Puget Sound Beach Sweepers – Keeping Debris out of the Sea

Pacific Shellfish Institute
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Grades 5-10
50-60 minutes.

Overview

This program explores plastics in the marine environment and encourages ways to reduce plastic pollution. Students will watch a short video called "Investigating Plastic Pollution: The Basics" and then rotate through 3 stations: **Sink or Float; Plastic Soup** and **Albatross Bolus Dissection**; and **Fishing for Microplastics.** At these stations students investigate plastic properties, where plastics are found in the ocean ecosystem, and microplastics in everyday products. Teachers may also request field notebooks, supplies, and assistance to organize their own campus cleanup to support scientific field investigation requirements and foster ongoing environmental stewardship.

Komachin Middle School student calculates percent plastics in an albatross bolus

Standards

Common Core Standards:

Science and Technical Subjects, SL.8.1: *Reading science and technical subjects: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)*

Reading #4: *Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a topic or subject area*

Writing #9: *Draw evidence from literary or informational texts to support analysis, reflection, and research*

Next Generation Science Standards:

MS-ESS3-3: *Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment*

Science and Engineering Practices –Asking questions, Developing and using models, Planning and carrying out investigations, Analyzing and interpreting data, Constructing explanations

Disciplinary Core ideas – ESS3.C Human impacts on earth systems

Crosscutting concepts – patterns, cause and effect, systems and system models

Introduction:

1. Play "Investigating Plastic Pollution: The Basics," a 6 ½ minute video produced by Algalita Marine Research and Education: http://www.algalita.org/video/plastic-pollution-a-serious-threat-to-the-environment-april-2013/.
2. After students have seen the video have them turn and talk for 60 seconds sharing one thing they learned.
3. Next read aloud the information paragraph below.

This year Thurston County residents voted to ban plastic bags commonly used at grocery and other retail stores. What are some of the issues you are aware of that led to the plastic bag ban? Plastics are everywhere, we use them every day, but as you learned from the video many of these plastics are finding their way into the marine environment and are impacting wildlife throughout the world. Today we're going to delve a little deeper into this subject through some hands-on activities. Each of you has a workbook that you will complete as you move through the stations. The letter (A,B,C) in the upper right hand corner of your workbook designates the Group that you are assigned to and the Station that you will go to first. *Station A*, **Sink or Float** explores plastic density and where plastics end up once they enter the marine environment. Station B, **Plastic Soup**, demonstrates how plastics impact marine life by observing water samples collected from the North Pacific Gyre "garbage patch." You will also dissect an Albatross boli collected from one of the Hawaiian Islands. Station C, **Fishing for Microplastics**, showcases sources of microplastics in personal care products and allows you to actually filter them out. You will have 8 minutes at each station to complete the activity.

Dissecting an albatross bolus is one station that students rotate through while learning about water quality at Priest Point Park during YMCA summer camp.

Station A: Sink or Float?

Goals: Students will be able to explain what depth various types of plastic end up in the water column (ocean model) and therefore where they will remain in the world's oceans. Students will also be able to share what organisms feed at which depths and what types of plastic objects will affect these organisms.

Objective: Using a model of the ocean, students will investigate whether 6 different types of plastic float or sink. Students will use their data to explain what type of organisms would be impacted by the different types of plastic.

Student Outcome: *I can use an ocean model to investigate whether different types of plastics float or sink and use that data to explain how different types of plastics might affect different types of organisms in the ocean.*

Students learn about plastic density using an ocean model

Vocabulary: benthic, pelagic, density, plastic, surface, buoyancy

Materials:

Workbook – *Sink or Float?*

Density Table and Water column cross-section sheet (surface, pelagic, benthic)

3 plastic tubs filled with water with dish towels placed underneath

3 sets of plastic objects: plastic bottle fragment, grocery bag fragment, plastic film, straw, eating utensil, packing peanut

Station Description and Background Information:

Different plastics have different densities which will determine where they will end up in the marine environment and which animals will be exposed to them. Density is the mass of an item divided by the volume. It is the measure of a material's compactness. For example, a cotton ball has a mass that can be measured. If you squeeze the cotton ball into a smaller shape, it will have the same mass, but a smaller volume – or it increases in density. Most plastic items are marked with an SPI code, which identifies they type of polymer molecules used to make the plastic item. Each type has a different density. If plastic is more dense than sea water (>1), it will sink. If it is less dense (<1), it will float or have more buoyancy.

