5th[t] Grade – Cells 1

Objective:

Students will learn about plant and animal cells by observing them under a microscope.

LS1.A: Structure and Function

- *All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)*
- *Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)*
- *In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)*

LS1.C: Organization for Matter and Energy Flow in Organisms

- *Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)*
- *Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)*

Docent Lab Guidelines:

1. Docent(s) should plan to arrive early to set up before the class arrives.
2. Input the day and time into the Science Lab Master Schedule. Please make sure you add 30 minutes of set up time and about 30 minutes of clean up time to the overall class time.
3. Safety glasses are not needed for this lab. But aprons should be worn to protect clothes from dye.
4. Give a brief 5 minute overview of the parts of microscope. You can also opt to play a short video on how to use a microscope. These are listed below.
5. There are two types of student microscopes. They are very basic microscopes. One uses a mirror to reflect light into the microscope for viewing. These microscopes are to be used with the small battery operated desk lamps. The

lamps are located in the box with the microscopes. The second type of microscope has a battery powered light source. There are only 18 of these microscopes. The student can switch with their neighbors and try out both types of microscopes.

6. During Part 1 of the hands-on portion of the lab students will view some prepared slides in their microscopes. In Part 2 of the lab students will have an opportunity to make their own slides an onion skin. Show the how-to-video for these experiments. The students will draw their findings. To view the pond water the class will need to use the high powered microscope. We only have two in the classroom. The students will need to rotate using these two microscopes.
7. Allow enough time at the end for students to wash up afterwards. Girls can wash up in the adjacent girl's restroom.
8. The last 5-10 minutes of class review with the students their observations.

Plant & Animal Cells by *Biology for Kids*:

(For Docent's Reference Only)

All living organisms on Earth are divided into **cells**. The main concept of **cell theory** is that cells are the basic structural unit for all organisms. Cells are small compartments that hold the biological equipment necessary to keep an organism alive and successful. Living things may be single-celled or they may be very complex such as a human being.

There are smaller pieces that make up cells such as **macromolecules** and **organelles**. A protein is an example of a macromolecule while a **mitochondrion** is an example of an organelle. Cells can also connect to form larger structures. They might group together to form the **tissues** of the stomach and eventually the entire digestive **system**. However, in the same way that atoms are the basic unit when you study matter, cells are the basic unit for biology and organisms.

In larger organisms, the main purpose of a cell is to **organize**. Cells hold a variety of pieces and each cell type has a different **purpose**. By dividing responsibilities among different groups of cells, it is easier for an organism to survive and grow.

If you were only made of one cell, you would be very limited. You don't find single cells that are as large as a cow. Cells have problems functioning when they get too big. Also, if you were only one cell you couldn't have a **nervous system**, no **muscles** for movement, and using the internet would be out of the question. The trillions of cells in your body make your way of life possible.

One Name, Many Types

There are many types of cells. In biology class, you will usually work with **plant-like** cells and

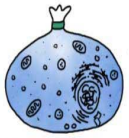
animal-like cells. We say "animal-like" because an animal type of cell could be anything from a tiny **microorganism** to a nerve cell in your brain. Biology classes often take out a microscope and look at single-celled microbes from pond water. You might see hydra, amoebas, or euglena.

Plant cells are easier to identify because they have a protective structure called a **cell wall** made of cellulose. Plants have the wall; animals do not. Plants also have organelles such as the green chloroplast or large, water-filled **vacuoles**. Chloroplasts are the key structure in the process of **photosynthesis**.

Cells are unique to each type of organism. If you look at very simple organisms, you will discover cells that have no defined nucleus (prokaryotes) and other cells that have hundreds of nuclei (multinucleated).

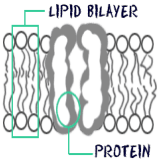
Humans have hundreds of different cell types. You have red blood cells that are used to carry oxygen (O_2) through the body and other cells specific to your heart muscle. Even though cells can be very different, they are basically compartments surrounded by some type of membrane.

Cell Membranes



According to **cell theory**, cells are the main unit of organization in biology. Whether you are a single cell or a blue whale with trillions of cells, you are still made of cells. All cells are contained by a **cell membrane** that keeps the pieces inside. When you think about a membrane, imagine it is like a big plastic bag with some tiny holes. That bag holds all of the cell pieces and fluids inside the cell and keeps any nasty things outside the cell. The holes are there to let some things move in and out of the cell.

