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GENERAL BIOLOGY PRACTICAL II

(BIO 108)

LABORATORY MANUAL

PREFACE

Welcome to the General Biology Practical II.

This manual has been carefully prepared to serve as your indispensable companion throughout this exciting journey into the world of biology experimentation. Whether you are a budding biologist or just beginning your scientific exploration, this practical manual is designed to help you gain hands-on experience and a deeper understanding of fundamental biological concepts. General Biology Practical II is an integral part of your biology curriculum. In this course, you will have the opportunity to apply the theoretical knowledge you've gained in lectures to real-life laboratory situations. You will explore the principles of biology, conduct experiments, make observations, and draw conclusions - al while enhancing your critical thinking and problem-solving skills.

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HOW TO WRITE A PRACTICAL/LABORATORY REPORT

Science students are often required to prepare a formal report about an experiment or investigation undertaken in the practical component of a course. The ability to report technical information clearly and concisely is fundamental to the sciences. Therefore, students must produce practical reports that clearly communicate the aims, methods, findings and conclusions of an experiment. This Learning Guide shows you how to prepare a practical report and provides tips for ensuring a good grade.

Practical Report Structure

Practical reports have a clear, linear structure. Table 1, below, shows the different sections of a practical report and states the function of each section.

Table 1: Practical report sections and section functions

Section	**Function**
Title	Clearly and concisely informs the reader of the practical reporttopic
Introduction	Provides background information needed for the reader to understand the context and purpose of the experiment. At the endof the introduction the aim is clearly stated.
Materials and Methods	Describes what you did in the experiment and includes materials used and procedures followed
Results	Presents findings of the experiment
Discussion	Interprets and explains the findings
Conclusion	Summarises findings and interpretations
References	Presents the sources of information used in the report
Appendix/Appendices	Provides detailed information (when necessary)

Introduction

The introduction must give the reader background information about the topic of the practical report. This should include a summary of what is already known about the topic and state why the topic is important. Therefore, the introduction will need to include references. Importantly, the introduction should finish with a clear statement of the aim of the experiment. Structure your introduction to answer the following three questions:

1. What is known about this topic?

2. Why was the experiment performed?

3. What was the aim of the experiment?

Materials and Methods

The materials and methods section should provide the reader with sufficient information to replicate the experiment. Use past tense because you are providing a description of what you did. The materials and methods section should answer two questions:

1. What materials were used?

2. What methods were used?

The structure of the materials and methods section follows what you did when you performed the experiment. Tell the reader what materials and methods you used at each step of the experiment. If you have been told to refer to the Practical Manual for the materials and methods section, be sure to provide page numbers for the relevant experiment and include the Practical Manual as a reference.

Results

The results section is where you present the data obtained in your experiment in a logical order. You must write a short summary of the results. You may need to present the results using tables or figures (eg. graph or photograph). The tables and figures in the results section must be referred

to using text BEFORE the table or figure is presented. Do this by clearly stating the result, referring to the figure or table below and then move on to the next result which you will clearly state and refer to the table or figure below. For tables, the title belongs above the table and for figures the title belongs below. Do not replicate how you present the data. If data is in a table, the same data must not also be presented in a graph. Ensure all tables and figures are labelled and include a legend to explain symbols or abbreviations. Note that the results section does **not** include interpretation or discussion of results.

Discussion

The main purpose of the discussion section is to relate the findings of your experiment to existing theory and knowledge. Therefore, the discussion section will need to include references. The discussion section should cover the following points, but note that for some experiments not all of these points will be relevant:

- Relate results back to the aim
- Compare and contrast results to findings of other research
- Provide an explanation of why the experiment produced those results
- Identify problems in experimental technique or design and suggest improvement
- State the significance of your results and suggest areas for future research

In the discussion, do not simply restate the results. You must interpret the data. For example, what trends are evident in the data? What is the implication of your results? Do your results allow you to accept or reject your hypothesis, or fulfil the aim of the experiment? Think carefully about how you structure the discussion so you achieve logical flow from one topic to the next.

Conclusion

The conclusion summarises the experiment and interpretation of results. The conclusion should be concise and brief. In some cases the conclusion may be incorporated at the end of the discussion. Importantly, the conclusion does **not** introduce new information.

