Suggested time allotment: 4 to 5 hours

MODULE 2 PLANT and ANIMAL CELLS

Overview

All organisms, big or small consist of **cells**. Some organisms are single-celled, composed of only one cell. Others are multicellular, possessing many cells that work together to form an organism. The moss plant for example, may be made up of hundreds or thousands cells. Your body has billions of cells while very large animals like elephants have trillions.

Most cells are so small that they can only be seen using the **microscope**. It is a special equipment to make small objects like cells look bigger. One kind of microscope used to study cells is called a **light microscope**. Light microscopes use diffused or artificial light to illuminate the object to be observed. From the simplest to the most powerful and sophisticated microscopes, scientists were able to gather information about cells. What you will see and learn about cells later have been revealed by microscopes. If your school has microscope, your teacher will teach you how to use it through activities you will perform.

In this module you will study plant and animal cells, their parts and functions.

Are all cells the same?
If not, in what ways are they different?

Cell Parts

Use the illustrations that follow to learn about parts of plant and animal cells.

Activity 1
Comparing plant and animal cells

Objectives

After doing this activity, you should be able to:

1. identify parts of the cell;
2. describe plant and animal cells;
3. differentiate plant cells from animal cells;
4. construct a Venn Diagram to show parts that are common to both and parts that are only found in either plant or animal cells.

Materials Needed

- sheet of paper
- ballpen or pencil
- Illustrations in Figures 1 and 2

Procedure

1. Study closely Figures 1 and 2. These are diagrammatic presentations of plant and animal cells and their parts.

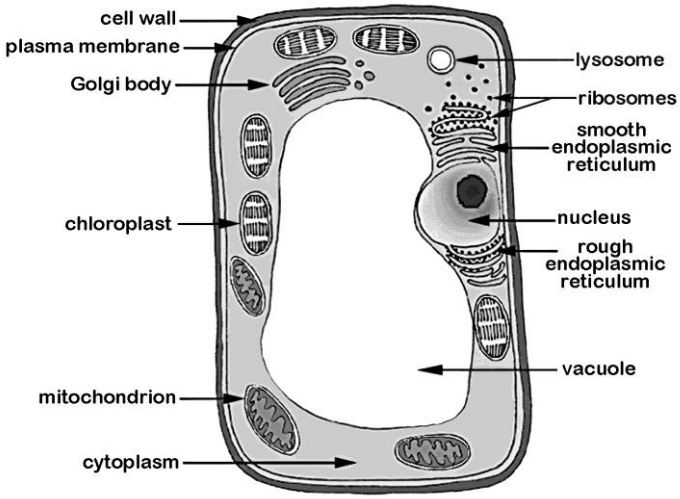

Figure 1. Parts of a plant cell

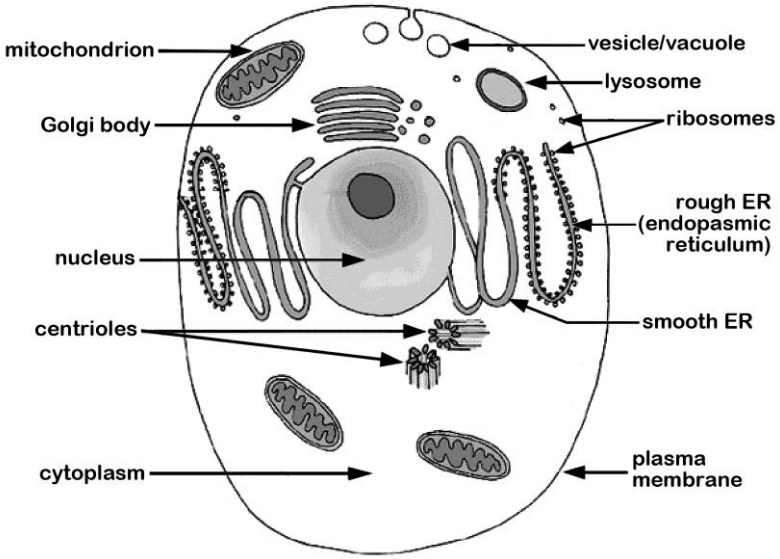

Figure 2. Parts of an animal cell

Q1. Compare the shape of a plant cell with that of an animal cell as shown in Figures 1 and 2.