Flexible Containers



The cell membrane is not a solid structure. It is made of millions of smaller molecules that create a flexible and porous container. **Proteins** and **phospholipids** make up most of the membrane structure. The phospholipids make the basic bag. The proteins are found around the holes and help move molecules in and out of the cell. There are also proteins attached to the inner and outer surfaces of the membrane.

Scientists use the fluid mosaic model to describe the organization of phospholipids and proteins. The model shows you that phospholipid molecules are shaped with a head and a tail region. The head section of the molecule likes water (**hydrophilic**) while the tail does not (**hydrophobic**). Because the tails want to avoid water, they tend to stick to each other and let the heads face the watery (**aqueous**) areas inside and outside of the cell. The two surfaces of molecules create the **lipid bilayer**.

Ingrained in the Membrane

What about the **membrane proteins**? Scientists have shown that many proteins float in the lipid bilayer. Some are permanently attached while others are only attached temporarily. Some are

only attached to the inner or outer layer of the membrane while the transmembrane proteins pass through the entire structure. The transmembrane proteins that cross the bilayer are very important in the **active transport** of ions and small molecules.

Videos on Cells & Microscopes:

Plant & Animal Cells

1. What is a cell? (Run time 2 min. 28 sec.)
   https://www.youtube.com/watch?v=3BZEA4areBM
2. Single Cell-Organisms (run time 3 min. 43 sec.)
   http://ca.pbslearningmedia.org/resource/tdc02.sci.life.stru.singlecell/single-celled-organisms/

Fun Educational Songs about Cells

3. The Cell Song from They Might be Giants (run time 2 min. 41 sec.)
   http://www.watchknowlearn.org/Video.aspx?VideoID=28356&CategoryID=249
4. The Cell Song (Plant & Animal Cells) – (run time 3 min. 10 sec.)
   http://www.watchknowlearn.org/Video.aspx?VideoID=49467&CategoryID=1099

How to Use a Microscope & Make a Wet Mount Slide

5. How to use the microscope
   https://www.youtube.com/watch?v=1k659rtLrhk
6. How to make an onion skin slide
   https://www.youtube.com/watch?v=XKPdnE6BGew
7. Preparing a wet mount slide of pond water
   https://www.youtube.com/watch?v=S_MN0pp4qHg

Experiment #1: Viewing Prepared Slides

Materials:

- Microscopes
- Prepared glass slides
- Battery Powered desk lamps
- Worksheet
- Pencils and colored pencils

Preparation:

1. Prior to the class arrival set out the microscopes on the tables. There should be enough for each students.
2. Place desk lamps at each microscope which doesn't have an internal light.
3. Put pencils, colored pencils and worksheets on the table.
4. Set out prepared slides on the table.

Instructions:

1. Observe the prepared slides under the microscope.
2. Draw what you see and label the type of cell. Students probably will not have enough time to draw six types of cells. Six spaces are provided on the worksheet for those that are quick drawers.

3. Discuss cells and how they can change or morph. For example, our skin receives energy from the sun in the form of heat & UV radiation. Over time, too much UV radiation will change our skin cell's DNA. The UV radiation will damage the cells. This damage will build up over time, the cells will start to grow out of control and will then lead to skin cancer. To prevent this cell change & damage, we use sunscreen, sun protective clothing, and reduce sun exposure.

Experiment #2: Making an Onion Skin Slide

Materials:

- Microscopes
- Battery powered desk lamps
- Clean glass or plastic slides and slip covers
- Freshly cut onion pieces
- Forceps
- Paper towels
- Staining solution (Iodine or food coloring)
- Droppers or pipettes
- Worksheet
- Pencils and colored pencils

Preparation:

1. Before class arrives prepare staining solution. Use either Iodine or food coloring. Dilute with water at a 1:1 ratio. Place staining solution in containers for use during class.
2. Cut pieces of fresh onion.
3. There are blue trays in the storage closet. Prepare trays with the onion pieces, staining solution, droppers, tweezers, glass slides and plastic slip covers. Prepare 1 tray for each table. These trays can be prepped ahead of time and set aside until needed.

Instructions:

1. Take a small piece of onion and using forceps peel off the membrane from the inside of the onion. It should just be a very thin layer. Remember to use the inside of the onion not the outside. Use your finger to nudge a thin layer of onion skin off and then pull off with the forceps.
2. Lay the onion membrane flat on the surface of a clean slide. Do not let the onion membrane fold in half.
3. Place a slip cover over the onion skin.
4. Next using a dropper add 1-2 drops of staining solution on one side of the slip cover. Be very careful; these dyes will stain your skin and clothes. Some of the stain will start to slide under the slip cover.

