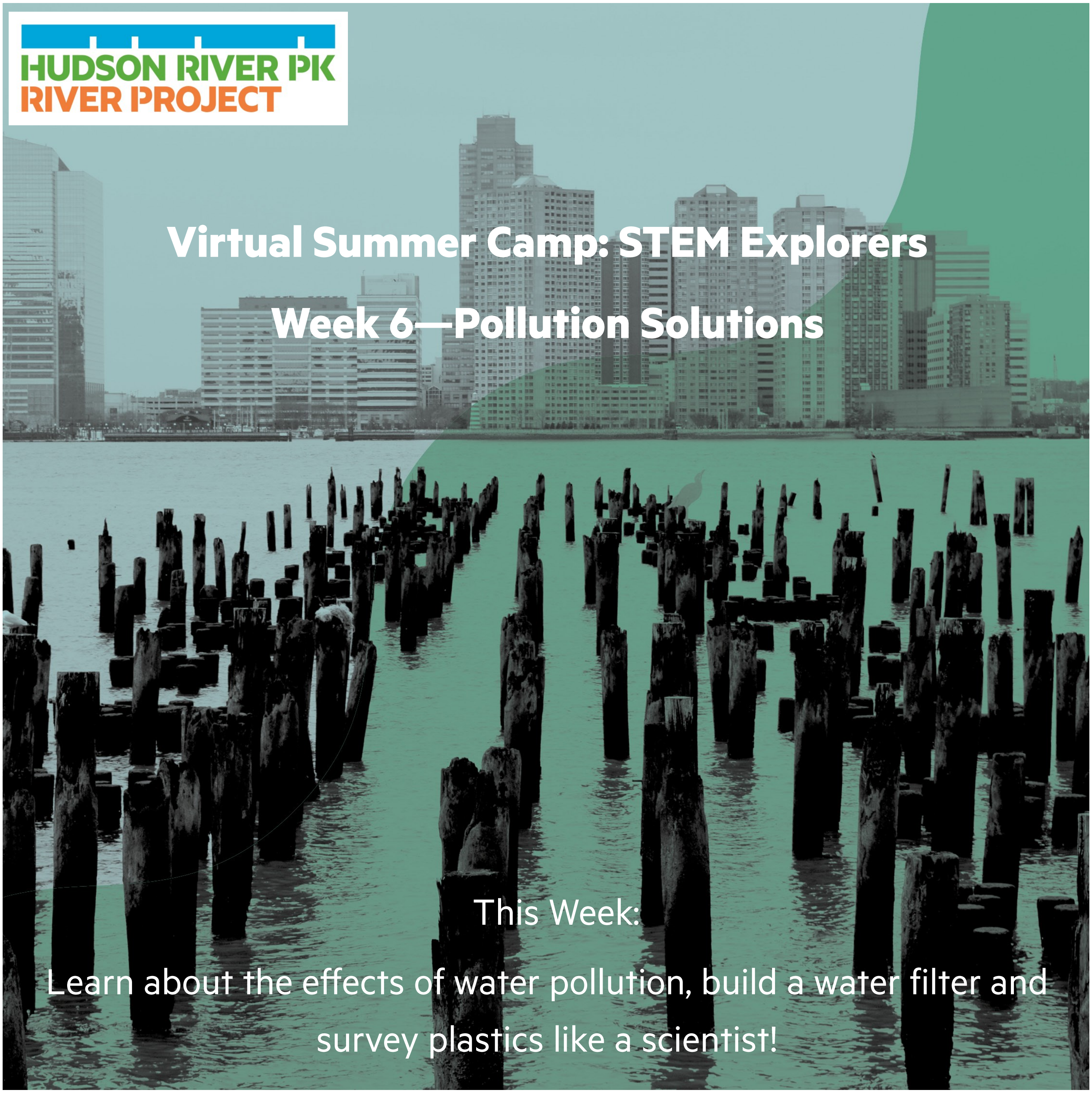


HUDSON RIVER PK RIVER PROJECT

Virtual Summer Camp: STEM Explorers

Week 6—Pollution Solutions

This Week:

Learn about the effects of water pollution, build a water filter and survey plastics like a scientist!

Friday-Monday: Review & Prep! Read through the packet and gather your materials.

Tuesday: Tune in! [Watch](#) our educators lead a live demonstration at 2pm.

