STEM ACTIVITY OF THE WEEK

Plastics and the Food Web

Theme: Hudson River Estuary; Native Species; Food Web; Pollution, Plastics
Ages: 8-14 years old
Prep Time: 15 minutes
Activity Time: 45-60 minutes

Activity Summary:
Plastic waste is a growing concern for Hudson River Park and local wildlife. To understand the impacts of plastic pollution on the environment, Hudson River Park conducts research to study the concentration of plastic debris and microplastics in the Park's waters. Additionally, in 2019, HRPK kicked off the Park Over Plastic initiative to reduce single-use plastics Park-wide and spread awareness for preserving NYC's natural resources like the Hudson River Estuary.

This lesson explores plastic's impacts on Hudson River wildlife and food web. Students will test the density of various plastic items in water to observe where different plastic products may be found in the Hudson River water column. Students will be introduced to several native species of Hudson River wildlife and their feeding behaviors to make connections of how plastics interact with the food web. The activity closes by discussing solutions to fight plastic pollution in local communities, inviting students to take a pledge to be stewards of the Hudson River and the environment.

Objectives:
- Students will identify at least one impact of plastic pollution on the environment
- Students will test the density of various plastic items in comparison to water
- Students will identify connections between organisms in the food web and plastic pollution
- Students will identify solutions to reduce plastic pollution at home

Lesson Materials:
- Plastic Density Worksheet
- Plastic Density Table
- Hudson River Animals Packet
- Plastic Reduction Pledge Cards
- Life in the Pile Fields Poster
- Used plastic items (cleaned)
- Large pot, bucket or sink filled with water
- Poster board or large sheet of paper
- Pencil
- Paper towels
- Scissors
- Tape or glue
- Salt (optional)
- Markers, crayons or paint for decorating (optional)

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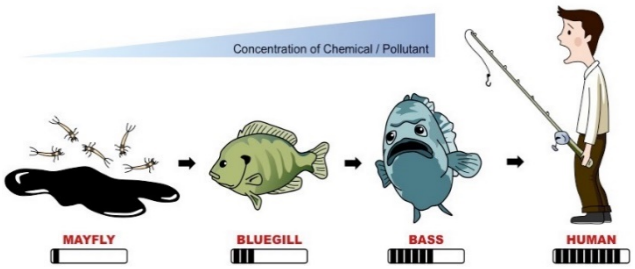
Background:

The Hudson River begins at Lake Tear of the Clouds on Mount Marcy, in the Adirondack Mountains, and flows to the Atlantic Ocean. This river is the main artery of the Hudson River Watershed or the area of land where all precipitation and connected tributaries flow downward to the ocean. Unfortunately, this body of water 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, climate change, erosion and Combined Sewer Outflows (CSOs). New York City depends on a combine sewer system. This is a system in which storm water from the streets are combined with sewage pipes. In the event of heavy rainfall, the system is overwhelmed and both the sewage and storm water drains directly into our waterways such as the Hudson River. These outflows of waste cause a dramatic effect on the quality of life in the Hudson River. Not only bacteria and harmful chemicals are introduced into the water, but also non-biodegradable pollutants like plastic are consumed by wildlife.

Plastic is present in our daily lives and its uses are convenient and endless. Plastic is made from a variety of materials, most commonly from petroleum oil, and its molecules are a series of chains called polymers. This composition allows plastic to be durable and malleable. Much of the plastics produced around the world are single-use, or manufactured to be used once and then discarded. Due to factors like over-consumption, improper disposal and NYC's combined sewer system, plastics often find their way into the city's waterways and build up over time. Plastics negatively impact our environment due to their inability to biodegrade, or decompose by bacteria into organic compounds. After many years plastics eventually break into smaller, microscopic, fragments called microplastics. The rate at which plastics break down is accelerated by the presence of UV rays and heat. Since water retains heat for longer periods than air, plastics fragment much quicker in oceans and other large bodies of water. Microplastics contain toxic chemicals such as bisphenol A (BPA) and PS oligomer. Not only do these chemicals come in contact with humans when they wash up on shorelines, they are also swallowed by organisms. When toxic chemicals build up in an organism over time it is called bioaccumulation**.** When small organisms like plankton and krill ingest microplastics they become malnourished and starve. Larger fish (consumers) depend on plants and plankton (producers) at the foundation of the food web. When populations of producers decrease or their health is compromised by ingesting toxic chemicals,

there can be detrimental consequences for the rest of the food web. Not only is there a threat of starvation and bioaccumulation for producers and consumers when ingesting microplastics, toxic chemicals increase in animals higher up the food chain in a process called, biomagnification. It is important to keep in mind our usages of plastic products in order to reduce its potential to enter our waterways and impact the health of the Hudson River ecosystem from the smallest phytoplankton to the largest predators.



