

Introduction

The study of biology provides students with opportunities to develop an understanding of the living world. Biology is the study of life and its evolution, of organisms and their structures, functions, processes, and interactions with each other and with their environments. Scientific inquiry is the primary process by which scientific knowledge is gained. It involves the basic skills of questioning, prediction, qualitative and quantitative observation, classification, inference, communication. Additionally, inquiry develops integrated skills such as identifying and controlling for variables, generating procedures, planning strategies for testing hypotheses and answering questions, and for collecting and interpreting appropriate data. The knowledge of biology includes scientific data, concepts, hypotheses, theories, methodology, use of instruments, and conceptual themes. Biologists recognize that knowledge based upon experimental results and accurate observation is gained through a variety of experiences. Thus, the role of the laboratory and field learning becomes a key component in understanding biology.

Most of the activities of grade 7 and 8 that have to be conducted in the laboratory are included in the manual. However, other important activities noted on the text but not in this manual need due attention and consideration.

Laboratory Safety rules

Laboratory safety rules are guidelines to keep you safe when experimenting. Most of the laboratory work you will do is quite safe. However, some laboratory equipments, chemicals, and specimens can be dangerous if handled improperly. Laboratory accidents do not just happen. They are caused by carelessness, improper handling of equipment and specimens, or inappropriate behavior. So it is always wise to follow all laboratory safety rules. The most basic rules that should be followed when in biology laboratory.

Major laboratory do not's.

Do Not

- Eat or drink in the laboratory.
- Taste any chemicals or substances you are working with.
- Use your mouth for pipeting substances.
- Handle broken glass with bare hands.
- Pour chemicals down the drain without permission.
- Operate lab equipment without permission.
- Perform your own experiments unless given permission.
- Put the microscope at the edge of the table.
- Leave any heated materials unattended.
- Place flammable substances near heat.
- Engage in childish antics such as horseplay or pranks.

Activity 1: How to make microscopes from local materials.

Objective: To make microscopes from local materials.

Introduction: Microscope is one of the basic tools in biology which is very important to see small creatures or small organisms that cannot be seen with our naked eyes. We can make/improvise a simple microscope from simple local materials and use it in biology lesson.

Materials required:

- plastic bottle (500ml) 1
- Scissors / cutter
- Scotch tape
- Tooth pick
- Pin/ Needle
- Match
- Spirit lamp
- Scissors
- onion
- Dropper (1)
- Water (one drop)

Procedure:

1. Cut the plastic bottle (about 8cm below the cape).



2. Heat a needle (Wosfie) with sprit lamp and pierce through the center of the cap with the needle. The size of the hole is recommended to be less than 2mm.



3. Cut two squares from the under part of the plastic bottle.



4. Stick one plastic square on the cap with scotch tape.



5. Put the sample that you observe (e.g. onion skin) on the other square and fix it with scotch tape on the brim of the plastic bottle without trapping in air.



6. Put a drop of water on the center of the square on the cap (make it spherical using tooth pick and adjust by rolling). The drop of water works as a lens.



7. Observe the cell under bright light (e.g. mobile phone light) without moving the microscope quickly).
Don't move the microscope quickly because water lens may fall down.)



Questions:

1. Discuss in your groups other alternatives to prepare microscopes from local materials and prepare a microscope.
2. Then observe different things by using your microscope.

Activity: 2 Demonstrating parts of microscope.

Objective: To identify the different parts of microscope and their functions.

Introduction: Microscope is one of the principal tools of a biologist. Microscope provides windows to the world of the cell. Its importance in revealing numerous life forms that lies beyond the limit of ordinary vision. It widened mans of knowledge about his surroundings, structure and organization of cells and identification of pathogens and other micro-organisms. Two important values in microscopy are magnification and resolution.

Magnification is the enlargement of a specimen's image beyond the actual size. Total magnification of any specimen being viewed multiply the power of the eyepiece (ocular lens) by the power of the objective lens being used.

For example: If the eyepiece magnifies 10x and the objective lens magnifies 40x, then 10×40 gives a total magnification of 400x.

Resolving Power (Resolution):- is the ability to discriminate two objects close together as being separate. The human eye can resolve objects about $100\text{ }\mu\text{m}$ apart (note: $1\text{ }\mu\text{m} = 1\text{ micrometer} = 1\text{ millionth of a meter}$). Under ideal conditions the compound microscope has a resolution of $0.2\text{ }\mu\text{m}$, about 500 times the resolving power of the human eye.

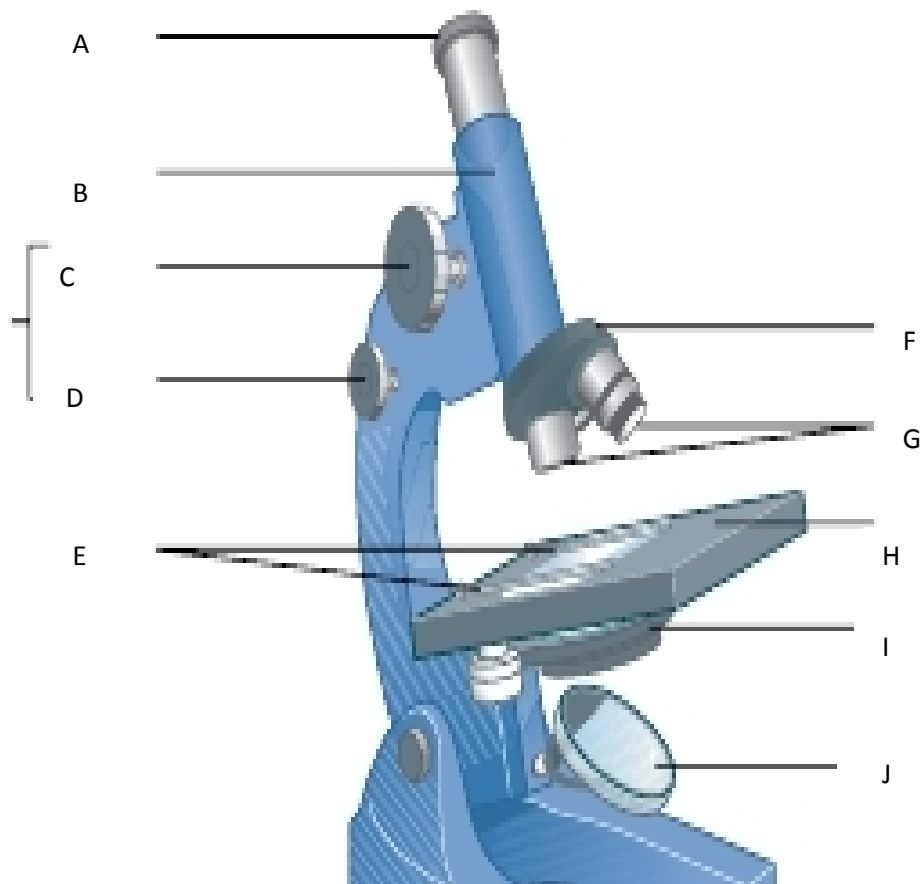
Apparatus: Compound microscope

Procedure:

Place the microscope where there is good light from a window of your laboratory bench with its arm facing you.

