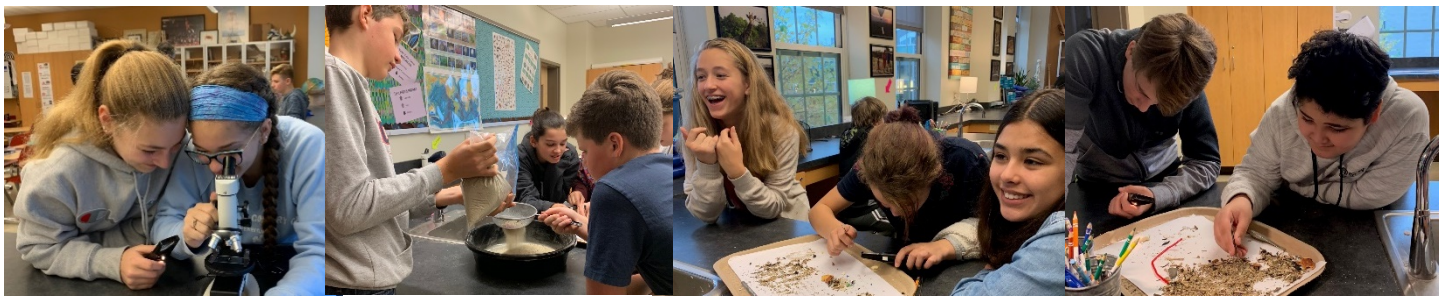

MICROPLASTICS IN THE CLASSROOM

143 Pleasant Street
Portsmouth, NH 03801
(603) 431-0260
www.blueoceansociety.org

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Welcome to Microplastics in the Classroom!

This guide outlines how to conduct Blue Ocean Society for Marine Conservation's Microplastics Research Lab activity in your classroom. Note: this guide is intended to explain how to conduct the Microplastics Research Lab activity independently. To book this program with a Blue Ocean Society educator at your school in the Seacoast region or a community nearby, please contact us directly or submit an online inquiry.

In this guide, you will find:

- **Background information** on microplastics, their sources and sinks, ecological effects and how Blue Ocean Society conducts our microplastics research
- **Curriculum** outlining how to conduct our Microplastics Research Lab activity independently in your classroom
- **Additional resources** you can use to enhance, modify or supplement this activity.

Background

What are microplastics? Microplastics are very small pieces of plastic marine debris, less than 5 mm in size, that end up in the ocean. Marine debris is anything human-made and solid that ends up in the ocean that doesn't belong there. Plastic bags and straws are examples of marine debris. The National Oceanic and Atmospheric Administration (NOAA) defines marine debris as "any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes." Marine debris can be found in the ocean and rivers worldwide, and most of this debris is made up of plastic. Microplastics mainly enter the ocean in two ways: (1) through the fragmentation of larger plastic marine debris and (2) when small plastics enter waterways and travel to the ocean. Microplastics are classified as primary or secondary microplastics based on the original item type or use. Primary microplastics are intentionally manufactured to be less than 5mm in size, where as secondary microplastics start out as larger items (i.e. plastic bottles) that break apart into smaller fragments due to sunlight and wave action among other processes. Below we describe the sources and how these primary and secondary microplastics may end up in the ocean.

Primary microplastics: Small plastic pellets manufactured for industrial use, such as resin pellets (also called pre-production plastic pellets), can be lost during transportation and become marine debris. Because they are used as the primary feedstock in the production of larger plastic items, nurdles are known as *primary microplastics.* Another source of primary microplastics is personal care products. Many face washes, body washes, soaps and toothpastes contain plastic microbeads that act as exfoliators. The plastic microbeads in these products are designed to wash down the drain and may be too small to be captured by water treatment facilities. These microbeads make their way into rivers, streams, lakes and the ocean as primary microplastic debris.

Secondary microplastics: Microplastics resulting from the fragmentation of larger marine debris items are called *secondary microplastics*. Some examples of larger marine debris items are plastic water bottles and straws. These items break apart or fragment into smaller pieces through wave action and sunlight, among other processes. Secondary microplastics also include microfibers. Synthetic fibers from clothing, such as fleece, also travel through waterways to the ocean as they shed off clothing in washing machines.

Where are microplastics found? Plastics and microplastics can be found not only in the ocean worldwide, but also in rivers and streams. Some plastics are buoyant and stay at the surface of the ocean. However, other *sinks* of microplastics include sand on beaches and offshore. A *sink* is any place that collects microplastics (or larger debris items) once they have entered the environment. It is estimated that there are 5.25 trillion plastic particles on the ocean surface. Plastics and microplastics may also be found elsewhere, such as within living organisms that have consumed it, in the substrate, on the ocean floor, or on shorelines around the world.

What are the impacts of microplastics in the environment? There is ongoing research about the impacts of marine debris, and specifically microplastics, on the ocean and the organisms that live there. Due to their small size many animals ingest them mistaking them for food. The effects from eating microplastics can range from mild abrasions to dangerous blockages. Microplastics can fill up the stomachs of animals causing them to feel full and depriving them of the nutrients they need. As mentioned previously since we find microplastics all over the world this makes the impacts they have on the marine environment a global concern.

