



From Here to There

Grade: 4

Subject Areas:

Life Science, Earth
Science, Social Science

Skills: predicting,
role playing, reading,
investigating, describing

Duration: 1-2 hours

Connections:
physics, chemistry,
environment, ocean
science, watersheds

Vocabulary

organism

source

marine debris

decomposition

plastic

microplastics

ocean currents

plankton

North Pacific Gyre

vortex

point sources

non-point sources

runoff

Objective:

Students learn how pollution enters
the ocean environment and will make
connections between watersheds and
the ocean.

Materials

- 10-20 small canisters (labeled)
- masking tape and marker
- a glass gallon jar
- large spoon for stirring
- tap water
- an assortment of materials including powders and chemicals (see list inside)
- drawing showing a watershed
- pictures of marine debris
- pictures of animals caught in garbage
- video on marine debris
- paper and pencil
- sample of garbage from the North Pacific Gyre

Standards

Strands: Excellence in Environmental Education Guidelines
Strand 1 — Questioning and Analysis Skills: B) Designing investigations: Learners are able to design simple investigations. **F) Working with models and simulations:** Learners understand that relationships, patterns, and processes can be represented by models. **G) Developing explanations:** Learners can develop simple explanations that address their questions about the environment.

Strand 2.1 — The Earth as a Physical System: A) Processes that shape the Earth: Learners are able to identify changes and differences in the physical environment.

Strand 2.3 — Humans and Their Societies: D) Global Connections: Learners understand how people are connected at many levels—including the global level—by actions and common responsibilities that concern the environment.

Strand 2.4 — Environment and Society: A) Human/environment interactions: Learners understand that people depend on, change, and are affected by the environment. **C) Resources:** Learners understand the basic concepts of resource and resource distribution.

California State Educational Standards:

Earth Sciences (ES) 5a: Students know some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

ES 5c: Students know moving water erodes landforms, reshaping the land by taking it away from some other places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, deposition)

Investigation and Experimentation (I and E) 6c: Students will formulate and justify predictions based on cause-and-effect relationships.

Background

Water Woes

Water awareness is becoming increasingly important as we learn about the impact people are having on the environment. Freshwater systems are becoming polluted and sources of drinking water are becoming depleted. Some of the pollution originating on land combined with ocean dumping has formed mats of floating garbage adrift at sea. The healthy state of our world's oceans is quickly being threatened by human interaction and inaction.

People and wildlife are directly tied to the ocean. It supplies oxygen to breathe, water to drink, and it helps regulate the climate. More than 80% of all organisms live in the ocean. An **organism** is any living thing including plants, animals, fungus and bacteria. People have been enjoying the ocean for thousands of years. It is an abundant source of food and it is the cheapest and most efficient way to transport people and goods across long distances.

Over 70% of the Earth's surface is covered by the ocean. It is so vast in fact, people have viewed it as endless. This attitude has allowed cities, factories, boats and even the military to use the ocean as a dumping ground. Every year, tons of factory, farm and human waste is sent down pipes, much of it ending up in the sea. Other forms of pollution, like garbage, enter the ocean from many sources including storm drains, beach litter, and dumping. A **source** is the point or place where something begins or originates. No matter where garbage is from, it all has one thing in common—it is man-made.

In 1975, the National Academy of Sciences estimated that 14 billion pounds of garbage was being legally dumped into the ocean every year. Some estimate that during this time, the world's merchant shipping fleet which includes barges, merchant ships and fishing vessels, was responsible for more than 85% of the trash entering the sea. Some garbage is intentionally dumped, however other times materials are dumped by accident or blown into the water by wind. According to the Academy, the United States could have been the source of approximately one third of this garbage or **marine debris**.

