Education and Research: Testing Hypotheses

Unit Lesson Plan—Ocean's Deadliest Catch

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Grade level: 6-8

Time: 6-7 class periods

Summary - Marine debris, especially plastics, are transported through the watershed via wind and water currents. Eventually, they end up in the ocean where they have a direct negative impact on marine life and an indirect negative impact on human life.

Much of the debris that ends up in the North Pacific Ocean gets drawn into the North Pacific Gyre by currents. The North Pacific Gyre is a swirling vortex of water made up of four prevailing surface currents that move in a clockwise direction: the North Pacific Current, the California Current, the North Equatorial Current and the Kuroshio Current. These currents trap and concentrate debris within the gyre. Comprising most of the northern Pacific Ocean, the North Pacific Gyre covers an area of about 10 million square miles. The large amount of debris that has accumulated in this area has given the North Pacific Gyre the nickname "the Great Pacific Garbage Patch."

Most of the marine debris in the ocean is not biodegradable. Plastic, instead of biodegrading, photodegrades—it breaks up into smaller and smaller pieces. These pieces of nondigestible debris are often mistaken for food by marine animals, including foraging birds such as the albatross. Adult birds gather these pieces and feed them to their chicks. Ninety percent of Laysan albatross chick carcasses are found with plastic inside of them. Derelict fishing nets and lines, another type of marine debris, can entangle and harm birds, seals and other animals.

In this lesson, students will collect debris on their school grounds,"x" number of miles from the ocean and compare the quantity of plastic in the sample with a similar sample at the mouth of the river, where it empties into the ocean. In addition, students will build and deploy marine drifters at a place along the river and retrieve them at the mouth of the river, to determine how long it might take a piece of debris to travel to the ocean when it enters at a location near their school.

Key Concepts

- **Ocean Literacy Principle 1**: The Earth has one big ocean with many features.

1g. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

- **Ocean Literacy Principle 6:** The ocean and humans are inextricably interconnected.

6e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

6g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

- **Oregon Standard: H.3S.2** Design and conduct a controlled experiment, field study, or other investigation to make systematic observations about the natural world, including the collection of sufficient and appropriate data.

Objectives

- ***Observe*** and ***identify*** debris that is collected in the school yard and at the mouth of the river.
- ***Record data*** from school yard and mouth of the river and ***compare*** the percentage of plastic in each group.
- ***Develop knowledge of*** ocean drifters and their use in collecting scientific data about the ocean.
- ***Design*** and ***Test*** a drifter that will be launched and retrieved from the river in order to determine the length of time it might take debris to flow from a starting point to the mouth of the river.
- ***Communicate*** results in culminating activity as a public service announcement at the end of the unit.

Materials :

- Containers for garbage
- Sterile gloves
- Scales
- Videos
- Oranges, apples, or potatoes
- Biodegradable straight sticks, dog treats or similar items to attach drogues
- Biodegradable material for drogues
- Permanent marker
- Handout: oceans of the world grid (to show currents & Global Conveyer Belt)

Day 1

Procedure

1. Introduce the topic of plastics ending up in our ocean with a video or book:

   Jean-Michel Costeau's Ocean Adventures:
   http://www.pbs.org/kqed/oceanadventures/video/gyre

   http://www.pbs.org/kqed/oceanadventures/educators/kure/debris.html

PRE-VIEWING QUESTIONS

- What is debris? What is marine debris?
- What are some ways that trash winds up in the ocean?
- What happens to debris in the ocean? Where does it go?
- Is marine debris harmful to marine life? What kinds of animals? How is it harmful?
- How long does marine debris last?

FOCUS QUESTIONS FOR VIEWING

- What are some of the items Jean-Michel Cousteau found on the beach on Laysan Island?
- Where did these items come from?
- How does garbage wind up on the beaches of the Northwestern Hawaiian Islands?
- What is the Great Pacific Garbage Patch?
- How much of the debris found in the ocean comes from land?
- Why do birds ingest plastic?
- How are birds affected by the plastic they ingest?