Wednesday: Experiment & Build! Follow the activity instructions in your packet.

Thursday: Share Your Results! Submit a photo of your results to education@hrpt.ny.gov to be featured on our website. Then, download next week's packet!

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Week 6— Pollution Solutions

Materials Check List

Build a Water Filter (suggested):

- ☐ Cup, bucket, or pitcher
- ☐ Vegetable oil
- ☐ Potting soil
- ☐ Food coloring
- ☐ Shredded paper
- ☐ Recycled water bottle
- ☐ Coffee filter
- ☐ Gravel
- ☐ Tissue paper
- ☐ Fabric
- ☐ Water

Plastic Rapid Survey:

- ☐ Plastic Rapid Survey Worksheet
- ☐ Writing utensil
- ☐ Calculator

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Build a Water Filter

Theme: Hudson River; Estuary; Water Quality; Human Impact on the Hudson River; Filter; Plastic Pollution; Combined Sewer Overflows
Ages: 3-8
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.

- 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:

VIRTUAL SUMMER CAMP: STEM EXPLORERS

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.

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?

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?

____

____

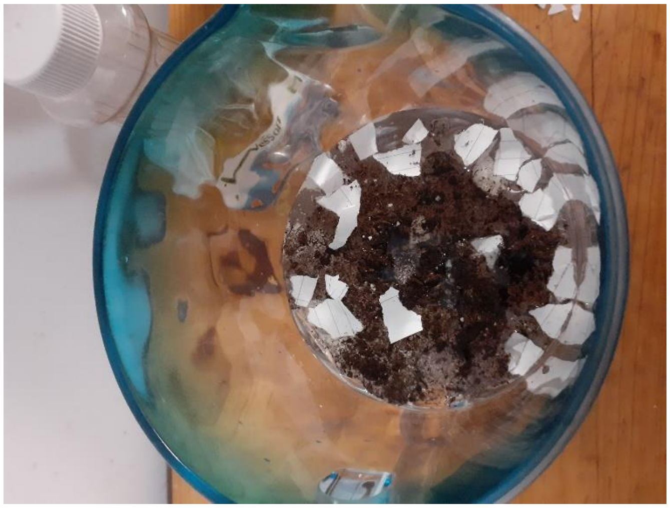
____

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



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!)



VIRTUAL SUMMER CAMP: STEM EXPLORERS

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

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Plastic Rapid Survey

Theme: Plastic Consumption; Water Quality; Combined Sewer Overflows; Pollution; Human Impact on the Hudson River Estuary
Ages: 8-14 years old
Prep Time: None
Activity Time: 30-40 minutes

Activity Summary:
The Hudson River has historically endured years of pollution and degradation. Today, we see that the health of the River's ecosystem has improved due to protective measures set in place through environmental activism, policy change and scientific monitoring of the river's water quality. However, one of the most persistent pollutants that still exists in our environment is plastic. After several years of researching microplastics and marine debris in the Park's waters, Hudson River Park began the Park Over Plastic initiative in 2019 to reduce single-use plastic use Park-wide and improve the health of the River.

This lesson demonstrates how plastics end up in our waterways and prompts students to investigate plastic use in their daily lives. Students will conduct a survey to explore differences between single-use and reusable plastic items found in their home. The activity concludes with a brainstorm of alternative materials to minimize our demand for plastic and ultimately protect our environment.

Goals:
- To understand the prevalence of plastics in our everyday lives
- To understand that plastics come in a variety of forms and used in different ways
- To consider solutions in creating a plastic-free environment

Objectives:
- Students will identify the difference between single-use and multi-use plastic
- Students will identify at least three plastic alternative materials