References

It is standard academic practice to provide the details of information sources used in preparing your reports. References are required both in text and in a list at the end of your report. In text references are required in the introduction and discussion sections, and possibly in the methods

section as well. Do not include information sources that you read but did not use in the report in the reference list, just the sources you actually cite (or mention) in the report. The reference list must be presented in alphabetical order by first author. Do not dot point or number the reference list. Make sure that you use the referencing style recommended by your lecturer and follow the style consistently. There is a Learning Guide about referencing that provides more information on this important topic.

Appendices

Appendices can be used to present detailed information that is not critical to the content of your report, such as calculations or raw data.

Tips for Getting the Best Possible Grade

There are a number of important strategies you can use to get a good grade for your practical report. Perhaps the most important advice is to **carefully follow any instructions** provided by your lecturer or described in the Practical Manual. When no specific instructions are provided **check the rubric** to determine what the marker is looking for. Remember that the marker has to follow the rubric, so if you leave something out that has been allocated marks on the rubric that will impact on your grade. Other important strategies for getting a good grade are:

- Use sub-headings
- Make it easy for the marker to give you the marks, for example, make sure that your aim is not 'buried' in text.
- Use italics and correct binomial nomenclature for scientific names, eg. *Macropus rufus* and thereafter *M. rufus.* Common names are in lower case and do not require italics.

Scientific writing is clear, concise, objective and accurate, not vague and ambiguous.

- Avoid using direct quotes.
- Do not use contracted words, eg. use ill not rather than won't.
- Write in complete sentences.
- Avoid the use of personal pronouns, eg. I or we.
- Use past tense and make sure you are consistent.
- When beginning a new sentence with a number, write the number in words, eg. Eighteen mice were used in this experiment.

- Give yourself plenty of time to prepare the practical report.
- Make sure you submit on time.
- Be prepared to work on your writing. Editing your work is very important.
- Show your practical report to a friend or relative. Can they understand it?
- Are acronyms introduced correctly? eg. The World Health Organisation (WHO) states that….
- Check sentence structure.
- Is the meaning of every sentence clear?
- Use correct paragraph structure and ONE topic per paragraph:

Topic sentence: Acts like a mini-subheading, clearly introducing the topic of the paragraph.

Body sentences: Provide evidence and explanation about the topic.

Concluding sentence: Concludes the topic and links to the next paragraph.

- Most importantly, carefully follow instructions provided in your course or discipline, or by your lecturer/practical demonstrator.

PRACTICAL 1

Title: Protozoa

Aim: To identify protozoan's from pond water

Materials: Pond water, glass slide, cover slip, dropper, microscope

Introduction:

Protozoa are single celled organisms living independently or in colonies of similar cells. They are mostly microscopic, and unicellular. They are found in aquatic/liquid environment. They can be found in streams, pond, moist soil and ocean. While others live as parasites on plants or animals. Protozoans are important for several reasons. First, it is widely believed that multicellular organisms evolved from them. Second, they provide excellent materials for the study of general principles of biology at a cellular level. Thirdly, some are important parasites of man and his domestic animals. In this respect, protozoa have assumed a prominent place in our health and economy.

Examples include: *Amoeba proteus, Euglena viridis, and Paramecium caudatum* e.t.c. Because of their small size, special techniques have to be employed in studying them. These include microscopic examination of vitally stained specimens.

Techniques for studying protozoan

Slowing down: Many flagellate and ciliate have to be slowed down in order as to observe them indetail. This can be done either by rendering their medium viscous or by anaesthetizing them witheither

A) 10% methyl cellulose

b) 2% sodium carboxyme cellulose

Method:

(1) Place a drop of pond water provided on a clean glass slide using a dropper.

(2) Cover with a cover slip making sure not to trap in air

(3) Observe your preparation under the microscope using low power objective lens first, then high power objective

(4) Look for at least 5 protozoan's and identify

(5) Draw a well labeled diagram of the protozoan's observed.