Questions:

- A. Identify the various parts of microscope.
- B. Discuss on the function of different parts of microscope.
- C. Draw the diagram of microscope and locate the different parts.
- D. Take as an example a medium power objective and an eyepiece lens with a 10X magnification



Compound light microscope

Activity 3: Observing different Plants and small animals using hand lens.

Objective: To observe different Plants and small animals using hand lens

Introduction: A simple microscope consists of a single convex lens that is capable of magnifying an object. A microscope which consists of only one curved lens is simple microscope. A hand lens is an example of simple microscope.

Materials required:

- Hand lens
- Flower from different plants
- Leaves from different plants
- Body parts of small insects (house fly, ants, grasshopper)

Procedure:

1. Collect flowers and leaves from different plants and samples of insects.
2. Pick your hand lens and the objects you are going to observe.
3. Sit in an area with good lighting or sunlight.
4. Observe the different flowers. (Try to observe the anther and the stigma) with your naked eyes and note what you observe.
5. Hold the flower on the opposite side of the hand magnifier from your eyes.
6. Move the object or the hand lens until you are able to see clearly through the lens and draw what you see.
7. Do the same for different insect samples you have brought to the class or laboratory and note the difference between what you have observed with your naked eyes and with the hand lens.
8. Also observe the skin at the back of your hand.

Questions:

1. Draw and label your observation
2. Note the difference between your observation with the hand lens and with your naked eyes.

Activity 4: Practicing mounting and focusing

Objective: To develop the skills of mounting and focusing the microscope.

Introduction: Mounting is preparation of an object/a specimen to be seen under the microscope. A slide is used to "mount" specimens so that they can be handled and seen under a microscope. There are two major methods for mounting a specimen, **dry mount** and **wet mount**.

Dry mounting a specimen is fairly easy. It merely involves placing the object to be viewed, or specimen on a glass slide. The object is then normally covered with a **coverslip**, which is another, smaller piece of glass. When viewing a dry object under the microscope, very thin slices will be best. This allows the light to pass through, from underneath the specimen, and allows the coverslip to be positioned to keep the object from moving about on the slide. Some objects will be too large for a coverslip in which case they should be cut thinner if possible. They also may be viewed under fairly low magnification, with the light source coming from above the object. In this case, when focusing, be sure not to allow the lens tube to touch the specimen.

A **wet mount** is used to view living organisms. This involves putting **water**, as well as the specimen, on the slide. It is necessary because most living things require water to survive, and its deprivation will make the object appear different from its natural state. To do a wet mount, be sure to begin with a flat surface. Then put a drop of water in the middle of the slide. Put the specimen on the drop and then apply the cover slip. When holding the coverslip, be sure to hold it by the sides, so that it does not get fingerprints or smudges that might be mistaken for being part of the specimen. If there are bubbles under the coverslip, they can be removed by pressing on it, and forcing the bubbles out through the edges. If there is not enough water under the slip cover, apply a drop on the slide at the edge of the coverslip.

Focusing is adjustment of focus to observe specimen clearly.

Materials required:

- Clean slide and cover slip
- A dot on a piece of paper
- Dropper
- Forceps
- Water in a beaker
- Compound light microscope

Procedure:

1. Lay down the piece of paper with a dot on a clean microscope slide.

2. Place one drop of water directly over the specimen and cover it with a cover slip.
3. If you put too much water over the specimen, cover slip will float on top of the water. This makes it harder to observe the specimen
4. Place the slide on the microscope stage, with the specimen directly over the center of the glass circle on the stage
5. Always start and end with low power objective, lower the objective lens to the lowest point, then focus using first the coarse knob, then with the fine focus knob.
6. Adjust the diaphragm as you look through the eyepiece and you will see that more detail is visible when you allow in less light. Too much light will give the specimen a washed-out appearance.
7. Once you have found the specimen on low power, then, without changing the focus knobs, switch it to medium power. Move the object or the hand lens until you are able to see clearly through the lens.
8. Once you have it on medium and high power remember that you only use the fine focus knob.
9. Click the high power objective lens in position and only use the fine adjustment knob to focus on Specimen. At this point if the specimen is too light or too dark, try adjusting the diaphragm.
10. Then focus using the fine adjustment for sharp focusing. Do not use coarse adjustment.

Question:

Is the dot compact or diffused? Draw it

Activity: 5 making a wet mount

Objective:

- To prepare specimen to observe under the microscope.
- To develop the skills of wet mount preparation.

Introduction: To observe any object through a microscope you need to place the specimen or the object to be studied on glass slide and then on the stage of the microscope. The process of placing the object to be studied on a glass slide, covering it with cover slip and then placing it on the stage of the microscope is referred as **mounting**.

The specimen (sample or object) to be examined under the microscope should be prepared in thin layer (preferably one cell thick layer with blade, knife or microtome). We need to either wet or dry mount the specimen on glass slide and cover with cover slip so that to observe it under the microscope. **Wet mounted** specimens are prepared with a drop of water and are used for the time only; temporarily. During dry (without drop of water) or permanent preparation, the object is fixed on the slide using proper procedure.

Wet mounting, which is also referred as temporary mounting procedure, it is commonly used for immediate observation purpose. During this mounting procedure **water is used as mounting medium**. Normally, to the specimen on a glass slide a drop or two of water is added and being covered with cover slip studied immediately under the microscope. Since water is used during wet mounting, the objects are observed in their original shape and size. Water in addition to serving to keep samples in their original shape and size; it also aids in collecting the light rays coming from the source of illumination and makes them pass through the object.

Materials required:

- Compound microscope
- Slides
- Flowers
- Cover slip
- Beaker with dropper
- water

Procedure:

1. Gather some pollen from a flower.
2. Place it on a slide and add a drop of water
3. Cover with cover slip and observe the pollen under the microscope

Question:

Draw the cells you see on your note book.

Activity 6: A simple stain.

Objective: To prepare simple stain from local materials.

