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| **Lesson Title :** Framing the Problem | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **2** |
| **Activity Title:** Metal Leaching & Cellular Mechanisms |

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| **Estimated Lesson Duration:** | 9 days |
| **Estimated Activity Duration:** | 6 days |

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| **Setting:** | Classroom |

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| **Activity Objectives:**   1. Students will be able to explain how metals influence cell organelle functions in a brochure. 2. Students will be able to identify cell organelles and describe their function. 3. Students will be able to explain how changing the environment of the cell will affect the cell effectiveness. 4. Students will be able to list elements that are conducive for life. |

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| **Activity Guiding Questions:**   1. How does consuming metal affect living cells? 2. How does the environment of a cell affect the success of the cell? 3. What elements are conducive for life? 4. How do cells of different tissue function differently? 5. How do organelles work together to carry out cell functions? |

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| Asking questions (for science) and defining problems (for engineering) | Patterns |
| Developing and using models | Cause and effect |
| Planning and carrying out investigations | Scale, proportion, and quantity |
| Analyzing and interpreting data | Systems and system models |
| Using mathematics and computational thinking | Energy and matter: Flows, cycles, and conservation |
| Constructing explanations (for science) and designing solutions (for engineering) | Structure and function. |
| Engaging in argument from evidence | Stability and change. |
| Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| Demonstrating Science Knowledge **(D)** |
| Interpreting and Communicating Science Concepts **(C)** |
| Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| Make sense of problems and persevere in solving them | Useappropriate tools strategically |
| Reason abstractly and quantitatively | Attendto precision |
| Construct viable arguments and critique the reasoning of others | Look for and make use of structure |
| Model with mathematics | Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

**Ohio’s New Learning Standard: Science Inquiry and Application (p. 228):**

During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

* Identify questions and concepts that guide scientific investigations;
* Design and conduct scientific investigations;
* Recognize and analyze explanations and models;
* Communicate and support a scientific argument

**Ohio’s New Learning Standards (ONLS) Content Elaboration: Cells (p. 295):**

* Every cell is covered by a membrane that controls what can enter and leave the cell.
* Within the cell are specialized parts for the transport of materials, energy transformation, protein building, waste disposal, information feedback and movement.
* Most cells function within a narrow range of temperature and pH. At very low temperatures, reaction rates are slow. High temperatures and/or extremes of pH can irreversibly change the structure of most protein molecules. Even small changes in pH can alter how molecules interact.
* A living cell is composed of a small number of elements, mainly carbon, hydrogen, nitrogen, oxygen, phosphorous and sulfur.

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

1. Cell Pictures (1.1.2a)
2. Research Document (1.1.2b)
3. Cell Answers (1.1.2c)
4. Function Notes (1.1.2d)
5. Cell Membrane Lab (1.1.2e)
6. Lead Article (1.1.2f)
7. Summary Guidelines (1.1.2g)
8. Lead PowerPoint (1.1.2h)
9. Brochure Project (1.1.2i)
10. Peer Feedback (1.1.2j)
11. Kidney ([Website](http://www.livestrong.com/article/123563-kidney-cell-types/))
12. Neurons ([Website](https://faculty.washington.edu/chudler/cells.html))
13. Egg/sperm ([Website](http://www.bbc.co.uk/schools/gcsebitesize/science/triple_edexcel/control_systems/menstrual_cycle_fertilisation/revision/3/))
14. White board ([Whiteboard](https://www.lowes.com/pd/FashionWall-47-75-in-x-7-98-ft-Smooth-White-Panelboard-Hardboard-Wall-Panel/3015239))
15. Markers ([Source](https://www.amazon.com/Low-Odor-Markers-Chisel-Assorted-12-Count/dp/B0004F7GUI/ref=sr_1_11?s=office-products&ie=UTF8&qid=1499693941&sr=1-11&keywords=expo+markers))

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| **Teacher Advance Preparation:** |

**Day 4**

* Make copies of Cell Membrane Lab

**Day 5**

* Review PowerPoint
* Prepare group assignments

**Day 6**

* Organelle Challenge Notecards

**Day 7**

* Notecards with words on them
  + Nucleus, nucleolus, cell membrane, ribosome, rough endoplasmic reticulum, smooth endoplasmic reticulum, mitochondria, Golgi apparatus

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| **Activity Procedures:** |

**Day 4: Cell Organelle Inquiry Activity**

1. Check homework from Day 3 and have students leave homework on desk to self-check after lesson.
2. Pass out Cell Pictures (1.1.2a) to each student and explain the rules of the inquiry activity:
   1. Students will report to their stations where they will find a Research Document (1.1.2b).
   2. Students must use their prior knowledge about cells and the research document to attempt to correctly label the blank diagrams.
   3. Students can check with the teachers as many times as needed throughout the process.
   4. The student team that correctly labels the organelles first will win a prize.
3. Once students finished the lab, go over the correct answers with students (1.1.2c).
4. Conclude by passing out cell organelle function notes (1.1.2d) and having students staple them into notebook.

