STEM ACTIVITY OF THE WEEK

Build a Water Filter

Theme: Hudson River; Estuary; Water Quality; Human Impact on the Hudson River; Filter; Plastic Pollution; Combined Sewer Overflows
Ages: 8-14
Prep Time: 10-15 minutes
Activity Time: 20-25 minutes

Activity Summary:
Pollution comes in different forms and from many sources. The pollution we create can often end up in our waterways which then must be filtered out before our community can use it in our homes. Students trial various materials in finding the right combination in order to filter artificial pollution using simple household items.

Goals:
- To understand the issues of water pollution and plastics and its effect on the Hudson River Estuary
- To understand that the Hudson River's health is improving and we can support as NYC residents

Objectives:
- Students will identify and count plastic items
- Students will identify at least one plastic alternative

Lesson Materials:
- **Sample Vessel** - cup, bucket, pitcher, or another container that will hold your contaminated water sample
- **Pollutants-** Pollutants are the materials that will pollute your water sample. Great materials that can be used to contaminate your water include shredded bits of paper, potting soil or ground pepper, olive oil or vegetable oil, dried beans or uncooked rice, and food coloring, bright colored juice, or iced tea. You will add a mixture of these materials into the water in your sample vessel to make your polluted sample.
- **Filter -** There are two main parts to each water filter: the **Container** and the **Filter Media**
    - **Container:** The container will house your filter media, and you will pour your polluted sample into this container so that it can be filtered. The important thing to remember about this container is it should be able to let water pass through the container when poured in, otherwise your sample will not be filtered. You may have to use scissors to poke holes into the bottom of your container for this purpose. Potential containers include: old take out containers, plastic water bottles, colanders, plant pots, etc. Please have an adult help puncture holes in your container.
    - **Filter Media**: Filter Media refers to the materials inside of the filter that water will pass through, getting cleaned up along the way. There are lots of different potential filter materials: you can use sand, paper towels, coffee filters, tissue paper, felt, sponges, rice, gravel, beads and more. The important thing to remember is that water should be able to pass through the filter media. Avoid materials that might completely absorb or discolor the water.

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- Water

Background:
The Hudson River is a dynamic river, which begins at Lake Tear of the Clouds (the Source) on Mount Marcy, in the Adirondack Mountains, and flows to the Atlantic Ocean (the Mouth). This river is part of the Hudson River Watershed or the area of land where all precipitation and connected tributaries flow downward to the ocean. The Hudson River is the main artery of our watershed.

The bottom half of the Hudson River, from the Troy Dam to the New York Harbor, is a tidal estuary or an environment where salt and fresh water meet becoming brackish water. Salt water from the Atlantic Ocean moves up the River through tides and mixes with the fresh water from Lake Tear of the Clouds. This mixing of fresh and salt water makes estuaries one of the most productive marine environments due to the abundance of food and nutrients it collects. Therefore, the Hudson Estuary is an incredible habitat for a wealth of plant and animal life. The Hudson is also an invaluable resource for humans, providing us with drinking water, endless recreational opportunities and a reliable shipping channel.

The Hudson River, however, has endured decades of pollution and degradation from industrial, recreational, agricultural and domestic sources. Polychlorinated Biphenyls (PCBs) and heavy metals from factories have an especially long half-life and therefore continue to persist in our waters, sediments, and living organisms. Boat traffic has released gasoline and ballast water introducing toxic chemicals and invasive species to the River, while agricultural runoff and sewage has contributed harmful amounts of Nitrogen, Phosphorus and bacteria. Since 1972, with the passage of the federally mandated Clean Water Act, the Hudson's water quality has drastically improved as sewer treatment plants were institutionalized and dumping regulations tightened. However, real time monitoring highlights interesting fluctuations in water quality indicators that speak to the dynamic nature of the system and influence of stressors like runoff, Combined Sewer Outflows (CSOs), climate change and erosion. Monitoring water quality indicators teaches students a great deal about the physical and chemical makeup of the Hudson River and the changes that this river has experienced through time.

Lesson Procedure

Pollution comes in different forms and from many sources. The pollution we create can often end up in our waterways which then must be filtered out before our community can use it in our homes. Students will work in teams to trial various materials in finding the right combination in order to filter artificial pollution using simple household items.

As biodiverse as waterways like the Hudson River are, we haven't always treated it with respect. For many years, people polluted the Hudson River. Oil, animal waste, garbage, and chemicals are all pollutants that have a negative impact on the estuary. When pollutants enter our waterways, we want to try to remove them to reduce this negative impact. Today, we will make a contaminated water sample using household materials that mimic certain pollutants in the Hudson River.

