Lesson 1

Filtering Water

INTRODUCTION

This lesson will introduce students to the concepts of water pollution and access to clean water through class discussion and a water filtration experiment.
Note: The filtration methods used in this activity are a simple demonstration and the water should not be considered safe for drinking.

LESSON OVERVIEW

Grade Level & Subject: Grades 5 - 8: Science and Social Studies

Length: 1 class period

Objectives:
After completing this lesson, students will be able to:

- Understand the issues of water pollution and the importance of access to clean water.
- Experiment with filtering various substances from water by making their own simple water filters.
- Observe and draw conclusions based on their experiment.

Next Generation Science Standards **Addressed:**

- **MS-LS2-5**. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- **MS-ESS2-4.** Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- **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.
- **MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Materials Needed:

- Chalkboard or whiteboard
- One 2-liter soda bottle for each student or small group of students

    - These should be pre-cut in half by an adult (see preparation instructions below)
- Filtration materials, such as:
    - Napkins
    - Gravel
    - Sand
    - Cotton Balls
    - Clay
- Materials to be used as "pollution," such as:
    - Dirt
    - Litter (bits of plastic, small objects like paperclips, etc.)
    - Food scraps (i.e. orange peels, egg shells, lettuce, etc.)
    - Bits of leaves or grass
    - Food coloring
    - Cooking oil
    - Glitter
    - Salt or other spices
    - Use any of the above, or any other materials you may have
- Cups or containers for mixing the "polluted water."
- Towels or napkins for clean-up
- Worksheet #1 – **Water Filter Procedure** (one for each student or small group of students)
- Worksheet #2 – **Water Filter Lab Worksheet** (one for each student)

Assessment:
Students will be assessed through the following activities:

- Participation and contribution to class discussion
- Participation in Water Filter Activity
- Completion of Worksheet #2 – **Water Filter Lab Worksheet**

LESSON BACKGROUND

Relevant Vocabulary:

- **Pollution:** Unnatural or harmful substances.
- **Filtration:** The process of removing matter from a liquid by means of porous media (materials with holes, various-sized).

Information:
Although Earth is covered with water (over 70% of Earth's surface), only about 3% of the water on our planet is not salt water. Of this tiny amount of freshwater, much is locked up in ice and glaciers. Of the remainder, less and less is available to humans because of rising populations and increased pollution. Everyone on Earth must share the same water continuously cycling through, and we are all connected by watersheds. Almost everyone in the United States is used to having clean water anytime, at the turn of a faucet. Most of the world's people are not so lucky, and must obtain water from a variety of sources. Many of these water sources contain pollution of some form, whether it is bacteria and microorganisms, chemicals, toxins, waste, litter, or other substances and materials.

Resources:
https://water.usgs.gov/owq/
http://www.earthday.org/
http://waterwatch.usgs.gov/wqwatch/

Preparation:

1. Before the lesson, the 2-liter bottles should be pre-cut for each student or small group of students.
2. Cut circumferentially around the bottle about 1/2 or 1/3 of the way down.
3. Keep both pieces together and set aside for activity.

PBS Kids: pbskids.org/zoom

LESSON STEPS

Warm-up: *Water in Your Life*

1. Begin this lesson by discussing with your class the importance of water in our daily lives. Have your students brainstorm how many times today they have used water, and write their answers on the board.
    a. Examples: *drinking, flushing the toilet, taking a bath or shower, brushing teeth, watering yard or garden, washing dishes, filling a pet's water dish or fishtank, cleaning, doing laundry, swimming, fishing, etc.*

