MESSING AROUND WITH MICROSCOPES

BENCHMARKS AND TASKS

SC.A.2.2.1 The student knows that materials may be made of parts too small to be seen without magnification**.**

SC.F.1.2.4 The student knows that similar cells form different kinds of structures.

- The student observes and studies minute details of objects using a variety of tools (hand lens, microscope).
- The student uses a microscope to see that living things are made mostly of cells.
- The student identifies the main parts of plant and animal cells.
- The student explains that all organisms are composed of cells - the fundamental unit of life. Specialized cells perform specialized functions in multi-cellular organisms. Important levels of organization for structure and function include cells, tissues, organs, organ systems, whole organisms, and ecosystems.

KEY QUESTION

What do magnified onion cells look like?

BACKGROUND INFORMATION

A simple microscope uses a single convex lens that provides a magnified view of an object. A hand lens is an example of a simple microscope. The magnifying power of a single lens is defined by the number of times an object viewed through the lens is magnified. If the lens is 3X, then the object viewed will appear to be three times larger than the actual object.

A compound microscope, like the Magiscope, uses two magnifying lenses – an objective lens placed near the object being viewed and an eyepiece lens placed near the eye of the viewer. The magnifying power of a compound microscope is found by multiplying the power of the objective lens times the power of the eyepiece lens. For example, if the objective lens is a 4X lens and the eyepiece lens is a 5X lens, then the magnification will be 20X. The object viewed will appear to be 20 times larger than the actual object.

Magnification not only makes objects look larger, but also reveals details that were invisible with the unaided eye. Color comic strips provide an excellent example of how perception changes, depending upon viewpoint. A magnifier reveals that some comic-strip colors are actually dots of other colors, printed side-by-side.

All living things are made up of smaller units called cells. Although cells vary in shape and size, most of them have a similar cellular structure. All cells have cell membranes, and plant cells also

have cell walls. The cell wall is a strong, rigid structure that protects the cell and gives structural support. Inside the cell wall is the cell membrane. It is so thin that it is difficult to observe. The cell membrane allows dissolved material to enter and leave the cell. Cytoplasm is the jelly-like substance that fills each cell. **Chemical changes** take place in that part of the cell. There is a darker, sac-like structure inside some cells. This nucleus, a dark, round structure, is the control center of the cell and controls all the processes that occur within the cell. Cells are organized into **tissues** and **organs.**

Most animal cells resemble plant cells in many ways. For example, both have a nucleus and a cell membrane. There are also important differences. Most plant cells have thick cell walls, while animal cells do not; animal cells do not contain chlorophyll, so they cannot make food by **photosynthesis** as plants do.

MATERIALS

Per pair or group

1 microscope
1 blank slide
1 white onion slice
1 cover slip
paper towels
2 toothpicks
1 pair of tweezers
water
1 dropper
small amount of diluted Methylene Blue solution in a dropper bottle
color comic strip with many different colors

Per student

1 hand lens
science journal
paper/pencil
1 metric ruler

Per class

collection of living and nonliving objects
collection of other colored print materials

TEACHING TIPS

1. Blot onions on a paper towel to reduce possible eye irritation.
2. Cut the onion so that each group can have one slice.
3. Cut the color comic strips apart so that you have several for each group.
4. Set up groups depending on the number of microscopes that are available. Ideally, students should work in pairs.
5. Wash materials and hands carefully after the activity!
6. Make a solution using half Methylene Blue and half water and pour a small amount into a drop bottle for each group.

ENGAGE

Ask students to draw a rectangle on their paper about 0.5 cm x 2 cm in size. Then have them try to write a secret message inside the rectangle that is so small that it cannot be read without a magnifier. Later students can exchange papers with a partner and try to read the secret message.

EXPLORE AND EXPLAIN (Part 1)

Introduce students to the microscope that they will be using. Talk about the various parts of the instrument and explain how the microscope is used to magnify objects. Reinforce the concept that lenses magnify. (See Background Information.) Show students how to correctly focus the microscope. Allow students to explore freely by viewing various objects.

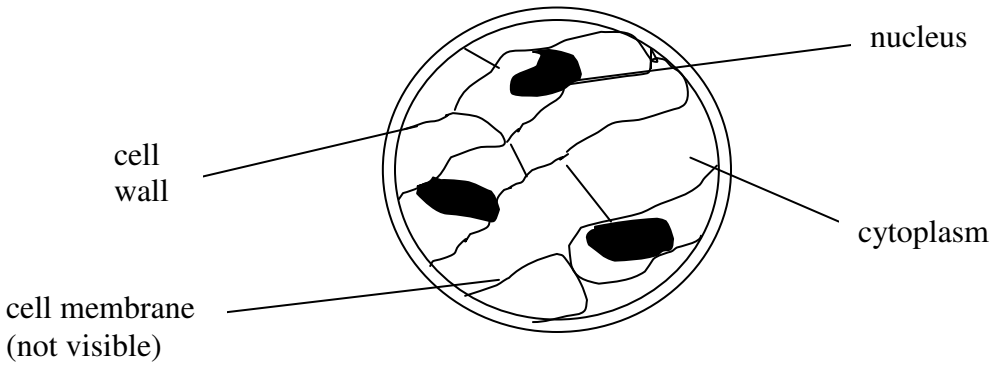
EXPLORE and EXPLAIN (Part 2)

