



BACK BAY SCIENCE CENTER

Marine Debris/Plastics Module

ACTIVITY I: Field Inventory

CALIFORNIA STATE CONTENT STANDARDS

Grades 6 – 8

6th Gr. Science:

Ecology - 5b, e

7th Gr. Science:

Physical Principles in Living Systems - 6d

Investigation and Experimentation - 7a

8th Gr. Science:

Reactions - 5a;

Chemistry of Living Systems - 6a

Density and Buoyancy - 8a,c

History/Social Science: 8.3.6; 8.12.5

Grades 9 – 12

Science:

Biology/Life Sciences:

Ecology 6a, b;

Evolution 8a, 8b

Earth Sciences:

Energy 4c;

Biogeochemical Cycles - 7b

AP Science:

Science Practices: SP 1.1, 1.2

Earth Science: ES 5.3

Life Science: LS 3.1, 3.2

History/Social Science:

11th Gr. 11.11.5

12th Gr. 12.3.2

EEI P and C: Ic; IIa; IVb, c

Ocean Literacy Principles: 1g, h; 3e, f; 4a; 5h;

6e, g; 7c, d

Climate Literacy Principles: 2c,d; 4g; 6c, d; 7d

BACKGROUND INFORMATION

The issue of Marine debris is no longer one we can ignore. We are a water planet and all living things depend upon water for survival. But more and more evidence is piling up that what is in the water may actually be lethal. We can see the litter on our streets, and are increasingly aware that this same litter ends up in our rivers and amasses in our oceans. Although we cannot see the chemicals, we can test for their presence in the water. In recent years scientific expeditions have been surveying the extent of the plastic that is floating in the ocean, and the ways in which that is impacting life on our planet. Humans have a choice about what is allowed to flow into our water.



It is fairly easy for most of us to understand the physical impact of plastic debris floating in the ocean. We

have seen birds and mammals entangled in plastic fishing lines or netting and then unable to swim, fly, hunt or swallow food. Because plastic is buoyant, it floats along in the water column, often resembling prey items. Because there are plastics with different densities, they float at different depths in the water column, attracting and ensnaring different predators. We have seen pictures or heard of birds, fish and mammals ingesting floating plastic bags which then block their stomach and cause death. A less obvious, but just as lethal effect is on baby birds. They are fed by the regurgitated food their parents have captured. When plastic bottle caps, broken pieces of plastic, or pre-production plastic nurdles entering the ocean from run-off or beach litter are ingested, their stomachs fill up without offering any nutrients, imperiling the infants.

What is perhaps less obvious is the chemical impact of the plastic debris. Small fragments of decomposed plastic have been found in the stomachs of marine animals. We know that water stored in plastic bottles contains chemicals that have leached out of the plastic and into the water. It is not surprising, then, that chemicals are present in toxic concentrations in the ocean. Urban run-off transports residues of pesticides, fertilizers, gasoline and car oil, cleansers and flame retardants. This group of organic chemicals is known as Persistent Organic Pollutants (POPs). POPs, like plastic, are not soluble and so remain in the water. Plastic is actually hydrophobic, and acts as a magnet to the hydrophobic POPs,

as well as DDT (linked to weakening eggshells), so ingestion of plastic becomes even deadlier. The more plastic an organism ingests the more toxins bioaccumulate in its tissues. Because predators eat several prey, the toxins that have bioaccumulated in each of the ingested prey are now biomagnified. This continues to intensify up the trophic levels.

In the past few years, there has been increasing discussion about “garbage patches” floating in our seas. Research vessels have discovered these areas of accumulated refuse in all nine of the major oceanic gyres of the world. These circular currents created by rotating high-pressure systems circulate waters, and whatever is in them, around the globe. Their contents are revealing much information about the health of our planet. It is important to keep in mind that phytoplankton produces much of Earth’s oxygen, and is also the base of aquatic food-webs. In 2008, a scientific expedition in the North Pacific Gyre revealed the ratio of Plastic to Plankton as 6:1. In 2011 the ratio of Plastic to Plankton had risen to 20:1 or 30:1, depending on the source. Research along the local San Gabriel, Coyote Creek and Los Angeles River in 2011 collected debris on dry as well as moderately and heavily raining days. When factored together, an extrapolation for 72 hours resulted in 2.3 billion plastic objects and fragments, weighing 30 metric tons. This is not a small problem.

What can one person do? A lot! The simplest and most direct action is to look at personal behavior. Each of us needs

to ask three questions: “When I throw something out, where does it go?”; “Does this item need to be permanent or temporary?” and “What alternatives could I use instead?” We know the answer to the first question - landfills and the ocean, so we can all take actions to decrease our personal trash-footprint and contributions to the overall non-source point pollution: Re-use the plastic items we have, and pick up trash we see in our neighborhood or at the beach. To answer the second question, it is helpful to remember that plastic is useful when we need a product that is stronger and more durable than paper, and can be reserved for multiple or prolonged uses. Our automatic reliance on single-use items such as grocery bags, bagties, plastic cups, straws, throw-away pens, pencils and tape dispensers can easily be stopped. Answering the third question, there are alternatives. We can carry water from home instead of perpetuating the use of bottled water. We can buy products that come in glass jars or bottles and can be re-cycled, or look for products using newly developed bioplastics, such as Mirel, that biodegrade by half within 2 years. It is important to remember that we consumers can re-take the driver’s seat. If we stop purchasing products, and tell the manufacturers why, they might change instead of losing business. Ultimately, we can continue to stay informed on the issues, following research, so we can make choices that are healthier for us and our planet.

