Biology

Year 1

SECTION

1

INTRODUCTION TO BIOLOGY, THE SCIENTIFIC METHOD, ORGANISMS AND MICROSCOPES

EXPLORING BIOLOGY IN THE SOCIETY

Biology as a Science of Life

INTRODUCTION

The first part of this section explores the definition Biology, its primary branches, along with various sub-branches. The relevance of Biology in our daily life and its significance are also emphasised. Career opportunities in Biology are also explored. Subsequently, you will be introduced to the scientific method, its components, and its application in solving everyday issues. Later on in the section, you will explore body orientations, symmetry, sectioning of specimens, and hone your biological drawing skills.

The final part of the section will guide you to explore microscope types, parts, functions, safe usage, and slide preparation, along with distinctions between wet mount and permanent slides.

The aim is for you to apply this knowledge to address real-world challenges, to support yourself and your community.

At the end of this section, you should be able to:

- Observe and discuss the importance of biology, its various branches, and its applications in everyday life.
- Solve everyday problems using the scientific method
- Observe and identify the various body orientations, symmetries and sectioning of different organisms.
- Identify the parts of the microscope and state their functions.
- Demonstrate the safe usage of the microscope to observe specimens.

Key Ideas

- Biology is the study of the structure and function of living things and their interaction with their environment.
- Botany, zoology and microbiology are the main branches of biology.

- Knowledge in biology is applied in food production and preservation, agriculture, human, animal and plant health, home hygiene and conservation of natural resources, among others.
- Career pathways related to the study of biology include but are not limited to: pharmacy, medicine, teaching, biomedical science and nursing.
- The scientific method is an empirical method for investigating natural phenomena by formulating hypotheses and testing them through experimentation.
- Biologists use skills such as Observation, Curiosity, Measuring, Recording and Reporting in their approach to solving everyday problems.
- Inductive reasoning makes generalisations from specific observations while Deductive reasoning makes specific conclusions from generalized phenomenon.
- The scientific method yields valid reliable results in solving everyday scenarios and can be replicated by others.
- Symmetry is an imaginary line or plane that divides an organism into two identical halves or mirror images.
- An organism exhibits bilateral symmetry if it can be divided along only one plane into two halves which are mirror images.
- An organism exhibits radial symmetry if it can be divided along more than one plane to produce two or more halves which are mirror images.
- An organism is said to be asymmetric if it has no line of symmetry.
- A cut made through an object or organism that allows the internal structures to be seen is called a section.
- Orientation refers to the position of an organism when being viewed.
- The microscope is an instrument used in viewing or observing minute specimen.
- Microscopes are made up of the imaging system and the illuminating system.

WHAT IS BIOLOGY?

Imagine a world where every living thing, from the tiniest microbe to the mightiest elephant, is connected in a complex web of life. This is the world of biology, the branch of natural science that studies living things, their structure, function, and their interaction with the environment.

Biology has three major branches: botany, zoology, and microbiology. Learning Biology is based on data obtained from research through empirical studies to solve everyday problems.

As we study biology, let us look around us and see the various interactions that go on between living things and their environment.

IMPORTANCE OF BIOLOGY

Biology is not just a theoretical subject, but it is deeply intertwined with our everyday activities. From food production to gardening, from home hygiene to human and animal health, and from the conservation of natural resources to plant health, biology plays a crucial role in our lives.

1. **Food production**: Honey from beekeeping serves as a sweetening agent for syrups and other food items. Microbes are used in some of the fermentation processes that produce food such as bread, kenkey, cheese, local Ghanaian cheese (*wagashi*) and some drinks such as palm wine and *pito*.

   NOTE: In the food production process, preservation is done to reduce or prevent the growth of bacteria, fungi and other microbes. Look at Figure 1.2, in salted Tilapia/koobi" production, salt is put into the fish to dehydrate it which creates unfavourable conditions for microbial activities. Also, in the production of kenkey, corn dough is fermented by microbes. Look at figure 1.3a. on page 5.

Figure 1.1: Bee Farming

Figure 1.2: Salted Tilapia/ "Koobi"

Figure 1.3a: Land Degradation

Figure 1.3b: Kenkey production in Ghana

Figure 1.3c: local cheese "wagashi"

2. **Gardening**: Using organic kitchen waste and animal droppings to prepare compost which can be used to improve soil fertility employs knowledge in biological science. Tilling the land to improve soil aeration for soil microbes and plant roots is based on knowledge in biology.
3. **Home hygiene**: Knowledge in biology teaches practices such as washing of hands before eating or handling food and after visiting the wash room to get rid of microorganisms which may cause diseases.
4. **Human and animal health**: The study of biology provides understanding of growth factors of diseases such as malaria, cholera, anthrax, their diagnosis, prevention and treatment.
5. **Conservation of natural resources**: Knowledge in biology ensures the sustainable use of natural resources. Practices such as afforestation, crop rotation, cover cropping, and proper waste disposal improve conservation of

natural resources. Overall, conservation biology improves forestry, fisheries, water and wildlife management.

6. **Plant health**: Reducing air pollution, water pollution and land degradation can greatly improve plant health. Knowledge in optimal biological conditions in the soil offer great importance in reducing the use of synthetic nutrition and pesticides as well as limiting the need for tillage.

Activity 1.1: Investigating the importance of biology in gardening, plant and soil conservation.

Mr. and Mrs. Manu observed that the yield from their backyard maize garden decreased yearly over a four-year farming period. They were advised to apply organic manure and carry out irrigation, after which they had a good harvest.

1. Why did the yield decrease over the four-year period?
2. What accounted for the increase in yield?
3. What is the significance of irrigation and organic manuring in gardening?
4. Compare your answer with that of your friends and let your teacher review your responses.

Hint: *responses should focus on these: plant health, soil conservation and gardening*

Activity 1.2: Investigating the importance of biology in bottle juice production.

Search from the internet, textbooks, scientific journals and other relevant sources and discuss with your peers how useful the knowledge of biology is in bottle juice production.

BRANCHES OF BIOLOGY

The major branches of biology include:

1. Zoology - the branch of biology that studies animals
2. Botany - the branch of biology that studies plants
3. Microbiology - the branch of biology that studies microscopic organisms.

Fig 1.5: Botany

Fig 1.6: Zoology

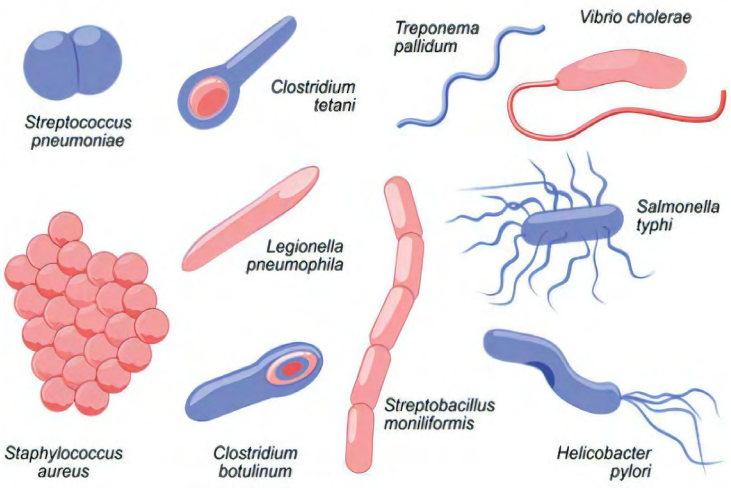


Figure 1.7: Microbiology

Examples of Other Branches of Biology

Table 1.1: Branches of Biology

Ecology	The branch of biology that studies how living things interact with each other and their environment.
Mycology	Study of fungi
Cytology	Study of cells
Histology	Study of tissues
Genetics	study of heredity and variation
Evolution	Study of the gradual change in heritable characteristics among species in a population over time.

