TOPIC 1:INTRODUCTION TO BIOLOGY

The concept of Biology

Biology is the branch of science that deals with the study of living things.

The word Biology is derived from two Greek words, **Bios** which means Life, and **logos** which means study of.

Thus biology is a study of life and living organisms.

BASIC CONCEPTS AND TERMINOLOGIES OF BIOLOGY

Biology is derived from two Greek words, that is, bios which means life and logos or logia which means study or knowledge. So biology can be defined as a branch of science which deals with the study of life. The term biology can also be defined as a branch of science which deals with the study of living things or organisms.

- Biologist A person specialized in the study of biology

Life means being alive or existing. Something is alive or existing if it possesses life processes. The life processes are growth, movement or locomotion, respiration, excretion, reproduction, sensitivity and nutrition.

Organism is anything which has life. It is the other name of a living thing. Organisms are made up of cells.

A cell is a basic unit of living things. The cell has three main parts, cell membrane, cytoplasm and nucleus. Cells which make up plants are called plant cells and those which make up animals are called animal cells. Some organisms are made up of one cell. They are called unicellular or single-celled organisms e.g. amoeba, euglena and yeast. Some organisms are made up of many cells, they are called multicellular organisms e.g. animals, plants, and most fungi.

THE CHARACTERISTICS OF LIVING THINGS

1. **Movement/locomotion**

All living organisms are capable of movement. Movement is the change of position of the whole organism or just part of an organism. For animals and unicellular organisms the movement is of the whole body. This is known as locomotion. Most animals move about using legs, wings or fins. Unicellular organisms such as amoeba, paramecium and euglena use the locomotory structures pseudopodia, cilia and flagella respectively.

In plants only part of it may move towards different factors such as light, water, gravity etc. They move by growing. Their roots grow down in the soil and their shoots grow up into the air or towards a source of light.

2. **Irritability (sensitivity)**

Irritability is the ability of an organism to respond to a stimulus. Stimulus (plural; stimuli) is anything that causes a response in an organism.
Examples of stimuli include: an alarm clock, a smell of breakfast cooking and a fly landing on your skin.

All living things are sensitive to certain changes in their surroundings, that is, they are aware of what is happening around them. This is possible because they have special organs known as sense organs by which they detect these changes.

Examples of sense organs include: eyes for vision (sight); skin for temperature, touch, pressure detection; tongue for tasting; nose for smelling; and ears for hearing and body balance. Plants do not have sense organs but are still able to detect and respond to things like gravity, water and light.

3. **Feeding (Nutrition)**

All living things need food to provide energy for such activities such as growth, repair and health.
Animals get their food by eating other living things or food materials that were once living things. Herbivores (e.g. rabbits) eat plants, carnivores (e.g. lions) eat other animals, and omnivores (e.g. humans) eat animals and plants. Plants make their own food through the process called photosynthesis.

The process of taking in food, synthesizing it, digesting and oxidizing it to release energy or build the body is called nutrition.

4. **Respiration**

Respiration is the breaking down of food materials within cells to release energy.
Respiration usually involves the use of oxygen. All living things need energy for movement, growth and development, and functioning of body organs.

5. **Excretion**

Excretion is the process of removing metabolic waste products from the body of living organisms.
All living things produce wastes such as carbon dioxide, water, urea, ammonia etc.. Some of these chemicals if left to accumulate in the cells would seriously poison the living organism hence they need to be removed. Waste products are removed from the body by excretory organs such skin, kidneys, lungs and liver.

6. **Reproduction**

Reproduction is the process by which living things produce new individuals of their kind. All living things reproduce, to replace organisms lost by death. If a group of organisms does not reproduce fast enough to replace those which die, the group becomes extinct. Reproduction ensures continuation of life when the parent generation dies.

Human beings bear babies; birds hatch chicks; and plants produce seedlings as new organisms, which eventually grow to mature organisms to replace those lost by death.

7. **Growth**

Growth is defined as an irreversible (permanent) increase in size and dry weight of an organism involving differentiation. All living things need food in order to grow and build up their bodies.

Animals grow until they reach a certain adult size, but most plants can grow continuously throughout their lives.

A table of differences between living things and Non -living things

LIVING THINGS	**NON-LIVING THINGS**
They respire	Do not respire
They grow	Do not grow
They respond to stimuli	Do not respond to stimuli
They reproduce	Do not reproduce
They excrete	Do not excrete
They feed	Do not feed
They move	Do not move

BRANCHES OF BIOLOGY

Biology is a subject and it has many branches. The main branches are **botany** and **zoology**.

Botany is a branch of biology which deals with the study of plants. A person who studies botany is called a **botanist**.

Zoology is a branch of biology which deals with the study of animals. A person who studies zoology is called a **Zoologist**.

OTHER BRANCHES OF BIOLOGY

1. **Mycology**: this is the study of fungi. A person who studies mycology is called a mycologist Bacteriology: this is the study of bacteria. A person who studies bacteriology is called a **bacteriologist**.

2. **Virology**: this branch of biology deals with the study of viruses. A person who studies virology is called a **virologist**.

3. **Immunology**: is concerned with body defense against diseases and foreign substances. A person who studies immunology is called an **immunologist**.

4. **Entomology**: refers to the study of insects A person who studies entomology is called an **entomologist**.

5. **Parasitology**: this branch deals with study of parasites and their effects on living organisms. A person who studies parasitology is called a **parasitologist**.

6. **Dermatology**: It is concerned with medical study of skin and its diseases. A person who studies dermatology is called a **dermatologist**

7. **Ecology**: Is a branch of biology that deals with relationships among living things and between organisms and their surroundings. A person who studies ecology is called an **ecologist**

8. **Anatomy**: Is the study which deals with the structure of living things. A person who studies anatomy is called an **anatomist**

9. **Endocrinology**: This is the study of structure of endocrine glands and the hormones associated with them. A person who studies endocrinology is called an **endocrinologist**.