Marine debris is any man-made object that enters the ocean after being discarded, disposed of or abandoned. Today, many ocean-going animals like sea birds, sea turtles and sea lions are being harmed by marine debris. Mistaking pieces of plastic as food, sea turtles and sea birds such as albatrosses eat the garbage. A plastic bag floating in water can look a lot like a jelly fish and plastic beads are sometimes mistaken as fish eggs. When animals eat plastic, they may starve to death even though their bellies can be full of it. Animals can also get tangled in garbage and drown. This entanglement mostly arises from

Local Connection

For over twenty five years, the Ocean Conservancy has sponsored an International Coastal Clean Up day. During this time, over eight million people from over 150 countries have walked more than 291,000 miles and have picked up over 144 million pounds of trash. School children from the Northcoast have not missed out on this opportunity and have regularly joined the worldwide efforts.

Every September, many schools along with other community groups clean the local beaches. Participants receive garbage bags, gloves, pencils and tally cards supplied by the Ocean Conservancy. All trash picked up is counted and put into a database. The cards are easy to fill out and they help identify certain types of trash and their potential sources like recreation and boating. In the past, this one day event has been coordinated by the Northcoast Environmental Center (NEC) headquartered out of Arcata. You can contact the (NEC) at <http://yournec.org/> or call.

A healthy ocean is an important component of a healthy planet. The ocean supplies oxygen to breathe, water to drink, food to eat, and helps to regulate the climate. By participating in this event, students play an active role in reducing the amount of garbage entering the sea. Their awareness about garbage is increased, the beaches are scoured clean, and important information is collected that can help future endeavors.

fishing line, abandoned nets and plastic six pack rings .

Traveling Plastics

Fortunately, since 1988, dumping garbage into the ocean has become illegal. However, garbage is still dumped into the ocean partly because the law is difficult to enforce. Abandoned fishing nets are another problem. Nets trap pieces of garbage and can trap wildlife too. In earlier times, nets were made from natural materials like plant fibers and would eventually decompose. Today, however, fishing nets are made of nylon or plastic which float and take a very long time to break down or decompose. **Decomposition** happens when microbes break down material into useable forms.

How long it takes plastic to decompose depends on a lot of things. Plastic breaks down easier in the ground than it does in water. It can take over 200 years for a plastic bottle cap to break down when it is in sea water. Almost 90% of floating garbage is plastic. **Plastic** is a non-renewable product that is made from oil. People have become dependent upon plastic for its desirable properties like durability and stability. Unfortunately, these properties prove very undesirable in the ocean. Certain plastics can act like a big sponge and absorb toxins. Plastic can also supply a surface for small organisms like snails and sponges to attach to. When bigger animals eat these smaller organisms they end up with toxic chemicals in their system. As plastic breaks down, it forms smaller and smaller pieces called microplastics. **Microplastics** are small bits of plastic ranging in size from 0.3—5.0 mm. This range is equivalent to the size of two human hairs to the size of a rice grain. Research is revealing that plastic never completely disappears, especially in the ocean, because bacteria and other organisms don't consume it; at least not yet.

Light weight garbage, like plastic,

collects in places where the wind and water currents take it. Wind and ocean currents are mostly caused by the earth's rotation. Wind can be slowed by geographical features like mountains or living things like trees on land. Out at sea, where they are few obstacles, wind can travel quickly. Wind stirs up the ocean and mixes materials. **Ocean currents** are organized flows that travel from one place to another and persist over a certain geographical area. Currents have been known to carry animals and plants called **plankton** along with nutrients and heat. Off of the northern coast of California cold currents cause upwelling which contributes greatly to a rich abundance of sea life.

There are at least five places in the ocean where currents pull in garbage forming large dispersed mats. These currents are referred to as gyres. Located between California and Hawaii is one of the largest of these gyres, and it has collected debris into what is sometimes called the Eastern Pacific Garbage Patch or the **North Pacific Gyre**. This floating raft of marine debris is a spinning vortex that changes over time. A **vortex** is a spiral motion of fluid within a limited area. This vortex is spinning in a clockwise direction and forms a mat of garbage larger than the size of Texas. Research vessels are now beginning to study it. Based on some analysis of the garbage found there, at least 40% of it comes from land and the other 60% comes from cruise liners, merchant ships, oil tankers, and other vessels.