Introduction: It is known that microscope is an instrument that is used to magnify the size of an object and resolve the structures. To observe more detailed parts of an object, we use some stains or coloring materials. In this activity you are going to make a simple stain that can be used to observe the nucleus of plant cells under improvised microscope.

Materials required:

- Beaker (100ml) 1
- Food coloring/ stamp ink (2-3ml/ one spoon)
- Vinegar (2-3ml/ one spoon/5-6 drops)
- Bunsen burner/sprit lamp)
- Match
- Water
- Stirrer/glass rod

Procedure:

1. Add about 20 ml water into a beaker



2. Add one spoonful of food coloring/stamp ink and one spoonful of vinegar into the beaker.



3. Stir and heat until the mixture starts to boil.



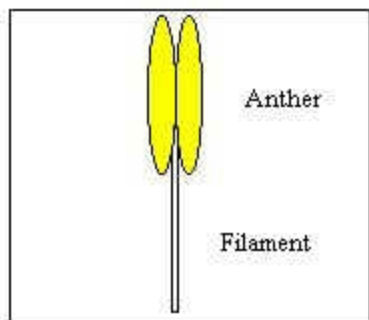
4. Cool it and use it for staining a specimen

Activity 7: observing pollen Grains Under a microscope.

Objective: To examine the structures of pollen grain.

Introduction:

Male Reproductive Organ: Stamen



The male parts of a flower consist of one or more stamens. Each stamen is made up of paired anthers (sacs containing pollen) on a filament or stalk.

The anther is the orange/yellow structures often seen in the centre of a flower.

Pollen from the anthers of one flower is transferred to the stigma of another usually either by wind, or by animals, especially insects.

Required materials:

- Flowers from different plants
- Blade or scalpel
- Compound microscope/ Hand lens (optional)
- Cover slip
- Beaker with dropper

Procedure:

1. Gather some pollen from a flower.
2. Remove the stamens and crush the anther on a glass slide and prepare a wet mount and observe it under a microscope. If there is no microscope you can use hand lens.
3. Do the same for different plants.

**Questions:**

1. Observe if different plants have similar pollen grains or not and write your conclusion.
2. Draw the cells you see on your note book.

Activity 8: Observing plant cells (onion epidermal cells).

Objective: To observe plant cells under the microscope and identify structures of plant cells

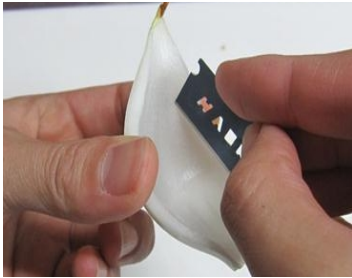
Introduction: An onion bulb is composed of a series of fleshy, nutrient storing, modified leaves. The outer part of each leaf, composed of a single layer of cells, is the epidermis, whose function is protection.

Materials required:

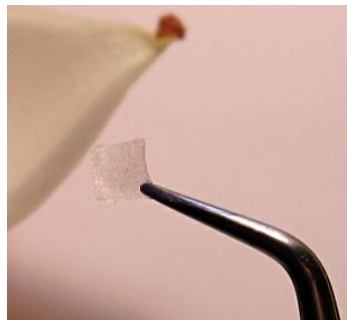
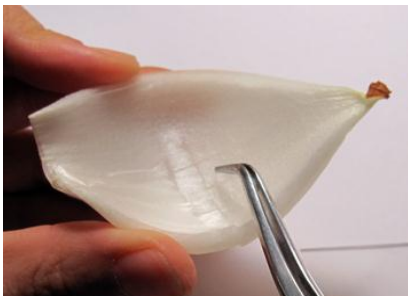
- Compound microscope
- Microscope slide
- Covers slip
- Dropper
- forceps
- Onion
- Beaker with water
- Iodine solution

Procedure:

1. Take a small piece of onion and using cutter cut the membrane.

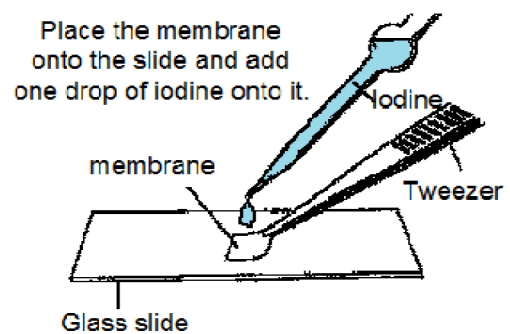


2. Peel off the piece of membrane.



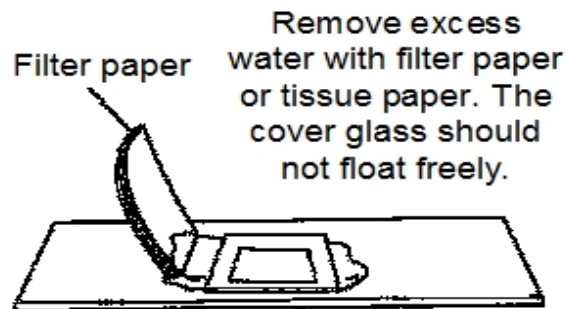
3. Place the membrane onto the slide and one drop of iodine onto it.

Or place two drops of water on the onion skin. This is called a "Wet mount."



4. Starting at one edge, gently lower a cover slip over the onion skin.

5. Remove excess water with filter paper or tissue paper. The cover glass should not float freely.



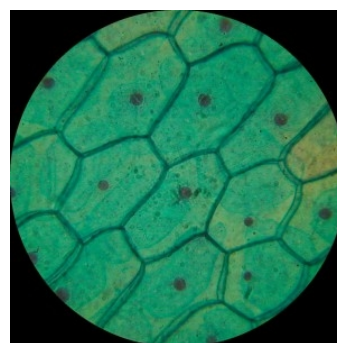
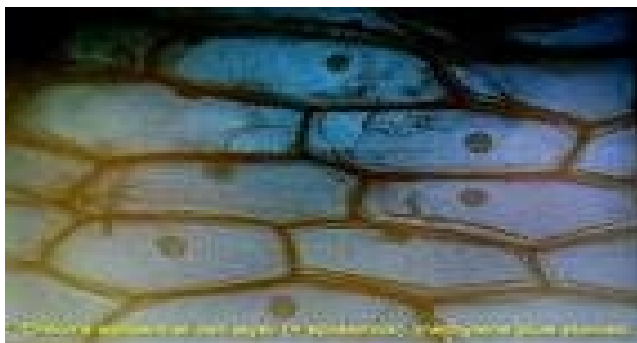
6. Use nail polish to seal off the cover glass if you want to keep the prepared slide for some time.