10. **Histology**: Is the study of structure of tissues A person who studies histology is called an **histologist**

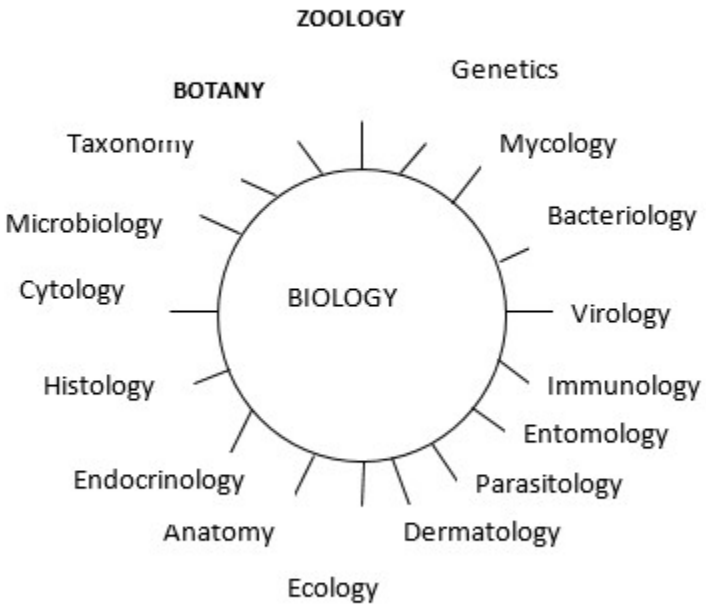
11. **Cytology**: Is the study of structure, composition and function of cells. A person who studies cytology is called a **cytologist**.

12. **Microbiology**: Is devoted to the study of organisms that can be seen only with a microscope e.g. bacteria, viruses, some fungi and some protoctists. A person who studies microbiology is called a **microbiologist**.

13. **Taxonomy**: Is the scientific classification of organisms. A person who studies taxonomy is called a **taxonomist**.

14. **Genetics**: Study of heredity and variation in organisms. A person who studies genetics is called a **geneticist**.

Diagram representing branches of Biology



THE IMPORTANCE OF STUDYING BIOLOGY

The study of biology is very important to man. The following is an outlines of why the study of biology is important:

1. It helps us to understand ourselves better since we are living things.
2. Skills and knowledge of biology can be applied to other scientific fields such as agriculture, forestry medicine, nutrition, pharmacy and veterinary science.
3. It helps us to understand our environment better and principles of conserving it.

4. Biology helps to answer some important questions such as, what do living things need, why do we resemble monkeys, why do frogs lay many eggs but only few become adults?
5. Knowledge of biology helps us to improve our health since causes, symptoms, transmission and treatment of various diseases are studied in biology.
6. Knowledge of biology helps us to avoid ourselves from magical beliefs, superstitions and other traditional taboos.
7. Knowledge of genetics helps us to clear some common doubts about certain inherited characteristics e.g. albinism, sickle cell anemia, hemophilia, etc.
8. Knowledge of the structure and chemical composition of the organisms enable us to acquire food, clothes and shelter from them.

RELATIONSHIP BETWEEN BIOLOGICAL SCIENCE & OTHER RELATED FIELDS

1. Agriculture

Agriculture is concerned with production of useful plants and animals through a farming system. Agriculture provides us with almost all our food. It provides materials for clothing and shelter. It provides materials used for making many industrial products such as paints and medicines. Agriculture uses knowledge of biology to improve plant and animal breeding. Genetically modified organisms (GMOs) ensure better quality, early maturity and high yield products. Crop and animal diseases and pests can only be overcome by applying biological knowledge.

2. Forestry

A forest is a large area of land covered with trees. It is much more than just trees. It also includes smaller plants such as mosses, shrubs and wildflowers. Forestry is the science of managing forest resources for human benefit. The practice of forestry helps maintain an adequate supply of timber and management of such valuable forest resources such as water, wildlife, grazing areas and recreational areas.

Biology helps in improving the qualities of the trees through manipulating the genetic constitution of the particular plant species.

Climate, soil and water determine the type of plants to be grown which entirely applies biological knowledge. Use of biological control to combat tree pests applies biological principles.

3. Pharmacy

Pharmacy is the profession concerned with the preparation, distribution and use of drugs. Members of this profession are called pharmacists or druggists. Pharmacy also refers to a place where drugs are prepared or sold The drugs are made depending on the chemical composition of the body of an organism and

how they can react with such medicines. Knowledge of biology also helps to know the effects of drugs on living things (pharmacology) and possible remedies to be taken.

4. Medicine

Medicine is the science and art of preserving health and treating illness. Medicine is a science because it is based on knowledge gained through careful study and experimentation. It is an art because its success depends on how skilfully medical practitioners apply their knowledge in dealing with patients. The goal of medicine include saving lives, relieving suffering and maintaining the dignity of sick people. Biological knowledge helps the doctors, surgeons and nurses to diagnose, treat and prescribe the right medicine to cure the disease.
Biological knowledge will also help them to offer education to the patients on how to prevent themselves from the diseases e.g. purifying drinking water, vaccination against polio, measles and other diseases.

5. Nutrition

Nutrition is the science which deals with food and how the body uses it. People, like all living things, need food to live. Food provides substances that the body needs to build and repair its tissues and to regulate its organs and systems. Food also supplies energy for every action we perform. Knowledge of biology helps to identify the type of food required by an individual based on its quality and quantity.

6. Veterinary medicine

Veterinary medicine is the branch of medicine that deals with the diseases of animals. Doctors that treat animals are called Veterinarians. Veterinarians are trained to prevent, diagnose and treat illness in large and small animals. Their work is valuable because many animal diseases can be transmitted to human beings e.g. rabies, tuberculosis, tularaemia (rabbit fever) anthrax etc. Basic knowledge of biology is required for successful study of veterinary science.

