



Eukaryotic Cells: The Factories of Life

By: Marlo Spallone & Susan Zona

Focus on Inquiry

The students will create a model that is analogous to a cell. They will use a predetermined model to associate cell function to structure and will discuss the limitations of the models used in the investigation. They will communicate their work and then evaluate the work of their peers in a given context.

Lesson Content Overview

Students will be able to identify the main parts of a cell and to describe the basic function of each part. The students will match parts of a cell to parts of a city that have functions that are analogous to each cell part. They will then develop their own analogy and present it to the class. Finally, they will practice their knowledge using a computer-based review game.

Duration 100 minutes	Setting Classroom	Grouping 2-4 students/group	PTI Inquiry Subskills 3.3, 3.4, 3.6, 5.3, 5.7, 5.8, 5.9, 7.1, 7.2, 7.3
--------------------------------	-----------------------------	---------------------------------------	--

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	20 min	3.3, 3.4, 5.8	None	3	Students will make a detailed drawing/diagram of a restaurant, store, or theme park
Explore	15 min	3.3, 3.4, 5.3	None	3	Students will match cards containing city parts and their functions to cards with cell structures and their functions
Explain	25 min	3.6, 5.3, 5.7, 5.8, 5.9	none	3	Students will use their drawing to make an analogy of a cell, matching cell structures to the parts of their picture that represents the function of each cell structure.
Expand/Elaborate	20 min		Web-enabled device	3	Students will play computer-based games to review; matching cell parts to their functions.
Evaluate	2-3 min (per group)	7.1, 7.2, 7.3	none	3	Students will present their drawing to the class, explaining their analogies. Classmates (and teacher) will use a grading rubric to evaluate the analogy. Students will complete a summative assessment on cell structures and their functions.
	10 min			1	

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

- NGSS Practice 1: Asking Questions and Defining Problems
- NGSS Practice 2: Developing and Using Models
- NGSS Practice 4: Analyzing and Interpreting Data
- NGSS Practice 6: Constructing explanations
- NGSS Practice 7: Engaging in arguments from evidence
- NGSS Practice 8: Obtaining, Evaluating and Communicating Information



Next Generation Science Standards – Content

MS-LS1-2.: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.



HS-LS1-2.: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

Florida Science Standards – Nature of Science

SC.912.N.3.5: Describe the function of models in science, and identify the wide range of models used in science.

**Florida Science Standards – Content**

SC.912.L.14.3: Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.

**Materials and Advance Preparation****Materials List****Class set:**

- City parts/functions cards (Blackline Masters #1) folded and cut into back to back cards. Glue or tape can be used to adhere two sides together. (1 set per group)
- Cell parts/functions cards (Blackline Masters #2) folded and cut into back to back cards. Glue or tape can be used to adhere two sides together. (1 set per group)
- Envelopes or bags to hold collections of cards (1 or 2 per group)
- Computer or other web-enabled device (1 per student)

Student materials:

- Poster paper (1 per group)
- Markers, colored pencils, and/or crayons
- Presentation Evaluation (Blackline Master #5) 1 copy per student
- Cell Structure and Function Quiz (Blackline Master #6) 1 copy per student

Blackline Masters

1. Blackline Master #1: City Parts/Function Cards
2. Blackline Master #2: Cell Parts/Function Cards
3. Blackline Master #3: Cell Analogy Evaluation Sheet
4. Blackline Master #4: Cell Structure and Function Check for Understanding
5. Blackline Master #5: Cell Structure and Function Check for Understanding Answer Key

Advance Preparation

1. Print out Blackline Masters #1 and #2 and fold them on the center line so that the first and second column of each Master are on opposite sides of the same paper (1 of each per group).
2. Cut the copies into cards.
3. Adhere the front of the card to the back with glue or tape.
4. Divide the cards into groups of City parts and Cell Parts and put in envelopes.
5. Print out Blackline Master #3 and Blackline Master #4 (1 of each per student)
6. Make sure that you can access the website for the review games and that the games will run on your technology: <http://www.biomanbio.com/GamesandLabs/Cellgames/Cells.html>

Lesson Information**Learning Objectives**

1. The student will be able to identify the different structures found within a cell and relate the structures to their functions. These structures include: cell wall, microtubules, cell membrane,

microfilaments, cytoplasm, vacuoles, nucleus, mitochondria, nuclear envelope, Golgi apparatus, endoplasmic reticulum, chloroplasts, cilia, flagella, ribosomes, lysosomes, chromatin, nucleolus.

2. Students will be able to describe the models that they worked with in this lesson and explain their function in learning more about cells.