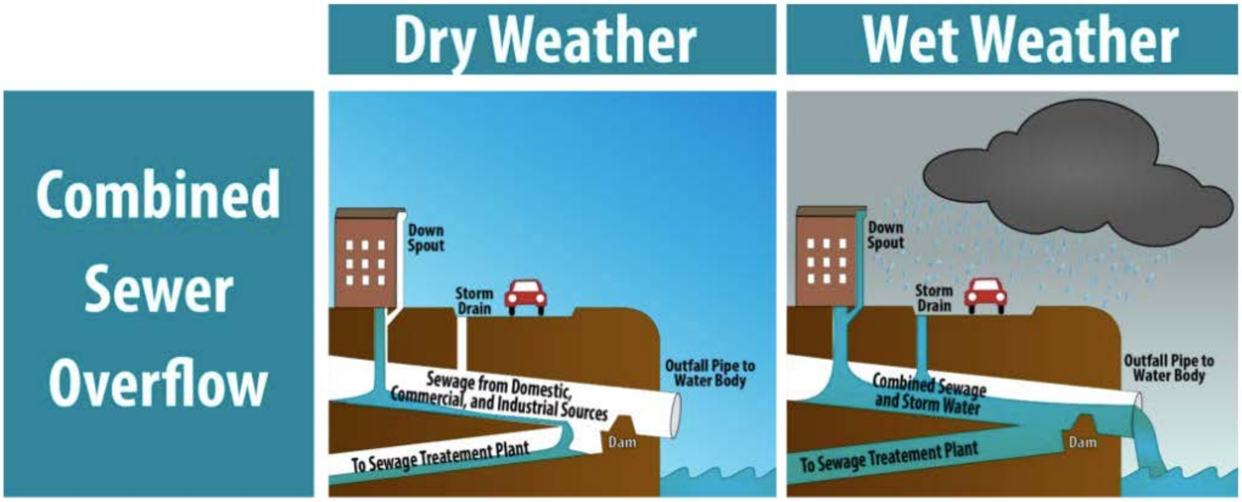
Lesson Materials:
- Plastic Rapid Survey Worksheet
- Calculator
- Pencil
- *Optional* Plastic Rapid Survey Answer Key

Background:
The Hudson River has endured decades of pollution and degradation from industrial, recreational, agricultural and domestic sources. A few examples of historic pollutants to the estuarine ecosystem are chemical runoff from farms and factories, and leaking (or in some cases, intentional dumping) of sewage and gasoline from motor vehicles and boats. Thankfully, in 1972, the United States government passed the Clean Water Act, which mandates that certain measures are taken to protect our country's waterways and the wildlife that inhabit them. Today, the health of the Hudson River ecosystem is improving, with continued help from scientists and stewards all along the river's 315 miles. In Hudson River Park, scientists are monitoring a variety of water

quality parameters to better understand how human behavior impacts the health of the estuary. This information helps guide the Park in its mission to protect these natural resources.

Plastic is common in our daily lives; it is malleable, durable, lightweight and cheap to produce. These characteristics make it suitable for infinite purposes. It is a highly practical material, but there is a downside to consider: when we are done using these plastic items, that durability means the material lasts in the environment for years to come. This is part of what makes plastic one of the most prevalent forms of pollution in our urban environment. Unlike materials like wood, paper, cotton, etc. plastic is synthetic, or manmade. It can not be broken down by natural processes and returned to the earth. In other words, it is not biodegradable. Plastic can break into tiny pieces that are undetectable to the naked eye, but it never really disappears. This leads to a couple questions: (1) How does plastic end up in the Hudson River? (2) Why does it matter?

1. In New York City, plastic ends up in our waterways for a number of different reasons but one of the major routes is our sewer system. NYC's wastewater primarily runs on a combined sewer system. This is a system in which storm water from the streets are combined with sewage pipes in our homes, schools, and businesses. 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. It is during these **Combined Sewer Overflow** events (**CSOs** for short) that plastic litter on our sidewalks and plastic debris from our homes, such as fibers from our clothes and products that are flushed down the toilet, get washed into the River.



Source: Sewerequipment.com

2. When plastic enters the Hudson River, it is exposed to heat and UV rays from the sun. These factors cause the integrity of the plastic to break down. As larger plastic items break into smaller pieces and float through the water, wildlife confuses these bits of plastic mistaking it for food. Eating these plastics is harmful because while animals might feel full, they have not actually consumed any nutrients they need to survive. Additionally, plastic contains toxic chemicals such as bisphenol A (BPA) and PS oligomer, which can make the animal that consumed them sick. In a process called biomagnification, the wildlife that depends on those sick animals for food are harmed by the chemicals stored in the bodies of those that ate the plastic in the first place.

One of the Hudson River Park's monitoring projects is the ongoing Microplastics Survey, conducted with partners at Brooklyn College. This study determines the concentration of microscopic plastic fragments floating in the Park's waters by trawling, or pulling a fine mesh net through the water, at various locations in the estuarine sanctuary. Another is the Marine Debris study that relies on volunteers from our community to help count, categorize and remove plastics from the shorelines at Gansevoort Peninsula and Pier 76. This study focuses on plastic items larger than one inch and looking for trends in the types of plastic and what kind of products most commonly found washed up along the shore.