Apart from monitoring our personal behaviors, we can also follow the activities in our local and global communities, and advocate for more

intelligent practices. The issues need to be tackled on many levels, and there are a number of citizen groups that track environmental issues. In many cases it can take years of dedicated effort to advocate, legislate or litigate. Individuals can make a difference in these efforts. In 2011, after a state-wide ban was lost following tremendous petroleum industry lobbying, many California municipalities banned single-use plastic bags at restaurants and markets, in response to local and vocal constituents. Point-source pollution is addressed by governmental agencies that follow local, state or federal laws. Because land-based sources of plastics and pollutants is so much a part of the problem, Trash Total Maximum Daily Loads (TMDLs) for the Los Angeles and San Gabriel River watershed have been established, but only for macrodebris larger than 5 millimeters. Some industries are establishing Best Management Practices (BMPs) on their own or in response to contact from individuals and community groups. Operation Clean Sweep was started to control discharges of plastic debris into urban runoff by the plastics manufacturing sector, and to determine if existing regulations are effective in controlling discharges. Currently under California law, microdebris is not considered trash or subject to regulation, although research has shown it comprises a significant source of pollution. Advocating for legislation that supports our environment and increases producer responsibility is something that individuals can do. Staying informed and lending our voice and energy when we care about an issue is something we can all do to

make sure our government and industry is responsive to the citizenry.

EXTENSIONS:

1. Itemize all the plastic you use in one day. What alternatives can you think of?
2. Audit your cabinets - what foods, health products, cleansers, cosmetics, office supplies are in plastic containers? What alternatives can you think of?
3. Track your garbage: Before you toss it out, classify it on a paper kept by your trash container - plastic, paper, cardboard, glass. What can be recycled? Is alternate packaging available?
4. Talk to your friends, family members and classmates about using alternatives.
5. Email the manufacturer of products you use that package in plastic. Tell them you enjoy using their product but will be switching to a brand that does not use plastic that would not decompose. Ask them to consider bioplastic or switch to glass or aluminum. (If you do not ask, the answer is certainly NO)
6. Email your local councilmember to advocate for banning single-use plastic bags. Many California municipalities have already done this.
7. Organize or join a neighborhood clean-up of litter.
8. Re-think the products you use: Cleansers, Shampoos, Pesticides. What

environmentally -friendly alternatives can you think of?

RESOURCES:

- <http://sio.ucsd.edu/Expeditions/Seaplex/>
- 2009 Scripps,UCSD expedition to survey plastic distribution and abundance in Pacific
- http://www.algalita.org/movs/pelagic_plastic_mov.html - You Tube video on issues
- http://www.algalita.org/uploads/Urban_River_Debris.pdf - Survey of local river debris
- <http://www.algalita.org/research/index.html> - Resources, including brochures, posters, research, presentations and a powerpoint on Plastic water bottles
- <http://www.coastal.ca.gov/publiced/marinedebris.html>
- <http://www.scientificamerican.com/article.cfm?id=oc-ocean-pollution-costs>
- <http://riseaboveplastics.org/>
- http://www.plasticdebris.org/Trash_BMPs_for_Munis.pdf
- <http://www.reusethisbag.com/why.asp>
- <http://www.scientificamerican.com/article.cfm?id=plastic-not-so-fantastic>
- http://www.cawrecycles.org/issues/plastic_campaign/plastic_bags
- <http://www.environmentalcalifornia.org/oceans/great-pacific-cleanup>
- <http://na.oceana.org/en/living-blue/plastics-pledge>



TEACHER GUIDE – Marine Debris/Plastics Module

ACTIVITY: Field Inventory

OBJECTIVES:

Students will be able to:

1. Itemize at least three ways that Marine debris endangers Land and Ocean animals.
2. Identify at least five sources of Marine debris.
3. List at least three things they can do in their personal lives to lessen Marine debris.
4. Use Binoculars

KEY TERMS:

Aquatic Food-web Bioaccumulate
Biodegrade Biomagnify Bioplastic
Buoyant Concentration
Decomposition Density Garbage
Island Hydrophobic Leach Lethal
Macro Marine debris Micro
Non-Point Source Pollution North
Pacific Gyre Organism Nurdle
Persistent Organic Pollutants
Phytoplankton Point Source Pollution
Run-Off Residue Soluble Toxic
Trophic level Water column

MATERIALS:

Field Observation Worksheets, with Analysis Questions
Clipboards
Pencils
Non-Latex Gloves for each student if they're going to pick up trash items
Pens and colored pencils
Binoculars
Spotting Scopes at Fixed Stations