Activity 1.3: Word search and crossword puzzle on branches of biology.

a) Use the word search tool and below to identify some branches of biology.

Branches of Biology

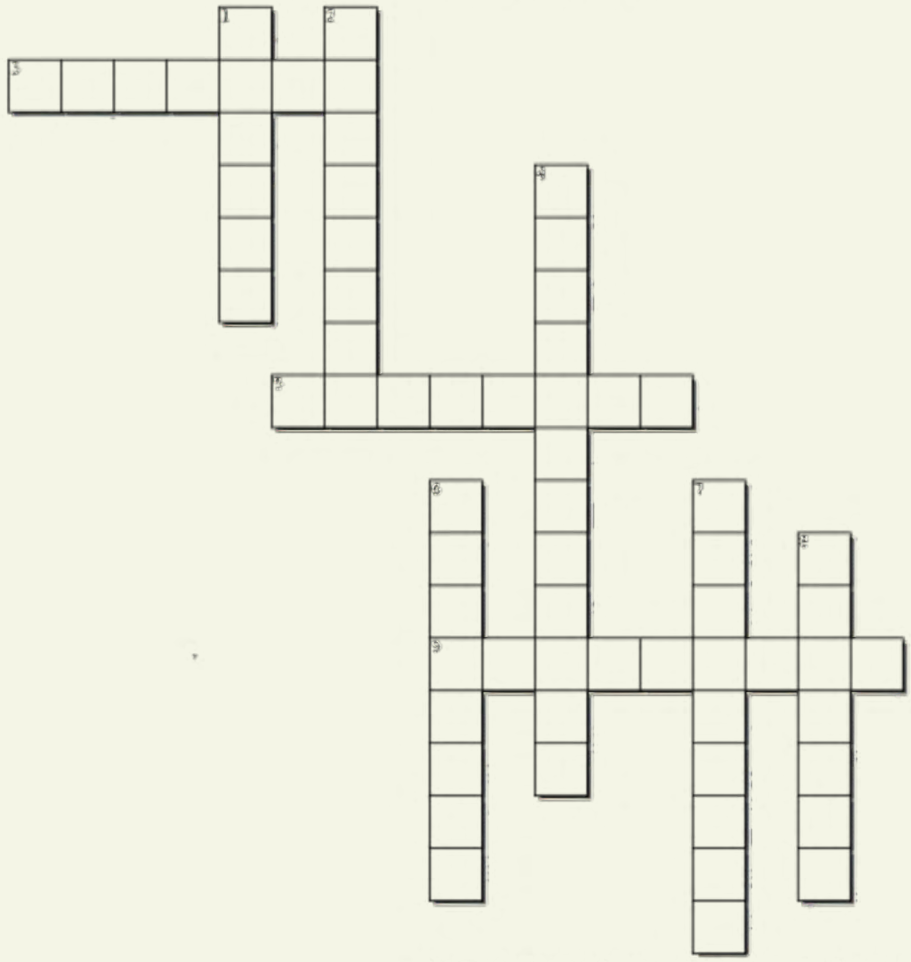
Find branches of biology

U	S	P	T	Q	D	B	J	F	I	V	I	K	E	X	K	Y	V	E	B
C	V	Y	K	N	P	R	Q	W	U	Q	U	G	Z	D	I	C	J	V	M
R	G	Q	I	W	L	U	Y	S	O	B	E	E	F	W	T	O	T	P	G
V	B	Y	W	N	X	R	E	T	V	C	V	N	S	G	T	V	B	H	U
E	N	J	P	V	E	O	A	Q	O	K	Y	E	J	B	C	M	J	B	V
V	X	J	S	X	Z	G	T	L	Y	O	I	T	H	U	B	P	N	N	V
A	W	O	X	K	M	Z	O	N	N	K	B	I	J	W	N	P	E	O	D
H	E	K	Y	I	F	G	Y	X	A	T	S	C	I	F	V	L	B	R	C
G	Z	R	T	G	Y	H	Z	G	T	T	P	S	Q	O	N	A	A	Y	T
U	O	W	V	F	O	G	W	M	O	L	N	E	U	Y	Z	F	T	A	S
H	O	Z	I	I	B	L	O	L	B	L	T	I	F	E	D	I	U	F	D
V	L	Y	R	A	P	K	O	L	F	E	O	G	I	U	V	B	L	J	E
X	O	Z	R	B	J	G	J	I	O	E	G	C	U	K	L	X	X	V	K
R	G	F	D	Y	Y	Z	S	S	B	T	I	B	Y	N	Q	F	O	Z	E
Y	Y	S	I	D	S	X	T	E	U	O	Y	Q	F	M	L	L	W	L	Y
E	B	E	U	P	L	N	P	C	M	J	R	C	T	J	U	A	C	S	T
E	E	T	X	E	K	B	I	Q	L	L	S	C	L	T	F	T	W	N	U
J	O	U	L	L	U	S	Q	A	J	B	F	A	I	H	J	Q	O	X	R
J	M	Y	Y	M	O	H	M	A	H	W	R	O	S	M	X	Z	H	L	V
Z	T	D	K	R	E	I	Q	U	T	I	N	N	R	V	L	Y	W	Z	A

ECOLOGY
MICROBIOLOGY
HISTOLOGY
BOTANY
MYCOLOGY
GENETICS
ZOOLOGY
CYTOLOGY
EVOLUTION

Name: _____

Complete the crossword puzzle below



Created using the Crossword Maker on TheTeachersCorner.net

Across

3. the branch of biology that studies animals
5. the branch of biology that studies fungi
9. the study of the gradual change in heritable characteristics among species in a population over time.

Down

1. the branch of biology that studies plants
2. the study of cells
4. the branch of biology that studies microorganisms
6. the study of heredity and variation
7. the study of tissues
8. the branch of biology that studies how living things interact with each other and their environment.

FIELDS OF WORK RELATED TO BIOLOGY

As you study biology, you can be employed in various workplaces such as:

Hospitals: Doctors, nurses and biomedical scientists apply knowledge in medicine and physiology to diagnose, treat and promote the prevention of diseases and disorders.

Figure 1.8: A Biomedical Scientist at work

Industries: In the breweries, cocoa processing and baking industry, knowledge in microbiology and biochemistry is employed to produce alcoholic beverages, chocolate and cocoa beverages, biscuits and bread.

Figure 1.9: Cocoa Processing Factory

Agricultural farms: Knowledge in genetics guides farmers to choose varieties with desirable characters. Also, genetic engineering is used to produce high yielding and disease resistant varieties.

Figure 1.10: An Okro Farm in Ghana

Educational institutions: Biology and Integrated science teachers use their knowledge in biology in imparting knowledge to their students.

Figure 1.11: A Biology lesson

Markets - Traders are able to preserve their perishables using methods such as drying, freezing, dehydration and smoking.

Figure 1.12a: A spice market

Figure 1.12b: Freezing as a method of food preservation

Figure 1.12c: smoking as a method of food preservation

Homes: Hygienic practices such as hand washing, washing of fruits and vegetables with brine or vinegar before eating and mopping of floors with disinfectants.

Figure 1.13: Home hygiene being practised

THE SCIENTIFIC METHOD

The scientific method is an practical method for investigating natural events/ occurrences by formulating hypotheses and testing them through experimentation. As scientists, biologists also use the scientific method in solving everyday problem.

Biologists use the scientific method in solving everyday problem. They start investigations by making observations of anything around them that draws their attention.