Prior Knowledge Needed by the Students

- Students should be able to compare and contrast prokaryotic and eukaryotic cells.
- Students should understand what an organelle is.

Background Information

No background information is needed as this activity is introducing the general cell structures and functions of plant and animal cells.

Lesson Procedure

Engage

1. Place the students into groups of 2 or 4 and distribute one piece of poster paper and markers, crayons, etc.
2. Direct the students to draw and color their favorite store, restaurant, or theme park.
3. Emphasize to the students that the picture should be as specific as possible and they will only have 20 minutes to complete the poster. As students are completing the poster, teacher should be walking the room
4. If students try to ask why they are creating the poster, politely say "You will see"
5. This is the introduction of the unit, so they will not know the goal or the objective of the day at this point, you want to pique their interest.

Explore

1. After the groups had 20 minutes to complete the poster, have them set the poster aside. Explain that it will be used later in the lesson.
2. Distribute a set of city parts/function cards. (Blackline Masters #1) and a set of cell parts/functions cards (Blackline Masters #2) to each group.
3. Give the students 15-20 minutes to match up each cell card and to a city card (using the listed functions to guide them). This is a great tool for accessing prior knowledge.
4. During this time, you can circulate and ask questions such as:
 - "What would be the power source of the city?" *the power plant*
 - "From where would the city be ran?" *city hall*
 - "What controls the cell?" *the nucleus*
 - "What is responsible for waste removal in the cell?" *the vacuole*
 - "What controls what goes in and out of the cell?" *the cell membrane*
 - "How is the city a model of a cell?" *the parts of the city each represent a different part of the cell. Their function in the city is similar to their function within the cell.*

Use these questions and others as needed to guide students to the right matches.
5. When each group thinks they have the correct parts and functions, the students raise their hand and teacher checks and corrects as needed.

Explain

1. After each group has successfully matched the correct parts and functions, have them get the poster with their drawing from before.
2. Explain to them that they now have to compare the drawing they created to either a plant or animal cell.
3. For every cell organelle, they have to compare it to their drawing and justify why. Give the students an example like "The entrance door is like the cell membrane because it directs what enters and exits the building." Tell the students to write the justifications on the poster.

4. Each group will have to label their drawing with both the actual object and the cell part it represents. (Some groups may opt to have a key to the side of the poster rather than writing the labels directly on the drawing).
5. Groups may add to their poster if they need to in order to assure they have an analogy for all of the predetermined cell structures.
6. Explain to the students that they will have to present their poster to the class and they will have to justify why they chose the part and give the function.
7. For this section, you may want to give the students a list of the organelles (or write on board or overhead) and assign the group either the plant or the animal cell.
8. Set the timer for 25 minutes.
9. Determine how you would like this part to be evaluated. Here are 3 options for evaluation:
 - a. Distribute the cell analogy evaluation sheet (Blackline Master #3) to each student. As groups complete their posters, select one person from each group to go to another group and present their poster and their analogy of the cell parts with their functions (along with their justifications). The students from the second group will then fill in the rubric as the presenter presents. You may want to have the each group present to more than one group.
 - b. Distribute the cell analogy evaluation sheet (Blackline Master #3) to each student. Assign each student within a group to evaluate a different groups' analogy. Once all poster are completed, each group will present their poster and their analogy of the cell parts with their functions (along with their justifications) in front of the class. The other students will each evaluate their assigned group as they present (and the teacher will also).
 - c. As each group completes their poster, have them display their analogies around the room or in a hallway. Have the students do a gallery walk around the room and/or hallway and look at other students' posters and analogies. You can give sticky notes to the students and have them leave comments on the posters. Make sure to go over what acceptable comments and critiques are versus those that are unacceptable. Another option would be to distribute the cell analogy evaluation sheet (Blackline Master #3) to each student and have them choose one or more posters to evaluate as they proceed with their gallery walk.

Expand

1. Ask students to log on to www.biomanbio.com.
2. Once there, have them click on "Cells" from the menu at the left of the screen.
3. There are several games and a quiz available to help them review cell structures and their functions.
4. "Cell Explorer: The Animal Cell" and "CellCraft" are both games that deal with all the structures. "Cell Defense" deals directly with the cell membrane, which you may want to save for a later lesson.
5. There is also a quiz that they can take that will not let them finish until they get all of the questions correct.
6. If technology is not available, then let the student choose between making a cell part foldable, a game, a travel brochure, or a song about the cell parts and functions

Evaluate

Informal/Formative Evaluation

1. Student presentation and explanation of the poster and cell analogy using Blackline Master #3
2. See the Explore section above for more details.