Q2. Which cell parts are found in both cells?

Q3. Which are present only in animal cells?

Q4. Which are present only in plant cells?

A Venn Diagram shows relationships between and among sets or groups of objects that have something in common. It uses two circles that overlap with one another. The common things are found in the overlapping area, while the differences are in the non-overlapping areas.

2. Using the information you have gathered from Figures 1 and 2, construct a Venn diagram of plant and animal cells on a sheet of paper. Label the overlapping and non-overlapping areas.

3. Present and explain your Venn diagram to class.

Q5. Based on your observations and study of plant and animal cells, cite differences and similarities between them.

A cell has three basic parts: the nucleus, plasma membrane and cytoplasm. The **nucleus** is a part of cells which is easily seen. It is very important because it controls all the activities of the other parts that occur within the cell. The nucleus contains materials that play a role in heredity. You will discuss about these materials in the later modules and grade levels.

The **plasma membrane** encloses the cell and separates what is inside it from its environment. It also controls what goes into and out of the cell. The plasma membrane allows entry of materials needed by the cell and eliminates those which are not needed.

Q6. What do you think will happen to the cell if the plasma membrane does not function properly?

The **cytoplasm** consists of a jelly-like substance where all the other parts of the cell are located. It does not however, include the area where the nucleus is located. Many different activities of the cell occur in the cytoplasm.

You have seen that plant cells have **cell walls** and **chloroplasts** that are not found in animal cells. The cell wall is made of stiff material that forms the outermost part of plant cells. This gives shape and protection to them.

Recall in your elementary grades that plants make their own food. Chloroplasts are important in plant cells because it is where food is made. It contains chlorophyll which absorbs energy from the sun to make food for plants.

Q7. What is the purpose of the cell wall in plants?

Q8. Look at Fig. 1 again. Why are there several chloroplasts in the plant cell?

Vacuoles are present in both plant and animal cells. In plant cells, they are large and usually occupy more than half of the cell space. They play a role in storing nutrients and increasing cell size during growth. Some plant vacuoles contain poisonous substances. Vacuoles also store water, thereby maintaining rigidity to cells and provide support for plants to stand upright. Plant cell vacuoles are responsible for the crisp appearance of fresh vegetables.

Vacuoles in animal cells are small and are called **vesicles**. They serve as storage of water and food and also function in the excretion of waste materials.

Q9. How would vacuoles in plants serve as defense against animals that eat them?

You have observed that **centrioles** are only found in animal cells. These have a role in cell reproduction which you will take up in the higher grade levels.

You have been introduced to the basic parts of plant and animal cells. For functions of the mitochondrion, golgi body, endoplasmic reticulum (rough and smooth), lysosomes and ribosomes which are not discussed here, you will come to know about them in the other grade level modules.

If you have a microscope you can also study plant cells by doing the next activity. Read and do the activities in the section on "How to Use The Light Microscope" before performing Activity 2.

Activity 2

Investigating plant cells

Objectives

In this activity, you should be able to:

1. prepare a wet mount;
2. describe a plant cell observed under the light microscope;
3. stain plant cells;
4. identify observable parts of a plant cell;
5. draw onion cells as seen through the light microscope; and
6. explain the role of microscopes in cell study.

Materials Needed

dropper	tissue paper
cover slip	iodine solution
glass slide	light microscope
onion bulb scale	forceps or tweezers
scalpel or sharp blade	50-mL beaker with tap water

Procedure

1. Prepare the onion scale by following steps indicated in Figure 3. Use the transparent skin from the inner surface of the onion scale.

CAUTION: Be careful in using the scalpel or blade!