The scientific method uses both **inductive reasoning method** and **deductive reasoning method.** The inductive reasoning method involves making generalised conclusions from specific observations or patterns. The deductive method on the other hand starts with a general principle and applies it to specific situations to predict and test hypotheses; it thus moves from a broader idea and narrows to specific conclusions.

Figure 1.14: A Biologist at work

Importance of the Scientific Method

1. It is a problem-solving tool that breaks down complex issues into simple components and hypothesis testing to find the root causes of a problem.
2. It provides a structured approach to inquiry so that the conclusion of research work is based on empirical evidence rather than personal belief or common sense.

3. The method should yield consistent results that can be replicated by other scientists and researchers.
4. It encourages critical thinking, as researchers question assumptions, evaluate evidence and challenge existing theories.
5. It ensures innovation and progress by encouraging continuous refinement of theories and hypotheses and experimentation

INDUCTIVE AND DEDUCTIVE REASONING

Inductive thinking is when one makes a generalised conclusion from a specific observation or pattern.

The following examples show the inductive reasoning method of scientific inquiry.

1. Sunlight is necessary for plant growth because you observe that plants that receive sunlight grow healthier.
2. Orange contains vitamin C. Orange is a citrus fruit, therefore citrus fruits contain vitamin C.
3. Davi Dzifa is a grandmother. Davi Dzifa has gray hair, therefore grandmothers have gray hair.

On the other hand, the deductive reasoning approach starts with a general principle and applies it to specific situations to predict and test some given ideas. It moves from a broader idea and narrows to specific conclusions.

Scenarios that make use of the deductive reasoning approach are listed below.

Scenario 1: All mammals give birth to live young ones; sheep are mammals therefore sheep give birth to live young ones

Scenario 2: Arthropods have jointed appendages; Spider is an arthropod therefore Spider has jointed appendages

Scenario 3: Green plants contain chlorophyll; mango is a green plant therefore mango contains chlorophyll.

Note: Inductive thinking is from specific to general, while deductive thinking is from general to specific. Inductive reasoning is less reliable than deductive reasoning.

Activity 1.4: Using the scientific method to solve everyday problems.

1. Your school/community has problems with refuse disposal and high rates of malaria infestation.

a) How important is the scientific method in solving this problem in your school?

b) What reasoning method will be useful in solving this problem?

c) What are some of the procedures you may consider finding solution to these problems?

2. Compare your answer with that of your friends and let your teacher review your responses.

3. Group the following statements under inductive and deductive reasoning:

a) Process of reasoning that starts from general statements to reach a logical conclusion.

b) Process of reasoning that moves from specific observations to broader generalisations.

c) Involves moving from specific to general.

d) Involves moving from general to specific.

e) A bottom-up approach.

f) A top-down approach.

g) The conclusion has to be true if the proposed ideas are true.

h) The truth of the proposed ideas do not necessarily guarantee the truth of the conclusion.

i) Fast and easy to use.

j) More difficult to use and needs facts that are definitely true.

STEPS IN THE SCIENTIFIC METHOD

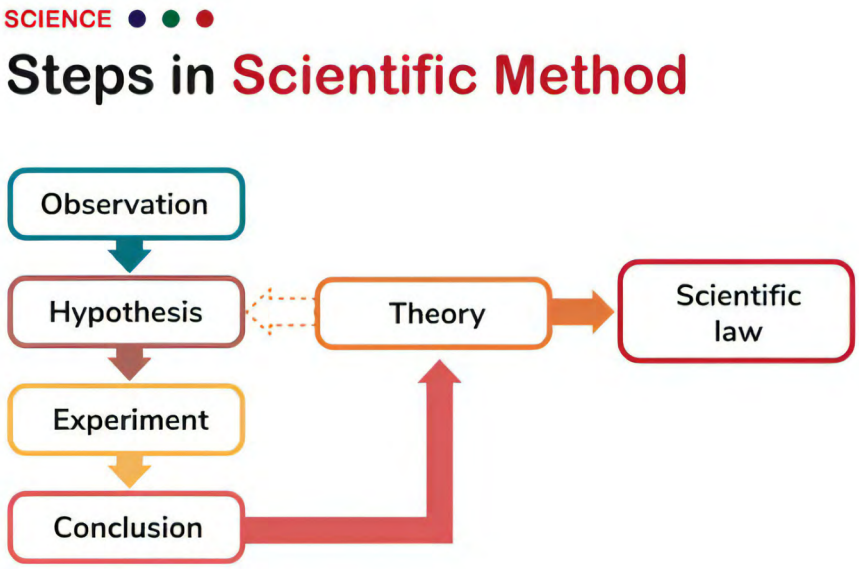


Figure 1.15: Steps in the scientific method

There are several steps involved in using the scientific method, depending on how the biologist or scientist uses the method and the problem involved.

The seven major steps are:

1. **Identifying the problem by observation/questioning:** Just like other scientists, biologists identify problems by making observations around the environment and noting down their observations. They then begin to ask questions as to why these observations and patterns are made in nature. This then, leads to problem identification. Thus, some tools and techniques employed in identifying problems include observation, problem-solving diagrams, problem-solving mind maps, problem-solving software, fish-bone diagrams and flowcharts.
2. **Reading around the problem to understand its nature by researching, and looking for further information:** This is done by researching literature and related sources to have a clearer understanding of the problem and how to solve the problem.
3. **Making a hypothesis:** A hypothesis is an "educated guess", or an assumption to a testable statement about the relationship between two or more variables. It is also defined as a proposed explanation for an observed phenomenon in nature.

4. **Experimentation:** Experimentation refers to the process or procedure carried out under controlled conditions to find an unknown effect or law, to test or establish a hypothesis, or to illustrate a known law.
5. **Collection and Analysing Data:** Data is obtained from the experiment and presented in a form of tables, graphs and charts (e.g., cumulative frequency curves, bar charts, histograms, or pie charts) put together and examined to make meaning out of them.
6. **Concluding:** This is the final decision, judgement, or opinion that is formed after a scientific experiment or research.
7. **Communication:** Scientific communication refers to how ideas, methods, knowledge and findings in scientific exercise are made known to people in an accessible and helpful way. Examples include publishing in scientific magazines or journal.

Activity 1.5: Application of the scientific methods in problem solving.

1. Describe the processes and skills used by biologists to identify problems.
2. Perform this experiment as a group project. Your teacher may guide you through it.

Title: Investigating Plant Growth

Aim: To apply the scientific method to investigate how different light conditions affect plant growth.

Materials Needed:

- Small pots or cups
- Loamy or black soil
- Fast-growing seeds (e.g. Tomato seeds)
- Rulers
- Water
- Light source (e.g., lamps, windows)
- Notebook or paper for observations
- Markers or labels for pots or cups

Procedure based on the steps involved in the Scientific Methods:

1. **Ask a Question:**

   How does the amount of light affect the growth of a plant in terms of height?

   (*Such as high, medium and no light*)

2. **Research**:
   - Discuss with others what you know about photosynthesis and plant growth, making reference to intensity of light as one of the factors affecting photosynthesis

3. **Formulate a Hypothesis**:
   - Each group should write a hypothesis. For example:
   - *"If plants receive more light, then they will grow taller than plants that receive less light."*

4. **Conduct the Experiment**:
   - Variables:
   - Independent Variable: Amount of light (e.g., *High, medium and no light*)
   - Dependent Variable: Height of the plants

NOTE: Ensure all other conditions, or variables such as type of seed, amount of water, type of soil, and temperature are all present.