7. Place the slide on the stage under low power and observe with different objective lenses.

Questions:

1. Record your observation and draw and label what you saw.
2. What is the importance of using iodine to stain onion epidermal cells



Onion epidermal cells under a compound light microscope.

Activity 9: Observing the Epidermis of Elodea (water Plants).

Objective: To observe the structures of plant epidermal cells under the microscope.

Introduction: Epidermis, in botany, outermost, protoderm-derived layer of cells covering the stem, root, leaf, flower, fruit, and seed parts of a plant. The epidermis and its waxy cuticle provide a protective barrier against mechanical injury, water loss, and infection. Various modified epidermal cells regulate transpiration, increase water absorption, and secrete substances.

Materials required:

- Compound Microscope
- Forceps
- Slides
- Elodea
- Iodine solution
- Dropper
- Cover slips
- Beaker with water

Procedure:

1. Place a drop of water on the slide again, and put an Elodea (water weed) leaf in the water.
2. Put the Cover slip in place as you did before and observe the leaf through the microscope.
3. Observe a cell under low power and medium power.

Questions:

1. Make a drawing of the cell and label all of the structures that you see.
2. What cellular structures did you observe?
3. Compare onion epidermal cell and Elodea leaf epidermal cell

Activity 10: Observing Animal cells (human cheek cells).

Objective: To observe animal cells under the microscope.

Introduction: Observing human cheek cells under a light microscope is a simple way to quickly view a human cell structure. Many educational facilities use the procedure as an experiment for students to explore the principles of microscopy and the identification of cells. Observation uses a wet mount process that is straightforward to achieve by following an effective preparation method. You can replicate the observational experiment at home with any standard light microscope with magnification settings of X-40 and X-100

Materials Required:

- Microscope
- Microscope slides
- Cover slip
- Pipette/dropper
- Tooth pick/ mounting needle
- Beaker with water
- Methyl blue

Procedure:

1. Place a drop of water on a new clean slide.
2. Take a tooth pick and gently rub it against the inside of your cheek.
3. Stir the water on your slide with the end of the toothpick that you rubbed in your mouth. This will transfer the
4. Place a cover slip on it and examine it under the middle power
5. Place one drop of methylene blue stain on your slide. Be careful, methylene blue will stain your hands and clothing
6. Let this stain stay on the slide with for one minute and then place a cover slip on
7. Observe under low power in the microscope. Once you find a good specimen of single cells then turn to higher power and observe further.

Questions:

1. Make a clear drawing of the cells and label any identifiable structures. Be sure to find the **cell membrane**, **cytoplasm**, and **nucleus of the cell**.
2. What is the significance of staining with methylene blue?

Activity 11: Examining Calcium Found in the Bones.

Objective: To Examine the presence of calcium in the bones.

Introduction: Calcium is essential for maintaining the necessary level of bone mass to support the structures of the body. The body is constantly using calcium for the heart, blood, muscles and nerves. Calcium is also lost through normal bodily processes such as waste and the shedding of hair, fingernails, sweat and skin.

If individuals diet does not include enough calcium to replace what is used, the body will take calcium away from the bones, which weakens them and makes them more likely to fracture.

Materials required:

- Test tube
- Iodine solution
- Rib bones of cattle

Procedure:

1. Collect rib bones of cattle in your surroundings.
2. Clean the test tube and the bone.
3. Add some amount of iodine solution into the test tube.
4. Insert the rib bones to the iodine solution.
5. Leave it for 24 hours in the laboratory.
6. After 24 hours observe and check the strength of bones.

Questions:

1. Compare the bone which is inserted in iodine solution and not inserted in iodine solution.
2. Why the bone inserted in iodine solution became flexible?

Activity 12: Examining the main parts of flowering Plants.

Objective: To identify the different parts of flowering Plants.

Introduction: Flowering Plants are plants which have flowers. They have three major parts namely; the Stem, The leaf, and the root. At maturity these plants will have an additional fourth component, the flower. These structures in turn may be organized as reproductive and vegetative structures. The only sexual reproductive structure of a flowering plant is flower. The stem, leaf and root make up the vegetative part of the plant.

Materials required:

- Bean Plant
- Hand lens
- Maize/grass

Procedure:

Working in groups, carefully uproot bean and maize/grass plants grown for the purpose in pots.

Questions:

1. Identify the major parts of these plants as the stem, the root, the leaves and the flower
2. Draw and label the parts.

Activity 13: Examining fibrous and tap root systems

Objective: To differentiate the roots of different plants as tap root and fibrous root

Introduction: In plants there are two main kinds of root systems, namely the tap root system and the fibrous root system. In tap root system a single central main root grows deep downward into the soil and lateral branches developed sideways. In this root system the main root is wider in diameter and lateral roots are narrower. Fibrous root system is a type of root system which contains many smaller roots of similar diameters.

Materials required:

- Bean plant
- Hand lens
- Maize/grass
- Carrot plant

Procedure:

1. Working in groups, carefully uproot bean, carrot and maize/grass plants grown for the purpose in pots.
2. Brush away a little of the soil and wash off the rest so that the roots are well cleaned

Questions:

1. Identify the root system as tap root system and the fibrous root system.
2. Draw and label parts of the root system

Activity 14: Examining transport of water and mineral up through the stem.

Objective: To investigate the movement of water and minerals from the root to the leaves.

Introduction: Plants have a well-developed structure in their roots, stems, and leaves that is responsible for the transport of liquid water carrying dissolved minerals upward from the soil and some organic substances of tissue origin as well. A continuous supply of water is needed to replace water lost from aerial parts of the plant by transpiration and to deliver solutes to growing and developing tissues. Regardless of the organization within the stem, the function of the vascular components is essentially the same in all higher plants. The xylem transports water and minerals absorbed by the root up through the stems to the leaves and flowers.

Materials required:

- A compound light microscope
- glass slide
- A blade/knife/scalpel
- Red/blue ink or food red
- beaker

- Bean plant / Vegetable
(e.g. celery) / any Weed

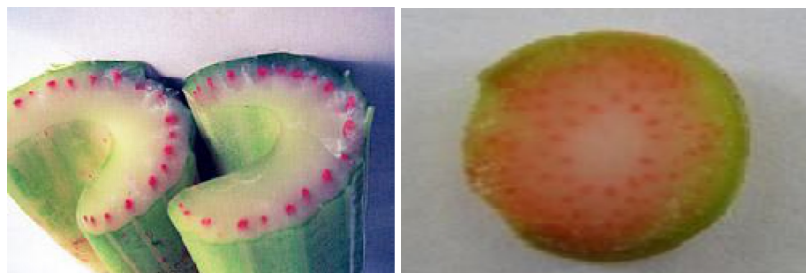
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Procedure:

1. Prepare red dye or ink (1 part of ink/dye and 10 parts of water) or food red.
2. Mix the red ink/dye with water in a beaker. Let the cut plant stand in the beaker for a night.