Questions

(1) Mention five characteristics of each of the protozoa seen

(2) Classify each organism from kingdom to species

PRACTICAL 2

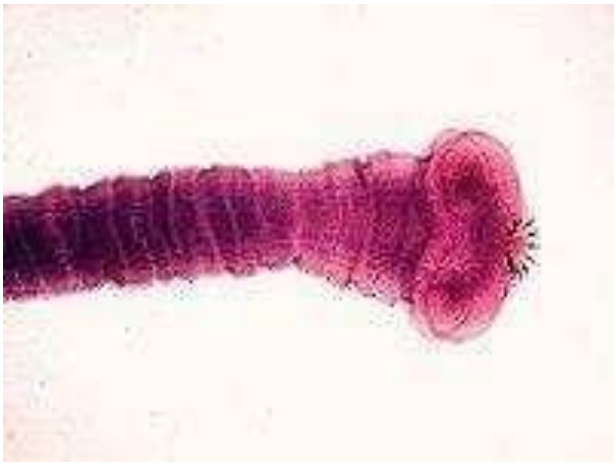
Title: Invertebrates: Platyhelminthes, Nematoda and Annelida

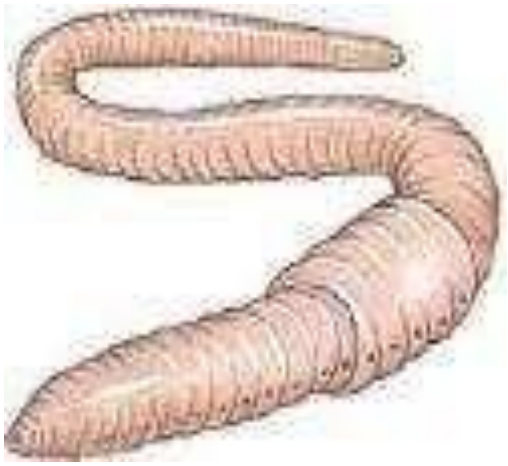
Aim: To study and identify some invertebrate animals

Materials: Preserved specimens of tape worm, liver fluke, round worm, earthworm, leeches, dissecting tray, forceps, Petri dish, hand lens/table lens

Introduction:

Invertebrates are animals without backbone. This is a very large group that includes several animals. The liver fluke and tape worm are flat worm that are none segmented. They are parasitic on or in the bodies of larger animals. The roundworms are also parasitic and non-segmented but cylindrical in shape tapering at both end with two openings – mouth and anus. Unlike the flatworms, the roundworms do not possess suckers or hooks but have lips that guard the mouth. The earthworm and leeches are also elongated and cylindrical but are true segmented worm with body covered by thin cuticle with setae. Some are parasitic while others are free living. They have well defined head region.





Method:

1. You are provided with specimens labeled A – F
2. Place each specimen given with the forceps in a dissecting tray/ Petri dish
3. Observe their structures under the hand lens/table lens both anterior and posterior portions
4. Make a large labeled diagrams of the specimens

Questions

1. Distinguish the differences noted on each specimen.
2. What are their adaptive features if any?
3. Classify each specimen to species level.
4. Write the local name of each of the specimen provided.
5. How many openings does a liver fluke has?

PRACTICAL 3

Title: Invertebrates: Arthropoda and Mollusca

Aim: To study and identify some invertebrate animals

Materials: Preserved specimens of land snail, periwinkle, crayfish, spider, cockroach, centipede, millipede, Petri dish/ dissecting tray, hand lens/table lens

Introduction:

The arthropods are animals that can be found almost in every environment. They are metamerically segmented with paired jointed appendages on each metamere. Presence of a skeletal covering that is composed of chitin that forms the exoskeleton. The mollusc are soft bodied animals and un-segmented. There may be presence of exoskeleton to the outside or the inside of the animals. Members exhibit a phenomenon known as TORSION and COILING. They are second to arthropod in terms of number and diversity ranging from minute snails of about ½ mm to giant squid.