Setup:

i. The class is divided into groups. Each group will plant seeds in three pots, each placed in different light conditions.

ii. The pots should be labelled accordingly.

iii. Water the plants regularly and measure their height every few days. Ensure to take notes on your observations, including any changes in the plants.

5. **Collection and Analysing of data**:
   - After three weeks, each group should compile their data into a table or graph, and discuss the results:

     "*What happened to each of the plants in high light, medium light or no light?"*

6. Draw Conclusions: Each group should write a conclusion based on their findings. They should state whether their hypothesis was supported or not and discuss possible reasons for their results.
7. **Communication or Presentation of Findings**:
   - Create a short presentation to share your experiment, data, and conclusions with the class.

3. There has been a surge in malaria cases in your community. Having gained knowledge as a biology student in using the scientific method in addressing problems, describe how you would employ this method to curb the surging malarial cases in your community.

SYMMETRY, ORIENTATION AND SECTIONING IN BIOLOGY

Body symmetry, body orientation and sectioning are interrelated concepts vital in studying or observing organisms. The body symmetry of an organism is necessary for its movement, balance and overall function. Body orientation (position) of an organism affects its posture and movement. Sectioning enables detailed studies and analysis of parts of organisms. Having a good understanding of these concepts is key as it provides the framework for understanding the structure and functions of living organisms.

BODY SYMMETRY

Most organisms typically can be divided into two equal halves that are identical or mirror images of each other. The imaginary line or plane that divides an organism to produce identical halves is called **line symmetry**.

Some organisms can be divided into identical halves or mirror images along only one plane. Such organisms are said to have **bilateral symmetry** or are said to be bilaterally symmetrical. Typical examples include human beings, elephants, fish, toads, millipedes, insects and fruits such as mango and cashew nuts.

Other organisms can be divided along more than one plane to produce identical halves or mirror images. These kinds of organisms are said to have **radial symmetry** or be radially symmetrical. Typical examples include, but are not limited to, fruits such as orange, apple, watermelon, star fruit, okra, pumpkin and certain marine organisms such as starfish and sea urchin.

However, it is worth noting that not all organisms can be said to have either of these two types of body symmetry. Organisms which do not have any type of symmetry are said to be **asymmetrical**. This means a division of their body along any plane will produce two halves which are NOT identical in appearance or features. In other words, they are not mirror images of each other. Examples of asymmetric organisms include sponges, snails, fiddler crab and narwhale.

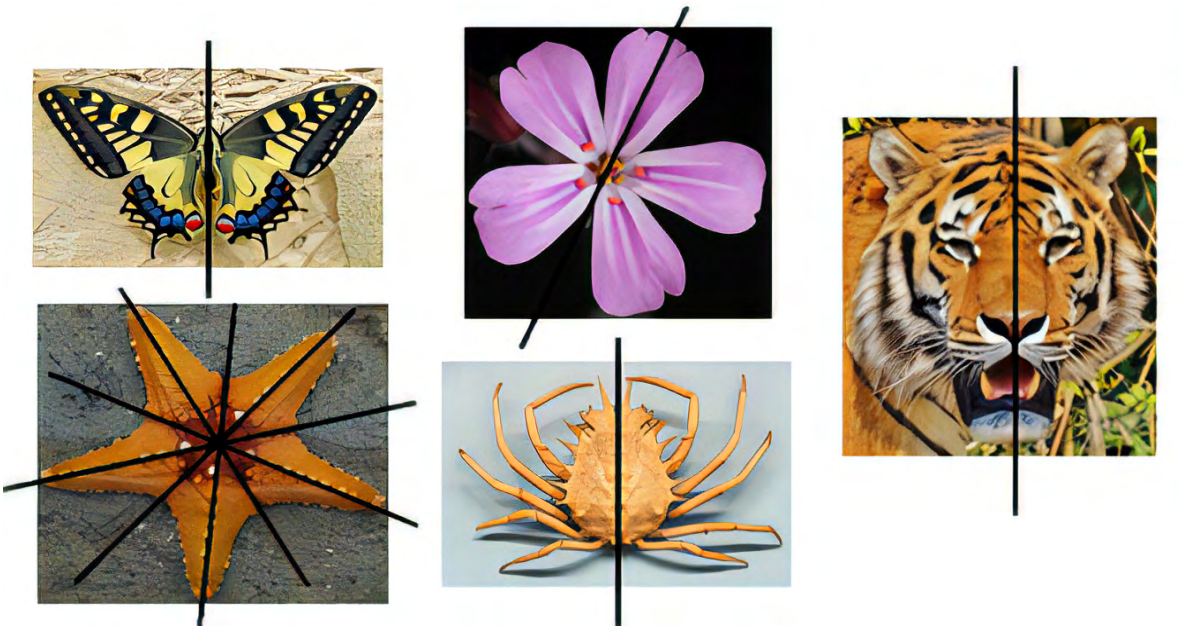


Figure 1.16a: Radial and bilateral symmetry of different specimens

Figure 1.16b: Sponge shows asymmetry

Figure 1.16c: Fiddler crab

Figure 1.16d: Narwhale

BODY ORIENTATION

The orientation of an organism refers to its position when being viewed or the position of an organism in relation to its surroundings and its alignment with a particular direction (view).

The various ways or directions in which an organism may be viewed are anterior, posterior, dorsal, ventral and lateral views.

1. **Anterior:** front or head region of a specimen.
2. **Posterior:** back or tail region of a specimen.
3. **Lateral:** sideways view/view from the side of a specimen.
4. **Ventral:** view from beneath/underside region.
5. **Dorsal:** view from above or the upper view

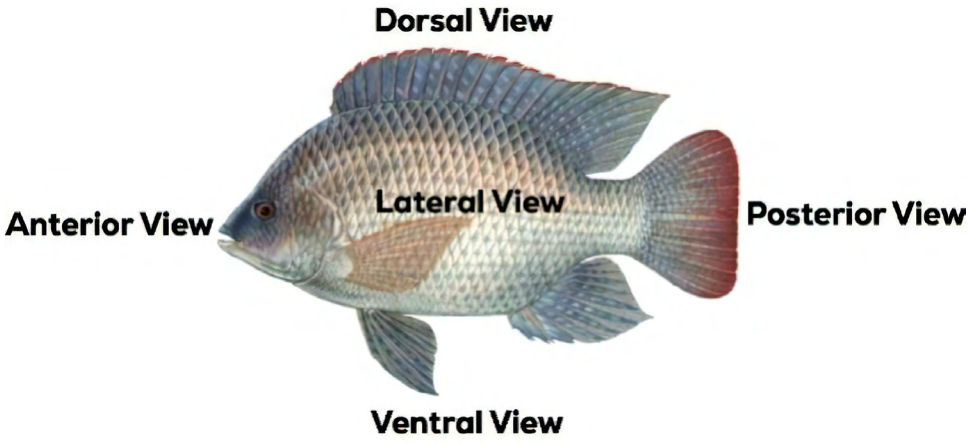


Figure 1.17a: A fish showing various body orientation

Figure 1.17b: Dorsal view of tilapia

Figure 1.17c: Lateral view of tilapia

Figure 1.17d: Anterior view of tilapia

Figure1.17e: posterior view of a chameleon

Figure 1.17f: Ventral view of a lizard

SECTIONING

A section is a cut made through an organism or object, which allows the internal structures to be seen. A sharp object such as a razor blade or scalpel knife is often used in the cutting.

Depending on how the cut is made, a section can either be described as one of the following:

1. **A longitudinal Section** (L.S.) or (L/S) - a cut or section through an organism that is made along the long axis or length of that object.
2. **Transverse Section** (T.S.) or (T/S) – a cut or section made across an object at a right angle to the long axis OR a cross-wise cut along the width of the organism.
3. **Vertical Section** (V.S.) or (V/S) – a cut or section made perpendicular to the horizontal plane of the organism/ object.