Follow the steps below to polluted water and design a filter to solve this problem, and respond to guiding questions along the way:

1. **MAKE POLLUTED WATER-** To simulate the pollutants we can find in the Hudson River and other local waterways, fill your sample vessel with water, and add different ingredients to it that will represent real types of pollution. If you have potting soil or ground black pepper, that can represent erosion, which is often naturally occurring materials that break down over time and wash into the River (things like soil from gardens and lawns). Olive oil or vegetable oil can represent motor oil the spills

out of boats, or even from vehicles on the road which washes into our waterways when it rains. Dried bean or uncooked rice can be used to represent animal waste. Shredded paper will represent trash and litter. Food coloring, colored juice or iced tea can represent chemicals.

2. **DEFINE THE PROBLEM:** Why do you think it is bad that we find these various pollutants in the Hudson River? How do you think it impacts wildlife?

3. **BRAINSTORM:** Look at the list of suggested materials for *Filter Media* found on the previous page. Be thoughtful not to use the same materials for your filter media as you chose for your contaminated water. What materials (choose 3) will you use to filter pollutants out of your sample water? Why?

4. **DESIGN:** Think about in what order you will order your filter media in your container, and assemble your materials.

5. **TEST YOUR DESIGN:** Slowly pour the polluted water sample from your sample vessel through the filter. Make sure there is another container or bowl beneath your filter to catch your filtered water.

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HUDSON RIVER PK
RIVER PROJECT

6. **REVIEW YOUR DESIGN:** Rate how well your filter worked to remove each pollutant on the scale below by circling the number score, where 1 = none was removed (all of the pollutant went through your filter) and 10 = all was removed (there is none of that pollutant in left in your water):

a. Erosion

1 2 3 4 5 6 7 8 9 10

b. Motor Oil

1 2 3 4 5 6 7 8 9 10

c. Animal Waste

1 2 3 4 5 6 7 8 9 10

d. Trash and Litter

1 2 3 4 5 6 7 8 9 10

e. Chemicals

1 2 3 4 5 6 7 8 9 10

Add up the numbers you circled to find your total score. What is your filter's score? _____/50

7. **IMPROVE:** Revisit the problem, how well did your filter work? Which pollutant was the simplest to remove? Which was the most challenging?

8. **REDESIGN:** Based on the results of your first test, make changes to your filter to try and improve performance. What filter media will you add to improve your original design? Why?

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RIVER PROJECT

9. **RE-TEST YOUR DESIGN:** Pour the polluted water through your newly designed filter

10. **FINAL REVIEW OF YOUR DESIGN:** Rate how well your redesigned filter worked to remove each pollutant on the scale below by circling the number score, where 1 = none was removed (all of the pollutant went through your filter) and 10 = all was removed (there is none of that pollutant in left in your water):

a. **Erosion**

1 2 3 4 5 6 7 8 9 10

b. **Motor Oil**

1 2 3 4 5 6 7 8 9 10

c. **Animal Waste**

1 2 3 4 5 6 7 8 9 10

d. **Trash and Litter**

1 2 3 4 5 6 7 8 9 10

e. **Chemicals**

1 2 3 4 5 6 7 8 9 10

Add up the numbers you circled to find your total score. What is your filter's score? _____/50

11. **REFLECT:** How well did your redesigned filter work compared to your original design? What materials were best at improving your filter? What pollutants were *still* challenging to remove from the water?

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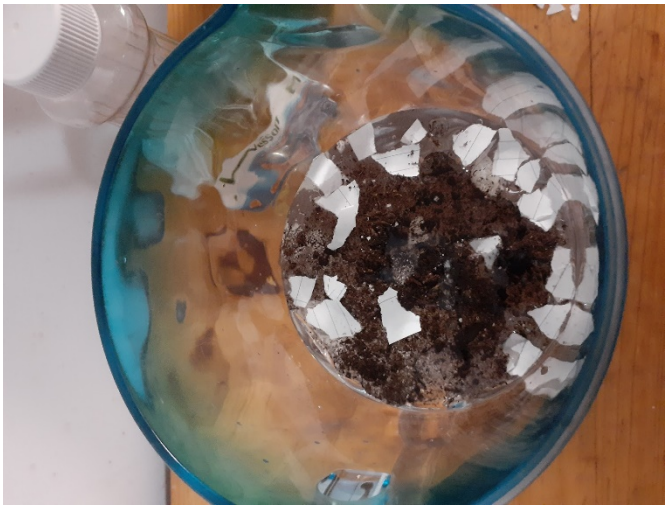
Example Filter Build:

See the images below to see examples of a water filter build and trial. Remember, you might have access to different materials in your home, and that's ok! Be creative and experiment!

1. Contaminated Sample vessel with Contaminants (paper, soil, vegetable oil)

2. Contaminated Sample



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3. Filter Container (make sure that water can pour through the container. If utilizing an old takeout container like this example, make sure to poke holes in the bottom!)


4. Assemble Filter Media (example uses paper towel, sand and tissue paper layers. Remember to try experimenting with your own types of filter media!)



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5. Pour contaminated sample into your filter! Make sure that you have a container under your filter to collect the filtered water!