How can garbage from land end up in the ocean? Oil, chemicals, detergent, paint, and garbage can enter waterways by flowing water. Pollution enters waterways from point sources and non-point sources. **Point sources** can be traced back to a specific place, usually a stationary pipe that is dumping some sort of waste product. Examples of point sources include farms, waste water treatment plants and factories. **Non-point sources**, on the other hand,

come from a variety of sources and cannot be traced to one particular place. These sources of pollution can come from a storm drain, a drainage ditch, or irrigational runoff. **Runoff** refers to water that has not been absorbed into the ground and therefore, flows over the ground. Runoff occurs when we wash our cars, hose off our sidewalks or over water our gardens. Water carries chemicals along with garbage into drainage areas. People who live closest to the ocean have to be the most careful about what goes down the drain.

Play Your Part

The King Range National Conservation Area has over twenty miles of pristine coastline. Coastal features include harbors, bays, coves, estuaries and beaches. After a day on the beach, people can get careless and may leave garbage behind. After a windy day or a rain shower, garbage may accidentally enter the sea. The same thing can happen from a moving boat or car. Light weight materials like plastic bags and styrofoam have the greatest chance of being blown out to sea. Animals can get into garbage and spread it around too if a garbage lid is not secure. People can help reduce marine debris by not littering, recycling all plastic items and finding alternatives to plastic.

No matter where you live, pollution can be a problem. What goes down a drain whether it is a storm drain or the toilet may reach a waterway. Large items are removed during treatment, but small items can make their way down a river and may eventually reach the ocean. Litter can be carried for miles by rain and wind. Making connections between pollution on land and how it enters the sea, is one way people can understand the interconnectedness between human actions and the environment.

Activity 1: Who Spoiled the Waters?

Preparation

Place a sample of each material listed above into a film canister. Label each one identifying what type of material is inside using masking tape. Each material represents a type of material that may end up in a waterway. In this activity, students will observe how each of these materials behaves in water after reading a short hypothetical scenario of how the material ended there. Materials should be household products and several alternatives are possible.

Procedure

1. Begin by telling the students that today they are going to learn about a big problem facing the ocean—garbage. Begin by talking about the ocean and why it is important. Ask them a few questions centered around human actions and how they affect the ocean. See if they can predict how a river can be connected to the ocean and how materials from a river or drainage (storm drain) can get to the ocean. You may want to tell a short story to the students about how a piece of wood or a plastic bag got into a river to help clarify.

Materials

- 10-20 small canisters (labeled)
- masking tape and marker
- a glass gallon jar
- large spoon for stirring
- tap water
- an assortment of materials including powders and chemicals (see list below)
 - Sand (river)
 - Dry Grass (salt marsh)
 - Crushed sea shells (shellfish)
 - Dried manure (ranchers)
 - Potting soil (farmers)
 - Silt (logging)
 - Cooking oil (restaurant)
 - Plastic pieces (fishing boat)
 - Styrofoam pieces (beach goer)
 - Baking Soda (car wash)
 - Dish detergent (laundry mat)
 - Sunscreen (sun bathers)
 - Vinegar (factories)
 - Dark vegetable oil (port) (add black powdered tempura paint to cooking oil to make it resemble motor oil)
 - packing peanuts (Mail Order Company)
 - balloon (Wedding)
 - walnut oil (truck)

- *What do you like about the ocean?*
- *Why is the ocean important? (i.e. source of freshwater, moderates temperature, food, transportation, recreation, etc.)*
- *What types of things might someone find floating in the ocean?*
- *How could something like a piece of wood or a plastic bag make its way from a river to the ocean?*
- *Do all rivers flow into the ocean?*
- *Has anybody here seen garbage on the beach? Where?*
- *How can garbage get into a river?*
- *Can garbage get from a street to a river?*
- *What problems are associated with garbage in water versus garbage on land? (it takes longer to decay and usually floats; also animals eat it).*

Activity 1 continued...