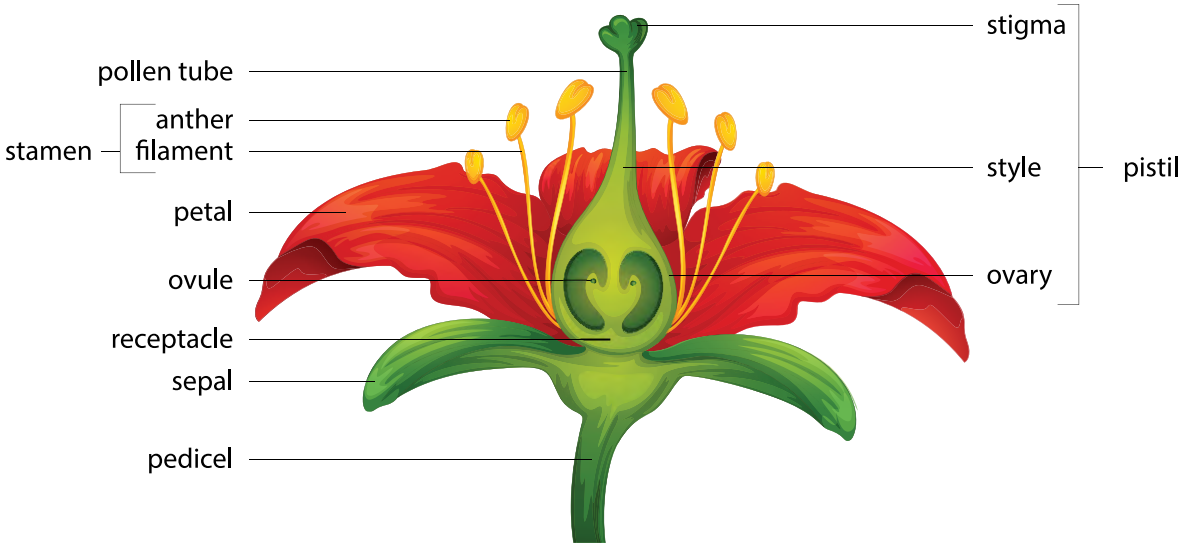


Figure 1.18a: Longitudinal section of a flower

Figure 1.18b: Longitudinal section of , pawpaw and tomato fruits

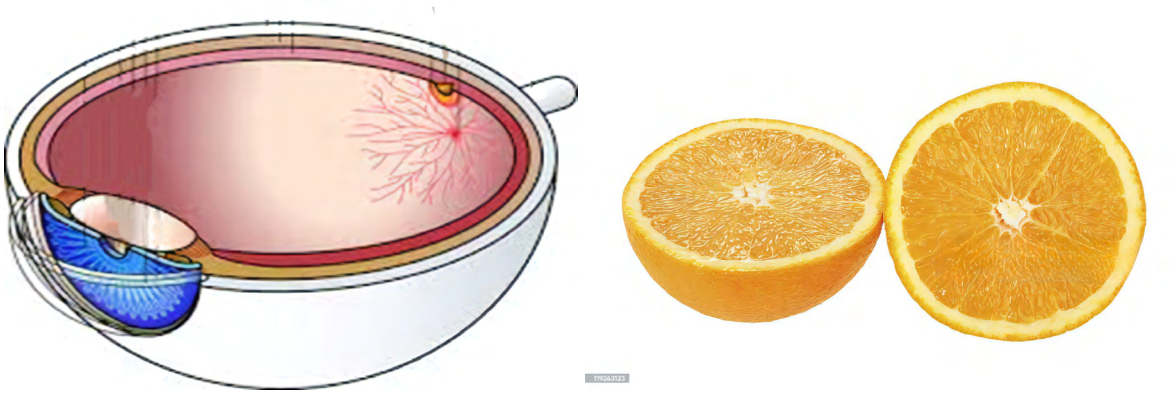


Fig 1.19: Transverse sections of the mammalian eye and an orange fruit

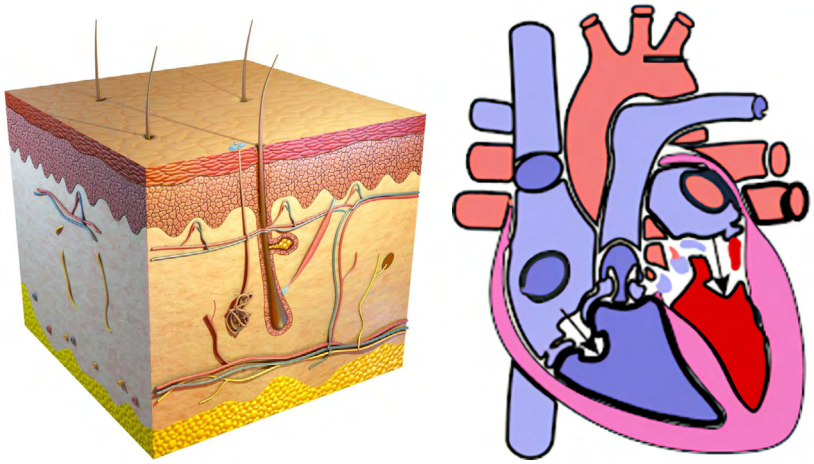


Figure 1.20: Vertical sections of the mammalian skin and heart

BIOLOGICAL DRAWINGS

Biological drawings are illustrations that form a visual representation of different aspects of an organism. They enable learners or biologists to understand the structures, processes and functions of living things.

Biological drawings are important in the following ways:

1. They enhance better understanding and explanation.
2. They allow for careful observation and description of specimen.
3. They also allow for detailed study of the features of an organism.

Materials needed in biological drawing include:

a) a well sharpened long HB pencil
b) an eraser
c) a rule

A good biological drawing should have the following features:

1. A biological drawing must have an **underlined heading/title/caption** written either **above** or **below** the drawing.
2. The drawing should **cover at least two-thirds (2/3) of the space** provided where no size/range is given for the drawing.
3. There must be **no arrowheads on the guidelines**.
4. Guidelines should **be ruled with a straight edge** and **not crossing** each other.
5. The guideline **must point exactly to the label**, not hanging or exceeding.
6. The **outline of drawings should be thin, firm and continuous**, not woolly and broken.
7. **Magnification is written at the bottom right corner** of the drawing (this is when the specimen being drawn is before you).
8. A **single label** should carry a **single guideline**.
9. Labels should be **written horizontally**.
10. It is advisable to use a **sharp HB pencil** when labelling since this can be erased easily when mistakes are made.

