

KEEPING OUR COASTLINES CLEAN

A U.S. Virgin Islands
Marine Debris Curriculum





SOURCES & TRANSPORT

Links to the Next Generation Science Standards, Quick Reference Guide

Curricula by Sub-Section		Middle School						High School					Sci & Engineering Practices
		ESS 3-1	ESS 3-2	ESS 3-3	ESS 3-4	ETS 1-1	ETS 1-2	ESS 3-1	ESS 3-3	ESS 3-4	ETS 1-1	ETS 1-2	
Composition & Abundance	Beach Box Exploration			✓									✓
	Investigating Oceanic Garbage Patches			✓					✓				✓
	A Degrading Experience			✓					✓				✓
Sources & Transportation	Watershed Walk	✓		✓				✓					✓
	Sources of Microplastics: Microbeads			✓									✓
Impacts	Entanglement Problems			✓	✓				✓	✓			✓
	Natural Disasters and Marine Debris		✓	✓	✓			✓					✓
Solutions	Linked Beach-Ghut Clean Ups	✓		✓					✓				✓
	Mitigating Microplastics			✓					✓				✓
	Upcycling Plastic Bags					✓	✓				✓	✓	
	Making Connections Through Art			✓					✓				✓

LESSON: Sources of Microplastics: Microbeads

This lesson was modified with permission from Oregon Sea Grant's "Bags, Bottles and Beads: Sources of Microplastics" lesson from the Marine Debris STEAMSS (Science, Technology, Engineering, Art, Math, and Social Studies) curriculum. (https://oregoncoaststem.oregonstate.edu/sites/oregoncoaststem.oregonstate.edu/files/MD/mitigating_microplastics_-_lesson_one.pdf)

Grade Levels: 5-8

Subject Areas: Marine Biology: Debris Sources, Ecology

NGSS Connections:

- MS-ESS3-3:
 - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
 - ESS3.C: Human Impacts on Earth Systems - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
 - ESS3.C: Human Impacts on Earth Systems - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
- Appendix F: Science & Engineering Practices

Time: ~60 min (1-2 class periods depending on class length)

Description & Objectives: These lessons are designed to be used after completing any of the Composition & Abundance lessons. Students will learn what microplastics are, where they come from, and their effect on the environment.

Guiding Questions:

- Where does marine debris come from?
- How does marine debris get into the ocean?
- How do microplastics impact the marine environment?

Key Ideas & Concepts:

- Microplastics are any plastic marine debris that is less than 5 millimeters and bigger than 1 nanometer.
- Microplastics come from personal care products, laundry lint, or from larger plastics that have been broken up or photodegraded into very small pieces.
- Approximately 80% of marine debris originates on land (litter, trash blown into the street) and the rest comes from the ocean-based sources (lost fishing gear, abandoned boats, dumped trash).

Pre-Requisite Skills: Students will need to understand the basics of what plastics are and the general idea of marine water movements (i.e., tidal activity, circulation, waves).

Teacher Preparation:

- This is an in-class activity where students will complete an observation-action cycle where they make observations about microplastics in a jar, change the habitat in the jars (shaking) and make new observations. Students will then use their observations to make predictions and explanations about what happens to microplastics in the ocean.
- Pre-label the jars, label half "A" and half "B". Fill the "A" jars with ~1 tablespoon of soap containing a plastic exfoliant, and the "B" jars with ~1 tablespoon of soap containing a natural exfoliant. Don't tell the students which jar contains which exfoliant.

Materials Needed:

- 2 jars that seal for each group or pair
- Water (enough for each group to fill their jars halfway)
- Liquid soap/face wash with plastic microbead exfoliators (here is a link to products with and without microbeads by country: <http://beatthemicrobead.org/en/product-lists>)*
- Liquid soap/face wash with natural (non-plastic) exfoliators
- Cleanup space
- Coffee filters
- Jar/bucket for microbead disposal (prevents escape to the sea)

***Teacher Note:**

- This original lesson was created pre-2015. The United States Microbead Free Waters Act of 2015 has now gone into effect which bans microbeads in personal care products; most "beads" in face washes and other products are now water-soluble, so it's unlikely products with exfoliating, plastic microbeads are still available. However:
 - The plastic from previously-used products is still in the ocean and microplastics are still a problem.
 - While personal care products with plastic microbeads are banned in the U.S., there are many places around the world where microbeads are still used in these and other products. Microplastics are truly a global issue, still.
- Consider completing the activity using just face wash with natural exfoliators.
 - Have students observe and draw the particles, and then explain that some soaps used to have plastic instead of the natural materials.

- Ask students to imagine those particles were plastic, to get an idea of the number of microbeads that might enter the ocean from one product.
- Emphasize that there are other sources of microplastics that enter waterways, including plastic fibers from clothing, and that microplastics are generated all over the world.