Why do we sample for microplastics on Seacoast beaches? Blue Ocean Society, in partnership with the University of New Hampshire Cooperative Extension and New Hampshire Sea Grant, began collecting samples for microplastics on Seacoast beaches in 2013. Our study involves collecting sand samples at several New Hampshire beaches from Rye to Seabrook, sieving them for plastics, and then sorting the plastics into various categories. We've learned that in addition to the large plastics on our beaches, there are small ones, too, with foams making up the largest percentage of microplastics across the beaches.

How do we collect our samples? We sample for microplastics at five sites along the Seacoast, visiting each site once per month from April through October. Our sampling protocols, briefly, are as follows:

- Materials needed: $1m^2$ quadrat (string); 4 pencils; one 5 gallon bucket; one 10 gallon bucket; one 5mm sieve; one 1mm sieve; trowel/hand shovel; ziplock bags; sharpie; 30m long string (for measuring distance between sampling sites).
- Step 1: Arrive at exact sampling location – there are 5 sampling locations per beach (roughly: along the highest high-water mark or wrack line; one at the center of the beach, one 30m north of center, one 30m south; one at the northernmost border of the beach and one at the southernmost border; see appendix for example layout).
- Step 2: At each sampling location, set up $1m^2$ quadrat, using pencils stuck into the sand to hold the string in place and form a square. Place smaller bucket nearby, within reach.

- Step 3: Using hands or trowel, scrape off top ~1/2-inch of sand from within entire area of quadrat, placing into small bucket. Stop when small bucket is roughly half-full of sand.
- Step 4: Position 5mm sieve over larger bucket. Pour sand from small bucket through 5mm sieve, ensuring that it falls into the large bucket and items larger than 5mm are collected in the sieve. Set these items aside as a labeled sample.
- Step 5: Pour sifted sand from larger bucket through 1mm sieve (can simply let fall back onto the beach). Collect any items captured in 1mm sieve as another labeled sample.
- Repeat for all sampling locations (5 per beach site).

Microplastics Research in the Classroom Activity

Goal: Demonstrate how microplastics are sampled and examined from beaches for research purposes. Allow student groups to try sampling on their own in the classroom, followed by sorting, and discuss why this research is conducted and how this type of pollution can be prevented.

Supplies (per group of 4): One bucket or bag of sand with microplastics, two mesh strainers used to sift, larger container to catch falling sand, one tray to sort microplastics, two magnifying glasses, one data sheet, two tweezers, one microscope (if available)

Time: ~50 minutes not including set up or clean up

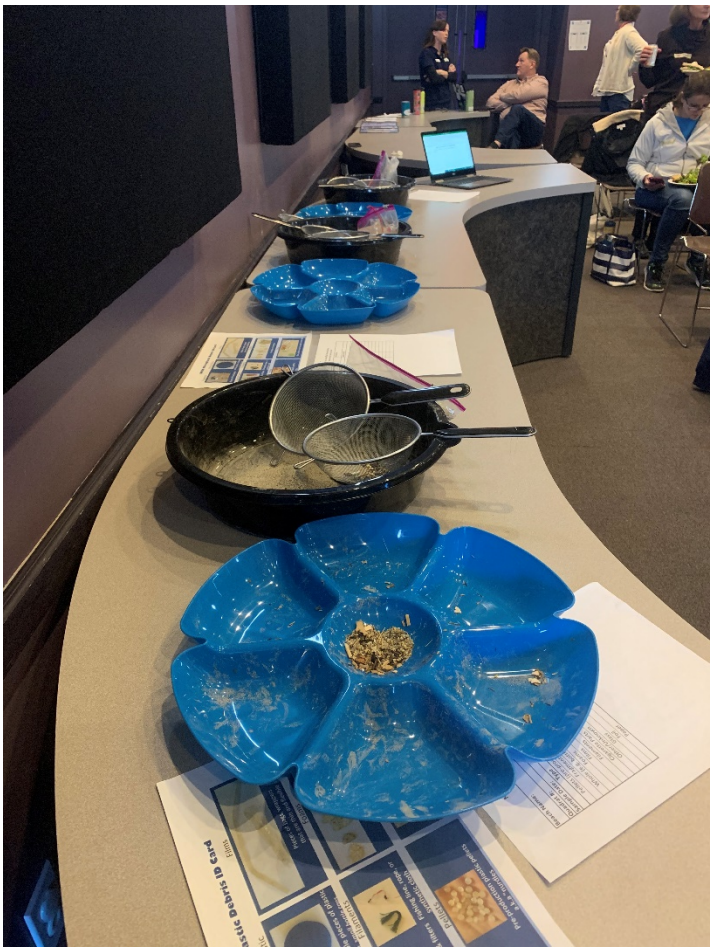
Grade Level: 6-8, or 9-12 when supplemented with larger projects

Suggested Standards: NGSS ESS3.C: Human Impacts on Earth Systems and MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Ocean Literacy Principle #6: The ocean and humans are inextricably linked.