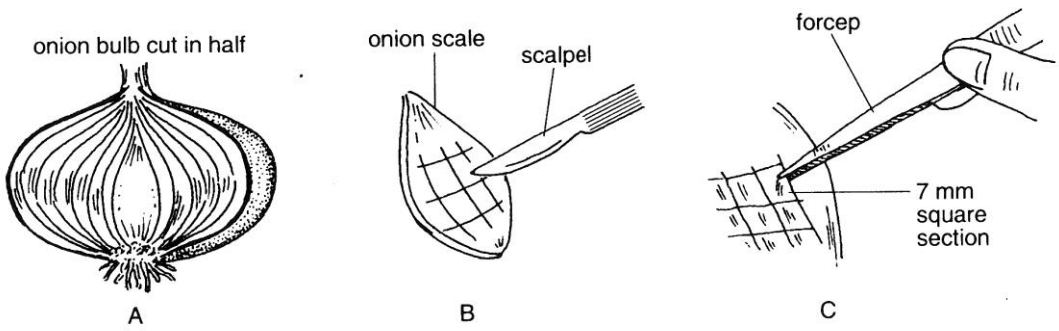

Figure 3. Preparing onion scale for microscopic study (Source: University of the Philippines. Institute for Science and Mathematics Education Development (2000). Sourcebook on practical work for teacher trainers: High School biology (vol. 2). Quezon City: Science and Mathematics Education Manpower Project (SMEMDP). p.164)

2. Following the procedure on how to make a wet mount described in "How to Use The Light Microscope", prepare one using the transparent onion skin from Step 1. Remember to place it on the glass slide with the inner surface (non-waxy side) facing up. Check too that the onion skin is not folded or wrinkled.

3. Examine the onion skin slide under the low power objective (LPO).

CAUTION: Do not tilt the microscope!

Q10. How much are these onion cells magnified?

Q11. In this case, why is it not good to tilt the microscope?

4. Shift to the high power objective (HPO).

REMEMBER: Raise the objectives a little and look to the side while changing objectives!

Q12. Describe the onion cells.

5. Remove the slide from the stage. You can now stain the onion cells with iodine solution.

IODINE STAINS!

Be careful not to spill it on your skin and clothing!

6. Using a dropper, place one or two drops of iodine solution along one edge of the cover slip. Place a piece of tissue paper on the other edge of the cover slip. The tissue paper will absorb the water, and iodine solution spreads out under the cover slip until the whole specimen is covered with stain (Figure 4).

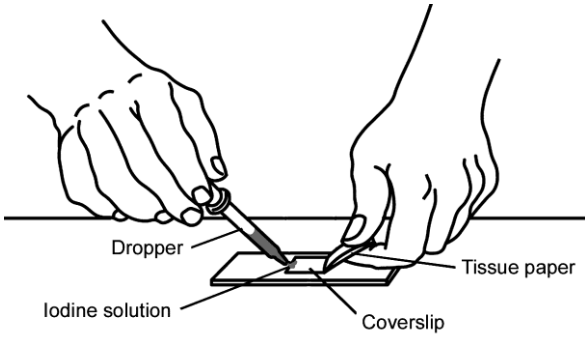

Figure 4. Staining onion cells (Source: Philippines. Department of Education. (2009). Science and Technology II. Textbook (Rev. ed.). Pasig City: Instructional Materials Development Corporation. p. 23.

7. Examine the stained onion cells under the LPO and HPO.

Q13. Did you observe any change in the image of onion cells before and after staining?

Q14. How did the iodine solution affect the image of the onion cells?

Q15. What parts of the onion cell can you identify?

8. Draw three to four onion cells as seen under the HPO. Label the parts you have identified. Indicate how much the cells are magnified.

Q16. Of what importance is the contribution of the microscope in the study of cells?

You have learned that the cell makes up all organisms. And that organisms can be made up of just one cell or billions of cells. The module also introduced you to the microscope which has contributed to the valuable information about cell structure and function.

You also found out about the fundamental parts of the cell which are the nucleus, plasma membrane and cytoplasm. These parts play very important roles in the survival of cells.

Specifically, Activity 1 showed you the similarities and differences in parts of plant and animal cells and the functions of these parts. Other than the three parts first mentioned, the mitochondrion, rough and smooth endoplasmic reticulum, Golgi body, vacuole/vesicle, ribosomes and lysosome are common to them. In fact, these are also present in fungi and protists which you will study in the next module. You have observed in the illustrations that plant cells have a cell wall, and chloroplasts which are not found in animal cells. These have something to do with the nature of plants having tough stems and their being able to produce their own food. On the other hand, animal cells have centrioles which are not found in plant cells. You have seen too the rectangular shape of plant cells as compared to the more or less rounded one in animal cells shown in the illustrations you have studied. You will know and see more of the other shapes of plant and animal cells in the next grade levels.