POST-VIEWING DISCUSSION QUESTIONS

- What kinds of trash are most likely to become marine debris? Why?
- What are some ways that we can prevent trash from getting into our waterways?
- How could we clean up the garbage patch in the North Pacific Gyre? Is it possible? Why or why not?
- What kinds of studies could scientists do to learn more about the effects of marine debris on ocean ecosystems?
- What types of scientists might do a study relating to marine debris?

Additional videos and books:

Toxic Garbage Island: *http://www.vbs.tv/watch/toxic/toxic-garbage-island-1-of-3*
(teacher review: some innapropriate language – not suitable for children)

Plastic in the Pacific: *http://www.kqed.org/quest/television/plastic-in-the-pacific*
Pete Puffins Wild Ride Cruising Alaska's Currents by Libby Hatton

All the Way to the Ocean by Joel Harper

Tracking Trash Flotsam, Jetsum and the Science of Ocean Motion by Loree Griffin Burns

2. Students go on a walking field trip to around the school yard to collect garbage.
3.. Have each group weigh their entire sample and then separate out the plastic.
4. Students create a chart or graph showing the contents of their gathering.

Day 2

The earth has one big ocean with many features. Currents are caused by winds, gravity, and variations in water density in different parts of the ocean. There are two distinct current systems in the oceans–surface circulation, which stirs a relatively thin upper layer of the sea, and deep circulation, which sweeps along the deep-sea floor.

The dominant pattern of surface circulation is the gyre–a well-organized, roughly circular flow. Five enormous gyres spin in subtropical waters, two in both the Atlantic and Pacific Oceans, and one in the Indian Ocean. Smaller polar gyres stir the northern Atlantic and Pacific. One surface current circles endlessly around Antartica. These gyres are made up of currents set in motion by winds and gravity, and steered by the placement of the continents and the rotation of the Earth. Wind is the most important cause of surface currents. When strong, sustained winds blow across the sea, friction drags a thin layer of water into motion.

The movement of the very topmost layer of the sea pulls on the water just beneath, which then in turn starts the layer under it moving. Energy from the wind is quickly dissipated, so wind-driven currents slow down with depth, and finally die out within a few hundred meters of the surface.

Review with students ocean currents, the Coriolis Effect, and the Global Conveyer Belt by showing the following video: http://www.learningdemo.com/noaa/lesson08.html

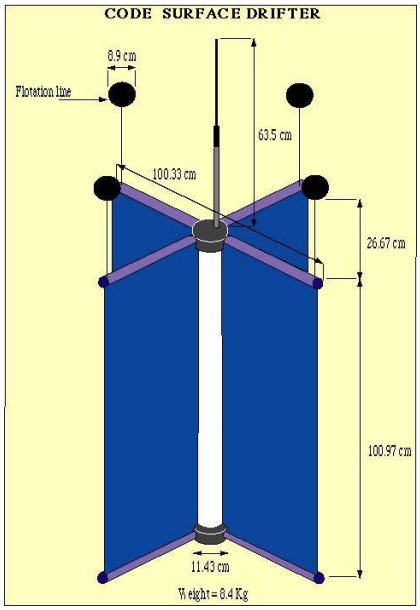
Activity: Students demonstrate an understanding of the ocean currents by using colored pencils to draw currents on a world map handout.

Day 3 and 4

Introduction to Drifters

Using devices known as drifters, scientists are beginning to grasp the complexities of global ocean currents, and, in turn, the many systems that they influence. With advances in technology, drifters now provide researchers with information about

ocean circulation patterns in real time. The data garnered from these devices will allow scientists to design models of climate and weather patterns, such as El Niño and hurricanes, as well as predict where pollutants, such as oil or sewage, will go if they are dumped or accidentally spilled into the ocean. Information from drifters can also be used to learn more about the distribution and abundance of marine life with early life stages that are planktonic. Plankton are freely floating organisms that travel with oceanic currents.