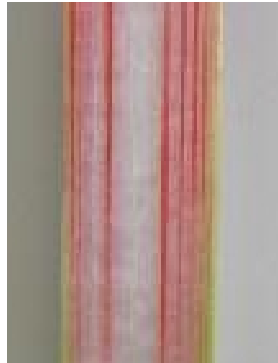
3. Take out the plant; make a cross section of stem of the plant using safety razor.



4. Make the vertical section. Tear away the stem of plant.



5. Cut the stem of plant by safety razor.



6. Cut a thin uniform section. A good section is cut in a straight, transverse or longitudinal plane.
7. Float the section on the water in laboratory dish.
8. Place the section onto the slide and add one drop of water.
9. Observe under the microscope before it dries up.

Questions:

1. Record your observation.
2. **explain** your conclusion from this experiment.

Activity 15: Observing stomata under the microscope or using Hand lens

Objective: To observe stomata under the microscope.

Introduction: Stomata are pores in the surface of the leaf and they are known to have two major functions which are vital for plants.

The first function is exchange of gases with the atmosphere. Plants need to take in carbon dioxide and release oxygen as part of the process of photosynthesis. Plants also take in oxygen and release carbon dioxide during cellular respiration. Since leaves usually have both an impermeable epidermis and a waxy cuticle to prevent uncontrolled water loss, the plant needs a way to get these gases to and from the cells. The stomata serve as channels in to the leaf, allowing the gases to diffuse directly into and out of the cells from within the leaf tissue.

The second function is allowing controlled release of water molecules into the atmosphere in the form of vapor. Although a plant cannot afford to lose too much water to the environment, the plant must have a way to carry water and minerals from the roots, up the stem, to the leaves and out through the stomata.

The **stomata** pores are surrounded on both sides by jellybean shaped cells called guard cells. Unlike other plant epidermal cells, the guard cells **contain chlorophyll** for photosynthesis. This allows the cells to expand/ contract to open or close the stomata. Guard cells also close when dehydrated. This keeps water in the plant from escaping. The opening or closing of guard cells can be viewed under the microscope by adding different water concentration to the leaf tissue. Most stomata are found on the **lower epidermis** of the leaves.

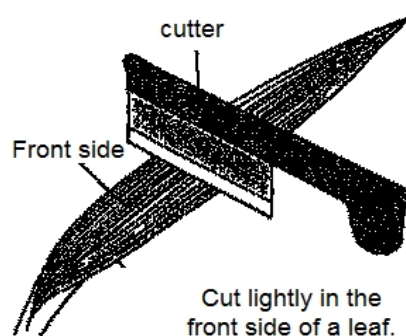
The number of stomata on the epidermal surface can tell you a lot about a plant. Usually, a high concentration of stomata indicates fast growth and wet climate. Lower concentrations of stomata indicate lower rates of photosynthesis and growth or adaptations for dry weather.

Materials required:

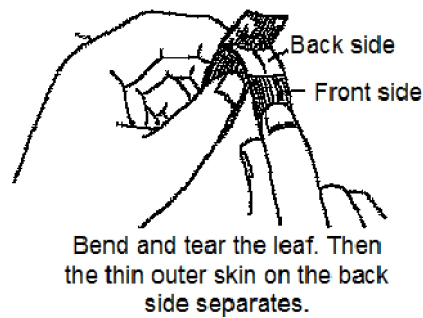
- Leaf of cana indica(Qey abeba) or leaf from any other plant.
- Blade/scalpel
- Nail varnish
- Microscope
- Cover slip
- Beaker, dropper and water.
- Glass slide
- Hand lens

Procedure:

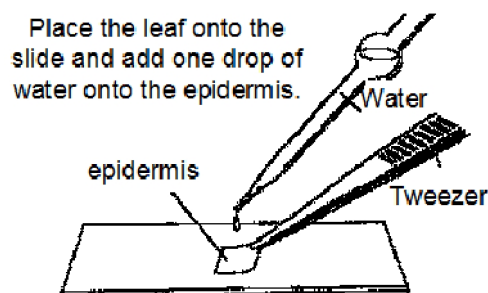
1. Cut lightly in the front side of a leaf.



2. Bend and tear the leaf. Then thin outer skin on the back side separates



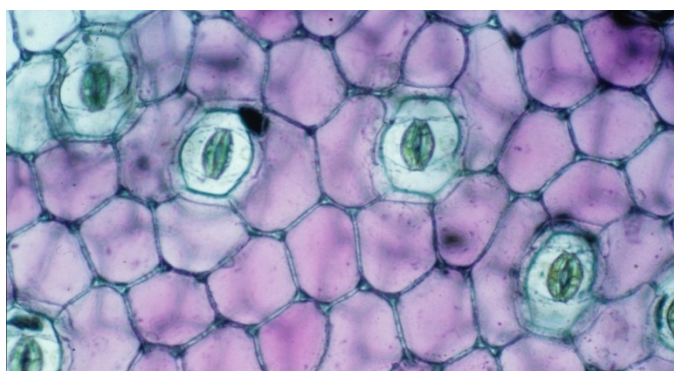
3. Place the leaf onto the slide and add one drop of water onto the epidermis.



4. Observe it under the microscope starting from low-power objective lens to high-power objective.

Questions:

1. Can you observe the stomata and the guard cell?
2. What do you think is their function?
3. Record your observation and illustrate it by using diagram.



Stomata seen under the light microscope

Activity 16: Examining Monocotyledonous and Dicotyledonous plants.

Objective: To identify the structures of monocotyledon and dicotyledon seeds and plants.

Introduction: Monocots (or monocotyledons) and dicots (or dicotyledons) are the two main types of flowering plants. They differ in morphological characteristics of leaves, stems, flowers and fruit of flowering plants.

Comparison chart

	Dicot	Monocot
Embryo	The dicotyledons embryo has two cotyledons.	Monocotyledons have one cotyledon
Leaf venation	Leaf veins are reticulated (branched).	Leaf veins are parallel.
Flowers	Petals in multiples of four or five. May bear fruit (if tree)	multiples of three
Secondary growth	Often present	Absent
Stem and vascular system	Bundles of vascular tissue arranged in a ring. The vascular system is divided into a cortex and stele.	Bundles of vascular tissue scattered throughout the stem with no particular arrangement, and has no cortex.
Pollen	Pollen with three furrows or pores	Pollen with a single furrow or pore
Examples	Legumes (pea, beans, lentils, peanuts)	Grains, (wheat, corn, rice, millet) onions
Root Pattern	Taproot system	Fibrous roots
number of seed leaves	2 seed leaves	1 seed leaf

Materials required:

- Different plants in the school Compound
- Tapes
- paper

Procedure:

1. Collect one `specimen for each flowering plant from your school compound.
2. Bring the specimens to the class, arrange and tape the specimens on a piece of paper, examine them carefully.