The second activity was a good opportunity for you to have observed real plant cells using the light microscope. The use of stains in studying cells has made cell parts more easy to find, observe and identify.

Suggested time allotment: 2 to 3 hours

HOW TO USE THE LIGHT MICROSCOPE

If your school has microscopes read this section and perform the following activities.

The microscope is a tool which can help you see tiny objects and living organisms. It makes them look bigger. This ability of the microscope is called its **magnifying power** or **magnification**. The microscope also has the capacity to distinguish small gaps between two separate points which humans cannot distinguish. It is called its **resolving power** or **resolution**.

The light microscope uses diffused light from the sun or artificial light to illuminate the object to be observed. From its source, visible light passes through the small or thin specimen to be observed through the glass lenses. As light passes through the lenses, it is bent so specimen appears bigger when it is projected to the eye. The form and structure of the specimen can then be seen because some of their parts reflect light.

This section will introduce you to the parts of the light microscope and their functions. More importantly, it will teach you how to use it properly for successful cell study and other investigations.

What are the parts of the microscope and how does each part function?

How do you use the microscope?

Objectives

After performing this activity, you should be able to:

1. handle the microscope properly;
2. identify the parts of the microscope;
3. describe what parts of the microscope can do;
4. prepare materials for microscope study;
5. focus the microscope properly;
6. compare the image of the object seen by the unaided eye and under the microscope; and

7. compute for the magnification of objects observed under the microscope.

Materials Needed

- lens paper
- light microscope
- tissue paper or old t-shirt
- newspaper page
- glass slide and cover slips
- pencil
- dropper
- scissors
- tap water
- forceps or tweezer

Procedure

A. The Microscope, Its Parts and their Functions

1. Get the microscope from its box or the cabinet. Do this by grasping the curved **arm** with one hand and supporting the **base** with the other hand.

2. Carry it to your table or working place. Remember to always use both hands when carrying the microscope.

3. Put the microscope down gently on the laboratory table with its arm facing you. Place it about 7 centimeters away from the edge of the table.

4. Wipe with tissue paper or old t-shirt the metal parts of the microscope.

Q1. What are the functions of the base and the arm of the microscope?

5. Figure 1 shows a light microscope that most schools have. Study and use this to locate different parts of the microscope.

6. Look for the **revolving nosepiece**. Note that **objectives** are attached it. You should know that there are lenses inside the objectives.

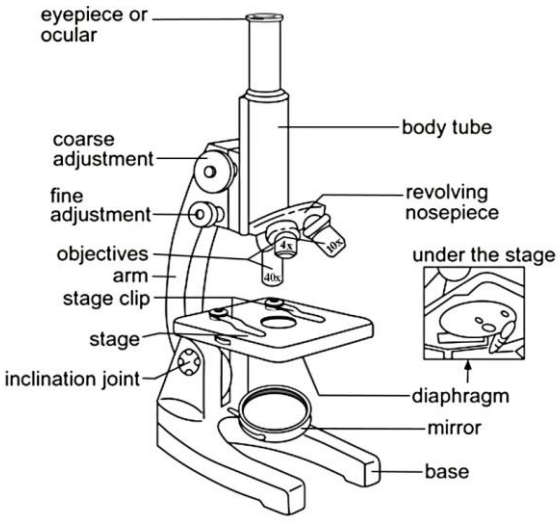

Figure 1. The light microscopes and its parts

Q2. What have you observed about the objectives?

Most schools have light microscopes with three objectives. Others have four. Usually, the shortest one marked 3x, 4x or 5x is called the **scanner**. The **low power objective** (LPO) is marked 10x or 12x while the **high power objective** (HPO) is marked 40x, 43x or 60x. The objectives magnify the object to be observed to a certain size as indicated by the 3x, 10x or 40x, etc. marks.