Collection of some invertebrates

Method:

1. You are provided with specimens labeled A – J
2. Place each specimen given with the forceps in a dissecting tray/ Petri dish depending on its size
3. Observe their structures under the hand lens/table lens
4. Make a large labeled diagram of the dorsal view of each of the specimen

Questions

1. Distinguish the differences noted on each specimen

2. What are their adaptive features

3. Classify each specimen to species level

4. Write the local name of each of the specimen provided

5. Indicate the type of mouth parts possess by each of the specimen

PRACTICAL 4

Title: Collection and Identification of common invertebrates and vertebrates from our Environment

Aim: To collect and identify common invertebrates and vertebrates from our environment

Materials: Specimen bottles, sweep net, killing chamber, cotton wool, chloroform, ethyl acetate, cyanide bottle, Petri dishes, watch glass, hand lens, dichotomous key for Identification of animals.

Introduction:

There are several methods available for collecting animal specimen. The method chosen may depend on such factors as convenience, the type of animal to be collected, the type of equipment available etc. Whichever method is used, care should be taken in the handling of the specimens especially the delicate and smaller specimens.

Some methods of collecting invertebrates include:

Nets: This is used for collecting active flying insects such as odonata, orthoptera and Lepidoptera.

Sweep net: are used to collect different types of insects from vegetation. Traps can be set for larger vertebrates while some can be handpicked.

Method:

Take a field trip to a nearby abandoned farmland or any field around. Using the various containers and equipments available, collect as many as possible the various animals that you can see around. Go back to the laboratory and sort them out. In the laboratory, the animals sorted are killed appropriately. There are several chemicals in used for killing animals which will subsequently be preserved and stored for future studies .The most commonly used device for invertebrates killing is the cyanide bottle. This is a wide-mouth jar containing cyanide (potassium cyanide, and saw dust covered with a layer of plaster of Paris). The jar must have a tightly fitting stopper and cyanide is released slowly through the top layer of plaster of Paris and kills all animals placed in the jar. Alternatively, plaster of Paris can line the bottom of the jar on to which other poisons such as

chloroform, ethyl acetate e.t.c. can be poured. The layer of plaster of Paris prevents wetting the animals placed in the jar. Killing chambers using cotton wool soaked with chloroform or ethyl acetate are also used. After killing the animals, sort them out into invertebrates and vertebrates. Using the dichotomous key, try to identify the animals as much as possible starting from the kingdom animalia down to the species level.

In the dichotomous key, you have a series of questions and each question is a choice between two characteristics. The identity of an organism is determined through the process of elimination of characteristics that do not apply to it. The characteristics keeps on increasing until you reach the name of the animal i.e. species level.

Questions

1. Identify all the animals collected using the dichotomous key from kingdom to species level.
2. Draw and label at least 10 specimens from your collections.
3. Write the local names of 10 animals collected.

PRACTICAL 5

Title: Ubiquity of Bacteria

Aim: To show that bacteria is everywhere.

Materials: four nutrient agar plates; permanent marker; 1 vial of sterile water; 16 sterile swabs.

Introduction: Bacteria, the tiny microorganisms that inhabit virtually every corner of our planet, are ubiquitous in nature. Despite their microscopic size, bacteria play a monumental role in shaping the world we live in, influencing everything from our health to the health of entire ecosystems. From the deepest oceans to the highest mountain peaks, and from the most extreme environments to the most mundane settings, bacteria thrive in astonishing diversity and abundance.

Procedure

Label the Plates

- Obtain the nutrient agar plates. With the marker, divide each plate into quadrants. (DO NOT WRITE ON THE LID – ONLY WRITE ON THE BASE!).
- Label all four plates with your name.
- Label one plate with one of the four areas below:
    - Inside Room;
    - Outside the Room;
    - Personal Possessions;
    - Areas of the Body.
- Label each quadrant sequentially.
- Decide on the four locations within each area that you wish to test (it is completely up to you!). Note those locations on your datasheet.

Obtain the Specimens

1. In order to transfer bacteria from one surface to another, it helps if they are moistened. Take a sterile swab and quickly dip it into the sterile water. Be careful not to contaminate the water by keeping the lid open too long.
2. Immediately swab the area to be tested. To do this, roll the moist swab across the area, being sure to touch an area of at least $1cm^2$.
3. Carefully open the nutrient agar plate, positioning the lid so that air contamination will not impact the results. Roll the swab across the surface of the agar in the same manner you used to pick up the bacteria. This will transfer the bacteria onto the agar in an exact replica of the way they were on the tested surface.
4. Immediately close the lid of the petri dish.
5. Discard the swab into the regular trash.
6. The sterile water should continue to be sterile and can be used for the entirety of this experiment.