Question:

Label the samples as monocot or dicot.

Activity 17: Examining the Seeds of Flowering Plants.

Objective: To identify monocotyledon and dicotyledon seeds.

Introduction: Flowering Plants are classified in two main groups. Monocots and dicots. Monocots have one cotyledon/food storage where as dicots have two cotyledons/food storage.

Materials required:

- Corn and bean seeds (soaked in water 1 day before).
- Peanut
- Knife (not sharp) to cut seeds.

Procedure:

1. Soak the seeds in water one day prior to the laboratory session.
2. Examine the seeds carefully.

Questions:

1. Draw exactly what you see.
2. List monocots in one row dicots on the other side.

Activity 18: Examining the effect of Plant hormones on stem cuttings.

Objective: To investigate the effect of plant hormone/auxin on root growth.

Introduction: When you hear the word hormones, you may think of typical human hormones, such as testosterone, estrogen or even adrenaline. These hormones in our bodies regulate different physiological activities ranging from the tone of our voices to our height to our fight or flight response. Plants, which seem rather unresponsive most of the time, also have hormones to control physiological activities.

Hormones are chemical signals that coordinate the different parts of an organism. The word 'hormone' comes from a Greek term that means 'to excite.' These chemicals are produced in very small amounts in one area of an organism and are then sent to another part, where a response is triggered. Let's use the human hormone adrenaline to illustrate this. Our adrenal glands are located above our kidneys. They produce a hormone called adrenaline that, when needed, is transported through our bodies to cause an increase in heart rate, dilation of pupils and other responses to make us more alert.

Hormones in plants act in similar ways. They are produced by cells in one area of the plant - such as the leaves, stems or root - and then transported to a different area of the plant in order to produce a response.

Materials required

- Scalpel
- Rose plant
- Auxin powder

Procedure:

1. In groups, prepare 10 rose stem cuttings and the ground for planting.
2. Prepare auxin solution by adding 5 mg in a liter of clean water.
3. Dip 2/3 of the 5 cuttings in to the solution prepared and plant them as indicated in activity 4.12 in the text book. Dip the other 5 into clean water and plant them as well.
4. Plant them in two rows, row 1 cuttings dipped in rooting solution and row 2 of stem cuttings dipped in pure water.
5. Keep the above- ground portion of the cutting moist and cool.
6. Observe rooting of the cuttings.

Questions:

1. Do the stem cuttings begin rooting?
2. What differences observed in the two rows?
3. What do you conclude from this experiment?

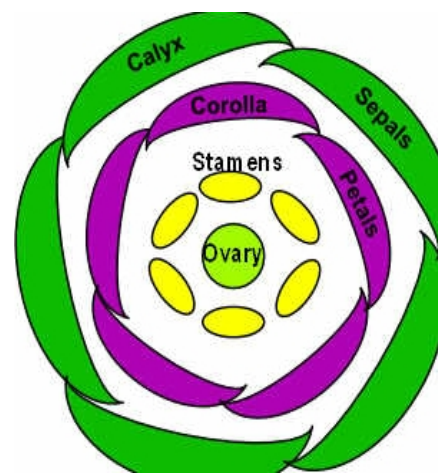
Activity 19: Examining Flowers

Objective: To identify different structures and parts of flowers and their structural modifications.

Introduction: A flower is the reproductive structure in flowering plants (angiosperms). The biological function of a flower is to mediate the union of male sperm with female ovum in order to produce seeds. The process which begins with pollination is followed by fertilization, leading to the formation and dispersal of the seeds.

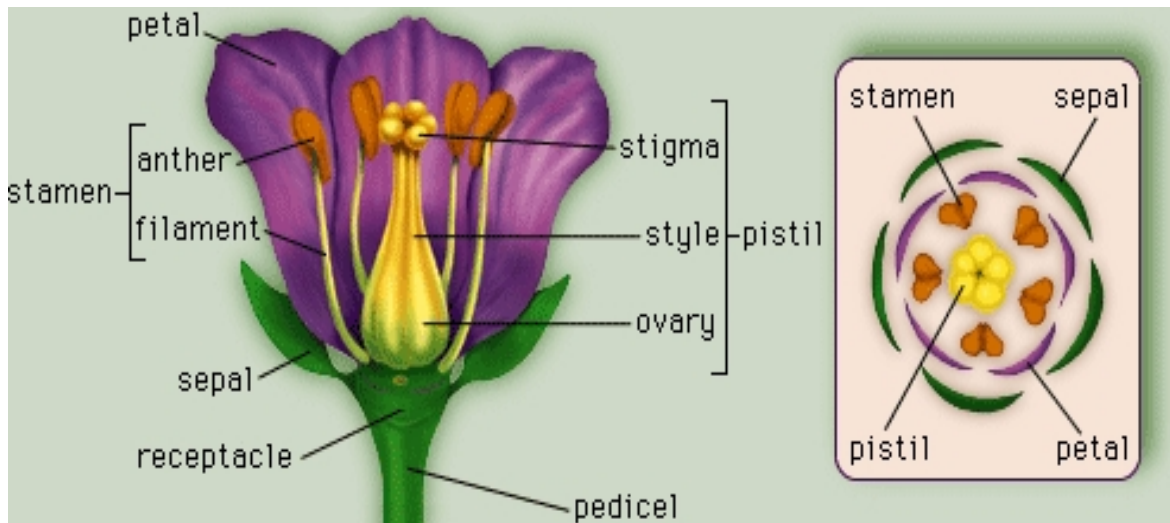
A flower is basically made up of four concentric rings of structures. There is an outer ring of modified leaves called **sepals**. These provide protection to the flower before it opens and are usually green. This outer ring is known as the **calyx**.

Inside the sepals is another ring of modified leaves called **petals** which are often brightly coloured. This layer is known as the **corolla**. Within the corolla



are one or more stamens containing pollen, which are the male reproductive structures.

In the very center of the flower is the female reproductive organ.

