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| **Lesson Title : Water Pollution** | **Unit #:****1** | **Lesson #:****2** | **Activity #:****4** |
| **Activity Title: How can water be cleaned?** |

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| **Estimated Lesson Duration:** | **4 Class periods** |
| **Estimated Activity Duration:** | **2 Class periods** |

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| **Setting:** | **Classroom** |

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| **Activity Objectives:** |

* Understand how human actions impact the natural environment
* Describe the methods used to clean water
* Identify different sources of pollution
* Describe methods of that could be used to reduce or eliminate pollution
* Design a model that can be used to filter water

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| **Activity Guiding Questions:** |

What is the difference between clean and polluted water?

What is a pollutant?

What are the different types of pollutants?

Where do pollutants come from?

How can pollutants be removed from the water?

Is there a mechanism in nature that “cleans” water?

| **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 **®** |
| ☒ Recalling Accurate Science **®** |

| **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):** |

**NGSS**

* Develop and use models
* Planning and carrying out investigations
* Analyze and interpret data
* Constructing explanations and designing solutions
* Obtaining, evaluating and communicating information

**OLS:**

* Designing Technological/Engineering Solutions Using Science Concept
* Demonstrating Knowledge
* Interpreting and Communicating Science Concepts

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| **Materials**:  |

For each group:

* 500 ml beaker to collect water
* Challenge supplies
* 11” X 17” paper
* The Engineering Design Process student worksheet

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| **Teacher Advance Preparation:** |

* Make copies of the worksheet “The Engineering Design Process” for the challenge
* Prepare supplies for building the filtration system

For each group:

1) 2 – 16 ounce water bottles

2) 50 ml of fine white sand

3) 150 ml of play sand

4) 200 ml of pea rock

5) 100 ml gravel

5) 1 small rubber band

6) ½ coffee filter

* Prepare Polluted water – 1-16 ounce bottle of water with 8 drops of red food coloring per group (1 (1 -16 ounce bottle for each trial or limit the amount of water to 1-16 ounce bottle for entire challenge)

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| **Activity Procedures:** |

Directions:

1) Lead the discussion to introduce the challenge: How can water get cleaned?

2) Introduce the worksheets titled “The Engineering Design Process” and explain how each student will be responsible for keeping track of how his/her team used the process to complete the challenge.

3) Instruct students to complete section 1, background information on their own.

4) Divide students into work groups.

5) Hand out one 11” x 17” paper to each group. Each individual team member is required to come up with at least one filter design.

6) Members of student groups select best design and complete questions that follow in the “Engineering Design Worksheet” before moving on to the next step, building the filtration model.

7) Follow the directions in the worksheet to complete the challenge, regarding limitations, testing and redesign.

**Formative Assessments:**

Engineering Design Process Worksheet – filled out by each group member and reviewed by the instructor to ensure that groups and individuals within the group are completing all components of the engineering design process.

**Summative Assessments:**

Students will be assessed using the Challenge Rubric, which includes components from the engineering design process worksheet.

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| **Differentiation:** |

Use “clarity” of the water for the summative assessment. Student groups keep samples of filtered water to demonstrate that they are making changes to the design. Limit the amount of “polluted” water each group is given.

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| **Reflection:**  |

Using the Engineering design worksheet helped keep each group on task and provided an easy way to monitor progress. Each team member was required to provide one solution to the challenge and when the best solution was selected, the team was required to explain why they selected it. These two steps were the foundation of positive group dynamics. It provided a common conversational focal point and it helped facilitate an atmosphere that enabled all members to feel essential to the success of the team.