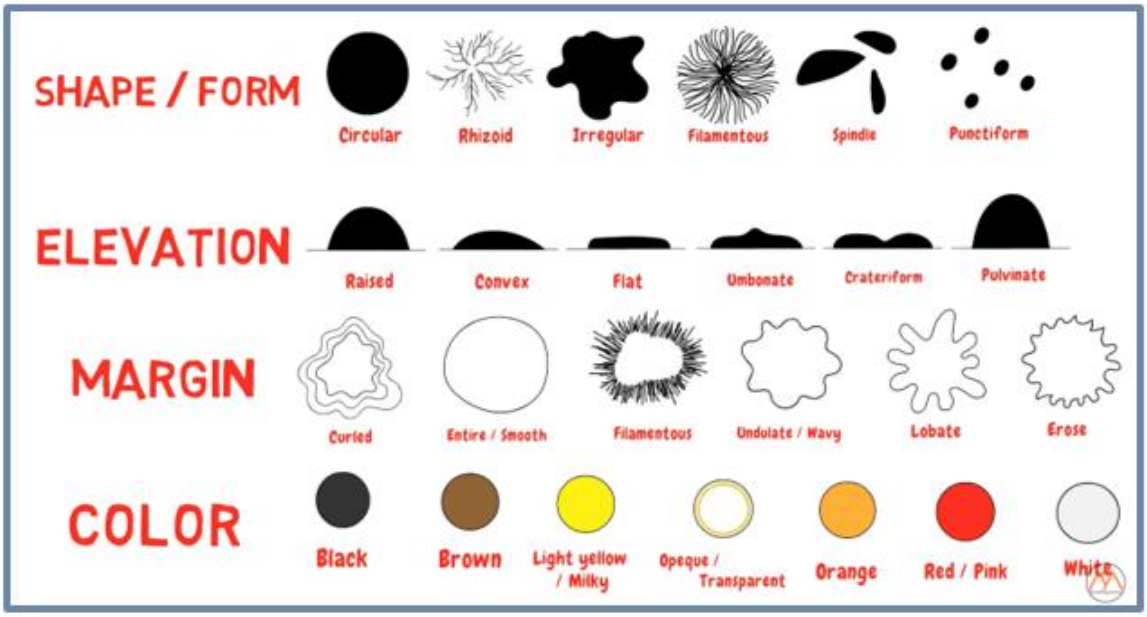
Incubate the Bacteria

1. When all four quadrants on all four plates are complete, turn all four petri dishes upside down and tape them together with masking tape. Label the masking tape with your name.
2. Place the stack of plates into an incubator set at 22℃. Be sure the plates are upside-down in the incubator.
3. Allow plates to incubate for at least 1 week.

Results

1. Remove the plates from the incubator and observe and count the number of bacteria on each surface. Record these numbers in the data tables.
2. Observe each tested location and choose a colony at random. Sketch this colony and use the colony descriptors below to describe the colony. Record this data in the data tables.

Colony Descriptors



1. Which location had the highest number of bacteria at each location? Highlight the one that is highest overall.
2. Imagine you did this test and one of the locations did not have any microbial growth. Do you think it is truly sterile? Why or why not?
3. You were instructed not to count any colonies that developed outside of the area where the swab touched the agar. What does it mean if you noticed microbial growth on an area of the petri dish where you are sure the swab did not touch?
4. Remember that bacteria need access to food and water. It has been said that there are more bacteria in and on the human body than there are people on Earth! Thinking about the areas that you tested, did you notice a pattern of bacteria being more abundant on the body or things that are touched? Name your location with the least amount of bacteria and your location with the highest amount of bacteria and suggest a reason for the differing amounts.
5. A common misconception is that bacteria are all the same. Based on what you sketched, how would you describe bacterial colonies?

PRACTICAL 6

Title: Non flowering plants

Aim: To study non-flowering plants using mosses as an example

Materials: Mosses, hand lens, glass slide, microscope, watch glass

Introduction:

Mosses are non – flowering plants. They belong to the group Bryophyta. They are commonly seen in forests and wood lands, growing on the trunk of trees. You can also see them on the walls of old drains, old building and other brick work especially if these have been damp for a long time. A common species seen in Nigeria is funaria spp. The familiar structure usually seen is the sporophyte.