A table showing differences between plants and animals

PLANTS	ANIMALS

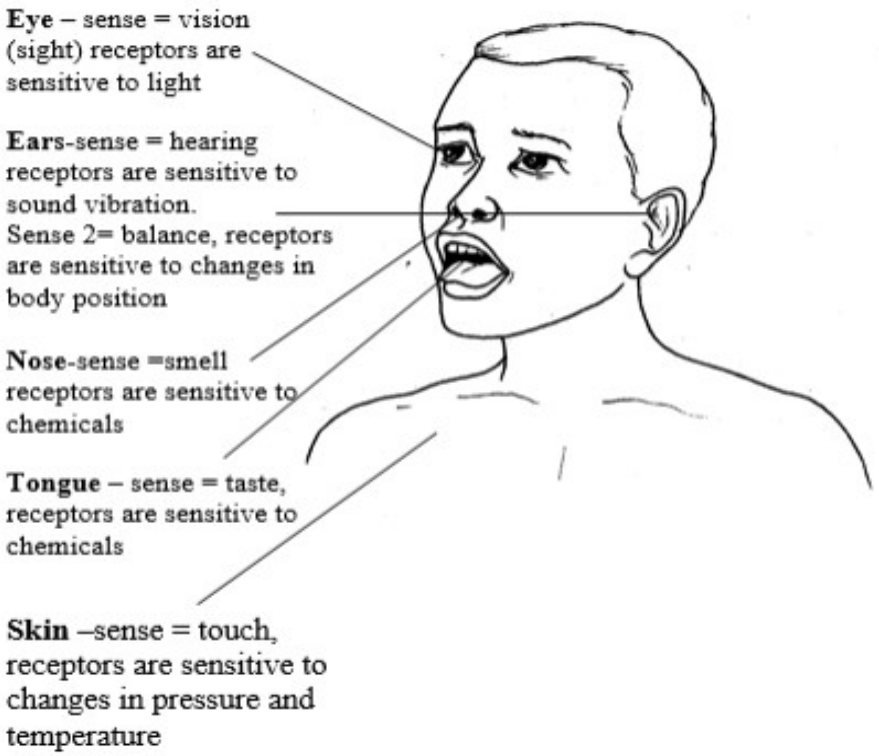
1. They are autotrophic, i.e. they can make their own food 2. Contain chlorophyll, can undergo photosynthesis 3. Growth occurs in some parts only i.e. root and shoot tips. 4. They have branched bodies 5. No nerves, muscles, blood system or special sensory cells. 6. Usually rooted in the ground and do not move to get food and move from place to place. 7. Have no digestive system food 8. Cells of plants have cell walls	1. They are heterotrophic i.e. they feed on complex organic compounds 2. No chlorophyll, cannot undergo photosynthesis. 3. Growth occurs in all parts of the body 4. They have compact bodies 5. Have nerves, muscles, blood system and special sensory cells. 6. Not rooted in the ground, escape enemies. 7. Have digestive system needed to break down 8. Cells of animals have no cell walls

SCIENTIFIC PROCESS

Biology, just like other science subjects, involves carrying out experiments. When studying living things simple observation can be made by using our own senses i.e. sight, smell, touch, taste and hearing.

The senses can be detected by our sense organs i.e. eye for sight, nose for smell, skin for touch, tongue for taste and ear for hearing.
To Use Own Sense Organs to Make Correct Observations

The body sense organs



MEASUREMENTS OF MASS , LENGTH , TEMPERATURE AND PULSE RATE

Take measurements of mass, length, temperature and pulse rate

Measurements

Measurement is a process of assigning numbers to observation.

When carrying out biological investigation measurements like mass, time, temperature, and length are unavoidable.
Instruments used for various measurements:

a. **Beam balance** – for measuring mass
b. **Thermometer** – for measuring temperature
c. **Clock/stopwatch** – for measuring time
d. **Ruler** – for measuring length
e. Pulse rate can be measured by using a stethoscope or by pressing the **fingers** firmly on the skin.

The study of biology like any science subject involves scientific processes. The scientific processes involved in the study of biology include observation, measurement and experimentation. Through these processes the study of biology becomes possible.

OBSERVATION

Through observation we can learn about many scientific phenomena. Observation is made by using our own sense organs. There are five sense organs in the human body which are eyes, ears, the nose, the tongue, and the skin. Each of these organs is specific to a certain type of observation. The following are sense organs and their associated functions in observation.

1. **Eyes**

How can you differentiate between the colors of an egg from that of a ripe pawpaw? In this case in order to answer this question correctly, you must be able to make the correct observation. By using your eyes you can observe differences in colors of the two things given and then tell their differences.

We use our eyes as a sense organ for vision. By using our eyes we are able to see and differentiate sizes, colours and shapes of various organisms and hence we can learn about them.

2. **Ears**

How can you distinguish between the sound produced by a singing bird and a roaring lion? Sometimes you can just use your ears to study various biological concepts. For example many organisms produce different sounds which we can use to identify them.

Therefore, it is easy for a biologist to know an organism just by hearing the sound without even seeing it. This proves how your ears are very important organs in scientific studies because they are used to identify and differentiate sounds of various living organisms.

3. **Nose**

Sometimes in scientific study we need to smell in order to identify and distinguish between various things. For example, how can you distinguish the smell of a ripe banana from that of a ripe pineapple? As a scientist you must be able to use your nose as a sense organ effectively and successfully. BUT avoid smelling anything in the laboratory without the permission from your teacher or laboratory technician.

4. **Tongue**

We use our tongues to taste various things. By using the tongue we can differentiate various tastes and be able to discover the type of the taste concerned. For example, one can differentiate salt from sugar solutions by just tasting using the tongue. BUT avoid tasting anything in the laboratory unless you are told to do so by the teacher or laboratory technician.

5. **Skin**

We can use the skin as a sense organ to detect heat, temperature, pressure and even pain. For example, during a hot day you feel hot while during cold days you feel cold. Even if you close your eyes, and someone rubs your skin using a block

of ice, you can simply tell it by just feeling the coldness it imparts to the surface of your skin.

This group of students are conducting an experiment on 'food tests' in the school laboratory. Can you tell the sense organs they are using in their study?