Activity One: *Water, Water, Everywhere?*

1. Lead students in a discussion about the overall scarcity of clean water on our planet, and the impact this has on humans around the world:
    a) Although Earth is covered with water (over 70% of Earth's surface), only about 3% of the water on our planet is not saltwater. Of this tiny amount of freshwater, much is locked up in ice and glaciers, and of the remainder, less and less is available to humans because of rising populations and increased pollution.
    b) What are some sources of water pollution? *Oil spills, bacteria and other organisms, toxic chemicals, litter, run-off from city streets, industrial waste, human waste, agricultural waste, etc.*
    c) In the United States, we are lucky to have sources of freshwater, and sanitation facilities and water treatment plants to clean our water. We are also lucky that most of us have running water in our homes, schools and other buildings, and we can access clean water any time of day.
    d) What would you do if you turned on your faucet at home, and no water came out? Where would you find water? Think of nearby bodies of water in your area. Is there a stream or river? A lake? The ocean?
    e) What do these places look like? Could you drink the water? Cook with it? Bathe with it? Feed your pet?
    f) Many people around the world do not have running water in their homes, or even access to clean water. They must gather water from sources near their homes such as communal wells, sewers, rivers, streams, ponds, lakes or swamps. What do you think they find in this water? *Fish, plants and other wildlife, trash, wastes, chemicals etc.*
    g) Depending on where they live, there could be all kinds of things in their water.

Activity Two: *Water Filter Activity*

1. Break students into small groups, and pass out **Worksheet #1 – Water Filter Procedure** (one for each student, or one for each lab group) and **Worksheet #2 – Water Filter Lab Worksheet** (one for each student). Distribute lab supplies to each station (2-liter soda bottle pre-cut in half, filtration materials, "pollution" materials).

2. Have students think about the types of pollution they discussed in the first activity. How could they represent these with the materials provided?

3. Have each group follow the procedure outlined in **Worksheet #1 – Water Filter Procedure** and answer the questions in **Worksheet #2 – Water Filter Lab Worksheet.**

4. Clean up.

Wrap Up: *Water Filter Discussion*

1. Have your students imagine again that they have no running water and no water treatment facilities, and they must collect water from sources near their homes. What might this water look like, taste like, smell like, etc. Would they like to use this water for drinking, cleaning, cooking, etc.?

2. Based on the water filter activity, how would they design a water filter to clean the water they would be using?
    a. What pollutants would they need to filter out?
    b. What materials would they use to filter each kind of pollutant?
    c. Are there any pollutants that they were not able to filter out with their hand-made filters?
    d. Even if the water looked clean, is it possible that the water was still undrinkable?
    e. How might they remove contaminants from the water that cannot be filtered out?
    f. Would they feel safe and comfortable using and drinking the water after using a homemade filter? Would they get sick?

3. Think about microscopic organisms that are too tiny to see and possibly too small to filter. Also, think about contaminants that are dissolved in the water and thus would be difficult to filter. How do water treatment plants and sanitation facilities solve this problem? (Ex. they use chemical cleaners to treat the water.)

4. Remind your students that, although most citizens in the United States generally have reliable access to clean water, many people around the world are not so lucky and must collect and clean their own water. In addition, conditions such as drought, pollution, increased population and unequal distribution of natural resources threaten Earth's water supply. This makes it necessary for each of us to conserve water and find ways to reduce our daily water usage.

Extensions: *Building a Water Filter and Learning About Your Area's Water!*

1. Have students design a water filter they would use if they had to, including drawings. How much would a filter like this cost? Would it be hard or easy to make? Do they have access to

all of these materials?

2. Take a field trip to a water treatment facility! Find out more about the filtration process and other steps involved in purification.

CONCLUSION

After completing this lesson, students will be more familiar with the issues of water pollution and access to clean water. Through experimentation with a simple, handmade water filter, they will have an idea of some methods of filtration.

LESSON PLAN CREDITS

Brenna Holzhauer
Kevin Hauff

Water Filter Procedure

PBS Kids: pbskids.org/zoom

Make Your Water Filter:

1. Place the top half of the soda bottle upside-down (like a funnel) inside the bottom half. (Make sure the cap is off). The top half will be the **filter** and the bottom half will hold the **filtered water**.

2. **Layer the filter materials** (sand, gravel, napkins, cotton balls, etc.) inside the top half of the bottle.

Make Your Pollution:

3. Make a concoction of **polluted water**. Use any of the "pollution" materials provided to you.

4. **Predict** what type of "pollution" might be removed by each layer of the filter materials. Write down your predictions on your worksheet.

Filter Your Water and Make Observations:

5. **Pour** the polluted water through the filter.

6. **Observe** what the filtered water looks like.

7. **Take apart** your filter and look at each of the different layers. Can you tell what each material filtered from the water? Write down the results on your worksheet.