Activity Steps:

1. **PRIOR TO ACTIVITY**: Short presentation on how and why organizations, such as Blue Ocean Society, sample for microplastics at beaches and what we are going to do in the student groups to contribute.
2. **START OF ACTIVITY**: Have student groups of four assign two people as sifters, and two as sorters. These pairs will switch roles halfway through so that everyone gets a turn trying all steps.
    a. **Hypotheses**: Students will create hypotheses about what they will see in their samples and what they will see under the microscopes.
3. The 2 sifters in each group will sift half of their sample to find microplastics by having one person hold the mesh strainer over the large container while the other pours half of the sand sample through the strainer. The person holding the strainer should shake it lightly side to side to sift the sand through. The first round of microplastic samples, along with seaweed, gravel, etc. will remain in the strainer.
4. The 2 sorters in the groups should then pour out the contents of the strainer onto the tray. Using the tweezers and magnifying glasses, they will try to find every piece of microplastic or other inorganic debris in the sample.

5. All pieces of microplastics or other debris should be marked on the data sheet provided.
6. **HALFWAY THROUGH ACTIVITY**: Student pairs should then switch roles, so that the sorters become the next sifters. Repeat all steps above so that previous sifters also get to sort.
7. **END OF ACTIVITY**: Students should take turns examining the microplastics samples and sand underneath the microscope and recording what they find on a separate sheet of paper.
    a. **Alternatively**: Can use a USB microscope to look at the sand and samples under a scope connected to the projector as a whole class at the end of the activity if this works better logistically.
8. **WRAP UP**: Ask students to raise their hands and share:
    a. What kinds of debris did you find in your samples?
    b. What did you think you would see under the microscope? What did you actually see?
    c. Have you ever seen trash this small at the beach?
    d. What can you do to help prevent microplastics from getting to the beach?
        i. I.e. Reducing your use of single use plastics, properly disposing of trash, removing trash in your neighborhood/beaches etc.
9. **BIGGER PICTURE**: This activity can be tied into larger semester projects such as:
    a. Sampling for microplastics in a waterway on or near school property
    b. Developing innovative ideas for microplastics-reducing technology
    c. In-depth research projects on the effects of microplastics
    d. Community-based plastic reduction plans and proposals



Materials example using supplies from a dollar store that can be reused repeatedly. Containers and sorting trays can be any that are accessible to you and your classroom.

Microplastics Sorting Data

Beach Name:	**Sorted By:**	
Sample #:	**Date Sorted:**	
Sample Date:		
Type	**Count**	**Total**
Pellets (pre-produced)		
Fragments		
Whole (e.g. bottle caps)		
Foams		
Films		
Filaments		
Cigarette Parts		
Other/Unknown		
Glass		
Foil		
Paper		

NHSG Microplastic Debris ID Card

Fragments

Pieces of hard plastic

Whole Plastic

Whole pieces of plastic
e.g. small bottle caps

Films

Pieces of bags, wrappers
that are thin and flexible

Cigarette parts

Cigarette butts & filters

Filaments

Fishing line, rope, or
synthetic cloth

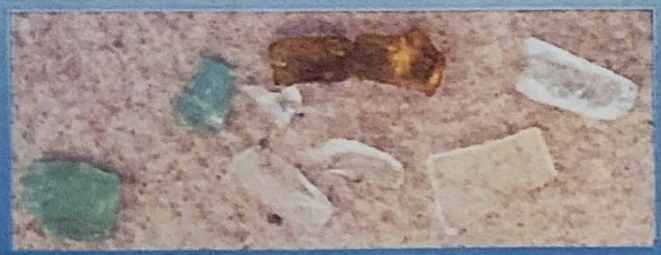
Foams

Styrofoam or insulation

Pellets

Pre-production plastic pellets
a.k.a "nurdles

Other



Glass, rubber,metal-non-plastic human debris

Additional Resources

Reports & Further Reading

- A Microplastics Survey of New Hampshire Beaches: A Citizen Science Pilot Study. 2014 report on initial pilot study with NH Sea Grant and UNH.
- Microplastic Marine Debris. One-pager from NOAA.
- An Educator's Guide to Marine Debris. NOAA Report & Guide.

Videos

- NOAA Marine Debris Program: What Are Microplastics? (1 min)
- Monterey Bay Aquarium Research Institute: Microplastics in the Ocean: A deep dive on plastic pollution in Monterey Bay (5 min)
- National Geographic: Plastics 101 *Excellent Resource for Chemistry Classes* (6 min)
- Plastic Soup Foundation: Micro-Plastics – Toxins in our Seafood? (18 min)

Curriculum

- Mitigating Microplastics: 2016 curriculum for 6th-8th grades from Oregon State University and OR Sea Grant.
- Microplastics and marine environment: "vertically articulated curriculum for students aged 5-15."
- The Plastisphere: Plastic Migration and Its Impacts. Lesson plan from TeachEngineering.org
- Microplastic Extraction of Exfoliating Beads from Cleansers: hands-on engineering activity from TeachEngineering.org
- For a list of microplastics-related curriculum, check out the Florida Microplastics Awareness Project and their K-12 Resources library

Example Layout of Beach Sampling Locations