By following along with the Plastic Rapid Survey Worksheet, you will conduct a mini-survey of your own that determines the abundance of different types of plastics used commonly at home. All you need is the Plastic Rapid Survey Worksheet, a writing utensil and a calculator, and you're ready to go!

Part 1: Learning Your Plastics

First, choose a room in your home in which you will conduct your plastic survey and gather the materials listed above.

The two main categories you will need to sort items into are single-use and multi-use plastics. **Single-use** plastics are products designed to be used only once. We often repurpose these items and use them again, but we still count them as single-use because of the intent of the manufacturer. **Multi-use** plastics are products designed to be used over and over again.

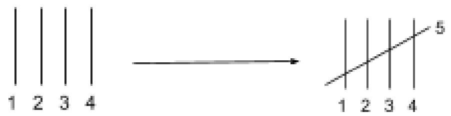
Take a few minutes and brainstorm some of these items you use and write them down on the worksheet

Part 2: Survey Your Plastics

Start off by writing down what room you have chosen to survey at the top of the Plastic Rapid Survey Data Chart.

Next, begin your survey by tallying ALL the single-use and multi-use plastics found in this room. Record your tallies in the spaces provided in the Data Chart. Tally by writing a line for each plastic item. Every 5th item, cross a line through the previous 4. This will make counting your total much easier.

Example:



If you are not sure what material something is made of, you can inspect the object for a label or ask someone at home for help. Feel free to reference the Plastic Rapid Survey Answer Key too.

Once this is complete, count up your tallies for single-use plastics and record the numbers in the space provided below the tally box. Do the same for your multi-use plastics.

Add together your total number of single-use plastics and your total number of multi-use plastics to find your "Total Plastic Items Counted."

Part 3: Analyze Your Results

Finally, take some time to review your findings. Refer to your data to the questions in this section.

For Question 1, use a calculator and the following formula to find out what percentage of your total was single-use.

[Total Single-Use Plastics] ÷ [Total Plastic Items Counted] x 100 = Single-Use Plastics%

For Question 2, Use a calculator and the following formula to find out what percentage of your total was multi-use.

[Total Multi-Use Plastics] ÷ [Total Plastic Items Counted] x 100 = Multi-Use Plastics%

For Questions 3 and 4, reflect on your findings. Brainstorm which products you could be replaced with ones made from non-plastic materials. Think about things you know exist in various manufacturing designs (example: a plastic just of milk vs a glass bottle).

Question 5 is a challenge question. It requires an understanding of the background information provided in this lesson plan, and critical thinking skills. All students are encouraged to give this question a try, and if you hit a roadblock, please refer to the Plastic Rapid Survey Answer Key.

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Plastic Rapid Survey Worksheet

Part 1: Learning Your Plastics

1. Write down 5 specific examples of **single-use** plastics (hint: think of things used on-the-go).

2. Write down 5 specific examples of **multi-use** plastics (hint: these are commonly found in our technology and materials that make our clothing)

Part 2: Survey Your Plastics

Plastic Rapid Survey Data Chart	
Survey Room:	
Single-Use Plastics	Multi-Use Plastics
Tally here:	**Tally here:**
Total:	**Total:**
Total Plastic Items Counted:	

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Part 3: Analyze Your Results

1. What percent of your Total Plastic Items Counted were **single-use** plastics? Please show your work.

2. What percent of your Total Plastic Items Counted were **multi-use** plastics? Please show your work.

3. List 3 **single-use** plastic items found during your survey that could be replaced with ones made from alternative materials (wood, metal, ceramic, cotton, wool, etc.).

4. List 3 **multi-use** plastic items found during your survey that could be replaced with ones made from alternative materials.

5. **Challenge Question** Consider what you know about plastics and CSOs. Even when we do our best to recycle, plastic products can wind up in the Hudson River (hint: refer to the **Background** section of this lesson).

a. What plastic products do you use that you could replace with non-plastic alternatives in the future? Try not to repeat answers from questions 3 and 4.

b. When it rains in New York City, there is usually a CSO event. What can you do at home to limit the amount of water added to the sewer system during these times and why?

c. What are 2 things you can do in your daily life to help solve this problem of plastics in the Hudson River?

