An Introduction to Cells and the Microscope

Intended for Grade: Fourth

Subject: Science and Math

Description: This project illustrates the major differences between plant and animal cells by comparing onion and human cheek cells under a microscope.

Objective: The student will be able to illustrate the differences between animal and plant cells and identify the major parts of the microscope.

Mississippi Frameworks addressed:
• Science Framework 2a: Identify parts and basic functions of various body systems (circulatory, respiratory, digestive, skeletal and nervous systems).
• Math Framework 7c: Multiply whole numbers by one-digit multipliers, and divide by one-digit divisors, with and without remainders.

National Standards addressed:
• Content Standard C: Life Science
• Math Standard: Number and Operations

Materials:
• Microscopes
• Microscope slides
• Cover slips
• Methylene Blue Dye
• Toothpicks
• Red onion
Background:

Anton von Leeuwenhoek is considered to be the inventor of the microscope. He lived in the Netherlands from 1632-1723. With his new invention, he studied numerous articles and described what he witnessed in detailed letters. Robert Hooke built upon von Leeuwenhoek's studies and coined the term cell. Cells are the smallest functional unit of life. Some organisms are composed of one cell big (unicellular) while others, like humans, are made up of many cells (multicellular).

Cells vary greatly in size, shape, and function. In this lesson, plant and animal cells are compared. The cells of onion skin tend to be very rectangular and may even appear to look like a brick wall in their uniformity. The major reason for their shape is the cell wall. The cell wall is a rigid layer of cellulose that helps maintain the shape of a plant cell. Animal cells lack a cell wall, so they are less regular in shape. The human cheek cell will serve as the model of a typical animal cell.

The microscope most likely to be used in this lesson is a compound light microscope. The term compound is used because it uses two lenses in order to magnify the specimen. Because two lenses are used, the magnification of each lens must be multiplied together in order to determine the total magnification. For instance, if the first lens is 10x and the second lens is 4x, then the total magnification is 40x. This microscope uses light, either electricity or sun, in order to illuminate the object. Whenever moving a microscope, a student should place one hand on the arm and the other hand under the base. The diagram below highlights the major parts of the compound light microscope. After the diagram, an explanation of each part is provided.
Diagram:

Coarse Focus Adjustment Knob: Can be used with the lowest two powers of objectives, but never on the highest. Brings the object into relative focus.

Fine Focus Adjustment Knob: Can be used at any objective power. Sharpens view of specimen.

Arm: Supports microscope.

Clips: Holds slides in place.

Base: Supports microscope.

Eyepiece: The first lens of the compound light microscope. May have one eyepiece (monocular) or two eyepieces (binocular). Usually has a magnification of 10x.
**Body Tube:** Supports eyepiece.

**Nosepiece:** Rotates to allow for use of multiple objectives.

**Objectives:** The second lens. Usually have three magnifying options, 4x, 10x, and 40x (or 43x).

**Stage:** Holds slides.

**Iris (Diaphragm):** Controls the amount of light that hits the slide.

**Mirror/Light source:** Illuminates slide.

**Procedure:**

**Microscope use:**

1. Introduce the microscope and its parts.
2. Raise the coarse adjustment knob all the way up.
3. Line up the lowest objective with the body tube and make sure it clicks in place.
4. Once a slide is prepared, place it on the stage and clip it down. [Use preparation techniques described below or use prepared slides.]
5. Turn the microscope on or adjust the mirror to allow light to strike the slide.
6. Slowly lower the body tube with the coarse adjustment knob until the specimen is in focus.
7. Carefully move the slide on the stage if the specimen needs centering.
8. Use the fine adjustment knob if necessary to sharpen the image.
9. Adjust the iris to control the light; more light is not always better.
10. Switch to next highest objective.
11. Focus the specimen, first with the coarse if necessary and then the fine adjustment knobs.
12. Switch to the highest objective.
13. Only use the fine adjustment knob with this objective to decrease the risk of damaging the slide and the microscope.