2. Next, explain to the students how many things naturally wash into the ocean. Trees float down rivers in storms, rivers deposit sand in the ocean, and plants can get washed out to sea. Other times humans are the cause of marine debris. Waste materials may enter a waterway by accident or carelessness. Other times, however, especially in the past, garbage and other pollutants are dumped into the ocean on purpose. Introduce point and non-point sources. The ocean is so big that sometimes people feel okay about dumping things in the ocean.
3. Next, gather the students around a big see-through container of water (glass gallon jar). Each student will read a short passage giving a hypothetical reason how the material ends up in the ocean. After they read the passage, they need to open up their film canister and dump it into the jar (see attached scenarios). Have them predict what will happen before it hits the water. After each material is added, have the students observe how each material behaves. Add the darkest ingredients last. Depending on the size of the class, each student may have their own canister, may work in pairs, or you may want to ask for volunteers .

- *Who can give an example of a material that is not harmful to the ocean?*
- *Who can give an example of a material that is harmful to the ocean?*
- *How might these materials be harmful to the ocean?*
- *Which material is found the most often in the ocean? (oil spills)*
- *Which two materials from our garbage is really bad for the ocean? (plastic and styrofoam)*
- *How can we reduce the amounts of plastic and styrofoam that we use?*
- *What can people do to reduce the amount of garbage that enters the ocean?*

Activity 2: From Here to There

Procedure

1. Begin this activity by reviewing the parts of a watershed. Pass out the watershed worksheet and have the students fill it out. Ask the students what things make a healthy watershed. Show some pictures of the North Pacific Gyre. Define marine debris and ask the students to come up with some of the problems associated with marine debris.

2. In addition, show pictures of animals harmed by floating debris. Showing images such as these, is a powerful way to promote empathy and encourage change. Immediately following, show a short video on garbage or the problem of marine debris.

3. Follow up by discussing what solutions there are to garbage. Make a list together. If time allows, have students list what types of garbage are non-recyclable, like juice boxes. Have the students write letters to companies encouraging them to make containers that can be recycled. This discussion may also lead to other activities like a campus wide clean up or an awareness campaign.

A kit is available from www.algalita.org/ it has a sample of marine debris in ocean water from the North Pacific Gyre.

Materials

- drawing showing a watershed
- pictures of marine debris
- pictures of animals caught in garbage
- video on marine debris
- paper and pencil
- sample of garbage from the North Pacific Gyre

Extensions

- Have students participate in a local beach clean up. The garbage collected can be weighed, sorted and classified.
- Incorporate geography by having students research various coastal features including bays, coves, spits, and harbors.
- Read a historical story about ships at sea and the importance of the shipping industry.
- Begin a classroom collection of plastic products. Use this collection to discuss alternatives to plastics and proper recycling of plastics.
- Study rates of decomposition of different materials by burying them in liter bottles full of soil or outside in a compost pile.
- Have a day of where students bring in a waste free lunch.
- Sing songs from the album *Only One Ocean* by the Banana String Band or other musicians.

References

- International Shipping and World Trade: Facts and Figures, Oct. 2009, <http://www.imo.org/KnowledgeCentre/ShippingFactsAndNews>
- Marine Debris, <http://water.epa.gov/type/oceb/marinedebris/index.cfm>
- Non point Source Pollution, http://oceanservice.noaa.gov/education/tutorial_pollution/05areas.html
- Ocean Pollution, <http://marinebio.org/oceans/ocean-dumping-2.asp>
- Ocean Plastic Pollution and How you Can Help, <http://oceans.greenpeace.org/en/the-expedition/news/trashing-our-oceans>
- Plastics in our Ocean, <http://www.whoi.edu/science/B/people/kamaral/plasticsarticle.html>
- The Trash Vortex, <http://www.greenpeace.org/international/en/campaigns/oceans/pollution/trash-vortex/Trash-Free-Seas>, <http://www.oceanconservancy.org/our-work/marine-debris/international-coastal-cleanup-11.html>
- Ch 5 from Curriculum, Water, Water Everywhere, http://www.coastal.ca.gov/publiced/waves/waves_5.pdf

