SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Build Your Own Microscope **Grade 8 – Cells**

Lesson Plan

Assessment	Questioning, observation
Cross-curricular	Mathematics

Big Ideas

- Healthy cells contribute to healthy organisms.

Learning Goals

- Differentiate between a single lens microscope and a compound microscope.
- Understand the importance of microscopy to cell biology.
- Understand the history of microscope development.

Specific Expectations:

1.1 assess the role of selected technologies in enhancing our understanding of cells and cellular processes
2.1 follow established safety procedures for handling apparatus and materials and use microscopes correctly and safely
2.2 use a microscope correctly and safely to find and observe components of plant and animal cells and make accurate drawings of their observations
2.3 prepare dry- and wet-mount slides of a variety of objects for use with a microscope
2.5 use appropriate science and technology vocabulary, including organelle, diffusion, osmosis, cell theory, selective permeability, membrane, stage, and eyepiece, in oral and written communication
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes

Description:

In this lesson students will learn the importance of microscopy to cell biology as well as the history of microscope development and the difference between a single lens microscope and a compound microscope.

Materials/Resources:

Searching for Scale Handout
Microscopes Across Time Handout
Wet-mount Procedure Cards Worksheet
Book
2 dual magnifying glasses, each with one high-power and one low-power lens
Metric ruler
2 cardboard tubes from paper towels, or black construction paper
Tape

Safety Notes:

Introduction

Discussion:

Begin by asking the class, **"What is technology?"** Students can answer orally, write on the board, or use sticky notes for their answers. Ask questions like, "Why do you believe that?" or "How do you know that?" to get an idea of students' current knowledge of the subject.

Move on and ask students, **"What does technology do for us?"** It helps us solve problems, makes our lives easier, and extends our abilities to do things. Technology is used to develop skills or tools, both in our daily lives and in our occupations. Write on the board "Technology is a means of extending human senses."

Note: Students should have already had a discussion about cell size and scale. You can use the handout Searching for Scale (See Link) to give them an idea of the relative sizes of cells, bacteria, organelles and molecules. Also, the website http://learn.genetics.utah.edu/content/cells/scale/ has a nice visual.

Idea: Show the Gary Larson cartoon, "Early Microbiologists".

Ask students what technologies have increased our understanding of life systems. Do these technologies extend any human attributes? If they do, which attributes are extended? Some answers may focus on technologies that extend vision. Examples could include radar, eyeglasses, contact lenses, and telescopes. Students should also know that microscopes allow us to see objects that we cannot see with the naked eye.

Action

Students will design and build a compound microscope using two dual magnifying glasses (Dual: each with one high-power lens and one low-power lens), cardboard tubes or black construction paper and adhesive.

Student Instructions:

<u>Part 1 Research and Investigate:</u>

Work with a partner and examine words in a book with your naked eye. Use the high-power lens to examine the same words. Note the difference between what you saw.

Hold the high-power lens about 5-6cm above the words in the book. Note: the words could look blurry through the lens.

Keep the high-power lens 5-6cm above the book, and hold the low-power lens above the high-power lens. Move the low-power lens up and down until the image is in focus. What else do you notice about the image? (It is upside down). You might need to move the high-power lens up and down as well.

Once the image is in focus, experiment with raising and lowering both lenses to obtain the highest magnification while keeping the image in focus. When the image is in focus and at the position of

highest magnification, your partner will measure and record the distance between the book and the high-power lens. Your partner will also measure and record the distance between the two lenses.

Write a description comparing what you saw with the naked eye and what you saw with magnification. Is there any difference if you use both low-power lenses? Both high-power lenses? What happens if the high power lens is on top and the low power lens is on the bottom?

Part 2 Design and Build:
Based on what you learned in Part 1, work with your partner to design your own two-lens (compound) microscope. Your microscope should:
1) Include one high-power lens and one low-power lens attached to a tube or rolled up paper.
2) Allow one tube to fit inside the other tube so the distance between the lenses can be adjusted.
3) Focus to produce a clear, enlarged image of the object being observed.
4) Be made with the materials available to you.

Sketch your design. Show your design to your teacher. Construct your microscope.

Part 3 Evaluate and Redesign:
Test your microscope by examining words from a book. Then, look at other objects, make drawings of two different objects and record your observations. Were you able to meet the criteria in Part 2?

Look at microscopes made by other students. Is there a way you could improve on your design?

Part 4 Analyze and Conclude:
Observing: Compare the images you observed using one lens with the image using two lenses. How could you calculate the magnification of what you are seeing?

Evaluating Constraints: When you used two lenses how did moving the top lens up and down affect the image? What was the effect of moving the bottom lens up and down?

Building a Prototype: Describe how you built your microscope and explain why you built it that way.

Evaluating the Impact on Society: Describe some of the ways that microscopes have aided scientists in their work.

This lesson is adapted from the National Institutes of Health supplement Using Technology to Understand Cellular and Molecular Biology, and a technology lab called Design and Build a Microscope by Pearson Education.
https://science.education.nih.gov/supplements/nih4/technology/guide/nih_technology_curr-supp.pdf
http://www.scasd.org/cms/lib5/PA01000006/Centricity/Domain/817/BuildMicroscope.pdf

Note: Students can also make a microscope with their smartphone, a lens from a laser pointer, a bobby pin and tape.

Consolidation/Extension

Conclude with a brief history of microscopes. You could show Microscopes Across Time (See Link). Ask students to describe differences they see in the designs.

Ask students, "Why would you use light microscopy to confirm the presence of disease?"

Show video on Foldscope. Have students explain why it is such a powerful tool.
http://www.foldscope.com/
https://www.ted.com/talks/manu_prakash_a_50_cent_microscope_that_folds_like_origami?language=en

Further Extension:
Have students do the activity on Resolution found in Lesson 2, Activity 1 in the link below.
https://science.education.nih.gov/supplements/nih4/technology/guide/nih_technology_curr-supp.pdf

Have students prepare dry- and wet-mount slides. Students get jumbled up instructions with pictures and then put the instructions in the correct order. Once the instructions have been ordered, students will follow them to create dry- and wet-mount slides. Use the homemade microscopes or compound microscopes to observe the slides, and make drawings. Handout for wet-mount Procedure Cards provided (See Link).

Students can take pictures with their smartphones through the microscope. If you are using a digital camera, use the macro setting.