Biomagnification
(BioNinja.com)

Lesson Procedure:

1 – Introduction to Plastics

Educator Note: To investigate plastics in your home further, check out our previous STEM Activity of the Week: Plastics Rapid Survey Lesson.

Educator Script:

Today, we are going to explore the environmental impacts of pollution and discuss their solutions. What are some examples of pollution that you've seen in NYC? (ANSWER: plastic, oil, chemicals etc.) That's right! Pollution is anything that is introduced into the environment that can cause harm to the health of the ecosystem. More specifically, today we will focus on how plastic can be harmful to habitat and wildlife in our waters.

Origin of Plastics: Let's begin by defining what plastic is. How would you define plastic? (ANSWER: plastic is a strong and lightweight material that can be molded to create a variety of products.) Plastic is found in many of the products we depend on today because it is cheap and strong. What are some plastic items that you own that you use every day? (ANSWER: toothbrush, water bottle, backpack etc.) Are there any items made from plastic that you absolutely need? (ANSWER: glasses, inhaler applicator, clothes etc). As you can see, we use plastics for all kinds of things that help us in our everyday life. The problem lies in what happens after it's discarded.

Challenges of Plastic Waste: Millions of plastic materials are produced each year and it can end up in the environment. What your thoughts on how plastic enters the environment? (discuss various ways such as indirect and direct littering, wind, improper disposal etc).) One major source of plastics entering waterways in NYC is through CSO events. CSO stands for Combined Sewer Overflow. During most rainy days, our sewer system overflows wastewater from our homes and street drains directly into our waterways. On average this happens once a week, pouring billions of gallons of polluted water into the environment every year! As a waterfront park, Hudson River Park sees this debris wash up on our shoreline or come in contact with wildlife every day.

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Impacts of Plastic Pollution: Plastic items never fully biodegrade, or break down into organic matter. Instead, they break into smaller and smaller pieces called microplastics. When plastics enter water bodies like the Hudson River or the Atlantic Ocean, plastics can break at a faster rate. Why would this be a problem for the ecosystem? (ANSWER: plastic is dangerous when ingested by wildlife because of the toxic chemicals it contains. This harms the food web, water quality, air quality and more.)

Now let's explore a little bit more about the animals that live in Hudson River Park and learn about how they feed!

Plastic debris on Gansevoort Peninsula at HRPK

2 – Introduction to Hudson River Wildlife

- Using the Hudson River Animals Packet, read the feeding behaviors and habitat zones of each animal. You can also reference the Life in the Pile Field Poster.
- Label your poster with the four zones spaced evenly, leaving room for a title at the top. For example, Surface Zone (or Spray Zone) should be labeled near the top of the poster while Benthic Zone should be closer to the bottom.
- Cut out the animal pictures on page 2 and 3 and tape or glue them on the poster according to their feeding zones and label each animal. You may also choose to draw the animals instead. For example, plankton should be placed under the Intertidal Zone but above the Subtidal Zone. Be sure to space the animals apart to leave room for drawings in the next exercise.

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3 – Testing the Density of Plastics in Water

- Fill a large pot, bucket or sink with water. You may also mix in 2-3 tablespoons of salt per gallon of water to mimic the brackish water of the Hudson River Estuary for a more accurate representation.
- Collect different types of used plastic items in your home and clean them well with soap and warm water. (examples: yogurt cup, water bottle, food wrapper etc.)
- Use the Plastic Density Worksheet to conduct your experiment. You can also use the Plastic Density Table as a reference.

Educator Script:
We will now begin our experiment by observing how different types of plastic behave in water. Remember, the Hudson River Estuary is actually made up of brackish water which is a combination of fresh water and salt water so, the actual results of this experiment would be slightly different in the River. Now, if a plastic item were to enter the River, let's find out whether it would sink or float based on its density. What is density? (ANSWER: the amount of mass per volume) basically, how heavy something is. Begin with the Plastic Density Datasheet and follow these instructions:

1. Fill in the first column with the name of the plastic item.

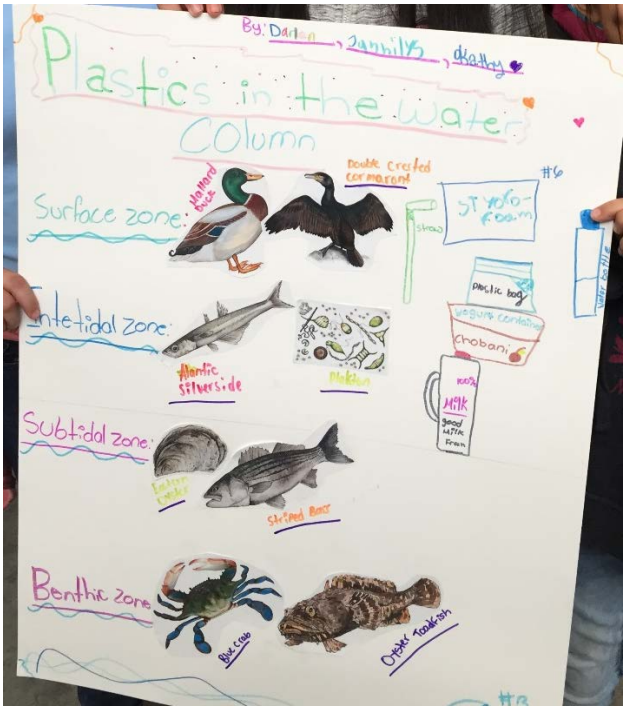
2. Fill in the second column with the RIC code, if available. This is the number inside of a triangle usually found on the bottom or back of the item.

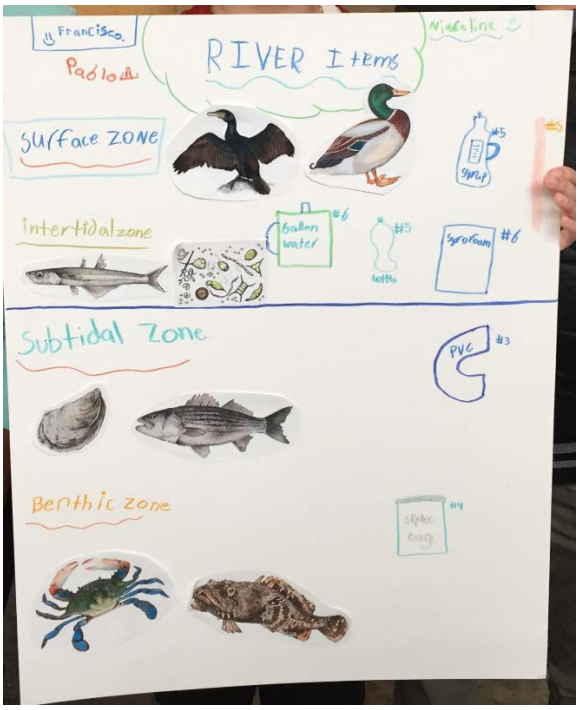
3. Fill in the third column with your prediction on whether the item will sink or float in the water. Think about the weight of the item and the recycling number to make comparisons.

4. Test your prediction! Slowly drop one item at a time into the water and record the result in the last column of your datasheet.

5. Now, go back to your poster. Draw and label your plastic items in the open spaces based on the results of the experiment. If the item floated, draw it in the top half of the poster and if the item sunk, draw it in the lower half of the poster. Remember to add a title and feel free to draw river habitat like piles, sponges, algae and rocks.

6. Record your answers to the Discussion Questions on page two of the Plastic Density Worksheet.





Example Posters from students of P.S. 86

Additional Points:

What's important to remember is that all of these animals are part of something called a food web. What is a food web? (ANSWER: a system of organisms linked together based on their energy relationship such as predator-prey or producer-consumer) You can think of a food web as a network of food chains intersecting with one another. All of the organisms rely on each other to supply their energy source. How are all of the animals on your poster impacted by plastic especially when microplastics are involved? (ANSWER: Since plastics can break down into microplastics, it is easy to be ingested by organisms of all sizes. Small organisms like plankton can carry toxic microplastics into the bellies of animals further up the chain).

4 – Solutions: Take the Plastic Pledge

Educator Script:
Now, let's think about alternatives to some of the single-use items that we tested today and start thinking about how to reduce pollution in our environment. Any suggestions? (ANSWERS: reusable tote bags, portable utensils, reusable water bottle) Great suggestions! Before we wrap up, think about one thing that you can do to help protect NYC's waterways from plastic pollution. It can be one simple change that you can do every day or week. The best type of solution is something that you can do with more than one person such as with your family or even a community you belong to! Once you think of a

solution, let's make that a promise by writing it on a Plastic Reduction Pledge Card and place it where you can see it every day as a reminder. Together, we can be champions of the Hudson River and protect our city's natural resources!

To learn more ways to help, visit https://hudsonriverpark.org/sustainability/park-over-plastic.