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| **Lesson Title : Surface Water Pollution** | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: Water Filtration** |

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| **Estimated Lesson Duration:** | **7-8 class periods (47 minutes each)** |
| **Estimated Activity Duration:** | **3 class periods (47 minutes each)** |

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| **Setting:** | **Science classroom** |

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| **Activity Objectives:** |

-To understand where and how communities get fresh water

-To describe the types of contaminants found in surface water run-off

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| **Activity Guiding Questions:** |

-What given materials work best to create the most sufficient water filter?

-Where is fresh water on Earth?

-What contaminants are most commonly found in ground water? Where are they generated from?

-What are common methods used to filter contaminants from surface and ground 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 New Learning Standards for Science (ONLS)** |
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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)** |

| **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, ONLS and/or CCSS):** |

**NGSS**

**MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and** **constraints of the problem.**

**MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best** **characteristics of each that can be combined into a new solution to better meet the criteria for success.**

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

**This activity was taken from the Northwestern University Center for STEM Education Website**

**The website URL for this activity is** [**http://www.stem.neu.edu/programs/k-12-school-field-trips/water-filtration/**](http://www.stem.neu.edu/programs/k-12-school-field-trips/water-filtration/)

Materials for Day One/Two:

* YouTube Video: “Where we get our fresh water”- <https://www.youtube.com/watch?v=Pz6AQXQGupQ>
* Pre-Assessment-True/False Statements for the YouTube video “Where we get our fresh water”
* Handout-Evaluation of water filter
* Materials for building the water filter:

For the Class:

* 2 bottles, plastic, clear, 2-liter with caps
* Funnel
* Masking tape
* Permanent marker
* 5 clear plastic 1-liter bottles with caps
* Tea leaves
* Potting soil
* Cornstarch
* Tablespoon measure
* Teaspoon measure
* 1 cup measure
* 16 liters of warm water

For each group

* Filter holder
* 2-liter bottle cap with hole drilled through it or size 4 rubber stopper with hole in it
* 1 cotton ball, jumbo size
* Cheesecloth cut into 10”-12” square
* 1 coffee filter, paper, round 8-12 cup
* Art sand, washed, uncolored, ½ cup
* Gravel, aquarium, fine, uncolored, ½ cup
* 2 cups, plastic, clear, 16 oz.

Day Three:

* “Three Truths and a Lie” worksheet (one per student)
* YouTube Video: “Fifteen to the River” <https://www.youtube.com/watch?v=GrBEEjijxaY>
* Chart paper or oversized paper to record brainstorming essential questions

I also like this video: https://www.youtube.com/watch?v=LMq6FYiF1mo

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| **Teacher Advance Preparation:** |

* Gather all materials for building the filters (enough for each group)
* Copies of evaluation sheets (one per student)
* Copies of pre/post assessment sheet (one per student)
* Copies of “Three Truths and a Lie” activity (one per student)

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| **Activity Procedures:** |

Day 1-2:

1. Warm-up activity: Students will take a pre-assessment about where we get humans get fresh water. This will be a series of true or false statements that students complete on their own. The class will refer back to these statements after watching the YouTube Video “Where we get our fresh water”.
2. Show students a bottle of Mystery Water. Encourage students to use their observation skills to guess what contaminants are present in the “mystery water”
3. Challenge students to work as environmental engineers. Tell them that their goal is to design water filters to clean this contaminated “mystery water.”
4. Students will assign a score to water filter designs to represent how well their water filter designs to represent how well their water filter met that criterion. They will add all of the scores together to determine a final score for their water filter.
5. Distribute samples of filter materials to each group and explain that students can use any of these materials to design their filters. Explain that each one of these materials will be assigned a cost.
6. Show students the set of “mystery water” dilutions that you created, and explain that students will use these bottles to determine color and particle scores by comparing their filtered sample with the diluted samples. Each sample number corresponds to the score.
7. Explain that the second step of the Engineering Design Process is to “Imagine” several different water filter designs.
8. Students individually brainstorm ideas for their design and then discuss their ideas with their groups.
9. Once groups decide on a design, they must draw a diagram of their water filter and calculate the cost of their filter.
10. Students then “purchase” their material and construct their filters.
11. Once all groups have finished, students will test their filters using the “mystery water.”
12. Groups then compare their filtered water to the five diluted samples to determine which theirs most closely matches. Groups will then calculate their scores.
13. Teacher will show the YouTube Video “Where we get our fresh water”. Students will then self-assess their answers on the warm-up activity (true/false questions). Have students identify the main points of the video, and discuss the importance of fresh water to populations around the world.

Day 3:

1. Warm-up task: Students will be asked to read four statements about the video “Fifteen to the River”. Before showing the video ask the students to predict which of the four statements is the false/incorrect statement (activity is also known as “3 truths and a lie”). Show Video: “Fifteen to the River” YouTube video. Go over the statements and discuss the lie with the students.
2. Introduce the “Big Idea” of the unit to the students.
3. Instruct students to complete the following in their science notebooks on their own:

* Rewrite the big idea in your own words (looking for student interpretation)
* Write down at least 3 essential questions you have that could clarify the big idea for you.

1. Allow students time to brainstorm essential questions on their own. Then implement “Think Pair Share” and “table talk” activity. Be sure to record students ideas somewhere in the classroom where everyone can see them.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

1. Students will take a pre-assessment about where we get humans get fresh water. This will be a series of true or false statements that students complete on their own. The class will refer back to these statements after watching the YouTube Video “Where we get our fresh water”. Students will be self-assessing their knowledge on Earth’s fresh water.
2. Students will be asked to read four statements about the video “Fifteen to the River”. Before showing the video ask the students to predict which of the four statements is the false/incorrect statement (activity is also known as “3 truths and a lie”). Show Video: “Fifteen to the River” YouTube video. Students will be self-assessing their knowledge of run-off.

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

none

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.  Refer to Activity Template for details. |

Auditory and visual learners will benefit from the YouTube videos that go along with the formative assessments (Warm-up activities for Day 1 and 2).

Kinesthetic learners will benefit from building the water filter (Day 1 activity).

Students will special needs will be working in cooperative learning groups during the Day 1 activity to build a water filter.

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

Successes:

Both YouTube videos were able to address students’ misconceptions about the amount of fresh water on earth, along with who is affected by storm water pollutants. Many students were not aware of how storm water run-off went directly into our nearby rivers and streams. Students were also not aware that our water comes from these nearby rivers and streams. This seemed to surprise most students. Most students were not aware that 70% of freshwater usage goes towards agriculture, most of them wanted to say that water is mostly used in cities.

The brainstorming portions of the activities had all students engaged. When brainstorming the essential questions, I used the think-pair-share and table talk strategies. With the table talk I rolled out large pieces of paper that the groups had to share. The students enjoyed sharing their ideas and adding on to their partners’ ideas using the giant paper and markers.

Students enjoyed the challenge of building a water filter. I also allowed other groups to help rate the effectiveness of each other’s water filters. That sparked a lot of discussion during the testing time.

Shortcomings:

Took 2 days to design, build, and test filters (only one day was anticipated). In order to really hit the standard, students should have been able to REDESIGN their original filters to compare/contrast their original and modified designs. A redesign activity would have taken an additional two class periods and more materials.