You Are What You Eat:
Plastics and Marine Life

Just because you can't see it doesn't mean it isn't there. Whether it sinks or floats, plastics in the sea spell trouble for all the animals in the ocean. Find out the many ways marine life can be affected by plastics in their aquatic home.

Concepts
- Plastics in the ocean affect animals that live there through entanglement, laceration, suffocation, and ingestion.
- Different plastics have different buoyancies, so where and what a marine organism eats determines the type of plastics to which it will be exposed.

Objectives
Students will:
- Understand that different types of plastics float, sink, or stay neutrally buoyant.
- Learn where ten marine species feed in the water column.
- Make connections between where a marine organism lives and feeds and the types of debris to which it is exposed.

Duration
One hour, including video

Method
Watch video, then group or individual work with worksheet, chart, and cards, followed by presentation of results and whole class discussion.

Background
Many animals that live in the ocean come into contact with discarded plastic. Because this plastic is not natural to their environment, the animals don't recognize it or know what to do about it, are cut and injured, or think it's food and try to eat it. The number of marine animals that die each year due to ingestion and entanglement approaches 100,000 in the North Pacific Ocean alone (Wallace, 1985). Worldwide, 82 out of 144 bird species examined contained small debris in their stomachs, and in many species the incidence of ingestion exceeds 80% of the individuals (Ryan 1990).

Plastics and Marine Life
The potential for ingestion of plastic particles by open ocean filter feeders was assessed by the Algalita Marine Research Foundation by measuring the relative abundance (number of pieces) and mass of floating plastic and zooplankton near the central high-pressure area of the North Pacific central gyre. (The gyre is a large recirculating area of water halfway between Los Angeles and Hawaii.) Plankton abundance was approximately five times higher than that of plastic, but the mass of plastic was approximately six times that of plankton. This area is far from land, and many types of marine life feed here.

Plastics don't go away; they just go somewhere else where we can't see them. The effects on marine life can be devastating. Aquatic animals may be harmed by plastic objects in a variety of ways, depending on the shape and buoyancy of the object. These animals may suffer injury or even death from their encounters with plastics. Animals can be harmed through entanglement, laceration, suffocation, and ingestion.

The buoyant properties of water allow some plastics to float, some to sink, and some to stay in the water column. The types of plastics marine animals may come into contact with depend upon where they live and eat; at the water's surface, its bottom, or floating in the water column between the surface and the bottom. All we can see are the plastics on the surface, but there are many different varieties and shapes of plastic objects below the surface. Because we can't see this pollution, we may forget that it exists. Marine animals know by first hand experience the devastating effects of plastics pollution in the ocean, but they aren't talking. As cities grow and more plastics are produced and enter the marine environment, marine species will continue to be affected unless we make wise choices regarding plastic use and disposal.

California Science Content Standards

8. Density and Buoyancy

All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:

8.c. Students know the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.

8.d. Students know how to predict whether an object will float or sink.

Materials

1. Video – Synthetic Sea: Plastics in the Ocean. Borrow from California Coastal Commission education website: www.coastforyou.com
2. "You Are What You Eat" worksheet
3. "Marine Animal Feeding Habits and Plastic Risk" chart
4. "Marine Animal Cards"
5. "Plastics and Their Uses" handout

Preparation

Order video Synthetic Seas: Plastics in the Ocean two to three weeks in advance. Photocopy worksheet, chart, cards, and table, one per student.

Activity

1. Watch the video Synthetic Sea: Plastics in the Ocean with your class. Conduct a whole class discussion on what students think about plastics in the ocean. Does plastic just go away? What types of animals are most affected?

2. Next, conduct a whole class discussion on the many ways we use plastics in our daily lives.

3. Hand out "Plastics and Their Uses" and discuss the different types of plastics. Note that most cities only accept SPI 1 and 2 for recycling; though many of the other types of plastics are labeled as "recyclable," in reality, this does not occur and the majority of plastics end up in landfills.

4. From water bottles to computers, we rely on the convenience and availability of plastics to provide many of today's necessities. List on the board the shapes that plastic can come in, and have students give examples of what they are used for:
One-dimensional objects (line, rope, strapping bands)
Two-dimensional objects (sheets, bags)
Reticulated (netting, six-pack rings)
Hollow-bodied (bottles, fishing floats)
Small particles (Styrofoam, pellets used in making plastic objects)
Angular (boxes, crates)

5. Discuss the marine zones in which animals feed (surface, pelagic, and benthic). Have students brainstorm what types of animals might live and feed in each of these zones.

6. Either divide the class into small groups (3-4 students) or distribute materials to individuals. Distribute copies of the "You Are What You Eat" worksheet, "Marine Animal Feeding Habits and Plastic Risk" chart, and the "Marine Animal Cards" to groups or individuals.

