Cell Parts

Strand Life at the Molecular and Cellular Level

Topic Exploring cell structure and function

Primary SOL BIO.3 The student will investigate and understand relationships between cell structure and function. Key concepts include
a) evidence supporting the cell theory;
b) characteristics of prokaryotic and eukaryotic cells;
c) similarities between the activities of the organelles in a single cell and a whole organism.

Related SOL BIO.4 The student will investigate and understand life functions of Archaea, Bacteria, and Eukarya. Key concepts include
c) how the structures and functions vary among and within the Eukarya kingdoms of protists, fungi, plants, and animals, including humans.

Background Information

Cells can be large (such as an egg), small (one bacterium, such as *E. coli*), complex (brain and nerves), or simple (onion). They can be square (plant), rounded (blood), or irregular (spirochetes). Cells are categorized as prokaryotic (Bacteria, Eubacteria, and Archaea) or eukaryotic (Eukaryota). Cells are also categorized as autotrophic (able to produce their own food from the process of photosynthesis) or heterotrophic (rely on other food sources). Some organisms are unicellular (protists), while many others are multicellular.

There is no "typical" cell. Various cellular components are found in many different cell types, including the outer membrane and cell wall components, the nuclear components, and the cytoplasmic components, but these components vary greatly in structure and function.

Materials

- Adding machine tape
- Egg
- Picture of an E. coli bacterium
- Copies of the three attached handouts
- Fabric swatches cut into 8-inch squares
- Sewing needles
- Thread
- Pillow stuffing
- Accessories such as buttons, sequins, pipe cleaners, pompoms, ribbons (perhaps brought in by students)

Vocabulary

cell membrane, cell theory, cell wall, central vacuole, chloroplast, cytoplasm, endoplasmic reticulum, eukaryote, Golgi apparatus, Golgi body, lysosome, mitochondria, nucleus, organelle, pasteurization, prokaryote, ribosome, spontaneous generation

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

1. Discuss the events leading up to the creation of the cell theory, including the following:
   - 1653: Leeuwenhoek invented the compound microscope.
   - 1665: Hooke coined the word *cell*.
   - 1668: Redi's experiment disproved that maggots came from rotting meat.
   - 1838-1839: Schleiden and Schwann observed that plants and animals have cells and concluded that "all living things are made of cells."
   - 1855: Virchow stated, "All cells come from preexisting cells."
   - 1862: Pasteur's experiment disproved spontaneous generation.

   Have students create a timeline on adding machine tape, including the date, the event, and a picture to illustrate the event.
2. Hold up an egg and a picture of an *E. coli* bacterium, and ask students what they have in common. They should respond that both are cells. Discuss the differences of these two cells, and then focus attention on the similarities. Have students compare the egg to other eukaryotic cells. Discuss the differences found in eukaryotic cells, especially the major differences between plant and animal cells.
3. Copy, cut apart, and give one of the attached Cell Parts Cards to each student. Have students find their partners for the activity by finding the students who have the cards that match their cards. (You could add additional cards that show images of the organelles for the groups of three.) Challenge pairs of students to match each organelle to a function it serves for a cell and for an organism as a whole. Discuss the similarities between the cell and an organism.
4. Facilitate the creation of "cell pillows" by having students sew 8-inch squares together, placing two squares front to front (inside out) and using basic ¼-inch to ½-inch stitches about ½ inch from each edge. Remind them to leave a 1-inch gap in the border unsewn through which to push the stuffing. Have them turn their pillows right side out, stuff them, and sew up the gaps. Guide students to add notions to create "anatomically correct" plant or animal cells. Direct students to create a key for their cell pillows.
5. Optional: Have one partner create a representation of a plant cell and the other a representation of an animal cell. Upon completion, have partners create a Venn diagram or paragraph comparing the similarities and differences between the two types of cells.

Assessment

- **Questions**
  - Is the cell you labeled a plant or animal cell? How do you know?
  - What is the name for cells that make their own food? How would you describe them? Which kingdom are most of them in? In which organelle does this process take place?
  - Which organelle breaks down photosynthesis-created energy to be used in cellular functions? What is the product of cellular respiration?
- **Journal/Writing Prompts**
  - Eukaryotic cells can belong to organisms that are either unicellular or multicellular. Explain the meaning of the terms *unicellular* and *multicellular*, and give an example of an organism that is unicellular and one that is multicellular.

  - Create a "senior superlative" for each organelle, or create an analogy (e.g., to a school, such as "the nucleus is like the office" or "the endoplasmic reticulum is like the hallway").
- **Other**
  - Present the organelle names and their definitions in random order, and hold a contest to see how fast students can correctly match each organelle with its definition.
  - Provide a list of vocabulary terms. Have pairs of students write each term and three one-word "clues" to that term on index cards. Then, group the pairs to create groups of four. Direct one member of one pair to select a card from the other pair and try to get his/her partner to guess the term without using any of the three clue words written below the term.
  - Prior to the next class after this lesson, write vocabulary terms on sticky name tags. When students enter the room, stick a term tag on each student's back. Have students ask yes/no questions of the class to determine their terms.