MEASUREMENT

Though we can use our sense organs to make observations, the observations alone are not so reliable. Every sense organ has its weakness. Since science lies upon measurable quantities there is a need for measurement. Scientists have been able to design ways to take measurements of various things. Some of the quantities which can successfully be measured include mass, temperature, length and pulse rate.

Measurement of length

We can use eyes to observe the length of various objects. However, our eyes can just tell which object is longer than the other but can not tell us what the exact length of each object is. Tape measure is one of the common instruments that are used for measuring length in our everyday life.
Tape measure, an instrument for measuring length

Measurement of mass

A scientist or biologist must have a standard way of measuring mass of a substance. Sense organs cannot give us the true value of mass of a substance. This can be done by using beam balance which is a special instrument for measuring mass of a substance.

Measurement of temperature

We can take the measurement of temperature of a substance just by using our sense organs. For example, by touching something you can tell whether a particular thing is hot or cold. However, you cannot tell the exact temperature of an object.

Therefore, to be able to know the exact temperature you need to use an instrument specially designed for measuring the temperature. This instrument is the thermometer. Using thermometers we are able to know the exact temperature of an object.

Measurement of pulse rate

Pulse rate refers to average beating of your heart. You can find how fast your heart is beating, that is your heart rate, by feeling your pulse.

HOW TO MEASURE YOUR PULSE RATE

1. Sit down comfortably on a chair with the palm of your hand

   facing upwards.

2. Gently place the index and middle fingers of your other hand on your wrist (see the diagram below). Can you feel your pulse as a repeated throb?
3. If necessary, change the position of your finger until you can feel your pulse rate well. Count the number of heart beats in one minute.
4. Repeat step 3 four times.
5. Write down the number of beats per minute.
6. Work out the average. This is what is called average heart rate per minute. It tells you how fast your heart is beating.

EXPERIMENTATION

Biology as a science subject involves practical work. In every area of biology, experimentation is necessary. However, there are several procedures to be followed in conducting any scientific investigation. These procedures include the following:

1. **Identification of a problem (problem statement)**

In our day to day life we often come across questions or phenomena which require explanations. Such questions or phenomena are of interest to a biologist who will seek to provide answers to them.

The phenomena could be for example; it was observed that the harvest of tomatoes in Juma's garden was low despite frequent irrigation, correct planting techniques, timely planting and adequate sunlight. So, what was the problem with Juma's garden?
This is the problem to be investigated by the biologist in order to come up with an answer.

2. **Hypothesis formulation**

Hypothesis is a tentative explanation for the observation made. Using your example of low yield in the tomato garden, the possible hypothesis could be poor yield could have been caused by low soil fertility and therefore application of the fertilizer could increase harvest of the tomatoes in the garden. This hypothesis must therefore be tested by experimentation if it has to be a scientifically acceptable explanation.

3. **Experimentation**

An experiment is a series of investigations intended to discover relationships or certain facts that may lead to finding a problem. In the case of low harvest of tomatoes, you are first supposed to construct a plan of investigation as follows:
Select two plots, A and B, from the same garden and subject both of them to the same conditions as before. In plot B apply fertilizers while in plot A don't put any fertilizers (plot A will be your control plot).

4. **Observation and data recording**

After setting up an experiment, a researcher must observe and record data. Observation is done by using sense organs such as ears, eyes, nose and skin. The researcher must record whatever he observes. The researcher obtained X kg in plot A and Y kg in plot B.

5. **Interpretation of data**

Once a researcher has collected data, he should try to explain the meaning of data in relation to the purpose of the experiment. In the tomato garden experiment, the harvest in plot A was little compared to the harvest in plot B.

In these plots, all the conditions were the same except that in plot A no fertilizers were applied while in plot B fertilizers were applied. Therefore, high harvest in plot B was a result of applying fertilizers. If this experimentation is correct, then the same results should be obtained if the experiment is repeated under the same conditions.

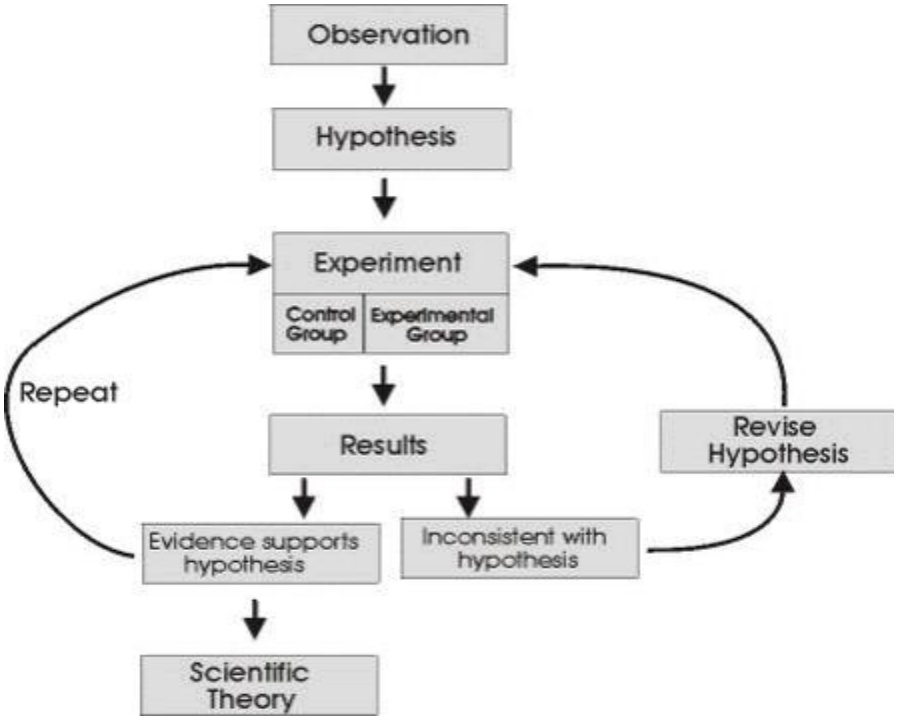
6. **Conclusion**

At the end of the investigation, a researcher must draw a conclusion. This conclusion is based on the collected data. The conclusion is either confirmation or rejection of the hypothesis under investigation.

