels in the necks of two 100ml measuring cylinders. Place some dry sand soil in the filter funnel, and an equal weight of dry clay soil in the soil in the second funnel. Pour 50ml of water on to each and leave to drain



through. When the water has stopped dripping through each funnel, read the level of water in the measuring cylinders.

Volume of water added to soil = 50ml

Volume of water in jar = X ml

Volume of water retained in soil = 50 – Xml

Much more water will be retained by the clay than by the sandy soil, this is due to the fact that the clay has a higher water holding capacity than sand, because of its small air spaces.

To compare the rate of drainage (porosity) of sandy and clay soil, the apparatus mentioned above is used. Pour equal amount of water on the two sets of soil at the same time. Note the time taken for the water to drain through each.

### **E. EXPERIMENT TO DEMONSTRATE THE RISE OF WATER IN SOIL BY CAPILLARITY**

Take three long, wide glass tubes and plug them at one end with glass wool. Fill each tube with soil (A) Sandy (B) Loamy and (C) Clay and place them upright in a trough of water as shown below.

Water will then rise to a higher in clay soil than the loamy soil than the sandy soil after 20 minutes, and it will be higher in sandy soil than loamy soil and in the loamy soil than clay soil after 10 minutes.

This is due to the air space between the soil particles. Capillary is the ability of water to rise through the different layer of soil.

### **Assignment**

1. List down the internal structure of the earth in their correct order or layer.
  2. Name the external layers of the earth.
  3. a) What are rocks?
- b) Give three ways in which rocks are important to crop farmers.
4. Give the main difference between the following pairs of rocks:
    - a) Igneous rocks and sedimentary rocks
    - b) Sedimentary rocks and metamorphic rocks

## **APPENDIX SAMPLE QUESTIONS**

1. a) State two functions of blood
  - Transports oxygen from the lungs to the body tissues
  - It carries digested food from the small intestines to the body tissues
  - It carries carbon dioxide from the body tissues to the lungs
  - It distributes heat in the body to regulate body temperature
  - It carries excretory products from the body tissues to the excretory organs
  - It carries hormones from the glands to target organs or tissues



- It contains white blood cells which help the body fight against disease
- It helps make the penis erect so that sexual intercourse can take place
- Platelets in blood help in blood clotting

b) Name two types of simple machine

- Lever
- Pulley
- Inclined plane
- Gears
- Wedge
- Wheel and axle
- Screw
- Screw jack

## 2. a)(i) **Pollution**

Is the contamination of our environment with substance that are harmful toxic to life.

or

Is the release of harmful substances into the environment which can affect living things

**List four pollutants**

- Carbon dioxide
- Methane
- Hydrogen sulphide
- Noise
- Dust particles
- Smoke
- Nitrogen dioxide
- Sulphur dioxide
- Chlorofluorocarbon
- Smog
- Excess carbon dioxide

A coconut of mass  $g$  hangs 15m above the ground

(i) Name the type of energy possessed by the coconut

- **Potential energy**

(ii) Calculate the value of the energy named in

**Give one example of plants that undergo each of the following types of germination**

Rice, maize, corn, cereals, all monocots

- Epigeal germination



- Hypogeal germination

3. State two functions of each of the following plant structures

**Root**

- Absorbs water and dissolved mineral salts from the soil
- Holds the plant firmly into the soil
- Some serve as food storage organs
- Some roots help plants to climb
- Transport/conduct water and dissolved mineral salt to the stem

**Stem**

- Conduct water and dissolved mineral up the plant
- Conduct manufactured food form the leaves to the other parts of the plant
- Transport/conducts manufactured food form the leaves to the other parts of the plant
- Holds the leaves in an upright positon ot facilitate photosynthesis and transpiration
- Holds the flowers in a correct position for pollination
- Some stems store food/act as food storage organs
- Ca respire for the plant
- Green stems undergo photosynthesis
- Hold the fruits up so that dispersal occur easily

**Define the following terms**

**Valency**

- The combining power of an element/radical
- The number of hydrogen atoms which will combine with or displace one atom of the element/radical
- The number of electrons an element will donate, accept or phare