Formal/Summative Evaluation

1. Cell structure and function Check for Understanding – Blackline Master #4

Supplementary Resources For Students

Geisen, K., Malone, M., & Starr, H. (2008). Inside a Cell. Retrieved April 26, 2016, from <http://learn.genetics.utah.edu/>

Home. (n.d.). Retrieved April 26, 2016, from <http://www.amoebasisters.com/>
Prokaryotes & Eukaryotes

Sullivan, J. (2015). Welcome to CELLS alive! Retrieved April 26, 2016, from <http://www.cellsalive.com/>
Plant/Animal Cell Model

CITATION OF SOURCES.

Biology Games & Virtual Labs! (n.d.). Retrieved April 27, 2016, from <http://www.biomanbio.com/>

Yes, I cited all materials and resources used in this lesson.

Marlo Spallone &

Susan Zona

Lesson author signature

Blackline Master #1

City Parts/Functions Cards

The main office that sends out instructions to run the city and controls its day-to-day operations

City Hall

The instructions on how to build the different buildings and structures throughout the city.

Blueprints

High level executive with an office within city hall that directs city hall and all of its plans.

The Mayor

Transported around the city to build buildings and structures.

Boxes of Bricks

<p>Gets rid of the city's trash and recycling</p>	<p>Landfill/Recycling Center</p>
<p>Takes the finished products of the city and sends them to their final destination</p>	<p>Trucks</p>
<p>Capture sunlight and turn it into usable energy for the city</p>	<p>Solar Power Plant</p>
<p>Holds excess water and food to be used later in different parts of the city</p>	<p>Local Food Bank</p>

<p>Pathways to haul materials around town and to construction sites</p>	<p>Roadways</p>
<p>Security that allows things into and out of the city.</p>	<p>Border Control</p>
<p>The central location in the city that holds excess water and food to be used later in different parts of the city.</p>	<p>City Food Bank</p>
<p>The dividing line between what is within the city and what is outside the city.</p>	<p>City Boundary</p>

<p>Empty space within the city where new buildings could be built or maybe a park could be established.</p>	<p>Open Land</p>
<p>Complex in the city where fuel is burned to provide power for the city.</p>	<p>Coal Power Plant</p>
<p>Material that can build structures or hold them in place.</p>	<p>Cement</p>

Blackline Master #2

Cell Parts/Functions Cards

Nucleus	Holds instructions that builds and controls the cell and its functions
Chromatin (DNA)	Blueprints for building a cell
Nucleolus	Controls the activity within the nucleus and holds the DNA.
Ribosomes	Place in the cell where proteins are produced

<p>Endoplasmic Reticulum</p>	<p>Provides a pathway to transport molecules and particles throughout the cell</p>
<p>Golgi Apparatus</p>	<p>Collects and moves molecules and particles and sends them around the cell or out of the cell.</p>
<p>Chloroplast</p>	<p>Captures sunlight and turns it into carbohydrates (chemical energy) for a plant cell to use (by photosynthesis)</p>
<p>Vacuole</p>	<p>Large sac that holds excess water, materials, and waste products</p>

<p>Plasma Membrane</p>	<p>Boundary around all cells that controls what goes into and out of the cell and keeps some things in while leaving other things out</p>
<p>Vesicles</p>	<p>Several small membrane sacs that store materials and waste products within animal cells</p>
<p>Cytoskeleton (microtubules and microfilaments)</p>	<p>System of protein fibers and tubules that provide shape to the cell, anchor organelles, and allow for movement of the cell</p>
<p>Lysosome</p>	<p>Vacuole that contains digestive enzymes that breakdown wastes and worn-out cell parts</p>

<p>Cytoplasm</p>	<p>Jelly-like substance that surrounds and cushions organelles and provides shape to the cell</p>
<p>Mitochondria</p>	<p>Breaks down food molecules to release energy for the cell to use (by cellular respiration)</p>
<p>Cell Wall</p>	<p>Rigid barrier that provides extra support for all cells EXCEPT animal and protozoan cells</p>

Blackline Master #3

Cell Analogy Evaluation Sheet

Group:				
Cell type: Plant or Animal				
	Cell Structure	On Poster and Presented	On Poster, but not mentioned	Missing Entirely from Both
1	Membrane	2	1	0
2	Cytoplasm	2	1	0
3	Nucleus	2	1	0
4	Chromatin	2	1	0
5	Nucleolus	2	1	0
6	Ribosome	2	1	0
7	ER	2	1	0
8	Golgi	2	1	0
9	Mitochondria	2	1	0
10	Cell Wall (plant only)	2	1	0 or N/A
11	Central Vacuole (plant only)	2	1	0 or N/A
12	Chloroplast (plant only)	2	1	0 or N/A
13	Lysosome (animal only)	2	1	0 or N/A
14	Vacuoles (animal only)	2	1	0 or N/A
15	Cytoskeleton (animal only)	2	1	0 or N/A
	Poster	Well Done /Complete	Acceptable	Missing
	Creativity	2	1	-----
	Color	2	1	0
	Labels/Key	2	1	0
	Completed	2	1	0
Score		/32		