FOSS Connection

Grade 4
Earth Science: Water, Earth Materials
Scientific Reasoning and Technology: Ideas
and Inventions, Measurements



Possible Measures

Measures to reduce or prevent marine litter are part of a larger issue which concerns each and everyone – that of waste management in society as a whole. People who are waste wise in general, and who realize that waste is a common problem and not one that “someone else” should take care of, will have the same responsible attitude towards the handling of waste that could end up as marine litter.

Merchant ships, offshore platforms, pleasure craft: Efforts should, first of all, be made to reduce the generation of waste onboard ships and platforms. Waste management plans are needed for larger vessels and platforms, and preparations for proper waste management should be made in advance also by those onboard smaller vessels and pleasure craft. Waste should be stored onboard and discharged ashore in a proper reception facility. However, this requires adequate space onboard for storage, and the provision of reception facilities in all commercial harbours and marinas. It also calls for harmonized regional and global regulations to avoid that harbours/marinas are not equipped to take care of the waste and/or that they cause ships undue delay in port. Also, ships should not be deterred from discharging waste to port reception facilities due to high costs, complicated procedures, unnecessary paperwork, excessive sanitary regulations, customs regulations, etc. Furthermore, coastal municipalities must make sure that the waste left in reception facilities is properly taken care of on land, in a manner that is optimal in terms of caring for the environment and human health – the management chain must not be broken.

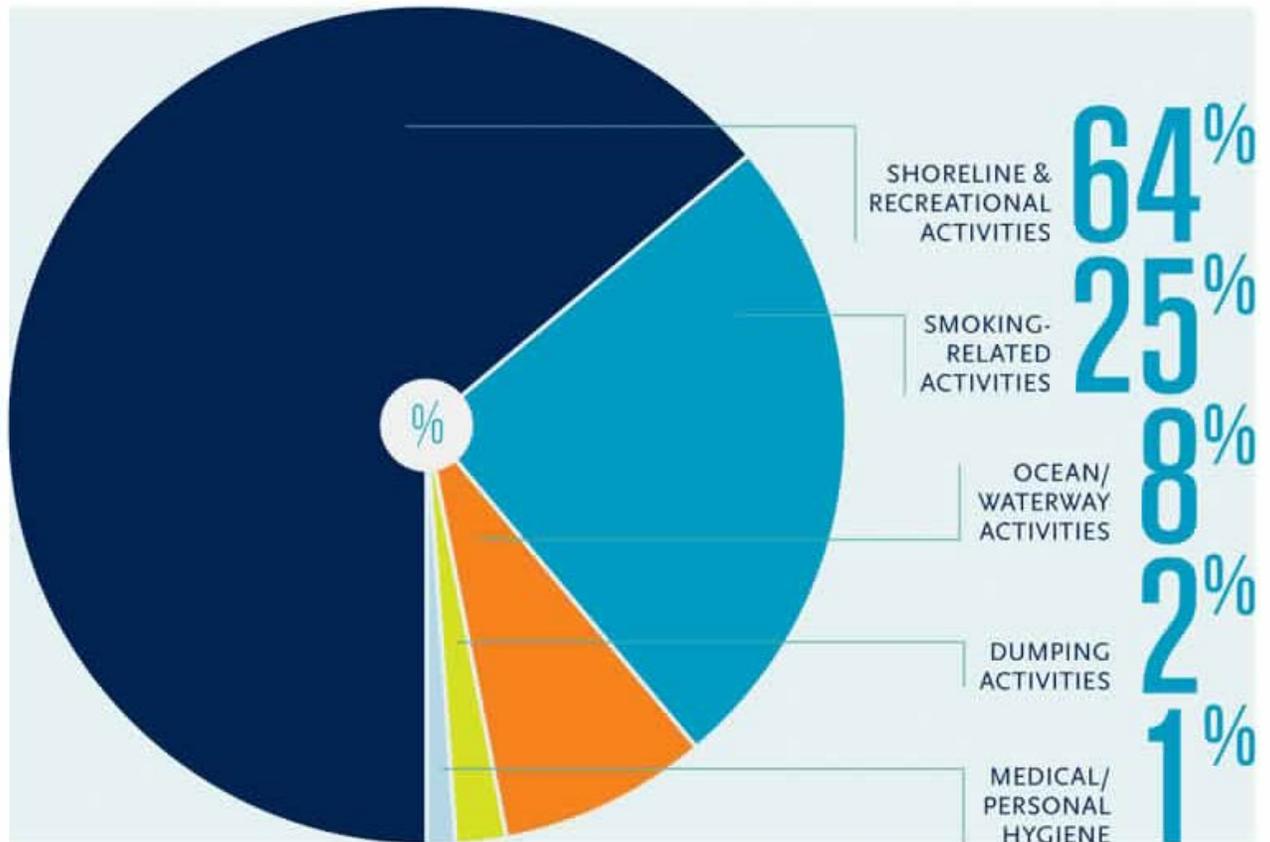
Fishing vessels: Efforts should be made to reduce the generation of waste onboard, and preparations should be made for storage of waste onboard until one comes ashore. Fishing gear, particularly drift nets, should be marked to make it possible to find them again if they are lost at sea. No fishing gear should ever be deliberately discarded but taken ashore for proper disposal.