In the tomato garden experiment, the results have shown that application of fertilizers has increased the harvest of tomatoes. Therefore, the low harvest of tomatoes was caused by poor soil fertility.

Chapter Summary

The following diagram summarizes the scientific process.
The scientific process



THE BIOLOGY LABORATORY

Describe the biology laboratory

A biology laboratory is a room or building specially designed for carrying out biological experiments.

A biology laboratory has:

1. Large windows and big space to allow enough air and light for better ventilation and visibility respectively.
2. Shelves – for keeping chemicals, specimens, apparatus and models.
3. Supply of gas, electricity and water
4. Working benches
5. An emergence door in case of danger occurs.
6. Preparation room

The biology laboratory rules

Biology laboratory has sophisticated instruments which need to be handled with special care. Chemicals which are being used are potentially harmful and they need special attention when working with them.

The following laboratory rules should be adhered to:

1. Don't enter the laboratory without permission from the teacher or laboratory technician.
2. Do not play, or run unnecessarily in the laboratory.

3. Do not eat or drink in the laboratory.
4. Do not use chemicals or handle apparatus or specimens without instruction from the teacher or laboratory technician.
5. Any accident or damage to the apparatus must be reported.
6. Label chemicals and specimens to avoid confusion.
7. Always keep flammable substances away from flames.
8. Turn off water and gas taps after use.
9. Never point the open end of the test tube to your fellow or yourself when heating.
10. Never smell substances, specimens, chemicals or gases directly.
11. Wash your hands with soap after the experiment.
12. Clean the apparatus and benches after the experiment.
13. Return the apparatus and chemicals to their normal position after use.

The **Difference between the Biology Laboratories from other School Facilities** Distinguish the biology laboratory from other school facilities Difference between biology laboratory and other school facilities:

- Dissecting kits
- Models of different organs and systems
- Refrigerators and ovens for storing and drying specimens
- Animal keeping units
- Chemicals designed for biological experiments

- Preserved specimens of living things

- Gases, electricity and water supply.

ACTIVITY1

Aim: To differentiate biology laboratory from other school laboratories or facilities

Procedure: let students visit the chemistry laboratory, physics laboratory, the school library, classroom and school store and allow them to perform the following.

1. Make a list of items that are found in each of the above named areas.
2. Compare the list with those which are found in the biology laboratory.
3. Construct a table of differences showing a list of items which are found in the biology laboratory and those which are found in the above named school facilities as shown below.
4. List items which are found in both the biology laboratory and other school facilities listed above and compare the differences.

Facility / Building Items

Biology laboratory

Chemistry laboratory

Physics laboratory

School library

Classroom

School store

Interpretation of Warning Signs on Containers of Laboratory Chemicals and Apparatus.

Interpret warning signs on containers of laboratory chemicals and apparatus
Warning signs on laboratory chemicals and apparatus

Some of the chemicals and apparatus used in biology laboratories may be harmful or dangerous. Before starting using any chemical you must know whether the chemical is toxic, flammable, oxidizing, explosive or irritant/harmful. To help you recognize such dangerous substances, the containers of modern chemicals carry special chemical warning signs as indicated below.

Toxic

Toxic substances can cause death. They may be poisonous when swallowed, breathed in or absorbed through the skin.
Examples of toxic substances include acids and alkalis, lead II acetate and potassium dichromate.

The symbol for toxic substances is represented as shown above.

Flammable

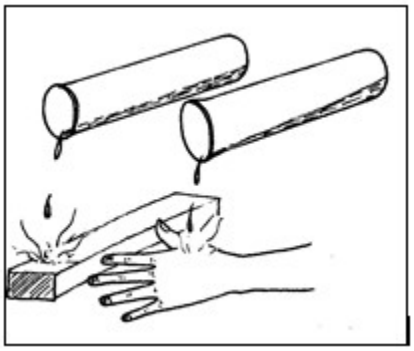
Flammable substances are substances which can catch fire easily.

Examples of such substances include petrol, alcohol, Thomas Baker (Phosphorus yellow or phosphorus red) and potassium metal. These substances normally evaporate fast and therefore should not be brought near open flames.
The symbol is as indicated above.

Corrosive

Corrosive substances attack and destroy living tissues. They may destroy the floor, desks as well as metals.

Examples of corrosive substances are concentrated acids, e.g. sulphuric acid, hydrochloric acid, nitric acid and concentrated alkalis e.g. sodium, potassium and ammonium hydroxides. If by accident a corrosive substance comes into contact with your skin, go to the sink and wash with a lot of water.
The symbol is shown above.



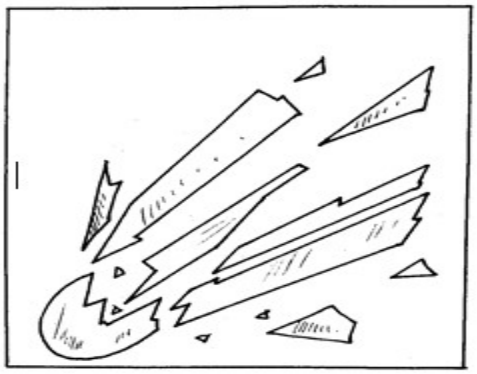
Oxidant

An oxidant is a chemical or substance which accelerates burning. Small fires can be made big in the presence of oxidizing agents.

Examples of oxidizing agents include potassium permanganate, potassium chlorate, and zinc nitrate.