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Take the Pledge!

What can you do at home to use less plastic? Talk with other family members to find a solution together! Write your solution and sign at the bottom. Print and place the pledge where everyone in your home can see it as a reminder to make the Earth a cleaner place!

Plastic-Free Pledge

PARK OVER PLASTIC
HUDSON RIVER PK

I, ______________________ , pledge to

(Name)

____

____

I'm taking action because

____

____

Signature:

____

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Plastic Rapid Survey Answer Key

Part 1: Learning Your Plastics

1. Write down 5 specific examples of **single-use** plastics (hint: think of things used on-the-go).

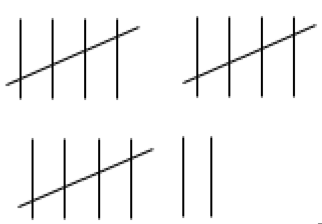
<u>Possible answers:</u> plastic utensils, straws, plastic cling wrap, take-out food containers, shampoo bottles, beverage bottles, flexible plastic cups and plates, chip bags, blister packs for medicines, pill bottles, dish soap and detergent bottles, packaging for electronics and other home goods, plastic shopping bags, etc.

2. Write down 5 specific examples of **multi-use** plastics (hint: these are commonly found in our technology and materials that make our clothing)

<u>Possible answers:</u> game consoles, keyboard keys, remote controls, laptop charger, sweat-wicking polyblend clothing (like athletic shorts), fabric found in sneakers, kitchen tools like plastic spatulas and measuring cups, food storage containers, rigid plastic cups and plates, athletic equipment like soccer balls, yoga mats, jump rope handles, bike helmets, etc.

Part 2: Survey Your Plastics

<u>Example:</u>

Plastic Rapid Survey Data Chart	
Survey Room: Kitchen	
Single-Use Plastics	**Multi-Use Plastics**
	
Total: 17	**Total:** 9
Total Plastic Items Counted (add your totals from above): (17+9) = 26	

VIRTUAL SUMMER CAMP: STEM EXPLORERS

Part 3: Analyze Your Results

1. What percent of your Total Plastic Items Counted were **single-use** plastics? Please show your work.
   $17 \div 26 \times 100 = 65.38\%$

2. What percent of your Total Plastic Items Counted were **multi-use** plastics? Please show your work.
   $9 \div 26 \times 100 = 34.62\%$

3. List 3 **single-use** plastic items found during your survey that could be replaced with alternative materials (wood, metal, ceramic, cotton, wool, etc.).

Example: Three single use plastics I found in my kitchen that could be replaced with alternative materials are my carton of eggs, plastic cling wrap and Keurig pods. In the future, I can buy eggs sold in cardboard, I can use beeswax-coated cotton food wrappers and I can switch to pour-over coffee which uses a ceramic funnel and reusable metal mesh coffee filter.

4. List 3 **multi-use** plastic items found during your survey that could be replaced with alternative materials.

Example: Three multi-use plastics I found in my kitchen that could be replaced with alternative materials are my reusable water bottle, chopsticks and food storage containers. In the future, I can use a reusable water bottle made from aluminium, I can buy metal or wooden chopsticks and I can switch to glass, ceramic or aluminum food storage containers.

5. ****Challenge Question**** Consider what you know about plastics and CSOs. Even when we do our best to recycle, plastic products can wind up in the Hudson River (hint: refer to the **background** section of this lesson).

a. What plastic products do you use that you could opt for non-plastic versions of in the future?

Example: One item I did not mention in my previous answers are my silicone oven mitts. I could instead use oven mitts made of cotton.

b. When it rains in New York City, there is usually a CSO event. What can you do at home to limit the amount of water added to the sewer system during these times and why?

Example: During rain events, I can avoid running the dishwasher and laundry machine because they use a considerable amount of water to clean what is inside. By waiting until after the rain has stopped, I am preventing that water from contributing to New York City's overwhelmed combined sewer system.

c. What are 2 things you can do in your daily life to help solve this problem of plastics in the Hudson River?

Example: One thing I can do to help prevent plastic from entering the Hudson River is refuse unnecessary plastic items in the first place, like plastic produce bags at the grocery store. Another thing I can do is help inform my friends and family about CSO events and how we can minimize their impact by using less water at home when it rains.