



# Marine Debris in the Hudson River

## LESSON PLAN OVERVIEW

This multi-activity lesson plan is for use at the Norrie Point Environmental Center, aboard the Hudson River Sloop Clearwater and at educational tabling events. The target audiences are the general public at outreach events or high school students in formal learning environments. This lesson should be facilitated by an educator in approximately 15 minute lessons. Participants will understand three categories of microplastics, what the main sources are, and how they impact the estuarine, near coastal, and ocean environments. They will look closely at microplastics under magnification, explore the breakdown of different types of marine debris, identify ecological threats of marine, and identify the sources of marine debris in the Hudson River Estuary and global oceans. Participants will also learn how to decrease plastic contamination of aquatic systems through personal lifestyle choices and behaviors.

## OBJECTIVES

1. Participants will be able to define microplastics
2. Participants will identify the three major types of microplastics
3. Participants will classify the primary ways microplastics enter the marine and estuarine environment
4. Participants will observe microplastics samples under magnification
5. Participants will discuss how microplastics effect marine and estuarine ecology
6. Participants will review ways to decrease marine debris through behaviors, legislation and research

## MATERIALS FOR ALL ACTIVITIES

1. Sample jars of plastic beads, textile fibers, and fragments.
2. Prepared slides of microbeads, microfibers, and microplastic fragments.
3. Visual Aids illustrating paths of contamination.
4. Three source artifacts: stuffed bear, facial cleanser, fleece jacket, and grocery bag
5. Viewing equipment: digital camera/tablet or magnifying box
6. Visual Aid showing actions for reducing marine debris pollution
7. Timeline rope (12 feet long)
8. Marine Debris Items: paper towel, newspaper, cardboard, cigarette filter, plastic bag, foam cup, aluminum can, plastic water bottle, diaper, glass bottle, plastic straw, fishing line.

## INTRODUCTION TO MICROPLASTICS: Background for Facilitator

**Marine Debris** is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment.

**Microplastics** are defined as small fragments of plastic marine debris smaller than 5mm. They are an emerging issue on the Hudson River. They are split up into three major categories:

**1. Microbeads** are commonly found in toothpastes, facial scrubs, soaps and other personal care products. They are uniformly spherical in shape and often times multicolored and buoyant. They are currently being phased out by the federal government and eventually natural alternatives to these “exfoliates” will have to be used.

**2. Microfibers** are the largest pollutant of microplastics and are found in any sort of synthetic material, most commonly rags, towels, sheets, and clothing made with synthetic materials. The most common material types are polyester, nylon, and acrylic and are used commonly in tight fitting sports and athletic wear. They become an issue during usage of these products or during washing where the fibers are pulled apart and end up in the wastewater.

**3. Microplastic Fragments** come from larger plastics, such as bags, bottles, containers, films that degrade or break down. This occurs when plastic debris is exposed to sunlight and it begins to weather and fragment, forming microplastics.

### Microplastics entering the Estuarine Environment:

The Hudson River is a tidal estuary with alternating currents flowing North and then South every six hours more than 150 miles inland from the Atlantic Ocean. The most common way microplastics enter this estuarine environment are when larger plastics pollutants enter the system from improper disposal in the watershed. When these plastics are exposed to UV rays and physical stressors like wind and wave action, they are broken into smaller and smaller fragments, eventually turning into microplastics. Another common source of microplastics are personal care items such as face wash, shampoo, and toothpaste, that contain plastic microbeads as agents of exfoliation. The last major source of microplastics are synthetic fabrics (such as fleece jackets) shedding fibers while in washing machines. When household water is drained, those microplastics make their way to the sewage treatment plant before re-entering the water system. However, these treatment plants are unable to filter out microplastics, and as a result, they make their way into the Hudson River Estuary.

Because the Hudson River is a tidal estuary, residence time of the water is slowed due to the alternating current, creating a longer exposure time of plastics to the estuary system which is a critical habitat for young migratory fish. Microplastics can be found anywhere from the top of water column to the river and coastal sediments.

## Ecosystem Impacts:

1. **They are manufactured using many chemical agents:** During the creation of plastics a lot of colorants, pigments, oxidizing agents and other chemicals are used to create the color, durability and shape of the plastics. These chemicals will leach off of the plastic overtime and may have negative effects on exposed species.
2. **They can accumulate toxins:** Plastics have been found to absorb toxins on its exposed surface, which can enter the food web when ingested. PCB's are one example of a chemical that can be absorbed in this substrate.
3. **They can promote microbe colonies:** Since the plastic goes through the wastewater treatment process and out in the "treated" water it can create a home to possibly harmful microbe colonies such as E. coli.
4. **They can be confused as food:** Small predators or filter feeders may fill their stomachs with plastic instead of food, leading to malnutrition and even starvation. The plastic can even puncture the stomach or intestines of the consumer and may cause other negative health effects as toxic chemicals leach off of the plastics. Predators higher on the food chain may accumulate these toxins by eating contaminated prey.
5. **Drinking water:** Microplastics have been found in most of our drinking water around the world and the impacts of that are just beginning to be understood.