Extensions and Connections (for all students)

- Provide students with the original words of one of the scientists whose work led up to the cell theory, and have them write what a nonscientist at the time might have thought of the scientist's findings.
- Have students create prokaryotic cell models and then compare their cell models to the plant and animal cell models.
- Discuss the different types of cells found in the mammalian body, and have students observe prepared specimens or images.

Strategies for Differentiation

- Provide the timeline with dates and events already listed, and have students draw an image for each event. Alternatively, provide images, and have students add the dates and/or events.
- In place of the cell theory timeline, have students complete the activity described on the attached handout The Cell Theory: Who Should Get the Credit?
- Have students write stories about a day in the life of a red blood cell or another cell type of their choice.
- Have students complete the attached Cell Organelle Beauty Pageant activity, assigning each student one of the following organelles: nucleus, mitochondria, chloroplast, rough endoplasmic reticulum/ribosomes, cell membrane.
- Have students create a commercial or ad to "sell" one of the organelles to another cell.
- In place of sewing a cell, have students create a graphic presentation, using clipart and a computer.

Cell Parts Cards

Cytoplasm	**Region within the cell membrane that includes the fluid and the cytoskeleton**	**Ribosomes**	**Site of protein synthesis**
Cell wall	**Rigid structure that surrounds the cell membrane and provides support to a cell**	**Golgi apparatus**	**Modifies, packages, and distribute s materials**
Cell membrane	**Acts as a barrier between the inside of a cell and the outside environment**	**Mitochondria**	**Site of cellular respiration in which chemical energy is converted into ATP**
Chloroplast	**An organelle found in plant and algae cells in which photosynthesis occurs**	**Lysosome**	**Contains digestive enzymes to break down waste in a cell**
Central vacuole	**A large cavity or sac that stores water and nutrients**	**Endoplasmic reticulum**	**System of membranes in a cell that assists in the transport of proteins in a cell**
Nucleus	**A membrane bound organelle that contains the DNA and controls cell activities**		

The Cell Theory: Who Should Get the Credit?

The cell theory was first received into the scientific community in 1839, but without the earlier work of some scientists, this discovery would have been impossible. Since then, others have contributed to the theory in some way, supporting it further or expanding it.

You will research the contributions of various scientists to the cell theory and then determine to what extent each should be credited for the work.

Procedure

Do the following with a partner.

1. Research the contributions to the cell theory made by the following scientists:
   - Anton von Leeuwenhoek
   - Robert Hooke
   - Francesco Redi
   - Matthias Schleiden
   - Theodore Schwann
   - Rudolph Virchow
   - Louis Pasteur
   - A scientist of your choice who further supported or expanded the original cell theory
2. Discuss with your partner the percentage of the total contribution to the cell theory each scientist made.
3. Using a computer-based graphing tool, create a to-scale pie chart to show these percentages. Remember, all the percentages must add up to 100%. Use different colors for each section (person) on your graph.
4. After you have made the designations of responsibility for each person, provide a written explanation as to why you assigned that amount. (Responses such as, “That’s the way it adds up to 100%.” are not valid and will not earn you credit.)
5. Write a revision of the cell theory as of this year—not just the minimum from the textbook, but also including some of the specifics from the scientist of your choice.

Products to Submit

- Pie chart
- Written explanations
- Revised cell theory

Cell Organelle Beauty Pageant

Prepare your organelles for the Cell Organelle Beauty Pageant. You will have 20 minutes to prepare the following for presentation to the entire class:

- A "glamour shot" of your organelle for the beauty portion of the contest (a drawing of your organelle, using materials available in the classroom)
- A two-minute persuasive speech on why your organelle is the "most important" organelle in the cell.

Your teammates will score your individual effort (4 pts). The judges will score your glamour shot and speech (6 pts).

Peer Evaluation Scoring Guide

4 – Excellent: Contributed positively to group discussion throughout the process and stayed "on task" at all times. Was thoughtful and appreciative of the contributions of others.

3 – Very Good: Contributed positively to the group discussion throughout the process and was "on task" most of the time. Was mostly thoughtful and appreciative of the contributions of others.

2 – Average: Contributed to the group discussion much of the time and stayed "on task" part of the time and/or was not thoughtful and appreciative of the contributions of others.

1 – Poor: Did not contribute or contributed very little to group discussion and did not stay "on task" most of the time.

	3 Excellent	2 Good	1 Adequate
Glamour Shot	**Drawing is an accurate representation of the organelle with great attention paid to the detail and/or labels.**	**Drawing is a generally accurate representation of the organelle with appropriate detail and/or labels.**	**Drawing is a somewhat accurate representation of the organelle with marginal detail and/or labels.**
Speech	**All facts were used appropriately throughout and were accurate.**	**Most facts were used appropriately, and there were fewer than 3 factual errors.**	**Some facts were used appropriately, but there were more than 3 factual errors.**