Method:

1. Walk around the school premises; locate an old building where the place has been damp for a long time. Look for the moss plant and collect some carefully from the wall.
2. Take it back to the laboratory
3. Examine the mosses collected using hand lens
4. Note the short stalk anchored by a number of root – like structures called RHIZOIDS and surrounded by a tuft of leaf – like structure
5. From the middle of this tuft, in some of the gametophytes, you may see some slender structures growing out. These are the Sporophyte
6. Make diagrams of the gametophytes one bearing a sporophyte and another not bearing a sporophyte.
7. Detach one Sporophyte and examine it more closely under low power magnification. Note the slender stalk called seta. At its tip, it has a pear shaped capsule with a lid (Operculum).
8. Make a labeled drawing of the sporophyte

Questions

1. Are mosses vascular or non-vascular plants. Give reasons for your answer
2. List three characteristics of Bryophytes
3. Classify the specimen to species level

PRACTICAL 7

Title: Non- flowering plants

Aim: To study non flowering plants using fern as an example

Materials: Fern (Dryopteris), glass slide, hand lens, microscope, watch glass, razor blade

Introduction:

Ferns are non-flowering vascular plants. They belong to the group Pteridophyta. Like the moss, the ferns grow very commonly in forest, farmlands, wood lands and sometimes from the ground. Unlike the moss however, the most familiar structure usually seen is the Sporophyte sometimes called the fern frond. The roots normally became well established and therefore are able to absorb water and food materials from the soil while the leaves and those aerial portions containing chlorophyll manufacture food by photosynthesis.




Method:

1. You are provided with a fern plant (Dryopteris)
2. Using the hand lens, observe the roots and the frond
3. Note the sori found on the underside of the frond
4. Identify, draw and label the structures observed

Questions

1. Classify the specimen provided
2. What are the functions of the sori found on the leaves?
3. What type of spares are produce in the fern plant?
4. How can you relate the structures to those of Bryophytes in terms of evolutionary trend?

PRACTICAL 8

Title: Flowering plants

Aim: To study the structure of flowering plants using pinus as an example (Gymnospermae)

Materials: A small portion (branch) of a pinus plant and hand lens

Introduction: Pinus is a flowering vascular plant that is terrestrial; it belongs to the group Gymnospermae. These are plants that show highest degree of internal tissue differentiation. The plant body is divided intoroot, stem and leaves. The reproductive parts are borne in strobili and are unisexual. The seed hasone integument and is naked.



Method:

(1) Make a large, clearly labeled diagram of the specimens provided.

(2) Note the two types of branches i.e. the dwarf and long branches, the two types of leaves (the scaly and foliage leaves)

(3) Observe the reproductive structures using hand lens

Questions: 1. How many foliage leaves are in a spur?

2. Of what taxonomic importance is the number of foliage leaves?

3. What is the shape of the leaves.

4. Classify the plant to species level

PRACTICAL 9

Title: Flowering plants

Aim: To study the structures of flowering plants using maize and mango plants as examples (*Angiospermae*)

Materials: Whole plant specimens belonging to the monocotyledons (maize) and Dicotyledons (mango) plants, hand lens

Introduction:

Maize and mango plants belong to the class Angiospermae. These are plants that possess true xylem. Have flowers with whorls of sterile and fertile parts that are usually hermaphrodite. The seed has two integuments enclosed in carpels/ovary which ripens to form true fruits.

Method:

(1) Make large, clearly labeled diagrams of the specimens provided i.e. monocotyledon – maize or any other example, Dicotyledons – mango or any other example

(2) Using the hand lens, observe the reproductive structures of both the monocotyledon and dicotyledon plants. Draw and label the reproductive parts

Questions

1. What are the differences between the two specimens in terms of root system, leaf venation, shape of leaves, stem structure and reproduction structures
2. What are the differences between them in terms of number of floral parts, nature of stigma, colour of petals?

PRACTICAL 10

Title: PLANT TISSUES

AIM: To study parenchyma, collenchyma and sclerenchyma tissues in plant.