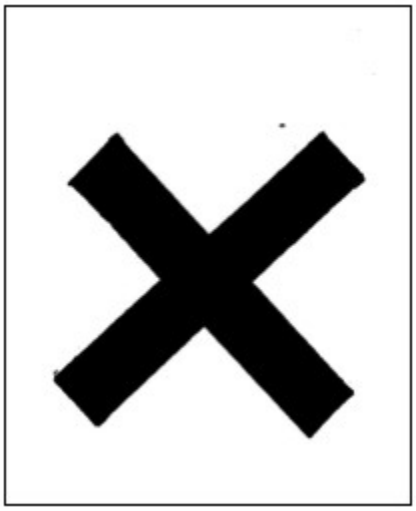
Explosive

An explosion is a forceful rapid reaction which involves random throwing of particles



Harmful or irritant

Harmful substances have a long term effect. They do not kill immediately. They have a cumulative effect. Therefore careful handling is required.



Irritant substances cause pains on the skin or eyes. They can endanger one's health if they come into contact with the skin or eyes for too long. Examples of harmful substances include lead chloride, lead nitrate, lime water ferrous sulphate and manganese (IV) oxide Examples above of some chemical containers with their warning signs.

ACTIVITY 2

Aim: to investigate chemical warning signs Requirements: varieties of chemical containers

Procedure: collect chemical containers. Observe them carefully and identify chemical warning signs on them. Record your results as shown in the table that follows.

Chemical container	**Warning sign**

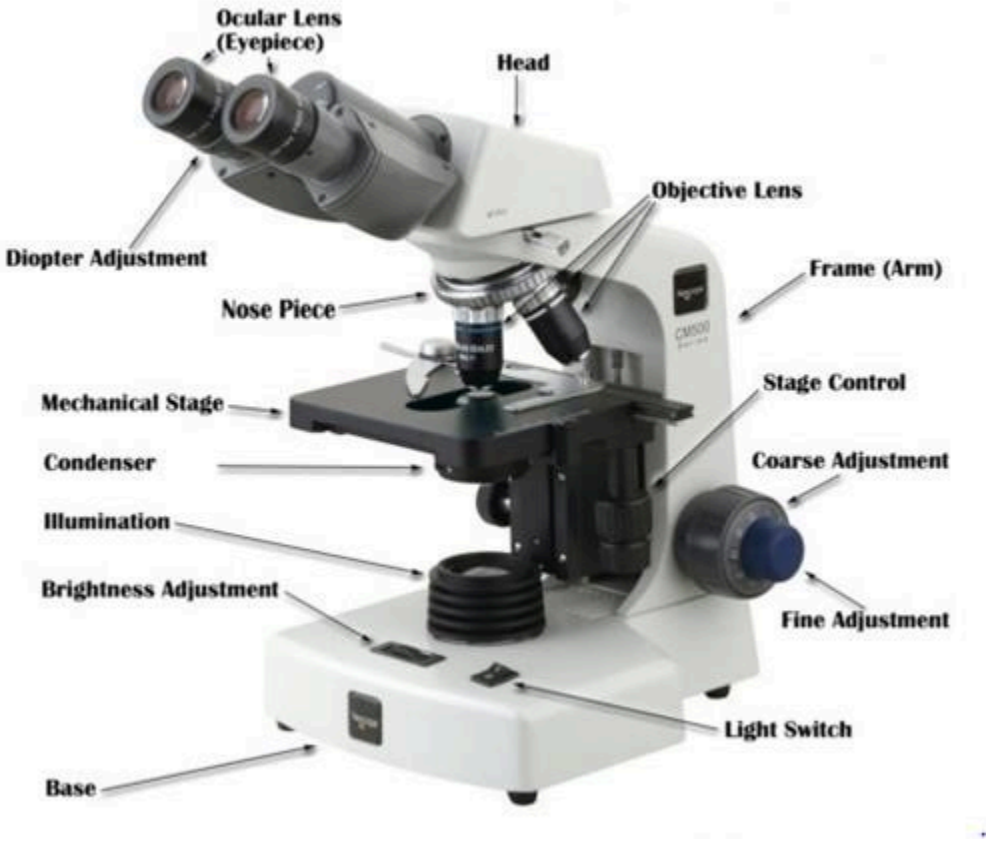
THE COMMON APPARATUS AND EQUIPMENT OF BIOLOGY LABORATORY

Identify common apparatus and equipment of the biology laboratory Some apparatus and equipment used in the biology laboratory.

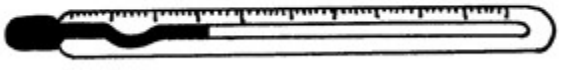
1. Microscopes
2. Hand lenses
3. Thermometers
4. Dissecting kits
5. Mortar and pestle
6. Dissecting trays
7. Delivery tubes
8. Measuring cylinders
9. Bunsen burners
10. Test tubes
11. Specimen bottles
12. Ovens
13. A pair of scissors
14. Chemical balance
15. Funnel
16. Test tube racks
17. Test tube holders
18. Beakers
19. Forceps
20. Surgical blades
21. Microscope slides
22. Droppers

23. Spatula
24. Corks
25. Glass straws
26. Fridge/refrigerator
27. Mounted needle
28. Beam balances
29. Glass rods
30. Scalpels