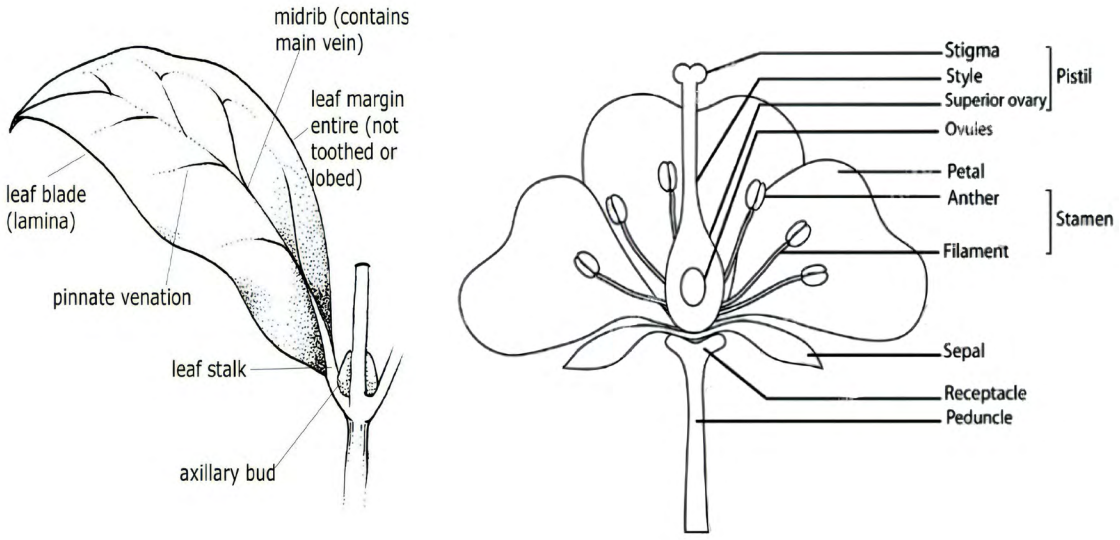


Figure 1.21: A labelled drawing of a leaf x2 and A labelled drawing of L/S of flamboyant flower

Activity 1.6: Identification of body symmetry in living organisms.

1. a) Collect the following specimen from the school compound or garden

- **i.** Land snail,
- **ii.** Pawpaw fruit,
- **iii.** Cactus plant,
- **iv.** Caterpillar,
- **v.** Garden egg
- **vi.** okra
- **vii.** tomato
- **viii.** Allamanda
- **ix.** mango
- **x.** orange
- **xi.** pear
- **xii.** groundnut
- **xiii.** spider
- **xiv.** Pride of Barbados (*Caesalpinia*)
- **xv.** *Crotalaria*
- **xvi.** Cockroach or any insect

b) Explore and indicate which of the organisms above are:

i. Bilaterally symmetrical?

ii. Radially symmetrical?

iii. Asymmetrical?

Activity 1.7: Body sectioning and biological drawing of living organisms.

1. a) Make transverse and longitudinal sections of each of the following specimen:

i. Oranges

ii. Bananas

iii. Bell pepper

iv. Pineapples

v. Tomatoes

b) Make a labelled drawing 10 – 12 cm long of **each** of the sections made in (1a) above.

Activity 1.8: Idenfication of the external structure and orientation of some common organisms.

1. Gather images or diagrams of the following organisms

Tilapia

Toad

Agama lizard

Rabbit

2. Identify and label the following structural views on the images or diagrams for each organism

Anterior

Posterior

Dorsal

Ventral

lateral

THE MICROSCOPE

The resolving power of the unaided human eye is just about 0.1mm, that is, the human eye can only distinguish between two points that are 0.1mm apart. The microscope is an instrument used to view or observe minute specimens like viruses, bacteria, cells and other living things not visible to the unaided human eye.

Biologists also use hand lenses, which magnify minute specimens ten times (10x) as much as the human eye can see to see greater details.

There are several types of microscope but the most widely used type is the **light microscope**.

Figure 1.22: The light microscope

The Light Microscope

The maximum magnification of a light microscope is around 1,500 times (1500x), and that of an electron microscope is around a million times (1,000,000x)

Although in schools and colleges it is only around 400 times (400x)

Parts of the Light Microscope

1. *Eyepiece Lens:* lens at the top that you look through to observe specimens. Magnification of the eyepiece lens is usually (10x or 15x). The eyepiece lens may be monocular (one lens) or binocular (two lenses).
2. *Tube:* connects the eyepiece lens to the objective lenses.
3. *Objective lenses:* objective lenses are found on the revolving nosepiece. There are three objective lenses with magnifications 4x, 10x and 40x. Together

with the eyepiece lens, the objective lenses are used to view specimens. The total magnification of a specimen viewed is obtained by multiplying the magnifying power of the objective lens used by that of the eyepiece lens.

4. *Arm:* part connecting the base to the eyepiece. It is held when carrying or tilting the light microscope.
5. *Revolving nose piece:* holds or houses the three objective lenses. It is movable and rotated to select the desired objective lens. Always start with low power first.
6. *Coarse Adjustment knob:* the larger pair of tuning knobs on the sides of the microscope used for general focusing.
7. *Fine Adjustment Knob:* the smaller pair of tuning knob on the sides of the microscope used for fine-tuning, bringing specimen into sharp focus.
8. *Stage:* firm platform on which specimen/slide is placed for viewing.
9. *Clips:* holds the specimen/slide in place.
10. *Aperture:* this is a hole in the stage of the microscope through which light is transmitted to the stage.
11. *Condenser:* lenses found under the stage that collect and focus light from the illuminator to the specimen on the stage.
12. *Illuminator:* the source of light located below the condenser is either a mirror or an electric bulb. If a mirror, an external light source is required. Not direct sun.
13. *Diaphragm:* controls the amount of light entering/reaching the specimen.

Activity 1.9: Identification of parts of the simple light microscope

Observe the simple light microscope in your laboratory or use the image below to identify the missing parts.

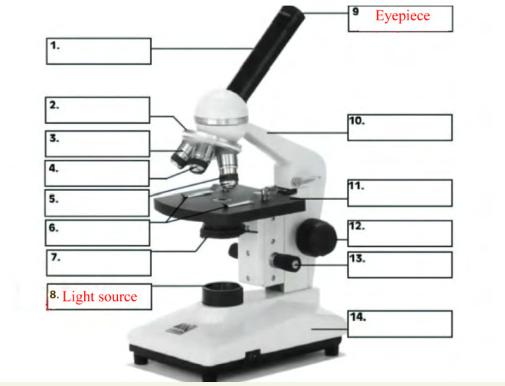


Figure 1.23: A light microscope

HOW TO CARE FOR A LIGHT MICROSCOPE AND SLIDES

Ways to care for the microscope include the following precautions and steps that are necessary for handling the light microscope to ensure its proper functioning and longevity.

1. Do not touch the glass parts of the lenses with your fingers. Use lens tissue to clean the lens.
2. Always carry the microscope with both hands with one hand supporting the base and the other holding the arm.
3. Always handle the slides with care, as they can easily be shattered or scratched because microscope slides and cover slips are small and delicate.
4. Never drop slides or covers slips . Set them down only on clean countertops.
5. Cover when not in use.
6. Store in a clean, dry place.
7. If the microscope uses electricity or a battery as the source of light, the bulb must be allowed to cool down before packing.
8. Never use direct sunlight as a source of light for the mirror
9. Keep the microscope user manual for reference.
10. Keep the lenses in a desiccator containing silica gel to prevent mould growth when not in use.
11. Keep the microscope in its box when not in use.

Activity 1.10: demonstrating how to safely handle the simple light microscope.

Demonstrate to your friend at least five safe ways of handling the simple light microscope

TYPES OF MICROSCOPE SLIDE

Microscope slides are used to examine single-celled organisms and to observe very small parts of organisms.

There are two types of prepared slides: Dry mounts (permanent slides) and Wet mounts (temporary slides). Each type of preparation method is used for mounting different types of cells or tissues.

If the specimen for a wet mount is particularly pale or translucent, it must be stained with **iodine, eosin** or **methylene blue** to ensure it is visible under the microscope.

CAUTION: Iodine and Methylene Blue are poisonous and should never be ingested. They may also stain skin (temporarily) and clothing (permanently) so always wear protective clothing such as a laboratory coat and hand gloves when handling the chemicals.

