



Stations: Effects of Marine Debris on Ecosystems

Objectives:

Students will understand the three major effects of marine debris on ecosystems: entanglement, ingestion, and toxic pollution. They will connect their personal consumer choices with the effects of marine debris on the marine environment, and design and evaluate ways to mitigate the ecosystem effects of marine debris. They will construct marine debris art pieces to illustrate the effects of entanglement and ingestion.

Concept:

Marine debris has many effects on marine ecosystems. The three main effects are entanglement, ingestion, and toxic pollution. Because plastics persist in the ocean environment for so long, they can have numerous impacts on marine life. Larger pieces of plastics pose a threat as they may entangle marine mammal. Smaller pieces of plastic and those that have photodegraded after exposure to the sun are more likely to be ingested. The longer plastic is in the water, the more likely it is to leach chemicals or attract a biofilm filled with pollutants.

Materials:

- ◎ Science notebooks
- ◎ Pencils
- ◎ Handout: Estimated Life Span of Plastic
- ◎ Sample of photodegraded plastic from gyre
- ◎ Laptop/computer and projector or SmartBoard
- ◎ Entanglement Challenge Station:
 - Photos of entangled animals
 - Rubber Bands
 - Stopwatch
 - Entanglement Challenge Student Directions
 - Entanglement Challenge Set-up Instructions
- ◎ Fishing Line Tug of War Station:
 - Large clump of monofilament or many 2-5 foot strands of monofilament
 - 2 thick pieces of rope
 - Fishing Line Tug of War Student Directions
 - Fishing Line Tug of War Set-up Instructions
- ◎ Top of the Ocean Mat Sculpture Station:
 - Pieces of blue and green netting
 - Pieces of blue and green rope
 - Blue and turquoise plastic bottles
 - 16 gauge wire
 - Scissors
 - Top of the Ocean Mat Sculpture sample
 - Top of the Ocean Mat Sculpture Student Directions
 - Top of the Ocean Mat Sculpture Set-up Instructions
- ◎ Feeding Frenzy Station
(adapted from Learn About Seabirds Curriculum, US Fish & Wildlife Service)
 - Tarp or large piece of cloth
 - Spoons
 - 6 Fanny packs or grocery bags & twine
 - Popcorn
 - Foam packing materials or foam pieces from marine debris clean up
 - Feeding Frenzy Student Directions
 - Feeding Frenzy Set-up Instructions
- ◎ Albatross Bolus Investigations Station:
 - Albatross bolus sample specimen
 - Wide mouth (1.5 in) 12 oz. plastic bottles
 - Small pieces of plastic commonly found locally as litter/marine debris (lighters, legos, bottle caps, etc.)
 - Tray or shoe box
 - Photos of dissected boluses
 - Photos of ingested plastics
 - Handout: Bolus Contents Data Sheet
 - Handout: Albatross - Case Study Background Information Sheet



Stations: Effects of Marine Debris *Continued*

- Albatross Bolus Investigations Student Directions
- Albatross Bolus Investigations Set-up Instructions
- ◎ Gyre Dangle Sculpture Station:
 - Scissors
 - Pieces of plastic marine debris (1-4 inches, Red, Orange, Yellow, Green, Blue, Violet & White)
 - Pieces of blue rope from marine debris
 - Fishing Line or 20 gauge wire
 - Leather punch or drill
 - Safety goggles
 - Work gloves
 - Gyre Dangle Sculpture sample
 - Gyre Dangle Sculpture Student Directions
 - Gyre Dangle Sculpture Set-up Instructions

Preparation:

Set up computer and projector or SmartBoard to show the “What’s an Ocean Garbage Patch” video on youtube (<http://www.youtube.com/watch?v=J-gqJAsXiKQ>). This video on youtube sometime begins with advertisements, so play through these during your preparation.

Prepare the 6 stations for rotation. Each station includes instructions for set-up and directions for students.

You will need a variety of marine debris items for the two sculpture stations. If you will not be able to conduct a marine debris clean up prior to this lesson, contact CACS for assistance acquiring appropriate materials.

Drill or punch ¼ inch holes in the plastic pieces for the Gyre Dangle Sculpture – or ask a volunteer to do it.

Introduction:

Begin by showing the “What’s an Ocean Garbage Patch” video on youtube (<http://www.youtube.com/watch?v=J-gqJAsXiKQ>). At the conclusion of the video, ask students to write their reaction in their science journal.

Ask students to write predictions of how long different plastic products persist in the marine environment. Pass out the handout with the timeline of how long plastics last in the environment.