1. Distribute some color comic strips to each pair.
2. Have students study the color comic strip using only the unaided eye. Encourage students to focus on the colors. Ask: *What colors do you see?* Have students record their observations in their science journals.
3. Next, have students study the same color comic strip with a magnifier. Have students record their observations in their science journals.
4. Students should then use the microscope to explore the color comic strip.
5. Ask: *Can you see any details that you couldn't see with the unaided eye or the hand lens? Do any colors look very different with the magnifier than without? What color dots and background dots did the printer use to make part of the comic appear pink? Purple? Orange? Green? Brown?* (Some colors in comic strips are made by printing other colors upon or near each other. Colors, such as pink and light blue, are often dots of red or blue printed on a white background. Orange is usually made of red and yellow; but because yellow is such a light color, it is often printed as a solid background with red dots on top of it. Because the yellow background makes the red dots more orange, students may say that the dots are red or orange. Very dark greens may look like solid colors because they are made of solid blue printed on top of solid yellow. Have students look for medium or lighter greens that appear to be made of green dots on a yellow background. Browns appear to be made of green and red or green and orange dots on a yellow background.)
6. Allow students to explore the class collection of other colored print materials (e.g., colored flyers, magazines, newspaper ads).
7. Emphasize that many things may be made of parts too small to be seen without magnification and that they will continue to explore this idea by using the microscope to study the parts of cells.

EXPLORE (Part 3)

1. Distribute materials.
2. Direct students to break the onion slice in two. Demonstrate how to use tweezers to carefully peel off a tiny piece of very thin skin found on the inside of the onion ring. This layer should be as thin as tissue paper.
3. Students should lay the onion skin flat in the center of the slide. Show students how to use a toothpick to smooth out the onion skin on the slide.
4. Ask students to observe the onion skin with the unaided eye and then with a hand lens.
5. Ask: *What do you see?* Have students record their observations by drawing and writing.
6. Have students place a small drop of water on the onion skin and then place a cover slip over it. They should press the cover slip down firmly with a paper towel to remove any air bubbles.

7. Demonstrate how to place the slide under the microscope. Have students place the slide under the microscope, adjust the microscope, and observe carefully.
8. Ask: *What do you see now? Can you see any details that were not visible before?* Have students record their observations by drawing and writing.
9. Have students lift the cover slip and stain the slide by using a toothpick to place one drop of Methylene Blue solution on the onion skin. (Note: If there is too much water and blue stain, lay a paper towel over the cover slip, gently press, and the towel will absorb the excess moisture.)
10. Ask students to predict what they think the stained onion skin will look like under the microscope.
11. Allow time for students to observe the stained onion skin and to record their observations by drawing and writing. (Remind students that they might need to readjust the microscope to see different aspects of the cell structure.)
12. Ask: *Do you see any cells?* (Explain that a cell is a division, the building block of all tissues.) *How many parts of a cell can you see through the microscope?* Draw a picture of a cell on the board and label the parts: cell wall, nucleus, cytoplasm, and cell membrane. Have students draw a plant cell in their journals and label it. Discuss the function of the various parts. (See Background Information.)



Parts of an Onion Cell

EXPLAIN (Part 3)

What was the shape of the onion cells? (rectangular)
How many sides does an onion cell seem to have? (four)
Why do you think the cells were all close together? (for strength and protection)
Is the onion skin composed of one cell or many cells? (many cells)
Why was it easier to see the cells after they were stained? (The stain created contrast between the light and dark structures.)
All plant cells have cell walls. What do you think the purpose of the cell wall is? (to provide strength and protection)
What is the control center of the cell called? (the nucleus)
Why do scientists use microscopes? (Many objects may be made of parts too small to be seen without magnification.)

EXTEND/APPLY

1. Have students exchange papers and use a magnifier to try to read the secret message they wrote earlier.
2. Place some objects, both living and nonliving (e.g., thin pieces of hair, thread, leaves, grass), on a table in the classroom. Invite students to use the microscope to study these living and nonliving things. They may not be that easy to distinguish; but in general, the cell structure of living things forms a more complex pattern under the microscope than that of nonliving things. Students should keep a record of their observations, listing the object viewed, whether it is living or nonliving, and noting such observations as whether or not it appears to be made of smaller units. (Note: Some objects were made by living things but are not themselves living [e.g., hair, fingernails]. Other things, such as sawdust and paper, were once living but have been processed so that the cell structure is no longer visible.)

EXTENSIONS

1. Have students make their fingerprints by making pencil smudges on a piece of paper, pressing each finger in the smudge, and then pressing the finger on a clean sheet of paper. Students can then use the hand lenses and microscopes to observe and classify their fingerprints.
2. Read about the scientist, Robert Hooke. He looked at a sliver of cork under his microscope and saw rows of "little empty boxes" that reminded him of rows of prison or monastery cells. He was the first to describe these structures, which he called "cells."