INTRODUCTION: Flowering plants are structurally complex as they are made up of different parts like roots, stem, leaves, flowers, fruits, etc. Each part is in turn an assembly of different types of tissues. Each tissue type has specific structure and performs a particular function. Plant tissues are broadly classified into meristematic and permanent tissues. Permanent tissues may be simple such as parenchyma, collenchyma and sclerenchyma. Complex permanent tissues are xylem and phloem. The structural features of tissues like wall characteristics, cell size, lumen size, and cytoplasmic contents are different in different tissues.

MATERIALS: Tender stem of a herb, safranin stain solution, dilute glycerine, chart of transverse section of stem, compound microscope, razor blade, slide, cover slip, brush, petridish and a piece of blotting paper.

Method:

1. A tender stem of any of the herb is cut into bits of about 3cm length and placed in water.
2. A piece is hold between the thumb and forefinger in your left hand.
3. A wet blade across the stem is passed in quick motion so as to get thin, unbroken, circular cross section of the material.
4. The process is repeated to get about fifteen transverse sections of the material.
5. The section is transferred to a petridish containing water. A thin, transparent section is selected and with a brush transfers it to a drop of water taken on a slide. Three drops of dilute safranin stain solution is added to the section and leave it for about five minutes.
6. The excess stain is blotted. Three drops of dilute glycerine is added on the stained section. A cover slip is placed on it. It is then focused under the low power of microscope and observe the section.
7. The section is focused under high power and observed again. The observations are recorded.

PRACTICAL 11

Title: Leaf Stomata

Aim: To study the pattern and distribution of stomata in both the upper and lower leaf surfaces.

Materials:

- Leaves (live)
- Clear nail polish (Buy a few bottles from the dollar store- they will last you years)
- Microscopes and slides
- Clear cellophane tape

INTRODUCTION: Stomata are tiny openings that are located in the young shoots of plants and epidermis of the leaves. Underneath each leaf, in the epidermal tissue, there are small openings called stomata. Surrounding each stomata are guard cells that regulate the opening and closing of the stomata. The stomata allow carbon dioxide into the leaf for photosynthesis and release excess oxygen into the atmosphere as byproduct of photosynthesis. Water is also lost from the plant through the stomata, so the size and number of stomata vary according to the environment and other adaptations of the plant.

Stomata are distributed differently between dicots and monocots, between the top side and underside of leaves, between different plant species, etc. Mostly, stomata are found on surfaces of plants that flourish under greater availability of light, lesser carbon dioxide levels in the atmosphere and also in moist environments.

In a dicot leaf, in comparison with the upper surface, the lower surface has a higher distribution of stomata whereas in a monocot leaf, usually, the upper and the lower surfaces usually see an equal distribution of stomata.

Method:

1. Collect leaves of 3-5 plant species. Identify the species with a plant field guide or dichotomous key. Create your hypothesis as to which species will have the most stomata and why.
2. On the bottom of each leaf, paint a 1 inch square section of clear nail polish. Allow to dry.

3. Place clear tape over each section of nail polish and carefully remove from the leaf. This will give you an impression of the epidermis of the leaf.
4. Fix the tape to a microscope slide and label with the plant species.
5. Repeat for each species that you are testing.
6. With the microscope on the lowest setting, focus your slide to see the stomata.

Note: Since the slide is tape and not a wet mount, there will be air bubbles which will be ignored. Look for round mouth-like structures (see the image below).

Question

1. Report your observation.
2. Compare the number and relative sizes of the stomata of various leaf species.
3. Look at the stomata from each magnification available. Determine at which magnification the stomata are the most easily viewed. Write this setting down to use with each slide.
4. Draw the stomata and describe their general shape and size.
5. In a single field of view, count the number of stomata. Switch the field of view and count again. Do this a total of 3 times. Repeat the entire procedure for each species.
   (Be sure to use the same magnification setting each time you observe, draw, and count the stomata).
   Calculate the average number of stomata in the field of view and create a bar graph to display your results.

Assignment

1. Discuss the closing and opening of the stomata.
2. Compare your results to your hypothesis to draw a conclusion about the stomata and adaptations of the plants you studied.