Compare the timeline to the predictions students made. Discuss that plastics photodegrade rather than biodegrade. That is, as plastics are exposed to ultraviolet rays, the secondary bonds (plasticizers such as phthalates) between the polymer chains are changed, causing the plastic to become brittle and break into smaller and smaller pieces. Pass around the sample of photodegraded plastics.

This is different than biodegradation. Things that biodegrade are broken into smaller pieces by bacteria or other biological actions. Biodegradation returns the object to compounds found in nature, whereas photodegradation breaks plastics down to the synthetic polymers, but not natural molecular compounds.

Procedures & Activities:

Ask students to brainstorm how wildlife and ecosystems are affected by marine debris. Have students record their ideas in their science notebooks, and write all of their concerns on the board.





Stations: Effects of Marine Debris *Continued*

If they do not include entanglement, ingestion, or water pollution on the list, help them to add those concerns. Explain to students that all of these effects are important to consider and work to mitigate, but the three greatest concerns related to marine debris in marine ecosystems are entanglement, ingestion, and toxic pollution.

To learn more about these ecosystem effects, they will rotate through 6 stations:

- Entanglement Challenge
- Fishing Line Tug of War
- Top of the Ocean Mat Sculpture
- Feeding Frenzy
- Albatross Bolus Investigations
- Gyre Dangles Sculpture

Divide students into 6 groups and designate their starting stations.

Every 10-15 minutes, have students rotate to the next station. Tell students when there is 5 minutes left in each station so they have time to finish up their activities and science notebook responses.

Bring the groups back together. Lead a discussion about how students can affect these problems.

Talk about the CACS fishing line-recycling program as a great example of how potential entanglement items can be taken out of the environment. Also, the decreased occurrence of six-pack rings in marine debris is linked to consumer choices. Awareness that these products caused problems in the marine environment led to a significant reduction in the manufacturing of these harmful products.

Ask students to revisit their science notebooks and review the potential ecosystem effects of marine debris they wrote down at the beginning of the lesson.

Break students into small groups 2-5 people and have them work together to discuss potential ways to mitigate these effects. Encourage them to think not only of ways to clean up marine debris, but also ways to prevent certain types of marine debris (toxic, fishing line, etc.) from ever entering the ecosystem or ways to change the nature of marine debris (fishing line that breaks down more easily, etc.)

Have each group decide on their top two solutions and describe them in their science notebook.

Wrap-Up:

Come together as a class and have each group present their top two solutions. Discuss the pros and cons of each. Explain that every technology has both positive and negative effects, so the above all best thing they can do is reduce their use of single-use plastics such as plastic bottles, straws, utensils, take out containers, etc. The less plastic is thrown away, the less is available to make its way into the marine environment.

Extensions & Lesson Connections:

After working on the Gyre Dangles and Top of the Ocean Mat sculptures, students will likely want to finish the piece and share it with others. See the "Art Exhibit" Lesson for more information on finalizing the sculptures, writing artists' statements, and preparing the art for public display.



Stations: Effects of Marine Debris *Continued*

A great extension to the Bolus Sorting activities is to dissect an actual albatross bolus. CACS has a few boluses available to loan to teachers for this purpose. The Bolus Content Data Sheet from the sorting activity can be used for a dissection too. Contact CACS for more information about bolus dissection and to access a bolus for class use.

You can also extend the Bolus Sorting activities by having students sort debris before putting it into the mock albatross stomach. Provide students with a variety of large and small debris objects that potentially could be eaten by an albatross (bottle caps, foam, plastic toys) and things less likely to be eaten by an albatross (cans, bottles, glass, larger pieces of plastics debris). Before having students test the amount of plastic necessary to create a bolus that is too large to regurgitate, have students sort the debris in the following steps:

- 1) Place the items in a tub of water. Albatross are surface feeders, so will only eat things that float near the surface. Eliminate objects that sink.

- 2) Take items that did float and try to fit them through a 1.5-inch diameter PVC pipe. Items that can't fit through the PVC wouldn't fit into the esophagus of an albatross chick. Eliminate the objects that are too large.

- 3) Use only the remaining items as you place objects into the bottle.

Evaluation:

Review student science notebook entries, including data entries and reflections from the stations

and their list of ways to mitigate the effects of marine debris on the ecosystem. Their list of ways to mitigate the effects of marine debris on the ecosystem should be evaluated for synthesis and application of the material learned. The other entries can be evaluated for completeness and effort.