5. Place a small piece of paper towel along the opposite side of the slip cover from where the stain was placed. The paper towel will immediately start to absorb the liquid and draw the stain under the slip cover staining the onion skin.
6. Make sure there are no air bubbles. If so lightly tap or press on the slip cover.
7. You may need to wait a few minutes for the stain to soak into the onion skin.
8. Put the slide onto the stage of the microscope. Make sure the objective lens is set on low power.
9. Look through the eyepiece lens and turn the focusing wheel until you can see the cells. Be careful not to lower the eyepiece directly on the slide. A glass slide can break. The onion cells should look like lizard skin.
10. Swap the objective lens for a high powered one so that you can see the cells at a greater magnification. Can you see the nucleus?
11. Draw your observations on the worksheet.

Experiment #3: Making a wet mount slide with Pond Water

Materials:

- High Powered Compound Microscope
- Clean glass slides and slip covers
- Fresh Pond Water in a beaker
- Paper towels
- Staining solution (Optional)
- Droppers or pipettes

Preparation:

1. Set up a station near the high powered compound microscopes. There are only 2 compound microscopes in the lab. They need to be placed on the counter next to a power outlet.
2. At this station set out glass slides, slip covers, droppers and pond water.
3. A blue or green food coloring stain may be used if students are unable to see anything with the clear water sample.
4. If using stain dilute the food coloring at a 1:1 ratio with water. Place in a container with a dropper.

Instructions:

1. Place 1 drop of pond water on a glass slide using a pipette. Draw in water near the bottom of the beaker. Make sure not to get the very bottom of the beaker as it will be mainly mud. The living organism are just above the mud/silt and vegetation.
2. At a 45 degree angle place the slip cover over the water. This will help prevent air bubbles.
3. Use a paper towel to dry up an excess water.
4. Put the slide onto the stage of the microscope. Make sure the objective lens is set on low power.
5. Look through the eyepiece lens and turn the focusing wheel until you can see organisms. If you do not see anything try adding blue or green stain as noted in Experiment #2.
6. Swap the objective lens for a high powered one so that you can see the organisms at a greater magnification. What do you see?

7. Draw your observations on your worksheet.
8. Students are encourage to leave their drawings to display on the walls for open house.

Special Clean-up Notes:

1. Save the staining solution for the next class. If your class in the last one of the day then discard the solution in the sink.
2. The plastic slide and slip covers can be thrown away. All glass slides and slip covers need to be rinsed in soapy water and set out to dry. They will be reused.
3. Rinse tweezers and droppers in soapy water and set out to dry.
4. If you are the last class of the day discard pond water in the sink or outside.
5. If you are the last class of the day put all the microscopes and desk lamps away.

Helpful Tips noted from Previous Classes:

The following tips are based on doing this experiment with the 5th graders for the first time in October 2015. The 3 - fifth grade classes were scheduled back to back. Each class was about 55 minutes. There was only about 10 minutes between classes to reset the tables for the next group.

1. When setting up for the lab consider the short turnaround time and set out enough materials to make the turnaround time smoother. You really have to move fast.
2. It took 2 docents about 30 minutes to set up.
3. The prepared glass sides are for Part 1 of this lab. Remind students the slides are glass and breakable.
4. Explain what forceps are. Many students were not familiar with this term.
5. Remind students they should not turn the eyepiece of the microscope directly on top of the slide set on the stage. They can break the slide.
6. There were 3 docents per class.
7. The students had challenges in the following areas:
    a. Angling the desk lamp to reflect in the microscope mirror.
    b. Once they got the light source perfectly lite in their microscope they would forget to leave it in the same spot. They would either move the microscope or move the light and have to start all over again.
    c. Students needed help pulling off a piece of onion skin.
    d. Put too much stain on the slide.
    e. Didn't know how to draw the stain through the slip cover with the paper towel.
    f. Forgetting the difference between a slide and a slip cover.
    g. Spilled the staining solution. We will try to get dropper bottoms for future classes.
8. We ran out of time for Part 3 of this lab. Part way through the lab session we realized we were running out of time for the students to make a pond water slide. While the students were busy making their onion skin slide one docent prepared two pond water slides and got them focused in on the compound microscopes. During the last 5-10 minutes of class we called up table groups to view the pond water. It was very exciting for them to see moving organisms.