Group:				
Cell type: Plant or Animal				
	Cell Structure	On Poster and Presented	On Poster, but not mentioned	Missing Entirely from Both
1	Membrane	2	1	0
2	Cytoplasm	2	1	0
3	Nucleus	2	1	0
4	Chromatin	2	1	0
5	Nucleolus	2	1	0
6	Ribosome	2	1	0
7	ER	2	1	0
8	Golgi	2	1	0
9	Mitochondria	2	1	0
10	Cell Wall (plant only)	2	1	0 or N/A
11	Central Vacuole (plant only)	2	1	0 or N/A
12	Chloroplast (plant only)	2	1	0 or N/A
13	Lysosome (animal only)	2	1	0 or N/A
14	Vacuoles (animal only)	2	1	0 or N/A
15	Cytoskeleton (animal only)	2	1	0 or N/A
	Poster	Well Done /Complete	Acceptable	Missing
	Creativity	2	1	-----
	Color	2	1	0
	Labels/Key	2	1	0
	Completed	2	1	0
Score		/32		

Blackline Master #4

Name _____ Date _____ Student No. _____

Checking for Understanding: Cell Structure and Function

- ___1. Which organelle is correctly paired with its specific function? (SC.912.L14.3)
- A. Vacuole - production of ATP.
 - B. Cell membrane – synthesis of proteins.
 - C. Chloroplast - transport of materials.
 - D. Nucleus – stores genetic information.
- ___2. A student prepared the following list of characteristics about a cellular organelle.
- Present in animal cells
 - Present in plant cells
 - Helps make energy available to the cell

Which of the following cellular structures is the student describing? (SC.912.L14.3)

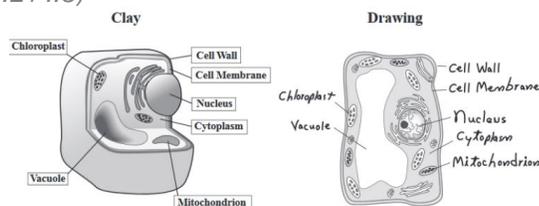
- A. Nucleus
- B. Cell Wall
- C. Chloroplast
- D. Mitochondria

- ___3. A cell has a defect that results in the loss of its ability to regulate the passage of water, food, and wastes into and out of the cell. In which of the following cell structures is this defect most likely to be located? (SC.912.L14.3)
- A. Ribosomes
 - B. Chloroplasts
 - C. Cell membrane
 - D. Endoplasmic Reticulum

___4. A scientist wants to study photosynthesis in a newly discovered species. He discovered this new organism using the reactants carbon dioxide and water to produce oxygen and glucose. The scientist justified his study saying it was the role of what organelle? (SC.912.L14.3)

- A. Vacuole
- B. Ribosome
- C. Chloroplast
- D. Mitochondria

___5. The pictures to the right show two different models of cells.



Which of the following statements explains why these models would be useful in learning about cells in science? (SC.912.N.3.5)

- A. These models both make the cells larger so that they can be studied by the naked eye.
- B. These models both make the cells smaller so that they can be studied by the naked eye.
- C. These models both accurately show the size and shape of the organelles so that they can be studied.
- D. These models both accurately show the way that the organelles work together in the cell so that their processes can be studied.

Blackline Master #5

Check for Understanding Cell Structure and Function Answer Key

D 1. Which organelle is correctly paired with its specific function? (SC.912.L14.3)

D 2. A student prepared the following list of characteristics about a cellular organelle.

- Present in animal cells
- Present in plant cells
- Helps make energy available to the cell

Which of the following cellular structures is the student describing? (SC.912.L14.3)

C 3. A cell has a defect that results in the loss of its ability to regulate the passage of water, food, and wastes into and out of the cell. In which of the following cell structures is this defect most likely to be located? (SC.912.L14.3)

C 4. A scientist wants to study photosynthesis in a newly discovered species. He discovered this new organism using the reactants carbon dioxide and water to produce oxygen and glucose. The scientist justified his study saying it was the role of what organelle? (SC.912.L14.3)

A 5. The pictures to the right show two different models of cells. Which of the following statements explains why these models would be useful in learning about cells in science? (SC.912.N.3.5)