Municipal landfills and sewage treatment: Coastal communities/municipalities and those along rivers should make sure that open landfills for household waste as well as industrial waste are eliminated, as part of their overall waste management strategy. Sewage treatment, in adequately equipped facilities, should be a priority for municipalities.

Households: Sewage-related waste should never be flushed down the toilet but treated as any other kind of household waste. And household waste should be sorted and taken proper care of. Again, societal waste management begins at home.

Beach-goers, campers etc.: All beaches and camping grounds should be sufficiently equipped with waste bins to cater for the needs of visitors using these locations. However, people should preferably always take home their own trash and make sure that it is properly sorted and disposed of for maximum recycling. If you are capable of carrying the full containers and bottles with you to the beach, surely you can carry them with you home when they are empty.

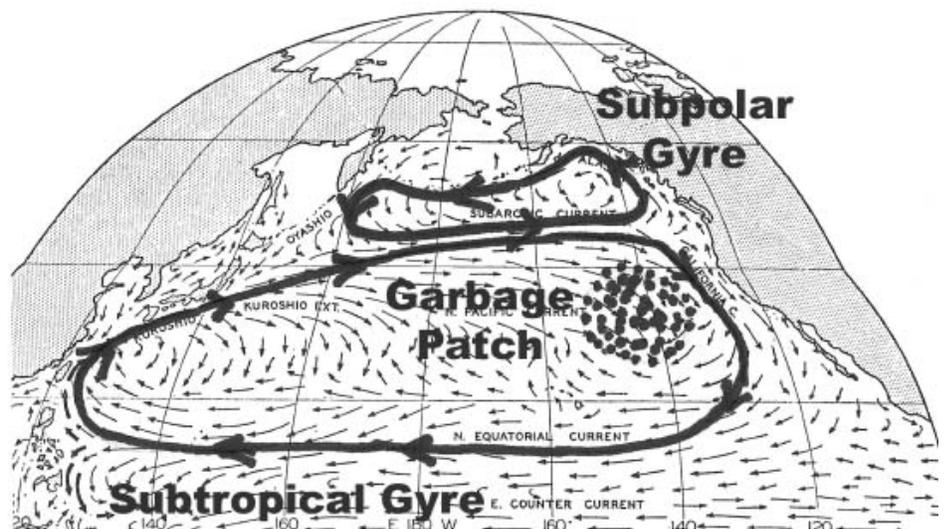
2009 WORLDWIDE SOURCES OF MARINE DEBRIS



TOTAL DEBRIS ITEMS COLLECTED WORLDWIDE

10,239,538

oceanconservancy.org



<http://seagrant.uaf.edu/marine-ed/curriculum/images/stories/grade7/77jaccumulationdebris.jpg>



http://farm2.staticflickr.com/1067/5126104966_96bdc4a393_z.jpg photo by Steve Ringman



http://farm5.staticflickr.com/4025/5143679378_a5c4801e00_b.jpg



Tragedy of the Bay

Read the story to the class below:

Once upon a time there was a beautiful piece of land near _____. On two sides the land was surrounded by a beautiful bay filled with clear ocean water. The bay had clean green islands dotted around. Fish lived in the water and the land was covered by trees. Both the land and sea teemed with all kinds of wildlife. Behind the land was a river and trees.

Instructions

A narrator (the presenter) should read the story above. Each student or team should dump their container of “stuff” after reading the appropriate passage below. Occasionally, “waves” and “wind” should stir the jar.

RESTAURANT (*cooking oil*)

People like to eat out sometimes. As more people moved into the area, restaurants were built. Restaurants nearest the ocean leaked cooking oil into the streets and into the bay.

SALT MARSHES (*dry grass*)