**Radical**

A group of atoms/charged particles that can exist in several compounds

**State the differences between eclipse of the moon and eclipse of the sun**

Eclipse of the Sun	Eclipse of the Moon
Occurs when the moon is between the sun and the earth	Occurs when the earth is between the sun and the moon
Occurs during daytime	Occurs at night
Less frequent	More frequent
Emit dangerous rays	Does not emit dangerous rays



4. State the SI Unit of each of the following quantities

Current	-	Ampere/amp
Energy	-	joule
Force	-	Newton
Heat	-	Joule
Mass	-	Kilogram
Power	-	Watt
Resistance	-	Resistance Ohms
Temperature	-	Degree Fahrenheit, centigrade, Kelvin
Volume	-	Cable
Weight	-	Newton

**SAMPLE BECE THEORY QUESTIONS**

**1. Define each of the following terms**

**i. Penumbra**

A partial shadow/darkness that occurs during an eclipse

**ii. Satellite**

A small body that revolves/moves around another body in space

Or

A heavenly body that revolves around/orbits a larger body in space

A celestial body orbiting the earth or another planet

**iii. Sublimation**

The change of state of a substance from solid to gas without going through the intermedia liquid state

**State four positive effects of Science to man**

- It improves health
- Improves transportation
- Improves communication
- Improves agriculture
- Improves sanitation
- Improves educational performance

**2. State four ways by which man's activities have caused damage to the environment**

- Deforestation



- Mining
- Indiscriminate hunting
- Agricultural activities/farming
- Bush burning
- Industrialization
- Construction of roads/buildings, etc.
- Pollution
- Overgrazing

**State three differences between a mixture and compound**

- In a mixture the components can be separated by physical means, whereas in a compound consistent cannot be separated by physical means but by chemical means
- The components of a mixture can be present varying amounts, whereas the constituents of a compound are present in a fixed amount by weight
- The properties of a mixture are an average of its components, whereas the properties of a compound are quite different from those of its constituent elements.
- No heat or light is given out or absorbs when a mixture is formed, whereas heat or light is given out or absorbed when a compound is formed
- The substance in a mixture are physically combined whereas the constituents of a compound are chemically combined

**Define a balance diet**

Is a food that contains all the essential food nutrients in their correct proportion

Name one element that is liquid at room temperature mercury

3. Put the following food items into the different classes below

Butter, beans, rice, cheese, egg, ;palm kernel, cassava, milk, yam millet

**Name six organs of the digestive system of man**

- Anus
- Oesophagus/gullet
- Stomach
- Duodenum
- Small intestine/ileus
- Large intestine/colon
- Rectum
- Pancreas



**Name one disease caused by the deficiency of**

- Iodine                      goitre
- Protein                      kwashiorkor                      Marasmus

4. Write down the chemical formula or each of the following compounds

- Calcium carbonate                      -                       $\text{CaCO}_3$
- Magnesium hydroxide                      -                       $\text{Mg(OH)}$
- Potassium sulphate                      -                       $\text{K}_2\text{SO}_4$

Balance each of the following chemical equation

- $2\text{Mg} + \text{O}_2 \longrightarrow 2\text{MgO}$
- $\text{CaCO}_3 + 2\text{HCl} \longrightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
- $\text{N}_2 + 3\text{H}_2 \longrightarrow 2\text{NH}_3$
- $2\text{KClO}_3 \longrightarrow 2\text{KCl} + 3\text{O}_2$

5. A simple machine is used to lift a load of 50 N through a distance 0.4m. the effort used is 25 N and it moves through a distance of 16m. Calculate the Mechanical advantage.

**State three importance of artificial satellites**

- For communication
- Weather forecasting
- Studying stars and galaxies/heavenly bodies
- Transmission of radio and television signals
- Scientific experimentation
- Mapping natural resources such as forests, diamonds
- Surveying/navigation
- For military purposes/espionage/defence
- Space exploration
- Agricultural purposes