Plastic Pollution Educator Guide

A resource for using QUEST video, audio and blogs in the classroom

QUEST SUBJECTS

Life Science	**Biology**
	Health
	Environment
Earth Science	Geology
	Climate
	Weather
	Astronomy
Physical Science	Physics
	Chemistry
	Engineering

CA SCIENCE STANDARDS

Grade 6
Ecology
5. (b) Matter transfers between organisms in food webs and between organisms and their environment.

Resources
6. (b, c) Renewable and nonrenewable resources; the natural origin of the materials used to make common objects

Grades 9-12
Ecology
6. (b) Analyzing changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species or changes in population size

QUEST MEDIA FOR TEACHING ABOUT PLASTIC POLLUTION

Read and comment on the blogs for these stories by clicking on the story link and clicking on the blog post link below the video/audio.

Listen to "Sea of Plastic" http://www.kqed.org/quest/radio/sea-of-plastic

- Where do our used plastic cups, packaging and other plastic products go? Quite possibly into the North Pacific Gyre and an expanse of garbage in the Pacific Ocean. **QUEST** reporter David Gorn finds out why some California cities and counties are looking to limit the amount of plastic waste they produce.

Watch ""Plastic in the Pacific" http://www.kqed.org/quest/television/plastic-in-the-pacific

- Only about seven percent of the plastic used in the United States is recycled. Much of the rest ends up in landfills, or worse, oceans. **QUEST** examines the problem with the "Great Pacific Garbage Patch" and asks if anything can be done to clean it up.

TOPIC BACKGROUND

A petroleum-based polymer, plastic is a material that doesn't easily break down or biodegrade in nature. Nonetheless, it has been one of the most widely used materials in the United States and other countries since the 1970s. In fact, in 2010 alone, some 330 million tons of new plastic will be manufactured around the world. It is used in packaging, electronics, home construction and many other arenas. However, very little of it will be recycled and the rest will eventually be discarded. Where does this plastic waste go?

The Great Pacific Garbage Patch, or Pacific Trash Vortex, is a large system of rotating water currents that contains an enormous concentration of plastic litter trapped by the swirling water. Found in the north central Pacific Ocean, this garbage patch is thought to encompass an area somewhere between the size of Texas and the continental United States. The spot can't be captured by satellite imagery, as much of the garbage contained within it is actually suspended in the upper water column. Because of the rotational water in this area, called a gyre, the region draws in debris from all across the Pacific, including the coastal waters of the United States and Japan. Much of the garbage found here is made up of small particles of plastic that concentrate as they get closer to the center of the region. Although it isn't known exactly where all of the garbage in the patch comes from, estimates put about 80 percent of it from land-based sources and around 20 percent from ships. The pollution found in the patch ranges from pieces of abandoned fishing nets to the small, abrasive plastic pellets found in some household cleaning products. As the plastic debris collects in the vortex, it breaks down into smaller and smaller particles. Eventually, it becomes small enough to be ingested by the tiny organisms living near the ocean surface and thus enters the food chain.

Additional background resources:

Bay Trash Hot Spots Map http://savesfbaygallery.org/hotspots08/index.html

NRDC: Issues: Water http://www.nrdc.org/water/default.asp

VOCABULARY

Contaminant
a biological, chemical, physical or radiological substance that is normally absent in an environment and can adversely affect living organisms

Current
the steady flow of surface ocean water in a prevailing direction

Debris
something discarded, trash

Fragment
a small part broken off or detached

Litter
carelessly discarded refuse, garbage or trash

Petrochemical
a chemical derived from petroleum or natural gas

Recycle
to reuse or process for

Toxin
a poisonous substance

Vortex
a spiral motion of fluid within a limited area, especially a whirling mass of water or air that sucks everything near it toward its center

INTRODUCTORY QUESTIONS

- Where do our plastic waste products go?
- What are some causes of water pollution?

FOCUS QUESTIONS

- Do you think there should be a statewide ban on polystyrene and other plastic items? Why or why not?
- What are some things we can do in our daily lives to help prevent plastic pollution?
- Where does the plastic debris in our oceans come from? How does it impact our environment?
- Why is it so difficult to clean up plastic marine debris?

For all media see:

- Segment Summary Student Sheet
  http://www.kqed.org/quest/downloads/QUEST_SegSum_StudentSheet.pdf
- Personal Response Student Sheet
  http://www.kqed.org/quest/downloads/QUEST_PersResp_StudentSheet.pdf

LESSON PLANS and RESOURCES from PBS, NPR and MORE

NOTE: Resources from the Teachers' Domain collection require a fast and free registration.

Plastics Piling Up in Atlantic Ocean NPR
http://www.npr.org/templates/story/story.php?storyId=129324783
Oceanographer Kara Lavender Law talks about a new study showing that large concentrations of pieces of plastic are collecting offshore in the Atlantic Ocean in this August 20, 2010, edition of **Science Friday.**

Boat Made of Plastic Bottles to Sail the Pacific NPR
http://www.npr.org/templates/story/story.php?storyId=91066185
In this June 2, 2008, piece from **Day to Day**, hear the story of Joel Paschal and Marcus Erikson, two scientists who attempted to raise awareness of the amount of plastics polluting the Pacific Ocean by sailing a boat made of 15,000 plastic bottles.

Future History: Plastic Water Bottles QUEST
http://www.kqed.org/quest/television/future-history-plastic-water-bottles
Travel to the future to learn what our current use of bottled water says about our society.