**Day 5: Cell Membrane Lab**

1. Start class with a “pop quiz” (not for a grade) using classroom “flippers” that asks questions such as:
   1. What organelle produces proteins?
   2. What organelle is in charge of distributing proteins?
   3. What organelle brings in materials from outside the cell?
2. Pass out the cell membrane lab (1.1.2e)
3. Ask students to complete this lab for the duration of the class period.
4. Review the lab results with students and begin discussing the importance of the cell membrane.
5. Guide students as they complete the lab.
6. For homework, give students the Lead Article (1.1.2f) and ask for a page summary using the Summary Guidelines (1.1.2g).

**Day 6: Cell Differentiation & Cell Environment**

1. Start class with a “pop quiz” (not for a grade) using classroom “flippers” that asks questions such as:
   1. What types of molecules are able to pass through the cell membrane?
   2. True or false: All molecules are able to pass through the cell membrane.
2. Check student lab for completion and go over answers with students.
3. Review the lab results with students and begin discussing the importance of the cell membrane.
4. Assign student groups a cell they are going to study: kidney ([Website](http://www.livestrong.com/article/123563-kidney-cell-types/)), neurons ([Website](https://faculty.washington.edu/chudler/cells.html)), and egg/sperm ([Website](http://www.bbc.co.uk/schools/gcsebitesize/science/triple_edexcel/control_systems/menstrual_cycle_fertilisation/revision/3/)).
5. Each group will research the following information about the cell on a large white board ([Whiteboard](https://www.lowes.com/pd/FashionWall-47-75-in-x-7-98-ft-Smooth-White-Panelboard-Hardboard-Wall-Panel/3015239)):
   1. Organelles present in the cell
   2. Cell function
   3. Cell picture
6. Conclude lesson with a discussion on cell differentiation emphasizing these specific questions:
   1. How does cell type affect cell function?
   2. How does the environment affect cells?
   3. Do toxic elements affect cells and why?

**Day 7: Lead and Cell Discussion**

1. Check student summary for completion and ask them to turn it in at the end of the period.
2. Break student desks into two large groups.
3. Post the following questions on the board and have students discuss the answers using their summary they completed for homework.
   1. How does lead affect the body?
   2. How does lead affect cells?
   3. How does lead interact with cells?
4. As students discuss, prepare the lead PowerPoint (1.1.2h).
5. Go through the Lead PowerPoint with students while specifically attempting to ask questions that relate to cell content.
6. Pass out the brochure project assignment (1.1.2i) and show how to find brochure templates on Word.

**Day 8-10: Lead and Cell Brochure**

1. Allow students time to work on cell brochure in class.
2. On the due date of the assignment, group student desks into two groups.
3. Pass out the peer feedback form (1.1.2j).
4. Ask each student present their brochure to their small group.
5. Ask other students in the group to provide feedback to on other group using the peer feedback form (1.1.2j).

**Formative Assessments:**

* “Pop Quiz” knowledge check
* Cell Organelle Quiz
* Cell Organelle Worksheet
* Classroom discussions

**Summative Assessments:**

* Cell Structure & Function Quiz
* Cell Brochure

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| **Differentiation:** |

* Heterogeneous mixing of student discussion groups.
* Less brochure requirements for some students.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

**Days 4-10**

*Revisions to Lesson-* A lot of changes were made to this activity. First and foremost, the brine shrimp tasks were eliminated due to the fact that the brine shrimp were not used. Secondly, the order or activities was rearranged. The cell organelle inquiry activity was delivered first due to the fact that it was engaging and asked students to recall prior knowledge. Cell functions were then given to students in a foldable format in order to expedite the lesson. The cell membrane lab was moved up a day and the cell differentiation and cell environment lessons were joined into one day. Ultimately, the cell content was taught before the lead concept was introduced. This allowed students to gather background knowledge before diving deeper into the toxicology.

Another major revision included the introduction of the Lead and Cell article written by a Harvard professor and the brochure assignment. This article was perfect for my students and incorporated literacy into the unit. The student summaries allowed for a comprehensive overview of how lead affects human cells. The brochure served as a summative assessment about the unit content and allowed students a chance to integrate the toxicology and cell content.

*Successes-* Overall, the biggest success of this unit was the lead article and the brochure assignment. These two assignments allowed students to practice their scientific writing and communication about complicated topics. Without the lead article, I do not believe students would have fully understood how lead affects humans on a cellular level. In addition, the brochure assignment allowed students a chance to organize all lesson content and relate it to toxicology. Presenting these brochures and getting peer feedback was also very valuable to students as they made revisions before turning in their work. All in all, the revised order of this lesson was very effective for student learning and understanding about cells on a deeper level.

*Shortcomings-* The only failure of this lesson was a lack of detail in the brochure assignment requirements. I purposefully left the brochure open-ended; however, I ended up answering a lot of the same questions from group to group. Giving more specificity in the brochure assignment would improve this lesson.