Biology
Investigations
With the SmartMicroScope

By SmartSchool Systems

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Welcome to the Biology Investigations with the SmartMicroScope

Preface

Dear Instructor,

This investigation manual was designed specifically for your ease of use. It is written in such a way to make it easy to implement in your classroom.

These investigations will engage today's tech-savvy students and challenge them with a hands-on approach to science. We are confident that your students will enjoy the wonder of EXPLORING science.

As an educator your feedback and input is of tremendous value. Please feel free to contact us with comments or suggestions.

Sincerely,

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Contents

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Exploring Cell Structure and Function

Information for the Teacher

Activities: Forming and testing hypotheses, preparing slides, using a microscope.

Overview: Students will explore the complementary nature of structure and function in cells and tissues. Students will examine specialized cells and tissues, from pre-prepared and self-prepared slides, collect qualitative and quantitative data, and organize it in charts, using illustrations and written descriptions. Students will make inferences from the data about how cell structure allows cells to perform functions necessary for organisms to live.

Level: Grades 9 - 11

Prerequisites: Students should be familiar with the use and care of a digital microscope and be able to prepare stained slides.

Equipment: (for each student or group)

- SmartMicroScope 500X digital microscope with gooseneck and standard stands[1]
- Computer with SmartMicroScope software
- Flash drives for extra memory (optional)
- Printer (optional)
- Compound microscope (optional)
- Microscope slides
- Microscope slide covers
- Prepared slides of plant and animal cells[2]
- Iodine solution
- Methylene blue solution
- Stains, various stains needed for the plants specimens you choose (optional)
- Onion, a whole plant with roots and leaves
- Plant specimens, elodea, coleus, etc. (optional)[3]
- Pipette or eyedropper
- Tongue depressor or toothpick
- Forceps or tweezers
- Scalpel
- Microtome
- Paper towel

[1] If the SmartMicroScope 200X is available, Students may want to use it in addition to the 500X because of its larger field of view.
[2] Include slides of mammal epithelial front and cross-section, and onion epithelial cross-sections, and onion root. Include other slides that can be used to compare similar structures in plants and animals.
[3] As time permits, have Students examine various plants and make additional slides.

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- Student worksheet
- Notebook and pencil

Demonstration materials (for the whole class)

Close-up photos of specialized cells of plants and animals. Students need to identify them as plant or animal cells, so include photos in which the chloroplasts, vacuole, cell wall, etc. are clearly visible.

Time: Two to three 45-minute class periods
Note: The cells on the self-prepared slides may not last overnight.

Objectives: In completing the activity, Students should:

1. Become familiar with the structure of various types of specialized cells through observation.
2. Understand that the structure of specialized cells makes function possible.
3. Understand that organisms need specialized cells and tissues to perform activities necessary for life.
4. Form hypotheses about the differences and similarities shared by plant and animal cells; test these hypotheses by direct observation and compare to established theories.
5. Form hypotheses about how the structure of certain cells makes function possible; compare these hypotheses to established theories.
6. Understand how specialized structures develop in organisms.

Standards: Texas Essential Knowledge and Skills for Science Subchapter C. High School §112.34, Biology, Scientific processes 2E: Plan and implement descriptive, comparative, and experimental investigations, including asking questions, formulating testable hypotheses, and selecting equipment and technology; Science Concepts 5B: Examine specialized cells, including roots, stems, and leaves of plants; and animal cells such as blood, muscle, and epithelium; 7E: Analyze and evaluate the relationship of natural selection to adaptation and to the development of diversity in and among species; 7F: Analyze and evaluate the effects of other evolutionary mechanisms, including genetic drift, gene flow, mutation, and recombination; and 7G: Analyze and evaluate scientific explanations concerning the complexity of the cell.

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5E Plan

Phase	Goal	Process	Evaluate
Engage	Engage the Students' attention through a competition about specialized cells. Students will form hypotheses about the differences and similarities shared by plant and animal cells.	Divide the class into groups. Show them close-up photos of specialized cells and have them try to guess whether the cell is from a plant or animal. Use some black-and-white photos so that students don't base their choices on color only. Have Students work alone or in groups. Students will form hypotheses about the differences and similarities shared by plant and animal cells base on their knowledge of plant and animal activities necessary for life.	Students should participate in the discussion and give reasonable explanations for their choices. Students should write their hypotheses in their notebooks. Students should state the bases for the hypotheses (the types of structures needed for plant and animal activities)
Explore	Students will observe some of the differences and similarities shared by plant and animal cells. Form hypotheses about how the structures of specialized cells make function possible.	Students will follow the procedure in the student handout: 1) Prepare slides of plant and animal cells. 2) Examine specialized cells and tissues of plants and animals. 3) Form hypotheses about how the structure of specialized cells helps makes function possible	As part of the lab write-up, each student should include: 1) Images and descriptions of the slides he or she prepared. 2) Images and descriptions of other specimens used in the investigation (pre-prepared slides, plant structures, etc.) These should include vocabulary words, such as *nucleus*, *cell wall*, etc. 3) A chart comparing plant and animal cells (based on the investigation). 4) An explanation of the results of the investigation, including whether or not the hypotheses where supported. 5) Hypotheses about how the structure of specialized cells helps make function possible. Ideas for experiments to test their hypotheses.

