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| **Lesson Title :** Engineering Design Challenge | **Unit #:****1** | **Lesson #:****2** | **Activity #:****4** |
| **Activity Title:** Water Treatment Field Trip |

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| **Estimated Lesson Duration:** | 8 days |
| **Estimated Activity Duration:** | 3 days |

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| **Setting:** | Classroom & Local Water Treatment Facility |

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| **Activity Objectives:** 1. Students will be able to explain how water is collected and distributed in Dayton, OH.
2. Students will be able to describe health concerns related with Dayton water and the Dayton landfill.
3. Students will be able to articulate the importance of water purification and landfill operations to encourage optimum cellular performance.
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| **Activity Guiding Questions:**1. How is water filtered in my community?
2. How is trash disposed of in my community?
3. How does Dayton trash affect the water treatment facility?
4. Why is treating water important for the health in our community?
5. How does waste affect the elements present in ground water?
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| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| [x]  Asking questions (for science) and defining problems (for engineering) | [ ]  Patterns |
| [ ]  Developing and using models | [x]  Cause and effect |
| [x]  Planning and carrying out investigations | [ ]  Scale, proportion, and quantity |
| [x]  Analyzing and interpreting data | [ ]  Systems and system models |
| [ ]  Using mathematics and computational thinking | [ ]  Energy and matter: Flows, cycles, and conservation |
| [x]  Constructing explanations (for science) and designing solutions (for engineering) | [ ]  Structure and function.  |
| [x]  Engaging in argument from evidence | [x]  Stability and change.  |
| [x]  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)** |
| [x]  Demonstrating Science Knowledge **(D)** |
| [x]  Interpreting and Communicating Science Concepts **(C)** |
| [x]  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)** |
| [x]  Make sense of problems and persevere in solving them | [x]  Useappropriate tools strategically |
| [x]  Reason abstractly and quantitatively | [ ]  Attendto precision |
| [x]  Construct viable arguments and critique the reasoning of others | [ ]  Look for and make use of structure |
| [ ]  Model with mathematics | [x]  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):**

* 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. Engineering Design Packet (1.1.3a)
2. Guiding Questions (1.1.3b)
3. Field Trip Summary (1.1.4a)

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| **Teacher Advance Preparation:** |

**Day 15**

* Print copies

**Day 16**

* Book field trips at least a month in advance

**Day 17**

* None

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| **Activity Procedures:** |

**Day 15: Field Trip Pre-Work**

1. Describe the importance of the field trip and relay details about the trip.
2. Pass out field trip summary packet (1.1.4c).
3. Have each student individual write 3-4 questions they have for each facility and make sure they bring these questions on the trip tomorrow on their packet.
4. Pick two student groups to present their brochure to the water treatment employees.
5. Have these two student groups practice their presentation to the class and allow for peers to provide feedback.

**Day 16: Field Trip to Dayton Water Treatment Facility**

1. Prior to field trip, ensure that all students have their field trip packet.
2. Ask students to fill out relevant information about the field trip on the packet.
3. Organize student presentations and oversee student tours at the water treatment facility.

**Day 17: Field Trip Follow-Up**

1. Have students write a follow-up reflection responding to questions centered around the learning objectives (questions produced *after* the field trip in order to draw relevance to their experiences).
2. Have students trade and grade these reflections for thoroughness and thoughtfulness.
3. Collect the reflections and use this formatively assess students.

**Formative Assessments:**

* Field Trip Reflection
* Field Trip Questions

**Summative Assessments:**

* None

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| **Differentiation:**  |

* Cell Structure & Function Unit Test
* Allow for alternative assignment for students who were unable to attend the field trip.

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

**Days 15-17**

*Revisions to lesson-* One revision made to this lesson was eliminating the landfill field trip. I could not finalize a field trip to the landfill due to safety concerns. Another revision was the addition of the field trip summary and student presentation. The field trip summary is a document that students worked with prior to the field trip, during the field trip, and after the field trip. This document allowed for students to have a place to reflect on how the field trip related to the unit. The last change was incorporating our class work into the field trip. Two student groups presented their brochure to the employees of the Dayton Water Treatment Facility and educated the employees about the effects of lead on our cells.

*Successes-* The successes of this lesson include mainly the field trip to the water treatment facility. Students being able to step out of the classroom and see the societal impacts and applications of water treatment was invaluable. Students had questions prepared and were very great listeners throughout the field trip. Another success includes the student presentations. Having students present their lead brochures to the water treatment employees gave students a sense of empowerment. Students had the chance to educate other about what they learned and ultimately this represented the most successful part of the unit. Lastly, the field trip summary was a success because it provided meaning to the field trip.

*Shortcomings-* There were no major failures of the lesson; however, next year I would try to create more opportunities for students to present their work at the water treatment facility.