**Cheek cell preparation**

1. Obtain a clean microscope slide and cover slip. Be sure to hold them by their edges to avoid getting fingerprints on the slide.
2. Place one drop of dye in the middle of the slide.
3. Scrape - do not poke - the inside of your cheek with the flat end of a toothpick.
4. Dip the toothpick in the dye and gently stir.
5. Dispose of the toothpick in a garbage or red biohazard bag.
6. Slowly lower a cover slip over the dye.
7. Observe the cheek cells using a microscope. They should have a blue tinge to them, especially the nucleus of the cell. Avoid the objects that have a dark black ring around them. These are not cells. They are air bubbles.
8. If the cells are too dark, place a drop of water outside the cover slip and a paper towel on the opposite side. The towel will draw the dye out and bring the water under the slip.
9. When the observation is complete, place the slide and cover slip into a bowl of dilute bleach solution.

**Onion cell preparation**

1. Remove the first thick layer of the onion.
2. Between this layer and the next layer there should be a thin membranous layer.
3. Cut pieces of this layer into approximate 1 cm by 1 cm squares.
4. Obtain a clean microscope slide and cover slip. Be sure to hold them by their edges to avoid fingerprints getting on the slide.
5. Place one drop of water in the middle of the slide.

6. Place the onion membrane in the drop of water. If necessary, add a second drop of water onto the skin.

7. Slowly lower a cover slip over the skin.

8. Observe the onion cells using a microscope.

9. When the observation is complete, place the slide and cover slip into the bowl of dilute bleach solution.

**Evaluation:**

The two attached handouts are the primary evaluation tools. The first worksheet can be used to ensure that the students were able to discover, draw, and understand what they observed under the microscope. The second handout tests to see if they can identify the parts of the microscope.

**Extended Activities:**

After each new system of the body is explored, have students use the microscope to compare the structure and function of the cells that help that system to work.

**Sources:**

http://inventors.about.com/library/inventors/blmicroscope.htm


Microscope drawing adapted from:  
http://www.enchantedlearning.com/devices/microscope/label/

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Animal and Plant Cells Worksheet

1. Prepare and stain a human cheek cell according to the provided directions. View the cheek cell under all three magnifications. Draw the relative size of the cheek cell, under the highest magnification, in the circle below and record the total magnification.

   Magnification: _____

2. Prepare a red onion cell slide. Draw what you see in the circle below. Record the magnification.

   Magnification: _____
3. How are the cheek and onion cell different? How are they the same?

Humans have three types of muscle cells, skeletal, smooth, and cardiac. Cardiac muscle cells are involuntary and are found in your heart. Smooth muscles move involuntarily and can be found in places like your bladder and digestive system. It is important that you cannot control these cells consciously; otherwise, you would have to think about your heart all the time and remind it to beat. Skeletal muscle cells are moved voluntarily, like when you move your arm and make a muscle. You are controlling your bicep. Using the prepared slides provided to you, draw the three types of muscles and record your magnification.

4. Skeletal muscle

![Circle diagram for skeletal muscle with magnification space](image-url)
5. Smooth muscle

Magnification: ______

6. Cardiac muscle

Magnification: ______

7. Do you have any hypotheses, educated guesses, about how you could tell from what you drew that smooth and cardiac muscles are involuntary and skeletal muscles are voluntary? What is similar and what is different about these cells?
The prepared onion root tip cell slide shows cells at various stages of division. If a cell could not divide, the organism could never grow. Four stages of division exist. See if you can find two of these stages and draw them below.

8. [Blank]
   Magnification: _____

9. [Blank]
   Magnification: _____
Microscope Parts

Directions: Label all of the parts of the diagram using the word bank below.

<table>
<thead>
<tr>
<th>Arm</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Mirror</td>
</tr>
<tr>
<td>Coarse focus adjustment</td>
<td>Nosepiece</td>
</tr>
<tr>
<td>Iris</td>
<td>Stage</td>
</tr>
<tr>
<td>Eyepiece</td>
<td>Clips</td>
</tr>
<tr>
<td>Fine focus adjustment</td>
<td>Body tube</td>
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</tbody>
</table>