If the longest objective of your microscope is marked 97x or 100x or OIO or the word "oil" on it, then it has an **oil immersion objective** (OIO). This objective is used to view bacteria, very small protists and fungi. The OIO requires the use of a special oil such as quality cedarwood oil or cargille's immersion oil.

7. Find the **coarse adjustment**. Slowly turn it upwards, then downwards.

Q3. What is accomplished by turning the coarse adjustment upwards? downwards?

8. Looking from the side of the microscope, raise the **body tube**. Then, turn the revolving nosepiece in any direction until the LPO is back in position. You will know an objective is in position when it clicks. Note that the revolving nosepiece makes possible the changing from one objective to another.

Q4. What is the other function of the revolving nosepiece?

Q5. Which part connects the eyepiece to the revolving nosepiece with the objectives?

9. Locate the **eyepiece**. Notice also that it is marked with a number and an x. Know that the eyepiece further magnifies the image of the object that has been magnified by the objective. If the eyepiece is cloudy or dusty, wipe it gently with a piece of lens paper.

REMEMBER: Only use lens paper in cleaning the lenses of the eyepiece and the objectives.

10. Look through the eyepiece. Do you see anything?

11. Now, locate the **mirror**. Then, position the microscope towards diffused light from the windows or ceiling light. Look through the eyepiece and with the concave mirror (with depression) facing up, move it until you see a bright circle of light.

CAUTION:

Never use direct sunlight as a light source to view objects under the microscope. Direct sunlight can permanently damage the retina of the eye.

The bright circle of light is called the **field of view** of the microscope. Adjust the position of the mirror so that it is not glaring to the eyes. Practice viewing through the microscope using both eyes open. This will reduce eyestrain.

Q6. What are the two functions of the eyepiece?

Q7. Describe the function of the mirror.

12. Locate the **diaphragm**. While looking into the eyepiece, rotate the diaphragm to the next opening. Continue to do so until the original opening you used is back under the hole in the stage.

Q8. What do you notice as you change the diaphragm openings?

Q9. What can you infer as to the function of the diaphragm?

13. Find the **inclination joint**.

Q10. What parts of the microscope are being connected by the inclination joint?

14. Grasp the arm and slowly pull it towards you. Sit down and try looking through the eyepiece.

Q11. What does this movement do?

REMEMBER:

Tilting of the microscope allows one to do observations while seating down. This is however, only done when materials observed do not contain liquids like water.

B. Making a Wet Mount

A **specimen** is a part or sample of any material e.g. plant, animal, paper or mineral, for study or examination under the microscope. Specimens should be small and thin for light to pass through them.

15. Cut out a small letter "e" from a newspaper page. Using forceps or tweezers place it in the center of a glass slide in an upright position.

Q12. What makes the letter "e" suitable for observation under the microscope?

16. Add a drop of tap water over the specimen. It will act as a mounting medium and make clear the image of the specimen. Position the cover slip at 45° with one side touching one edge of the water on the slide (Figure 2).

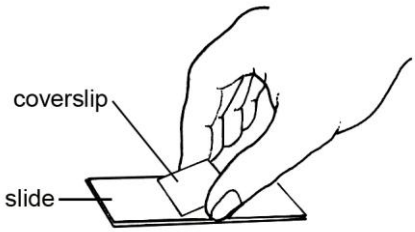

Figure 2. Making a wet mount

17. Slowly lower the other edge of the cover slip until it rests on the water and the printed letter. Bubbles are perfect circles you see on your preparation. Remove or minimize trapped bubbles by gently tapping the cover slip with the eraser-end of a pencil. Make the bubble move towards the edge of the cover slip.

C. Observing Specimens

18. Put the slide on the stage. Make sure that the letter is in the center of the hole in the stage and under the LPO. Hold it firmly with the stage clips.

19. Watching from the side, carefully lower the body tube until the end of the LPO almost touches the cover slip.

20. Look through the eyepiece. Slowly turn the coarse adjustment upwards to raise the objective until the letter "e" appears. Continue until you see the letter clearly. This would indicate that you have focused it already.