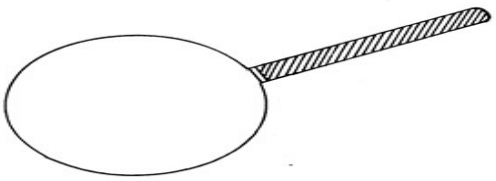
Microscope



Thermometers

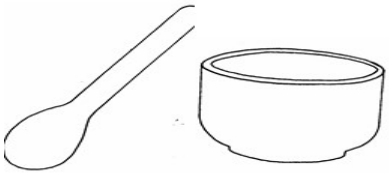


Hand lenses



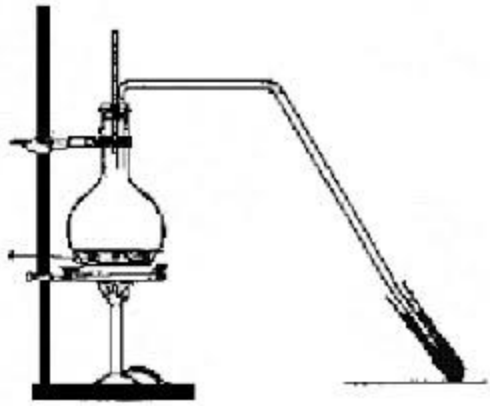
Dissecting kit

Mortar and Pestle

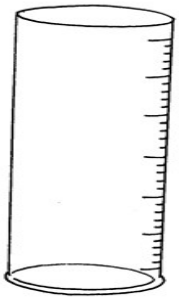


Dissecting tray

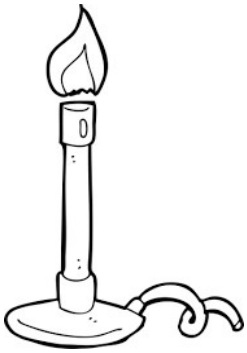
Delivery tube



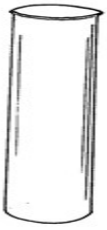
Measuring cylinder



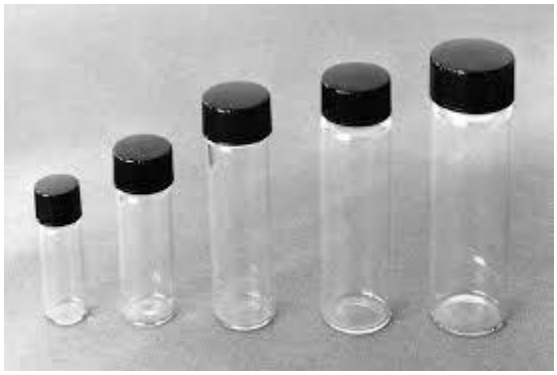
Bunsen Burner



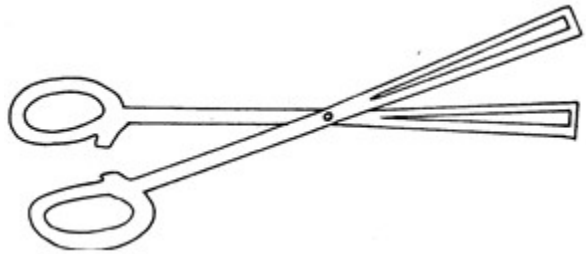
Test tube



Specimen Bottles



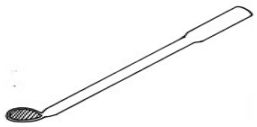
Pair of scissors



Funnel

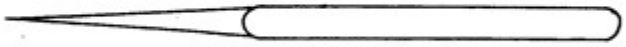
Surgical blades

Spatula



Glass straws

Mounted Needle



Beam balance

Glass rod

Scalpels

Dropping pipette

Some common chemicals used in the biology laboratory

1. Benedict's solution
2. Lime water (calcium hydroxide)
3. Sodium hydroxide (slaked lime)
4. Cobalt chloride
5. Hydrochloric acid
6. Copper (II) sulphate
7. Sudan III
8. Alcohol
9. Stains e.g. carmine red, methylene blue
10. Sodium bicarbonate
11. Potassium permanganate
12. Iodine solution

EXERCISE

1.In each of the following questions write **TRUE** for correct statements and **FALSE** for incorrect statements.

a. A biology laboratory is a place where biological experiments are conducted.....
b. Everything in the laboratory can be tasted .....
c. Warning signs can help someone to avoid accident in the laboratory.....

2.One of the following is not a basic quality of the biology laboratory.

a. Working benches
b. Large windows and big space
c. Supply of gas, electricity and water
d. Kitchen

3.Substances which may catch fire easily are said to be

a. Toxic
b. Flammable
c. Explosive
d. Irritant

4.An instrument used to measure temperature of the body is called

a. Chemical balance
b. Measuring cylinder
c. Thermometer
d. Barometer

5.One of the following is a common reagent used in the biology laboratory

a. Benedict's solution
b. Potassium iodide
c. Sodium acetate
d. Barium chloride

6.Which of the following list of instruments is not related to biology laboratory?

a. Fridge, a pair of scissors, surgical blades
b. Microscope, test tube, thermometer
c. Dissecting kit, scalpel, beaker
d. Meter bridge, pendulum bob and burette.

7.The warning sign shown indicates

a. Explosive substance
b. Oxidizing agent
c. Flammable substance
d. Corrosive substance

2.Match the items in list A with the corresponding items in list B.

LIST A	LIST B
1. Used for placing specimen during dissection 2. An apparatus used for stirring solution 3. A substance which accelerates burning 4. Do not play or run in the laboratory 5. A common reagent in the biology laboratory	a. Laboratory rule b. Oxidant c. Sudan III d. Dissecting kit e. Glass rod

3.What do you understand by the following terms?

a. Laboratory
b. Warning sign

4.Draw warning signs which may be used in bottles carrying a substance which is

a. toxic
b. flammable
c. explosive
d. harmful

5.List down any six (6) laboratory rules

6.State the use of the following apparatus

a. Specimen bottles
b. Test tube holders
c. Beam balance
d. Beaker
e. Mortar and pestle

7.Draw the following apparatus:

a. Measuring cylinder
b. Mortar and pestle
c. Funnel
d. Tripod stand.

THE MICROSCOPE

Much of the living world is too small for human eyes to see. Our eyes can only see objects that are larger than 0.1mm. Objects with sizes smaller than 0.1mm can be viewed by using microscopes.

What is a microscope?

A microscope is an instrument used for viewing objects which are too small to be seen by our naked eyes. It ranks as one of the most important tools of science.

- Physicians and biologists, for example, use microscopes to examine bacteria and blood cells.
- Material scientists and engineers use microscopes to study the crystal structures within metals and alloys (metal mixtures) and to examine computer chips and other tiny electronic devices.

There are two types of microscopes

a. Compound or light microscope
b. Electronic microscope

Optical or light microscope

An optical microscope has one or more lenses that refract (bend) the light rays that shine through or are reflected by the specimen being observed. The refracted light rays make the specimen appear much larger than it is.