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Explain	Students will understand what scientists have discovered about: 1) The differences and similarities shared by plant and animal cells. 2) The structures and functions of some specialized cells. 3) How specialized structures develop.	Engage Students in a guided class discussion: Make two charts on the board: 1) Plants vs. animal cells 2) Structure vs. function Have Students help you fill it in during the discussion. Discuss how specialized cells and structures have developed.	Students should participate in the discussion and give reasonable explanations for their ideas. Students should copy the charts into their lab notebooks.
Expand	Students will explore the various sources for gathering information about the results of scientific research. Students will understand how the structure of one type of specialized cells helps make function possible and how scientists were able to verify this.	Discuss what sources should be used. Students will follow the procedure in the student handout to discover: 1) How the structure of specialized cells helps make function possible. 2) Research methods used. 3) What research still needs to be done. Students will summarize their results in a short report.	Students should answer the questions in the student handout. Students should provide evidence that the sources they used are reliable and that the results in them are based on scientific research.

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Exploring Cell Function and Structure

Student Handout

Background Information

All living things are made of cells that originated from parent cells. There are many different types of cells. Each has specific features that allow it to perform certain functions that help the organism work as a whole. While cells are specialized, they all have several basic features in common.

In this activity, you will look at plant and animal cells through a microscope and observe some of their features. You will describe what you observed and form hypotheses about the cells, their special features, and functions.

Remember to practice safe laboratory techniques, conserve resources, and properly dispose of or recycle materials.

Equipment

- SmartMicroScope 500X digital microscope with gooseneck and standard stands
- Computer with SmartMicroScope software
- Flash drives for extra memory (optional)
- Printer (optional)
- Microscope slides
- Microscope slide covers
- Prepared slides of plant and animal cells
- Iodine solution
- Methylene blue solution
- Stains, other stains as needed for the plant specimens (optional)
- Plant specimens (optional)
- Onion, whole plant
- Pipette or eyedropper
- Tongue depressor or toothpick
- Forceps or tweezers
- Scalpel
- Paper towels
- Student worksheet
- Notebook and pencil

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Preliminary Hypothesis and Preparation

1) Make a list some of the types of cells you have learned about in class. Divide your list into three categories: one for plants, one for animals, and one for both. Make a similar list for cell structures.

2) Before looking at the cells, form a hypothesis about the main differences and similarities shared by plant and animal cells based on your real-life experiences. Think about the differences between plants and animals. What are some of the daily activities they need to do to live? What types of cells do you think they need for these activities? What structures might these different cells have? Write down your hypotheses and include them in your write-up. Include illustrations as appropriate.

3) Examine the onion plant. Record images and written descriptions of the various structures and tissues. Use the magnification and your name as part of the filename when you save your images, for example, *Photo_1_J_Student_500X*.

Prepare the Slides

4) Preparation of the plant epithelium cell slides:

You will prepare two skin cell slides using cells from an onion. To collect the cells, hold an onion slice so that the inner surface faces you and snap it backwards. This should expose a thin, transparent skin of cells. Without wrinkling it, use the forceps to pull off a small piece of skin. Prepare two wet mounts, one unstained, using water as the mounting medium; and one stained, using iodine as the medium. The stain will make some of the parts of the cell stand out more clearly.

5) Preparation of the mammalian epithelium cell slides:

You will prepare two epithelium cell slides using skin cells from your own cheek. If possible, remove any food particles by swishing some water around in your mouth and then swallowing it. Gently scrape the inside of your cheek near your molars with a tongue depressor. Prepare two wet mounts, one unstained, using water as the mounting medium; and one stained, using Methylene blue solution (or iodine if Methylene is not available) as the medium. Be sure to mix the cells in the mounting solution with the tongue depressor before putting on the slide cover.

6) (optional) Prepare slides of other onion tissues, such as leaves, roots, etc.

7) (optional) Examine and prepare slides of the other plants specimen(s).

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Observation

8) Examine the cells with your microscope. Try adjusting the amount of light and contrast. Use the measuring feature and record the dimensions of the cells. Observe and record the overall structure as well as the different parts of each cell. Record what you see using written descriptions and illustrations or computer images. Use a chart to organize the information.

Identify the nucleus, cytoplasm, cell membrane, cell wall, vacuole, and various organelles. Tiny dots in the cytoplasm of the onion cell are oil droplets that give the onions their distinctive odor and make your eyes run. What organelle is abundant in your cheek cells? (Hint: Saliva in your mouth starts the chemical breaking down of the food you eat.) Are the cells eukaryotic or prokaryotic?

Be careful to distinguish the cheek cells from food particles; the cells look something like flagstones. They are transparent and can't be seen in bright light (so you may have to adjust the brightness). If stained, they will be a very light purple or blue. Any solid, dark-purple dots are probably food particles.

Record computer images of the slides you prepared and carefully label and save them for use in your report.

9) As you make your observations, start to form hypotheses about what the functions of the cells are and how their special features help them perform these functions.

10) Record the differences and similarities of the plant and animal cells on the chart.

Analysis

11) Did your observations confirm your hypotheses about the similarities and differences between plant and animal cells? Explain in detail why or why not. Revise your hypotheses based on your observations.

12) Form hypotheses about the functions of the cells and the special features that help them perform these functions. Base your hypotheses on your observations. Describe how your observations support your ideas. Use illustrations or computer images where appropriate. How could you test your hypotheses in another experiment or experiments?

Extension

13) Do some reading to find out what scientists have discovered about the structure and function of cells. (Your teacher will tell you which sources to use.) Be sure the findings are based on scientific research. What were some of the methods used to determine the functions of different cells? How can the purpose of the tiny parts of a cell be determined? How do the findings compare with your hypotheses? What research still needs to be done? As a future scientist, what research would you like to do to enhance our understanding of this topic?

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