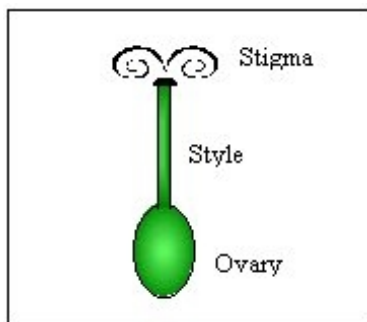


Activity 19.1: Examining the pistil.

Objective: To investigate the structures of pistil/female reproductive organ of different flowers.

Introduction

Female Reproductive Organ: Pistil



The female parts of a flower consist of an ovary, which contains one or more ovules, a style and the stigma. The ovary is at the base of the flower.

From the ovary, extends a tubular structure called the style and on the top of the style is a surface receptive to pollen called the stigma.

The stigma can take many different forms, most of them designed to help trap pollen. There are many variations on this basic structural theme.

Materials required:

- Scalpel
- Flowers from different plants
- Magnifying lens(hand lens/microscope)
- Paper

Procedure:

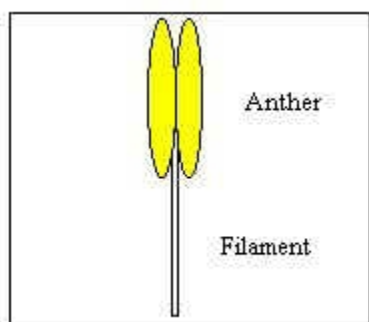
1. Collect different flowers from the environment.
2. Remove the sepals and the petals by pulling down the receptacle of the flowers.
3. Get the central part of the flower, the pistil and using the scalpel cut it lengthwise into two equal halves.
4. Use the hand lens to identify parts of the pistil.

Question:

Draw and label the parts of the pistil.

Activity 19.2: Examining pollen grains/male gamete of the flower.

Objective: To examine the structures of pollen grain.

Introduction:**Male Reproductive Organ: Stamen**

The male parts of a flower consist of one or more stamens. Each stamen is made up of paired anthers (sacs containing pollen) on a filament or stalk.

The anther is the orange/yellow structures often seen in the centre of a flower.

Pollen from the anthers of one flower is transferred to the stigma of another usually either by wind, or by animals, especially insects.

Required materials:

- Flowers from different plants
- Blade or scalpel
- Hand lens (optional)
- Paper

Procedure:

1. Gather some pollen from a flower.

2. Remove the sepals and the petals by pulling down the receptacle of the flowers.
3. Remove the stamens and crush the anther on a glass slide and prepare a wet mount and observe it under a microscope. If there is no microscope you can use hand lens.
4. Do the same for different plants.

Questions:

Identify the parts of the flower and then draw and label the parts as

- | | | |
|------------|----------|-----|
| ✓ Petal | ✓ Stigma | |
| ✓ Anther | ✓ Ovary | |
| ✓ Filament | ✓ Calyx | and |
| ✓ Style | corolla. | |

Activity 20: Comparing wind and animal pollinated Flowers.

Objective: To differentiate the different flowers as wind or animal pollinated types

Introduction: Pollination is the transfer of pollen grains from the anther (male part) to the stigma (female part). Since pollen grains or any part of flowers cannot move by their own, agents that move pollen grains from the anther to the stigma are required. These agents are known as pollinating agents.

Materials required:

Flowers from different plants

Procedure:

In groups, identify the flowers you have obtained from your school compound as wind or animal pollinated types.

Questions:

1. Give your own reasons as to why you have categorized the flowers as wind or animal pollinated types.
2. Make a comparison between wind and animal pollinated flowers based on the following characteristics.

Character	Flowers	
	wind pollinated	animal pollinated
Petal		
Color of petals		
Smell		
Nectar		
Pollen grains		
Nature of the anther		

Activity 21: Identifying seed structures and their functions

Objective: To identify different seed structures.

Materials required:

- Bean and corn seeds dry and wet (soaked overnight)
- A pair of tweezers or forceps, sharp knife or dissecting scalpel
- Magnifying lens

Procedure:

In groups, examine the seeds carefully by removing the external soft cover

(May be impossible for a corn seed)

Questions:

1. Identify the parts of the seeds and discuss their respective functions
2. What is the name of the small black scar you see on the bean seed?

Activity 22: Field Work through observation, counting and measuring

Objective:

- To apply appropriate field work method in teaching certain biology lessons.
- To plan and facilitate the field work activities for students to learn biology lessons.

Introduction: Field work is the collection of information / data outside of a controlled laboratory setting or classroom. In biology, it could be to observe animals, plants and how they interact with their environment. It allows students to integrate theory and skills learned in the classroom or laboratory into real

world environments. There are multiple benefits to participating in field work as follows:

- ✓ Learn or improve data collection and analysis skills;
- ✓ Develop observational and investigative skills;
- ✓ Work in teams to improve communication, team work and problem solving skills;
- ✓ Experience social or cultural environments outside of our daily routine;
- ✓ Network as we collaborate with other students, teachers and community members from other institutions.

Materials required:

- Rope
- Meter
- Forceps
- Scissors
- Ruler
- Rectangular frame made of metal/wood.
- Plastic bag
- Petri dish
- Beaker/ petri dish/glass bottle
- Plastic try/sheet of paper.

Activity 22.1 comparing the types of grasses in sunny area and in shady area: and identify the dominant species in each area.

Procedure:

1. Measure one meter by one meter area of the grass using ropes and ruler, both in sunny and shady area.



2. Divide the quadrant in to equal small squares ($4 \times 4 = 16$) as shown in the figure below.

Area 1 (Sunny area)

A			
	B		
			D
		C	

Area 2 (Shady area)

		A	
B			
			C
	D		

3. Select four small squares out of the 16 as samples and label "A" "B" "C" and "D" as shown in the figure above.
4. Identify the types and label the grass and write its characteristics of the plant (e.g. height, shape of leaf, size of leaf, etc) using the tables below.
5. Count the number of each type of grasses found in the four sample areas. Record it in the same tables.

Area 1: Sunny area

	Grass 1	Grass 2	Grass 3	Grass 4	Grass 5	Grass...	
Characteristics (e.g. height, shape of leaf, size of leaf, etc.)							
Area A							
Area B							
Area C							
Area D							Total
Sub-Total							
Population (%)							

Area 2: Shady area

	Grass 1	Grass 2	Grass 3	Grass 4	Grass 5	Grass...	
Characteristics (e.g. height, shape of leaf, size of leaf, etc.)							
Area A							
Area B							
Area C							
Area D							Total
Sub-Total							
Population (%)							

6. Estimate the percentage of population of each type of grass in the area based on the collected data of step 5. (by percentage)

Questions based on the data

1. How is the distribution of each grass in sunny and shady area?
2. What are the dominant types in the two areas?
3. Are the dominant types of grass in the two areas the same?