7. Have students complete the worksheet activity. Keep in mind that there are many different possible "right" answers. What is important is that students have a rationale for their choices.

Results and Reflection

1. After the groups or individuals have completed the activity, draw the chart on the board. Have each group or student choose one form of plastic (i.e., one-dimensional, two-dimensional, small particles, etc.) and present to the class their results and rationale of what species would be most affected.

2. Allow time to propose different answers, discuss them, and wrestle with different conclusions.

3. Conduct a whole class discussion on how to reduce the amount of plastics in the marine environment.

Conclusions

Marine organisms are besieged with plastics in their aquatic home. They can mistake plastic pieces as food and ingest them, or become accidentally trapped by plastic marine debris.

Extensions and Applications

1. Have students bring from home different types of plastic trash, or use the trash from their own lunches. Conduct buoyancy experiments to see which pieces float and which sink, and which are neutrally buoyant. Group like objects together based on buoyancy. Now check their recycle number on the bottom – the number in the triangle. Do all types of plastic with the same number have the same buoyancy? What might affect the buoyancy besides the type of plastic (e.g. the shape of the object)?

2. Get a list from your local refuse agency that indicates what plastics they accept for recycling, and sort your plastic trash from #1 above accordingly. Are the recyclable plastics primarily floaters or sinkers? So you think that the plastic that is more easily recyclable ends up in the ocean less often than those that are not recyclable in your area? Which ocean animals might recycling plastic help most?

Additional Resources

California Coastal Commission. The Problem with Marine Debris
www.coastal.ca.gov/publiced/marinedebris.html

Endangered Oceans, Louise I. Gerdes, Thomson Gale, 2003
ISBN: 0737722746

Crimes Against Nature, Robert F. Kennedy, Jr. Harper Collins, 2004.
ISBN: 0060746874

Adapted by Friends of Ballona Wetlands from: You Are What You Eat: Plastics and Marine Life (p 110-116) Waves, Wetlands, and Watersheds: California Coastal Commission Science Activity Guide.

You Are What You Eat

Do different forms of plastic affect animals feeding in different parts of the ocean? Here is some information that will help you answer this question and fill out your Marine Animal Feeding Habits and Plastic Risk chart.

The Three Marine Zones

Scientists divide bodies of water into three basic areas:

1. **The surface zone:** the very surface of the water where it meets the air and things float where you can see them.
2. **The pelagic zone:** the open water below the surface where neutrally buoyant fish swim and plankton float.
3. **The benthic zone:** what lies beneath the bottom of the water; consists of mud, sand, or rock.

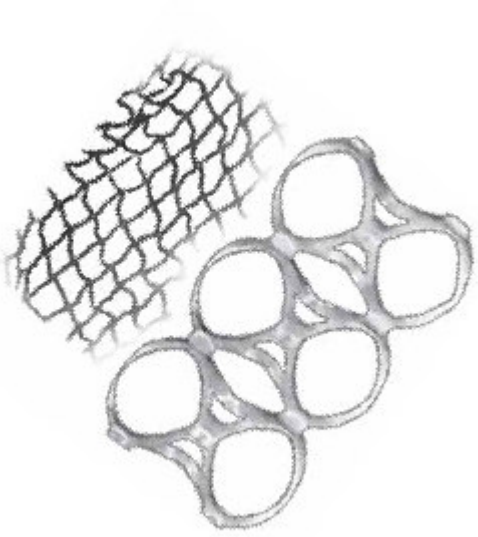
Where Marine Life Exists

Different forms of marine life gather their food in different zones. For example, some birds are surface feeders. They skim along just above the ocean's surface, and scoop up small bits of floating fish. Many fish are pelagic feeders. They swim about, eating smaller animals, plankton, and other food that share the water with them. Many whales, turtles, seals, and diving birds are pelagic feeders. Other kinds of fish, turtles, whales, and sea otters swim along the bottom to scoop up food from the ocean floor. They are called benthic feeders.

Animals that feed in different areas of the ocean often interact with different forms of plastic. For example, a bird skimming the ocean surface might accidentally scoop up bits of floating plastic pellets thinking they were food, but wouldn't scoop up a large, floating angular object such as Styrofoam ice chest, or a hollow object such as a plastic bottle.

Activity Directions

1. Arrange each card in your packet on the chart so the animals are:
   - located under the form of plastic they will have trouble with
   - next to the zone where they feed
2. Then, take the card off of the square and write the animal's name in the square. One animal may be affected by more than one type of plastic, and may feed in more than one habitat, so there will likely e more than one animal name in a square.
3. You will compare charts with other students. Be sure to be able to explain your rationale for placement.