## PRE-ACTIVITY DISCUSSION: Breaking Down

### PROCEDURE

Ask participants to imagine what the world would be like if nothing ever broke down (leaves, trees, trash, etc). Discuss what forces cause decomposition (water, sunlight, bacteria, etc). Introduce the idea that different materials take different amounts of time to breakdown into pieces we cannot see. Discuss the idea that breaking down means something becomes smaller but not disappearing, some things become food and other things may look like food but are contaminants.

### ACTIVITY 1: MARINE DEBRIS SOURCE

### MATERIALS

1. 12-ft Rope (painted with date ranges in red, yellow, and green)
2. 12 Time Tags (labeled with specific times associated with each marine debris item)
3. Marine Debris Artifacts (paper towel, newspaper, cardboard, cigarette filter, plastic bag, foam cup, can, plastic bottle, diaper, glass bottle, fishing line, and straws)
4. Time Tag Chart:

Epochs	Marine Debris Artifact
Less than 1 year	Paper Towel
Less than 1 year	Newspaper
Less than 1 year	Cardboard box
1 -100 years	Cigarette filter
1 -100 years	Plastic grocery bag
1 -100 years	Plastic foam cup
1 -100 years	Aluminum can
More than 200 yrs	Plastic straw
More than 200 yrs	Plastic beverage bottle
More than 200 yrs	Disposable diaper
More than 200 yrs	Monofilament Fishing Line
More than 200 yrs	Glass Bottle

## PROCEDURE

Stretch the color-coded rope across the table as a timeline. The participants work together to place marine debris artifacts along the timeline to show how long they think each will take to break down. The three colored lengths of the rope correspond to time ranges (red = more than 200 years, yellow = 1 - 100 years, green = less than 1 year). Once the participants have agreed on the placement of the debris items, discuss why they chose that order. The facilitator can correct any mistakes and participants can switch around the items as needed.

## DISCUSSION

While scientists don't know exactly how long different materials take to breakdown in the natural environment, what generalizations can you make about materials that take less than 1 year versus materials that take more than 200 years?

What forces cause these materials to break down? (waves, sunlight, bacteria)

Do you use any of these items in your daily life? What are the alternatives?

What are some ways you can prevent these items from becoming marine debris?

What happens when plastic materials break down and become microplastics? (next activity helps answer this one)

## PRE-ACTIVITY DISCUSSION: Plastics Around Us

### PROCEDURE

Ask the participants to look around and find plastics nearby, in the water, on the ground, or on their person. Have them close their eyes and imagine their bedroom or classroom and look for plastics in there. Invite students to think about where plastic objects go after they've been used.

## ACTIVITY 2: Identify and Match

### MATERIALS

1. Sample jars of plastics macrobeads, macrofibers, and macrofragments.
2. Prepared slides of microbeads, microfibers, and fragments.
3. Source artifacts: fleece jacket, stuffed animal, facial cleanser and grocery bag
4. Visual Aids illustrating paths of contamination.
5. Viewing equipment: digital camera/tablet or magnifying box

### PROCEDURE

Present source artifacts and sample jars of macro-plastics (beads, fibers, fragments) for participants to observe. Then ask participants to match the marine debris samples with the sources. Use the visual aid showing the path of microplastic contamination and discuss how plastics breakdown. Show visual aids of fish and plankton consuming plastic materials. Then demonstrate how the viewing equipment works and allow participants to observe the microplastic samples. Discuss the ways plastics affect the have on the ecosystem. Show visual aid with actions to decrease marine debris contamination and ask participants to choose one or two that they can implement immediately.

### DISCUSSION

How do microplastics affect the environment?

What are some of the sources of microplastics?

What can you decrease marine debris?

## Wrap Up: Decreasing Marine Debris

### Procedure:

Present the visual aid of Things You Can Do (from NOAA's Suggested Solutions) and ask participants to choose one that they could adopt immediately or implement in the future.

#### THINGS YOU CAN DO:

- Get involved in or organize a cleanup in your area.
- Reduce, reuse, and recycle.
- Choose reusable water bottles.
- Do not use disposable straws.
- Choose natural fibers like wool and cotton instead of fleece and acrylic clothes.
- Wash fleeces less often
- Use a fiber-catch device like a Guppy Bag or Cora Ball
- Collect and properly dispose of discarded fishing line
- Pick up any debris you see while outside.
- Support legislation and other measures that help stem the marine debris problem.
- Spread the word and serve as an example to others.

[www.marinedebris.noaa.gov/discover-issue/solutions](http://www.marinedebris.noaa.gov/discover-issue/solutions)

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