Activity 22 .2 comparing the types of small animals in sunny area and in shady area: and identify the dominant species in each area.

Procedure:

1. Take equal samples of soil with Beakers from sunny and shady areas (preferably under trees) as shown in the picture.



2. Take the samples to the lab or class and spread them on tray or sheet of paper.
3. Collect as many small animals as you can from the soil samples. Keep them in a container (e.g. petri dish, glass bottle).



4. Draw the pictures of the collected animals in the table below (at least 3).

5. Count the numbers of animals and record it in the same table below.

Area 1: Sunny Area

	Animal 1	Animal 2	Animal 3	Animal
Drawing				
Number				

Area 2 : Shady Area (under trees)

	Animal 1	Animal 2	Animal 3	Animal
Drawing				
Number				

6. Based on the collected data in the tables, compare the data of the two different areas (sunny place and shadow) in terms of number and type.

Questions:

1. Organize the data and the result, and present the whole class.
2. What are the dominant types of animals in the two areas?
3. Are the dominant types of animals in the two areas the same?

Activity 23: Collecting Insects and other Small Animals

Introduction: Insects and small animals are found every habitat. Insects may be found flying in the air or buried in the soil. They may be found in the water, on vegetation or under logs, stones and debris. There are various methods of collecting and preserving insects and animal specimens depending on their nature (Size, strength). This can be done using collecting

tools such as pitfall trap, pooter, sweep net, butterfly net and the like. They are collected from the field using certain methods trapping equipments and identified. Once insects are trapped then will be kept inside the killing jar until die.

Activity 23.1: Collecting Insects

Objectives:

- Identifying different insect collecting equipments.
- Collecting different insects from the field.
- Identifying each insect collected.

Materials Required:

- Sweep net- to sweep grasses, to collect grasshoppers and ground living
- Butter fly net- for sweeping through the air to catch flying insects.
- Potters (Aspiratore) - used to collect small insects from the leaf litter, tree trunks, rock and walls.
- Tree beating- used to collect insects from the tree. Collect the insects from the cloth or paper using fingers, forceps or potters.
- Alcohol and/or formalin
- Killing jar

Procedures:

1. Collect different insects using certain insect net.
2. Keep the insect collected in the killing jar containing alcohol/ formalin and bring them in to biology laboratory.
3. After the insect die transfer to another bottle
4. Identifying the insects

Questions:

1. How many body parts do the insect have?
2. How many pairs of wings do the insect consists of?
3. Does the insect have soft wings or hard wings?
4. How do you distinguish one insect from the other?

Activity 23.2: Collecting Aquatic Animals

Objective:

- To identify aquatic insect collecting equipments.
- To collect invertebrates from aquatic habitat.
- To observe and identify aquatic invertebrates.
- Collecting and preserving aquatic insects collected.

Introduction: There are different animals found in aquatic environment. Fish and aquatic invertebrates are among animals living in water. To collect water dwelling insects, a variety of equipments are used.

Materials Required:

1. **Pond net:** used for catching visible pond animals in open water (e.g. beetles, fish); for sweeping through water plants for hiding animals (e.g. larvae, snails).
2. **Plankton net:** used for collecting samples of the small, drifting pond life: young insects, algae, diatoms.
3. **Small fish trap:** consists of a glass jar with a cone of perforated zinc pushed in to its opening.
4. **Bulb pipette:** helps to transfer small aquatic animals to containers.
5. **Sorting dish:** is a small white plastic or enamel dish in to which specimens can be trapped. To examine and to select the smaller ones.
6. **Alcohol/formalin-** chemicals to preserve specimen.
7. **Killing jar-** container to collect insects

Procedure:

1. Collect different aquatic animals using collecting equipments.
2. Keep the collected animals in the killing jar containing alcohol/ formalin and bring them in to biology laboratory.
3. After the animal dies transfer to another bottle.
4. Identifying the animals

Questions:

1. List at least three aquatic invertebrate net.
2. List the aquatic invertebrates collected from nearby water.
3. How do you distinguish one animal from the other?

Activity 23.3: Method of preservation of collated specimen.

Introduction: preservation is the methods of keeping specimen for long period of time without spoiling. Preserved insect specimens will last indefinitely. There are avaricious ways of preservation. The proper method is

based on the type of insects to be preserved most are mounted dry on pin. Many small specimens are best glued to small cardboard points mounted on pins some are preserved in alcohol

❖ **Mounting Insects:**

1. Carding
2. Pinning
3. The use of formalin and alcohol

- **Formalin** - 4% solution of formaldehyde used to preserve animals (soft bodied species)

- **Alcohol (Ethanol)** - 70% alcohol is used as killing and preserving agent.

Preserved animals in alcohol

Materials required:

- Insect net,
- Alcohol/ Formalin
- Glass sided jar
- Pin
- Hard card board

Procedure:

1. Make a field trip, collect and bring small insects to laboratory.
2. Stretch and pin the small flying insects on thick hard board
3. Keep in alcohol, formalin or other solutions.
4. Write the name of the collected animal, where and when it is collected and the name of the collector on a paper slip and stamp on the specimen.

Question:

In your group discuss the significance of preserving animals and write a report.

Activity 24: Collecting Plant Specimens.

Objective:

- To collect different plant specimen from your school compound.
- To keep the specimen in school laboratory using pressing.

Introduction: Plants are collected from the field for different purpose: identification, classification and as permanent specimen. Usually fresh specimen is collected. During collection of plant specimen, you should try to obtain all parts: leaves, stems, roots, flower and fruits. During collection it is also necessary to make notes on growth habits, morphological feature of each plant and habitat. Collected plant specimen should be pressed, dried, and mounted as soon as possible.

Materials required:

- Diggers
- Scissors
- Hard board
- News paper
- Collecting bag
- Wooden frame and ropes

Procedure:

1. Uproot plants using digger and remove the soil & wash with water.
2. Cover the plant specimen with news letter, and place between two hard boards before it wilts until it become dry.
3. Place the plant specimen between the two wooden frames and then tied with rope.
4. Change the news paper if the previous one is wet. Keep the specimen for 2-3 weeks
5. Press the dried specimen using weighted material and keep in a herbarium.
6. Write the name of the plant, collection date, and place of collection and person who collected on paper slip.
7. Stick the slip on the specimen.

Questions:

1. What materials did you used to collect the specimen?
2. List the materials which were used for pressing?
3. What information should be written on the specimen pressed?
4. In your group discuss the information that should be written on the specimen pressed and significance of preserving plants.

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