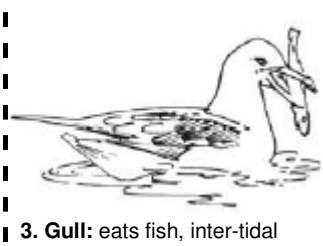


You Are What You Eat
Marine Animal Cards

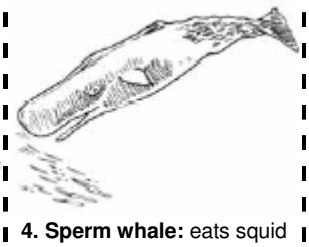
Photocopy and cut along dotted lines.
Each student receives one complete set.

1. Bottlenose dolphin: feeds on surfperch in open water below surface, grabs with teeth.

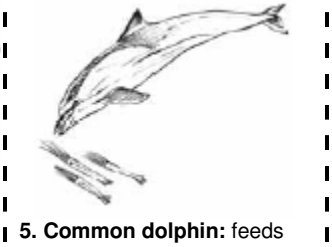
2. Orca: eats fish and marine mammals, grabs with teeth. Feed in open water below the surface.



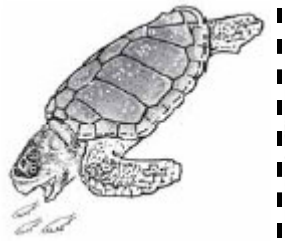
3. Gull: eats fish, inter-tidal organisms, beach debris. Feeds on shore, top of water, grabs food with beak.



4. Sperm whale: eats squid and fish below surface. Grabs food with long, narrow mouth.

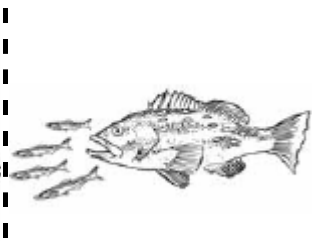


5. Common dolphin: feeds below the surface in open water. Grabs small squid, other small fish with teeth.



6. Loggerhead sea turtle: eats jellies, fish, mussels, clams, crabs; grabs them with toothless mouth.

7. Elegant tern: feeds on anchovies and other fish, floats or dives shallowly into the water.



8. Sea bass: feeds below surface in open water, sucks herring, krill, and anchovies into its large mouth.

9. Forster's tern: feeds on various small fish, floats along or dive shallowly into water

10. Sea otter: feeds on benthic urchins and shellfish, bringing them to the surface to eat.

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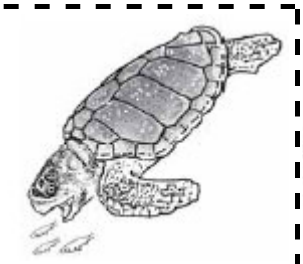

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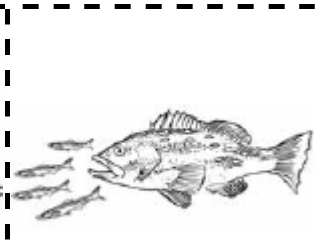

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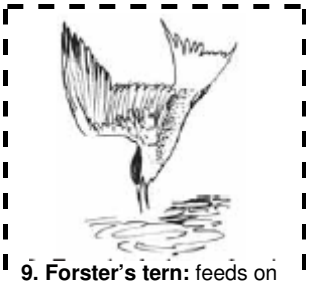

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Plastics and Their Uses

Name	SPI Code	Description	Uses
PET (Polyethylene terephthalate)	1	High strength; transparent; barrier to gas and moisture, resistant to heat; **sinks in water**.	Plastic soft drink and water bottles, beer bottles, mouthwash bottles, peanut butter and salad dressing containers, ovenable pre-prepared food trays.
HDPE (High density polyethylene)	2	Tough; chemical and moisture resistant; permeability to gas; translucent or opaque matte finish; **floats in water**.	Milk, water, and juice containers, trash and retail bags, liquid detergent bottles, yogurt and margarine tubs, cereal box liners
PVC (Polyvinyl chloride)	3	Hardy; chemical resistant; resistant to grease/oil; transparent, translucent, or opaque; **sinks in water**.	Clear food packaging, shampoo bottles, medical tubing, wire and cable insulation.
LDPE (Low density polyethylene)	4	Tough; lightweight; barrier to moisture; can be nearly transparent or opaque; low to high gloss; **floats in water**.	Bread bags, frozen food bags, squeezable bottles, fiber, tote bags, bottles, clothing, furniture, carpet.
PP (Polypropylene)	5	Hard; resistant to chemicals; resistant to heat; barrier to moisture; resistant to grease/ oil; transparent, translucent, or opaque; **floats in water**.	Ketchup bottles; yogurt containers and margarine tubs, medicine bottles.
PS (Polystyrene)	6	Stiff; transparent or opaque; smooth surface; **sinks in water**.	Compact disk jackets, aspirin bottles.
EPS (Expanded polystyrene)	6	Lightweight; heat resistant; insulating; opaque; foamed; **floats in water**.	Food service applications, grocery store meat trays, egg cartons, cups, plates.