Steps in Preparing a Wet Mount Slide

The general steps involved in the preparation of a wet mount include the following:

1. ***Gathering of Materials***: The following materials are needed for the preparation of a wet mount:

   a) Specimen with a drop of water or stain

   b) Staining dyes which can be used: iodine, eosin or methylene blue

   c) Dropper or pipette

   d) Razor blade or scalpel

2. ***Procedure***

   a) Clean both the microscope slides and coverslips with a lens paper or a soft cloth to make them free from dust or debris. The specimen is placed on a microscope slide. Use a dropper or pipette to place a small amount of water unto the centre of the slide if the specimen is in a liquid medium eg a drop of water containing microorganisms, If the specimen is solid eg a piece of onion epidermal tissue, a drop of water may be added to the specimen to help it adhere and also keep the cell hydrated.

   b) A cover slip is gently lowered onto the specimen at an angle to avoid trapping air bubbles. One edge of the cover slip is placed against the slide, and then slowly lower the rest of the cover slip over the specimen.

c) A dye such as eosin or methylene blue may be added to specimens that are transparent to enhance contrast and visibility.

d) A piece of blotting paper or tissue paper may be used to blot any excess liquid around the edges of the coverslip.

e) Label the wet mount with the type of specimen and any other relevant information to keep track of observations and findings.

f) The prepared wet mount is placed on the stage of the microscope. Turn the nosepiece such that the lowest magnification objective lens is brought in line with the eyepiece or ocular lens. Bring the specimen into focus using the coarse adjustment knob first, then the fine adjustment knob to view the specimen clearly. Focusing should be from the stage upward to prevent the tendency of breaking the slide with the objective lens. Higher magnification objective lenses are used in connection with the fine adjustment knob and not the coarse adjustment knob. Take care the high-power lens does not touch the coverslip.

g) After observing the specimen, the coverslip is carefully removed and the microscope slide is cleaned for future use. The specimen is properly disposed of according to laboratory protocols.

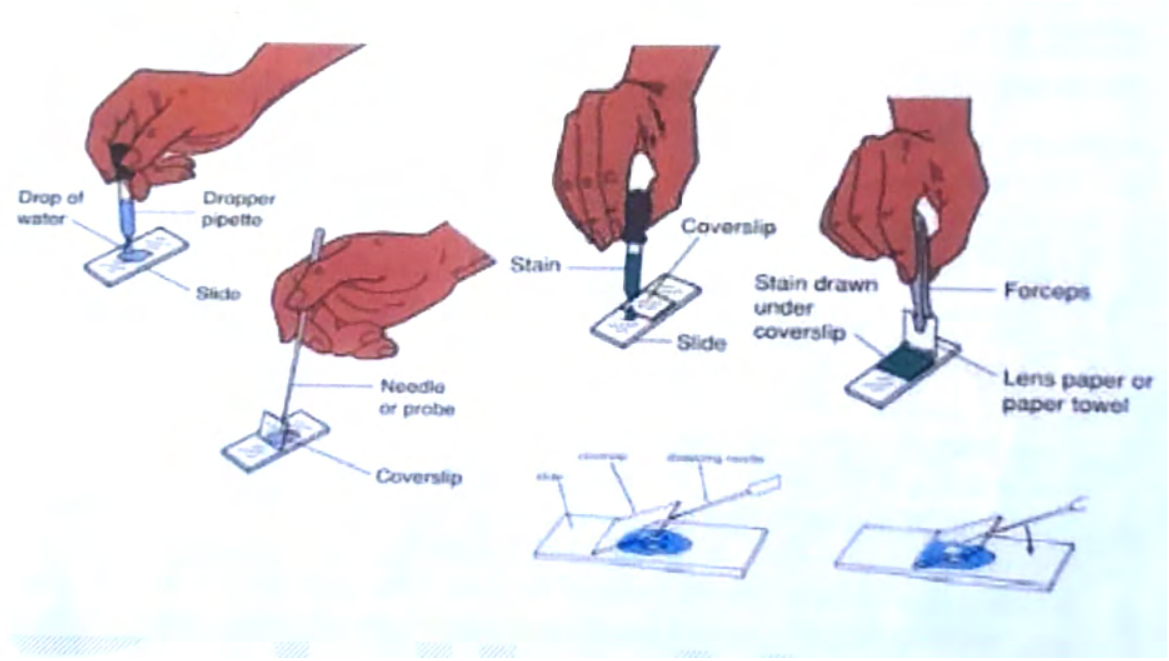


Figure 1.24: Preparing a Wet Mount

Activity 1.11: Preparation of a wet mount of onion epidermal cell

Material/equipment: Cover slip, Slide, Mounted needle/pin, Onion bulb and iodine solution.

Caution: handle needle and fragile cover slips with care.

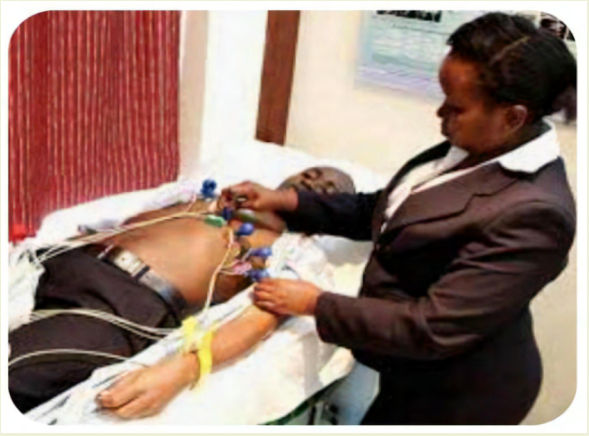
Steps:

1. Strip off a piece of epidermis from the inside of one of the inner 'fleshy' leaves of an onion bulb.
2. Dip a small piece of epidermis in iodine solution and with the help of the pin, transfer unto the slide. Slowly remove the pin as you lower the cover slip so as to avoid air bubbles.
3. Mount the prepared slide on the microscope stage and hold in place with the clips.
4. Observe under low power first then high power magnification of the microscope.
5. Make a drawing of the onion epidermal cell observed.
6. Discuss with your friend any key features observed and drawn.

NB: *Rheo discolour* may be used in the absence of onion.

REVIEW QUESTIONS 1.1

1. Identify the various branches of biology.
2. Describe everyday applications of three to five branches of biology.
3. Discuss how biology is related to at least five other fields of work.
4. A patient visits the doctor for a check-up on heart-related issues. Write out all the fields of work related to Biology from his visit to the hospital.



5. A student fell very sick and was sent to the hospital. He was diagnosed by the doctor with the following ailments: diarrhoea, blood in urine, stomach pain, ruptured tissues and a tumour in the brain. Identify the various fields of work related to Biology that make the diagnosis possible.
6. Consider the image below and use it to answer the following questions:

a) Explain the significance of adding salt to the fish?

b) Why was the fish dried for a number of days?

c) How does the salting and drying keep the fish from going bad?

7. Identify the branches of biology associated with the production of tinned milk.
8. How will you explain to your friends the concept of biology using the things around you?
9. How is the knowledge of biology applied in everyday life?
10. Discuss how the knowledge of biology is applied in the production of
    a) honey,
    b) "koobi"
    c) bottled fruit juice.
11. Your farmland has been degraded by illegal mining operators. Show how you would use your knowledge gained in biology to reclaim the degraded land.
12. Explain why you should use the scientific method in solving problems encountered in everyday life.
13. Describe the two methods of thinking associated with the use of the scientific method and give one example of each.
14. How would you explain the following terms to your colleague:
    a) bilateral symmetry
    b) radial symmetry
    c) body orientation
    d) sectioning
15. Why are some organisms said to be asymmetric?
16. Give any three examples of such organisms.
17. A student was asked to draw a dorsal view of a cockroach. How should he position the cockroach in order to get the right view?
18. Write down the position of the location of the following parts of a lizard:
    a) mouth
    b) tail
    c) ears
    d) Nuchal crest
    e) anus

19. Name two types of microscopes and state the maximum magnification of each.
20. Describe briefly how any four parts of the light microscope contributes to its effective functioning.
21. In what four ways would you care for the light microscope?
22. Describe how you would prepare a wet mount of an onion epidermal tissue to be observed under the light microscope.