Marine animals feed at different depths in the ocean, so different plastics will impact different animals depending of the buoyancy of the item. Many sea birds, like the Albatross, feed at the surface of the ocean, while many fish are either pelagic (open water) or benthic feeders (near the bottom).

Investigative Question:

Do various types of plastics sink or float in an ocean model?

1. Using the *Density Table* students determine the density for the 6 types of provided plastics and record the density onto the *Sinks or Float?* page.
2. Students predict whether each type of plastic will sink or float based on the plastic's density.
3. Students then test their predictions by observing what happens when they place each of the 6 plastic objects in their model of the ocean.
4. Students record whether the type of plastic sinks or floats.
5. Based on their results, students use the Density Table and Water Column Cross Section sheets to answer the "Connect" questions to explain which marine organisms might be affected by each type of plastic debris.

Station B: Plastic Soup and Layson Albatross Bolus Dissection

Goal: Students will investigate the contents from a seabird's bolus and water from the North Pacific Gyre "garbage patch" to explore the impact of plastics on our ocean ecosystems.

Objective: Students dissect a seabird bolus to collect data on what the seabird is ingesting. Students also observe water samples collected from the North Pacific Gyre "garbage patch" under a dissecting scope or using a hand lens to record what is in the water. Students use this data as evidence of how humans' use of plastics can have a detrimental impact on animals and ecosystems in remote places.

Student Outcome: *I can carry out an investigation to categorize and analyze the contents of a seabird's bolus and water from the North Pacific Gyre 'garbage patch" to explore the problem of plastics in the ocean ecosystem.*

Vocabulary bolus, ocean gyre, polymer, molecules, biodegrade, photodegrade, plankton, ecosystem

Materials

Workbook – *Plastic Soup* and *Layson Albatross Bolus Dissection*

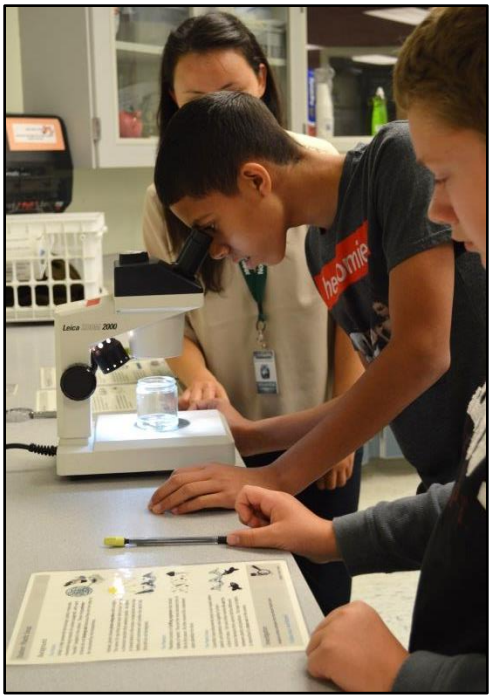
North Pacific Gyre water sample

Dissecting scope (optional) or hand lenses

Nurdle sample

Tracking Trash, Map, and Introduction to the Laysan Albatross sheets

3 dissecting trays, 3 albatross boli, 3 sets of forceps



Middle school students sketch contents from a North Pacific Gyre water sample

Station Description and Background Information

Once in seawater, plastic polymers do not biodegrade because they are too large to be consumed by microorganisms. Instead, UV rays from the sun break them into smaller and smaller pieces in a process called photo-degradation. These pieces travel throughout the world's oceans accumulating in five major gyres where they mix with plankton and inadvertently become food for fish, birds, and other marine organisms.

Seabirds, like the Black-footed and Laysan Albatross, feed on the surface of the ocean. They often mistake plastic debris as food. At this station, students will dissect an Albatross bolus collected from Midway Atoll, in the Hawaiian Archipelago. A bolus is a pellet, similar to an owl pellet, of indigestible items that the bird has regurgitated. Some of the items contained in the bolus are natural, like squid beaks, others are unnatural, like plastic fragments. Students will sketch the bolus and label its inorganic versus organic contents to learn about the diet of an Albatross.

Dissecting the Laysan Albatross

Investigation Questions:

What types of items are found in an Albatross's bolus?

What percentage (by weight) of the items found in an Albatross's bolus is plastic (or not natural)?

1. Students read the *Introduction to the Layson Albatross* sheet.
2. Students then dissect the bolus of the Albatross and categorize the items found.
3. Students count the number of items in each category and record.
4. After categorizing the materials, students weigh the plastic material and the natural materials found and record the measurements.
5. Students determine the percentage of natural vs plastic materials found.
6. Students answer the "Connect" questions.