Q13. Describe the position of the letter as seen under the microscope.

Q14. Compare the image of the letter that you see using your unaided eye with what you see through the microscope.

21. Look through the microscope again. Slowly move the slide to the right, then to the left.

Q15. To which direction does the image move?

22. Move the slide to the center. To shift to the HPO, raise the body tube first. Looking from the side, turn the revolving nosepiece to put the HPO in place. Then, using the fine adjustment slowly lower the objective till it almost touches the cover slip. Looking through the eyepiece, turn the fine adjustment until you see the clearest image.

Q16. Why do you have to watch from the side when changing objectives?

Q17. Why should the fine adjustment knob be used only with the HPO?

Current microscope models are said to be **parfocal**. This means the image in clear focus under the low power objective, remains focused after shifting to HPO. If the microscope you are using is not parfocal, slightly turn the fine adjustment knob in either direction to get a clear picture.

23. Look through the eyepiece again. Then, shift to the LPO, and the scanner. Observe closely the image of the letter.

Q18. In which objective/s can you see the whole letter "e"?

Q19. What are the advantages of using the HPO? the disadvantages?

Q20. In which objective is the light darker? brighter?

D. Magnifying Power of the Light Microscope

Can you recall the functions of the objectives and the eyepiece?

The magnification of a specimen can be calculated by multiplying the number found in the eyepiece with the number found on the objective being used. So, if a specimen is viewed using a 10x objective and a 10x eyepiece it will be magnified 100 times.

24. Examine the numbers indicated on the eyepiece and scanner.

Q21. How much is the letter "e" you are now viewing under the scanner magnified? under the LPO? Under the HPO?

Q22. If a cell being observed has been magnified 200x under the HPO, what is the magnifying power of the eyepiece used?

Q23. In what ways would the microscope contribute to the study of different objects and organisms?

25. After using the microscope, lift the stage clips to remove the slide from the stage. Wash and wipe or air dry the slide and cover slip. Keep them in their proper places. Dispose trash or other materials properly.

You have just familiarized yourself with the light microscope, its parts and their functions. Similarly, you have practiced using it.

After every use of the microscope, prepare it for storage following these steps:

1. Turn the revolving nosepiece until the LPO is in place.

2. Lower down the body tube so that the end of the objective is approximately 1 cm above the stage.

3. Position the clips so that they do not extend beyond the sides of the stage.

4. Rotate the diaphragm until the smallest opening is in position.

5. Let the mirror stand on its edge with the concave side facing the user to protect it from dust.

6. Some microscope boxes have a socket for the eyepiece. In this case, remove the eyepiece from the body tube and place it in the socket.

7. Put back the microscope's plastic cover. If the original plastic cover has been lost or destroyed, use any clean plastic bag big enough to cover the microscope.

8. Carry the microscope as described in Step 1 of Procedure A. Put it back in its case or storage cabinet or return it to your teacher.

Knowledge about objects and organisms revealed by the microscope is of great value not only to students like you but also to everyone who wish to study and understand life. It is but important for you to know how to take care of this tool for an efficient and longer use. Here are some practices to achieve this:

1. Check the microscope before and after use. Report any missing or damaged part to your teacher.

2. Use a clean tissue paper or soft cloth like old t-shirt to clean the mechanical parts of the microscope.

3. Prevent liquids, especially acids and alcohol from spilling on any part of the microscope. Always use a cover slip in observing wet mounts.

4. Check for moisture (such as from condensation of human breath) in the eyepiece. This may happen due to prolonged observation of specimens. Wipe with lens paper.

5. Avoid tilting the microscope while observing wet mounts. Water might flow into the mechanical parts of the microscope causing them to rust. Select a chair with suitable height so that both forearms can be rested on the table during observation.

6. Never store the microscopes in a chemical laboratory or any place where there are corrosive fumes. Make sure there are silica get packs inside microscope boxes or storage cabinet to absorb moisture.

The microscope has become an important investigative tool in studying objects and organisms around you. Knowing its parts as well as proper manipulation and care will make your study of science effective, interesting and more meaningful.

Reading Materials/Links/Websites

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www.biologycorner.com/bio1/microscope.html