Try it Again:

8. **Empty** the bottle, **throw out** the filter materials, and **wipe** out the bottle.

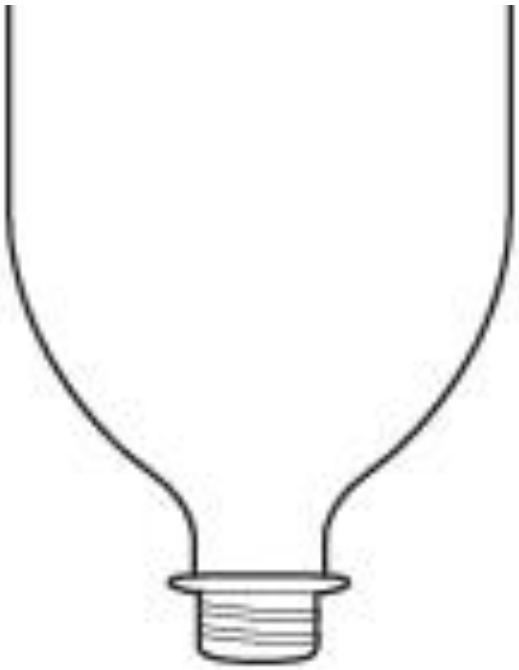
9. **Try it again!** See if you can make the filtered water even cleaner! Try putting materials in **different layers** or try using **different amounts** of each material.

This experiment was adapted from "Water Filter," PBS Kids, pbskids.org/zoom, 2008.

Water Filter Lab Worksheet Name _____

Make Your Water Filter:

1. Draw and label the layers in your filter on the image:



Make Your Pollution:

2. Write your predictions of what type of "pollution" might be removed by each layer of the filter materials:

Filter Layer 1:
Filter material _____
Pollution filtered out _____

Filter Layer 2:
Filter material _____
Pollution filtered out _____

Filter Layer 3:
Filter material _____
Pollution filtered out _____

Filter Layer 4:
Filter material _____
Pollution filtered out _____

Filter Your Water and Make Observations:

3. Write your observations of the filtered water here:
   It looks: _____
   Color: _____ Transparency: _____ Smell: _____
   Does this water seem like it could be drinkable: _____

4. Were your predictions about the filter layers correct? If no, why not? Explain below:

Filter Layer 1:

Filter Layer 2:

Filter Layer 3:

Filter Layer 4:

Try it Again:

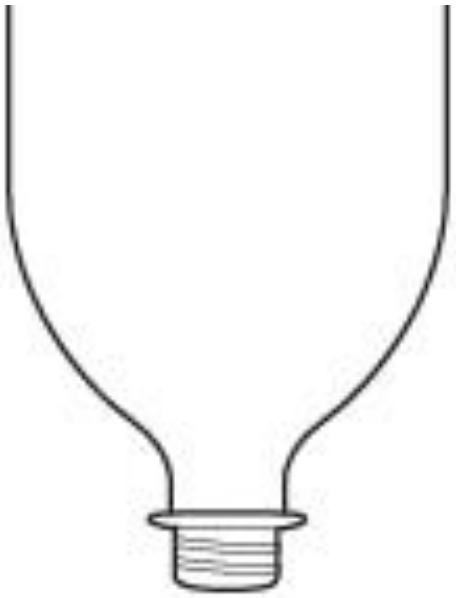
5. What do you think you could do to improve your filter next time?

Re-Make Your Water Filter:

6. Draw and label the layers in your filter on the image:

Re-Use Your Pollution:

7. Write your predictions of what type of "pollution" might be removed by each layer of the filter materials:



Filter Layer 1:
Filter material _____
Pollution filtered out _____

Filter Layer 2:
Filter material _____
Pollution filtered out _____

Filter Layer 3:
Filter material _____
Pollution filtered out _____

Filter Layer 4:
Filter material _____
Pollution filtered out _____

Filter Your Water and Make Observations:

8. Write your observations of the filtered water here:
   It looks: _____
   Color: _____ Transparency: _____ Smell: _____
   Does this water seem like it could be drinkable: _____
   Is this water cleaner than last time? Why or why not?