Teacher Instructions:

Introduction & discussion:

1. Have your students look around and write down all the plastic products they can find (give students 10-15 seconds to look around the room and record what they see). Ask students to share some of the items they recorded.
2. Ask students to think about the amount of plastics in their lives and what happens to those plastics when we are done using them. Ask them to think about what products might have or once had “hidden” plastic in them (microbeads).
 - **Guiding questions** (written or verbal discussion): Do you think there are a lot of plastics in this classroom? Do you think you use a lot of plastics in your everyday life? How many of those plastics do you use only one time (e.g., 16 oz plastic water bottles, sandwich bags)? How many of those plastics do you use multiple times? What products do you think could have or once had “hidden” plastic (microbeads)?
3. After students have completed the discussion and recorded their initial thoughts about plastic usage, talk with them about how microplastics are made. Be sure to mention:
 - Microplastic definition: plastic debris less than 5 millimeter in size and greater than 1 nanometer.
 - Three general types of microplastics: fragments, fibers, and beads.
 - Microbeads and fibers can be manufactured intentionally, but fragments are the result of larger pieces of plastic degrading and breaking down into smaller pieces over time.
 - Plastic microbeads are intentionally manufactured (not anymore in the United States, but still in other parts of the world) and are often used in personal care products like face wash and toothpaste. These flow down drains that eventually lead to the ocean, and have largely unknown consequences on the marine environment.
 - After nine states banned the manufacture and sale of products with microbeads, Congress passed the Microbead-Free Waters Act of 2015, banning the manufacture and sales of personal care products with plastic microbeads starting in 2017 in the United States. Still, many other countries in the world continue to use microbeads in these types of products.
 - Because of this ban, personal care products with plastic microbeads were no longer manufactured beginning in 2017 in the United States. The plastic from previously-used products, however, is still in the ocean and microplastics are still a problem. Microbeads contribute a small part of the total microplastics in the ocean. Synthetic fibers from clothes, as well as the fragmentation of large plastic marine debris, are important and present sources of plastic. Also, while products with plastic microbeads are banned in the U.S., there are many places around the world where microbeads are still used. Microplastics in all their forms, are truly a global issue.
 - Discuss what products contain plastics that they may or may not think about containing plastic (here is a link to products with and without microbeads by country: <http://beatthemicrobead.org/en/product-lists>). This can be done as a conversation or as a presentation with associated worksheets.
 - **Guided questions:** What are plastics made of? Which products contain or used to contain microplastics? Where do most microplastics in the ocean come from? What products used to (in the United States) or still do (in some other countries in the world) contain microbeads? Many microplastics float, but some sink. What are the implications for each in terms of where you are likely to find them (water column, versus sea floor) and the plants and animals using those environments? What might that mean for coral reef environments surrounding the U.S. Virgin Islands?

Experiment:

After the discussion/presentation, challenge your students to use their science skills to figure out which jar, A or B has the plastic in it. Teacher Note: If purchasing products in the United States, neither should, but you can choose two products with visually different exfoliants (ex: those containing natural fragments like walnut shells vs. those containing manufactured exfoliants like microcrystalline wax beads).

- Step 1: Ask your students to observe the two jars of soap and record everything they can see and smell. Remind them to not taste or touch the soap.
- Step 2: Ask your students to carefully fill each jar, A and B, halfway with water and put the lid on the jar. After they have filled the jar, ask them to record what they see. Have the soaps changed?
- Step 3: Ask your students to record what happens when they shake the jar. Remind them again, if necessary, to not taste the liquid.
- Step 4: Ask your students to think about and answer the following questions. You can use the provided worksheet, included at the end of this lesson, if you want to assign this as in-class work or homework.

- Step 5: Have your students filter out the microplastics using the coffee filters and look at the left-over material. Ask them to imagine those particles as plastic, to get an idea of the number of microbeads that might enter the ocean from one product. Explain how up until 2017 many of these commonly used personal care products contained microplastics (now, most are water-soluble beads). Reinforce that many countries still use plastic microbeads in these types of products.
- Step 6: Lead your students in a guided reflection about the activity.
 - Guiding questions: Have your students think about how much laundry gets done in their family (how frequently a washing machine is used at home or at a laundromat). Ask them to think about the type of things that may accidentally go through the wash (small plastic pieces, pens, etc.). How can these things contribute to the microplastics in the waste water? What about the detergent itself? Have your students think about other types of products they may use, such as face wash. Do their face washes have scrubbing elements in them? What about their toothpaste? Do they think those products once likely contained plastic microbeads or were they more likely to contain natural substances, like salt or sugar (this will depend on personal choices at the household level)? Do they think that microplastics get filtered out of household waste or gray water before it enters the environment, or not? How do we know? What would you do to find out? Help lead the students to understanding that many microplastics are found in waste and gray water and may not be filtered out before ultimately entering the ocean. Animals may later ingest the microplastics.
 - Optional activity: An active field of scientific research is understanding the potential impacts of microplastics on organisms, particularly marine organisms that people eat whole, like shellfish (e.g., oysters, mussels, clams). Have your students research the impacts of microplastics on these types of marine organisms and share back to the class.

Teacher Note: For more information about microplastics in local waters, please see *Spotlight: Microplastics - Danielle Lasseigne*.



U.S. Virgin Islands educators and participants from the 2016 Marine Debris Workshop work through the “Sources of Microplastics: Microbeads” activity (Photo credits: Kristin Wilson Grimes).

Watershed Walk Worksheet

Modified from Oregon Sea Grant's "Bags, Bottles and Beads: Sources of Microplastics" lesson from the Marine Debris STEAMSS (Science, Technology, Engineering, Art, Math, and Social Studies) curriculum.

1. What was different about the two soaps before you shook them up? _____

2. What was different about the two soaps after you shook them up? _____

3. What do you think happens to the plastic in soap after someone uses it to wash their face or hands? _____

4. What do you think happens to microplastics (microbeads, fragments, and fibers) when they enter the ocean?
 - a. Do they sink or do they float? _____

 - b. Do they get eaten by wildlife? _____

 - c. Do they dissolve or go away? _____

5. In 2015, President Obama signed the Microbead Free Waters Act, which says that no company can make or sell personal care products with microbeads in the United States.
 - a. How do you think this will affect the amount of microplastics going into the Caribbean Sea?

 - b. How do you think this act affects the amount of microplastics already in the Caribbean Sea?