ANSWERS TO REVIEW QUESTIONS 1.1

1. The three major branches of biology are Zoology, Botany and Microbiology. Other branches are Mycology, Cytology, Histology, Genetics and Evolution.

2.
   - Mycology: In the brewery industry, yeast is employed to respire anaerobically to cause sugar fermentation to produce alcohol.
   - Cytology: Stem cell engineering to cure disease such as cancer
   - Genetics: Crop varieties with improved disease resistance, drought resistance, high yield and early maturity.
   - Microbiology: Employed in the production of antibiotics and sewage treatment.
   - Histology: Employed in tissue culture of plant species with desirable characters.

3. Other fields making use of knowledge in biology
   - *Food processing industries*- The processing of cocoa beans into chocolate employs the activities of microbes
   - *Pharmaceutical industry*- uses knowledge in biology to test and develop new drugs and treatments for a variety of diseases and health conditions.
   - *Fisheries*- hygiene protocols to prevent algal growth that may cause demise of fish population and fingerlings.
   - *Conservation/restoration of natural resources*- degraded land can be reclaimed using biological techniques such as afforestation cover cropping and bioengineering.
   - *Medical research* - Research institutions such as centre for scientific research into plant medicine, Mampong use knowledge in plant anatomy, toxicity and dosage, as well as preparation and interaction with other plants in their research to establish suitability and efficacy of herbal preparations.

4.

- *Nurses* - take and record vital signs (blood pressure, temperature and weight) of the patient employing the knowledge of anatomy and physiology of the human body (zoology).
- *Biomedical scientists* - analyses blood and other body fluids making use of knowledge in parasitology and microbiology to detect the presence of disease-causing organisms.
- *Radiologist/Radiographer* - take chest x-ray and ECG (electrocardiogram) of the patient to find out any abnormalities in the appearance and function of the heart with background knowledge in biophysics.
- *Cardiologist* - will make a diagnosis based on interpretation of laboratory, x-ray and ECG findings.
- *Pharmacist* - prescribes appropriate medication using his knowledge in pharmacology

5. Professionals who make input in the diagnosis of the sick student:

- Diarrhoea - general nurses, public health nurses/specialists.
- Blood in urine - public health nurses/ specialists and biomedical scientists.
- Stomach pain - physician/physician assistant
- Raptured tissues - pathologist
- Tumour in the brain - neurologist/oncologist.

6.

a) Salt inhibits microbial activities by causing dehydration of the fish.

b) Drying further dehydrates the fish to prevent microbial activities.

c) Microorganisms such as bacteria which cause food spoilage to thrive well in moisture to carry out their activities. Both salt and drying create unfavourable conditions for them and so keeping the food in good condition.

7. Tin milk production employs Microbiology and Biotechnology. Microbiology - this involves **pasteurisation**. Pasteurisation is the process by which milk is heated to a certain temperature to kill harmful bacteria.

Biotechnology- this is involved in **homogenisation.** Homogenisation is used to standardise and disperse milk fat globules to improve the texture, taste and appearance of milk.

8. Biology is a branch of natural science that is concerned with the study of living things, their structure and function and their interaction with the environment.

9. In everyday activities such as food production, food preservation, home hygiene, gardening and environmental protection.

10.

a) In honey production, the sucking of nectar by worker bees, the enzymatic activities that transforms the nectar into honey in the gut of the worker bee all hinges on knowledge in biology. Knowledge in plant biology, bee biology and microbial interactions are essential for bee farmers in maintaining healthy hives.

b) In salted fish/"koobi" production, salt is put into the fish to dehydrate the fish which creates unfavourable condition for microbial activities. Fish is also dried to dehydrate it for preservation.

c) In bottled fruit juice production, knowledge in biology will inform us on the enzymatic reactions within various fruits. Understanding the biological processes that goes on in the fruits will aid in optimising timing, processing method, preservation to ensure fruit juice quality and maximise shelf life.

11.

- This can be achieved through growing cover crops to protect further surface soil erosion and loss of soil moisture.
- Practising crop rotation to ensure efficient use of soil nutrients at different soil strata.
- Afforestation: Planting of fast-growing tree species such as teak, cassia to reclaim areas affected by indiscriminate logging.
- Introduction of top soil to land areas affected by unregulated surface mining (galamsey),

12. It is a problem-solving tool that breaks down complex issues into simple components and hypothesis testing to find the root causes of a problem. It also provides a structured approach to inquiry so that the conclusion

of research work is based on empirical evidence rather than personal belief or common sense.

13. Inductive thinking is when one makes a generalised conclusion from a specific observation or pattern.

Example of Inductive Reasoning: Sunlight is necessary for plant growth because you observe that plants that receive sunlight grow taller.

Deductive reasoning starts with a general principle and apply it to specific situations to predict and test the hypothesis. It moves from a broader idea and narrows to specific conclusions. **Example of Deductive Reasoning**: All mammals give birth to live young ones; sheep are mammals therefore sheep give birth to live young ones.

14.

a) An organism exhibits bilateral symmetry if it can be divided along only one plane into two halves which are mirror images.

b) An organism exhibits radial symmetry if it can be divided along more than one plane to produce two or more halves which are mirror images.

c) A cut made through an object or organism that allows the internal structures to be seen is called a section.

d) Orientation refers to the position of an organism when being viewed.

15. Some organisms are said to be asymmetric because they have no line of symmetry.

16.

- fiddler crab
- *Amoeba proteus*
- *Achatina achatina* (giant land snail)

17. Place it on its belly i.e. its natural orientation.

18.

a) Mouth- anterior

b) Tail - posterior

c) Ear - lateral

d) Nuchal crest - dorsal

e) Anus - ventral.

19.

- Light microscope: Maximum magnification around 1,500x .
- Electron microscope: Maximum magnification around 1 million x. Although in schools and colleges only around 400x.

20. ***Hint:*** refer to notes on parts and functions of light microscope.

21. ***Hint:*** refer to notes on precautions for handling light microscope.

22. ***Hint*:** refer to notes on slide preparation.

23.

- Wet mounts are temporary slides preparations while permanent mounts are dry mounts and can be stored.
- Wet mounts have no fixatives while permanent mounts have.

GLOSSARY

Aeration: introducing air into a substance to increase oxygen levels

Biochemistry: study of chemical processes within living organisms

Countertops: flats surfaces in kitchens or bathrooms used for preparation and display

Empirical: based on observation, experience or experimentation rather than theory

Fermentation: chemical reaction converting sugars into alcohol, gases or acids often in microorganisms

Genetic engineering: altering an organism's DNA to introduce desired traits

Hypothesis: proposed explanation or educated guess tested through research

Irrigation: artificial supply of water for crops or land

Lab protocols: detailed procedures for conducting scientific experiments

Phenomena: observable events, situations or experiences

Physiology: study of functions and processes within living organisms

Theories: well accepted or substantiated explanations for natural phenomena

Translucent: allowing light to pass through but not completely transparent.

EXTENDED READING

The sites below provide resources for further studies

https://www.biologynotesonline.com

Also search YouTube for videos on *biology as a science of life, importance of biology, branches of biology and fields of work related to biology*.

ACKNOWLEDGEMENTS

Ghana Education Service (GES)

(GAST)

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