Four major components make up a drifter. These include a waterproof tubular body, sails, spherical floats, and a data collection/transmitter package. Use Google Earth to have students view or track drifters that have been deployed.

Activity: Students will design and deploy a drifter from materials provided in class at a central location along the river. The larger the quantity of drifters deployed, the more likely, some will reach the mouth of the river. Students can write a message on their drifter with a permanent marker, so that anyone who finds one can return it to the school along with information about the location it was found at.

Procedure:

1. Students sketch a model of their drifter design using available materials as resources.

2. Students construct their drifter and test it in a basin of water to see if it floats.

3. Have students write a message in permanent marker on the surface of their apple or orange.

4. Have students write down the date, time and location of their drifter deployment.

** If possible, have an adult in a boat, track the drifters for some distance to ensure that the current is indeed carrying the drifters towards the ocean!

Day 5

Activity: Field Trip to Mouth of River

The mouth of the river flows to the ocean.

Procedure:

1. Students can look in the area to see if they can identify any of the drifters that were deployed. If they have discovered any, be sure and have them record the date, time and location of their find.
2. Select an area for students to collect debris.
3. Have students catalogue the various debris found and separate the plastic.
4. Have students weigh the debris for comparison with school yard debris.

** If there are no visible signs of student's drifters, return to area for several days or ask for student families to volunteer to monitor the area.

Day 6

Activity: Students will apply what they have learned about how debris makes its' way to the ocean, and eventually to the Great Pacific Garbage Patch by creating a video, podcast or poster that encourages responsible use and disposal of potential marine debris. Posters can be displayed around the school or videos/podcasts can be uploaded to school web sites.

Assessments

- Students will be able to identify at least 5 different types of marine debris.
- Students will record data for two areas and compare the data.
- Students will design and construct a biodegradable drifter to be used to establish the length of time it might take for garbage to end up in the ocean via the river.
- Students apply what they have learned by creating a video, podcast, or poster as a public service announcement encouraging responsible use and disposal of potential marine debris.

Additional Resources

Kure Waste Chase
Students take on the role of volunteer for the U.S. Fish and Wildlife Service and explore various habitats to collect marine debris in this lesson that accompanies the Web-based game Kure Waste Chase.
www.pbs.org/kqed/oceanadventures/educators/kure/gamelesson.html

You Are What You Eat: Plastics and Marine Life
Find out about different types of plastic and investigate their impacts on marine life.
www-tc.pbs.org/kqed/oceanadventures/educators/pdf/OceanAdv-WhatYouEat.pdf

Wind-Driven Surface Currents: Gyres, NASA
oceanmotion.org/html/background/wind-driven-surface.htm

Turning the Tide on Trash: Marine Debris Curriculum, U.S. EPA
www.epa.gov/owow/OCPD/Marine/contents.html

Marine Debris Module, Northwestern Hawaiian Islands Multi-Agency Education Project

www.hawaiianatolls.org/research/NWHIED2005/resources/MarineDebrisModule.php

Marine Debris from Land and Sea (ABiodegradation Timeline), South Carolina Department of Health and Environmental Control
www.scdhec.gov/environment/ocrm/outreach/docs/debris/SC_MARINE_DEBRIS_POSTER.pdf

Marine Debris 101, National Oceanic and Atmospheric Administration
marinedebris.noaa.gov/marinedebris101/welcome.html

Got time?

If you have time before your presentation, it would be helpful for me for you to provide

- Relevant content standards—National Science Education Standards: http://www.nap.edu/readingroom/books/nses/html/6a.html
- Science skills (using the Essential Science Skills grid on the EARTH Web site: http://www.mbari.org/earth/skills.htm
- Ocean Literacy Standards: http://www.coexploration.org/oceanliteracy/documents/OceanLitChart.pdf