Observing North Pacific Gyre Garbage Patch Water Sample

Investigation Questions: What types of items/organisms are found in a North Pacific Gyre water sample?

1. Students look at the map and read information on the North Pacific Gyre
2. Students observe North Pacific Gyre water samples under a dissecting scope or with a hand lens.
3. Students categorize, sketch, and label the plastic fragments, zooplankton, and nurdles contained within the sample.
4. Finally students answer the "Connect" questions to apply how their observed items could impact the ocean ecosystem.

Measuring the length of an un-dissected albatross bolus

Station C: Fishing for Microplastics

Goal: Students will observe microplastics in everyday products and think of ways to reduce the amount of plastics and microplastics that are released into the environment.

Objectives: Students read labels on everyday products to identify if they have microplastics in them. Then they select one of the products containing microplastics and filter them out for observation.

Student Outcome: *I can determine if an everyday product has microplastics in it by reading the label and looking for an ingredient with the word "poly". By filtering a sample of the product I can see these microplastics. I can think of alternative products that are plastic-free and other ways to reduce plastic use.*

Students filter microplastics out of personal care products

Materials:

Workbook page -*Fishing for Microplastics*

An assortment of personal care products

Hot plate and small pot

3 Spoons and cups

3 Sieves and coffee filters

3 Collection containers (yogurt containers)

Station Description and Background Information

Many personal care products, such as facial scrubs, shampoos, soaps, toothpaste, and sunblock, contain tiny plastic particles (microplastics) that are used as an abrasive agent or for adding flecks of color. These particles wash down the drain and travel to the waste water treatment facility where their small size prevents them from being removed. The small plastic particles flow into Puget Sound where they mix into the water column and are inadvertently ingested by marine organisms.

In this station, students read labels on common personal care products to determine whether or not the products contain microplastics. These micro particles are listed as polyethylene, polypropylene, polyethylene terephthalate, polymethyl methacrylate to name a few (the "polys").

Fishing for Microplastics

1. Students read labels on common personal care products to determine whether they contain microplastics. These micro particles are listed as "the polys" - polyethylene, polypropylene, polyethylene terephthalate, polymethyl methacrylate, etc.
2. Students follow the directions on the *Fishing for Microplastics* sheet

    1) Fill a glass jar ¾ full with very warm water. **If using a hot plate, make sure safety measures are taken to avoid burns caused by the water getting too hot.**
    2) Add 1 spoonful of product to the jar and stir until dissolved.
    3) Pour contents onto a coffee filter nested inside a sieve. Hold sieve over a container to catch the water as it drains.
    4) Allow filter to dry on a sheet of newspaper and observe plastic fragments.

Students reading labels to determine if products contain microplastics

Additional Resources:

Algalita Marine Research and Education: www.algalita.org/

Find videos, publications, and inspirational action projects performed by students attending the Plastic Ocean Pollution Solutions Youth Summit.

NOAA's Marine Debris Program: marinedebris.noaa.gov/

Find the latest information, educational materials and details about the annual "Keep the Sea Free of Debris Art Contest!" held each October.

Port Townsend Marine Science Center: www.ptmsc.org/plastics.html

Learn about the Plastics Project and discover local efforts to study marine debris and microplastics.

Glossary:

Benthic – Benthos is the community of organisms which live on, in, or near the seabed, also known as the benthic zone.

Biodegrade – Capable of being decomposed, or broken down, by biological agents, especially bacteria.

Bolus – A small rounded mass of a substance, especially of chewed food at the moment of swallowing.

Buoyancy – The ability or tendency to float in water, air or some other fluid.

Density – The degree of compactness measured by the quantity of mass per unit volume.

Ecosystem – A community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system.

Ocean gyre – A gyre in oceanography is any large system of rotating ocean currents, particularly those involved with large wind movements.

Pelagic – Any water in a sea or lake that is neither close to the bottom nor near the shore can be said to be in the pelagic zone.

Photodegrade – The alteration, or change, of a molecule by photons, particularly those wavelengths found in sunlight, such as infrared radiation, visible light, and ultraviolet light.

Plankton – The collection of small or microscopic organisms, including algae and protozoans, that float or drift in great numbers in fresh or salt water, especially near the surface, and serve as food for fish and other larger organisms.

Plastic – A material consisting of a wide range of synthetic (man-made) or semi-synthetic organics that can be molded into solid objects of many shapes.

Polymer – A large molecule, or macromolecule, composed of many repeated subunits.

Surface – The exterior or upper boundary of an object or body.

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