Salt marshes grew along the edges of the bay. Every fall dried grasses from the salt marshes washed into the bay and became food for certain fish.

SHELLFISH (*crushed sea shells*)

Shellfish grew in the shallow waters around the bay including clams, oysters, and scallops. These mollusks are filter feeders and help clean water.

FACTORIES (*vinegar*)

Factories were built along the water's edge and often dumped their waste and chemicals into the water.

LAUNDROMAT (*dish detergent*)

As more people moved to this beautiful area of coast, laundromats were built. The laundry detergents went into sewage pipes and into the bay.

CAR WASH (*baking soda*)

People washed their cars at the local car wash. Run off during the wet season carried the soap to storm drains where it entered the sea.

FISHING BOATS (*plastic pieces*)

The bay and adjoining ocean were rich in fish. Fisherman took advantage of this opportunity, but were sloppy. They let their garbage enter the sea.

BEACH GOERS (*styrofoam pieces*)

On nice days, people would have picnics and play on the beach. Garbage including styrofoam cups and old ice chests were not always picked up.

PORT (*dark vegetable oil*)

As more people moved into the area, the bay became a large port. Here goods were transferred back and forth by ships. Oil from these ships was spilled.

RIVER (*sand*)

A river ran along one side of the land carrying sediment and sand as it flowed into the bay.



Tragedy of the Bay (cont.)

LOGGING (*silt*)

A logging operation logged a hillside in late fall. Soon after heavy rain occurred and silt and sediment flowed into a stream eventually ending up in the ocean.

WEDDING (*balloon*)

As a farewell wish to the bride and groom at their wedding, a bunch of balloons is released into the air. Eventually these balloons land back to Earth and one ends up in the sea.

TRUCK (*oil*)

Goods are trucked to restaurants and stores. Even the cleanest trucks leave a little bit of oil. Rain carries the oil to roadside ditches which eventually drain to the ocean.

RANCHERS (*dried manure*) *do last*

Behind the land, forests were cut and land was converted to pasture. Ranchers raised cows and goats for milk and meat. Manure would run off the fields and into the rivers and to sea.

FARMERS (*potting soil*) *do last*

The soil nearby was great for farming. Farmers would plow the land and erosion would carry soil into the rivers and to the sea.