Magnifying glass is the simplest optical microscope, and has only one lens. The best magnifying glasses can magnify an object by 10 to 20 times.

The compound or light microscope

The compound or light microscope uses two or more sets of lenses to provide higher magnifications. Each set of lenses functions as a unit and is referred to as a lens system. In microscopes with only one objective, the lens system and ocular are mounted at opposite ends of a tube. In microscopes with two or more objectives the objectives are mounted in a rotating nosepiece connecting to the end of the tube opposite the ocular. The person operating the microscope rotates

the nose piece to align one of the objectives with the opening in the end of the tube.

The workings of electron and compound microscope Electron microscope – Uses electrons to illuminate the specimen and can reveal much more structures than light microscope can do.
Light microscope – Uses light to illuminate the specimen

Parts of the light microscope and their functions

Parts of the light microscope has the following functions:

1. **Eyepiece** – Magnify objects under observation since it consists of magnifying lenses.
2. **Body tube** – Hollow tube attached to the arm. Its function is to hold an eyepiece lens and revolving nosepiece.
3. **Revolving nosepiece** – Holds objective lenses in place. Position of the objective lenses can be changed by manipulating the revolving nose piece.
4. **Coarse adjustment knob** – It lowers and raises the body tube so that a clear image is obtained.

5. **Fine adjustment knob** – Raises and lowers the body tube to obtain a fine focus.
6. **Objective lens** – Brings image into focus and magnifies it.
7. **Stage** – This is a place where specimen to be observed is placed
8. **Clips** – Hold the slide or specimen in position
9. **Mirror** – Reflects and directs light to the object under observation.
10. **Diaphragm** – Is an aperture that regulates the amount of light passing through the condenser to illuminate the specimen
11. **Condenser** – Concentrates light reflected by the mirror.
12. **Base or stand** – Supports the microscope steadily
13. **Arm or limb** – Supports the body tube and stage. It is used to hold the microscope
14. **Hinge screw** – Raises and lowers the stage.

MAGNIFICATION

Magnification power is symbolized by a number and abbreviation X. For example a 10X magnifying glass magnifies an object by 10 times. An object is magnified by multiplying the eyepiece lens magnification and objective lens magnification.

Example:

Magnification = eyepiece lens x objective lens magnification

= 10 × 20= X200

A table of magnification

Eyepiece lens magnification	**Objective lens magnification**	**Total magnification**
5	20	X100
10	20	X200
15	10	X150
10	25	X250
20	20	X400

How to use a microscope

1. Turn on your microscope light
2. Turn the nose piece so that the small (low power) objective lens clicks into place. Always start with a low power lens in place.
3. Place the prepared slide on the center of the stage under the clips so that the object is in the center of the opening. Make sure the cover slip is on top

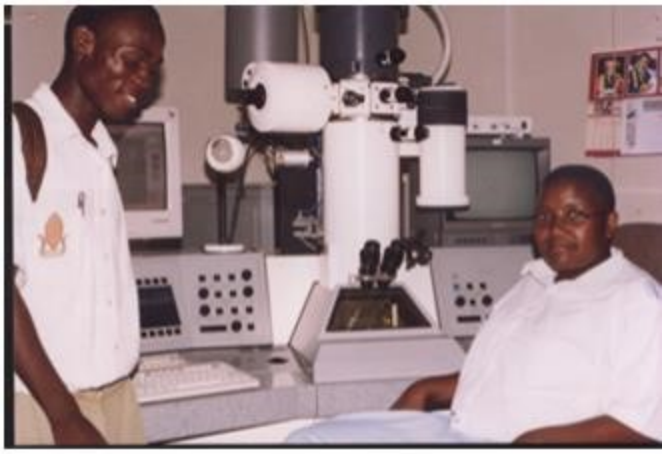
4. With your eye at stage level, use the coarse adjustment to bring the object and the low power objective lens as near to each other as possible. The objective lens should not touch the cover slip
5. Now with your eye to the eyepiece, slowly move the coarse adjustment to increase the distance between the object and the lens. Continue this until the image is focused.
6. Adjust the diaphragm so that the object can be seen as clearly as possible
7. To observe the object under medium and high powers, rotate the revolving nosepiece to bring the next highest objective lens into position. Make sure you hear the 'click' to ensure that the objective lens is in place. Then, focus using the fine adjustment only.

Ways of handling and carrying a light microscope

a. Use both hands to carry the microscope. One hand should hold the base and the other hand should hold the arm.
b. Always place the microscope on the desk or table carefully and gently and never place it at the edge of the bench.
c. Keep the microscope in an upright position when using liquids or when not in use.
d. Keep the stage clean and dry. If any liquids are spilled on the microscope, wipe them up immediately with a piece of tissue.
e. Focus with the low-power objective lens first.
f. Focus by moving the lens away from the slide, that is, by increasing the working distance.
g. Consult your teacher if the lenses are dirty.(viii) Consult your teacher if the adjustments do not work freely.
h. When your work is completed, move the low power objective lens into place and remove your slide.
i. Keep your microscope covered when it is not in use and keep your work area clean and tidy.

ELECTRONIC MICROSCOPE

This type of microscope uses a beam of electrons rather than a beam of light to produce magnified images. Electron wavelengths are much shorter than those of visible light. As a result electron microscopes can resolve much finer detail than light microscopes can do.



Electronic microscope

Types of electron microscopes

a. **Transmission electron microscope** (TEM) This type of microscope passes a broad beam of electrons through a specimen slice a few hundred angstroms thick.
b. **Scanning electron microscope** (S E M) This microscope scans a focused beam across the surface of the specimen.

Other kinds of microscopes

1. **Scanning probe microscope** The microscope scans a specimen with a sharp point called a probe.

2. **The ion microscope** (field -ion microscope) It is used to examine metals. It creates an image of the crystal structure of the tip of an extremely sharp metal needle. An electric field applied to the tip repels charged helium, neon or argon atoms which spread out and strike a special screen. The screen glows where the atoms strike it, forming an image of the arrangement of atoms in the metal.