Plastic Oceans PBS
http://www.pbs.org/newshour/indepth_coverage/science/plasticoceans/index.html
This science report from **Online NewsHour** offers in-depth coverage of the plastic pollution problem and how it affects fish, marine mammals and birds.

Sailing on a Sea of Plastic PBS
http://www.pbs.org/odyssey/odyssey/20050428_log_transcript.html
Read this April 28, 2005, entry from **Voyage of the Odyssey** to learn more about the sea of plastic debris found in the open ocean and the environmental implications of this pollution problem.

VISIT OUR PARTNERS

The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
http://bnhm.berkeley.edu/

U.S. Geological Survey
www.usgs.gov

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21st CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?
http://www.kqed.org/quest/downloads/QUESTWhyMedia.pdf

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning
http://www.kqed.org/quest/downloads/QUESTMediaTips.pdf

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis
http://www.kqed.org/quest/downloads/QUESTMediaAnalysis.pdf

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps
http://www.kqed.org/quest/files/download/52/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

OTHER WAYS TO PARTICIPATE IN QUEST

LOG ON

www.kqed.org/quest

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KQED 88.5 FM San Francisco &
89.3 FM Sacramento

WATCH

KQED Channel 9

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SEA OF PLASTIC — QUEST RADIO TRANSCRIPT

NOTES AND QUESTIONS

Whenever you order your double latte to go at the corner coffee shop, the empty cup and lid may end up in a giant pit of plastic ocean litter floating off the California coast. Some cities and counties are so concerned about the garbage in the so-called North Pacific Gyre that they've passed ordinances to try to limit the amount of plastic in our lives. David Gorn reports.

Hannah Rose Nevins is a researcher at Moss Landing Marine Laboratories. Today, she's in Santa Cruz, working the necropsy lab.

She steps into a huge walk-in freezer to pluck a frozen seabird off the shelves and then hefts the large carcass onto an examining table. And starts to tear away the rigid plastic wrapping.

NEVINS: Last year we got about 200 samples. And, those all came from the Beach COMBERS beach survey program.

Nevins is checking the stomach contents of each of these birds, which are called fulmars and look similar to sea gulls, to see if she finds any plastic inside them. So far, she says, she's found an average of about 15 pieces of plastic in the bellies of most of the birds she's investigated.

And in some of them, she says, she's found as much as 120 bits of plastic, jammed and pressed into a bird stomach the size of a walnut.

NEVINS: So there's a piece of line, plastic, so there's red, pinks and blues.

That much plastic may be dangerous for the birds, she says, but she's not investigating what plastic does to these birds.

NEVINS: Our study is mainly focusing on, not the population-level impacts, but how we can use the birds as samplers of the marine environment.

Nevins is using the fulmar stomachs as indicators of just how much plastic pollution is out in the ocean.

And there's a lot of it, says John Fentis. Most of the plastic in the northern Pacific—more than 3 million tons of it, he says—comes from land litter, much of it carried by stormwater runoff into the sea.

FENTIS: The plastic will collect in this area called the North Pacific Gyre.

Fentis is president of Algalita Marine Research Foundation, which first discovered the concentration of garbage about a thousand miles offshore in the Pacific Gyre, a swirling vortex of trash twice the size of Texas. Fentis is looking out over the relatively clean harbor in Long Beach, where Algalita has its headquarters. He says it's not just the size of the Gyre that's such a danger, it's more the density of the

amount of plastic found in the water. He holds up a thick sample of what the water looks like out in the Gyre.

FENTIS: This is a jar that, as you can see, is filled with plastic pieces, and a kind of a soupy mixture, part of which is plankton. This is more like a synthetic soup.

The plastic breaks down into such small bits that researchers can't strain it out of the water, so it's almost impossible to clean up. Birds and fish mistake it for food and the plastic ends up in their stomachs, and that could end up in our stomachs, according to biomedical researcher Bruce Blumberg of the University of California at Irvine. Some chemicals in the plastic, he says, can make their way into the tissue of the fish we eat. The possible endocrine disruptors in plastic, he says, could be hazardous.

BLUMBERG: Is ingesting plastic acutely toxic at the levels that we see it and is it going to kill us? Probably not in the short term, but is it causing long-term damage? I would say the data are pretty strong that it is.

The plastics industry maintains that plastics are safe, and that the solution for all of the marine debris is a stronger recycling effort. But Dustin McDonald, of the environmental group Surfrider Foundation, says that not all plastic can be easily recycled, and much of it breaks into small pieces that can't be managed.

MCDONALD: Trying to clean up polystyrene on a beach is like trying to filter the Sahara Desert. You just can't do it.

McDonald sees the same thing over and over during his beach cleanups in the tourist town of Capitola, population 9,000, just south of Santa Cruz. Tiny bits of plastic, everywhere you look. So Capitola, he says, was one of the first in the state to pass a ban on polystyrene. Those are the to-go containers for leftovers from restaurants, Styrofoam cups and the hard plastic lids from coffeehouses.

MCDONALD: Polystyrene is a big problem because once it's being used in a food environment, it's food contaminated and there's no way to recycle it. And that's the real reason why food vendors themselves are the ones that have been targeted by this particular ban.

The idea, McDonald says, is to stop the flow of plastic before it can get into the water and onto the beaches. A state panel recently agreed. The Ocean Protection Council is now recommending a statewide ban on some plastic bags and containers and will hold public meetings on the subject next month.

For QUEST, I'm David Gorn, KQED Radio News.