

Sound Choices

KEY CONCEPTS

Contaminants enter Puget Sound from a variety of point and non-point sources. Marine debris poses serious threats to marine wildlife, endangers the safety and livelihood of fishermen and recreational boaters, and destroys the aesthetic qualities of marine areas. Plastics are the most common man-made objects sighted at sea and as debris on the nation's beaches. Many current water quality problems in Puget Sound come from rapid population growth which increases the pressures on our water resources. Some of the solutions to our water problems spring from our individual actions; the choices we make can make a difference.

OBJECTIVES

Students will classify sources of pollution in Puget Sound.
 Students will model marine debris entanglement.
 Students will predict and rank order the debris most common in Puget Sound waters.
 Students will communicate sound consumer actions to others including their families.
 Students will design and implement a class action project.

PROCESS SKILLS

observing classifying predicting inferring
 communicating interpreting data hypothesizing

KIT MATERIALS

- Activity 1 - 8 "It Ends Up in the Sound" packets
- Activity 2 - *Trashing the Oceans* videotape
- Activity 3
 a six-pack holder
 32 thick rubberbands
- Activity 4
 a copy of A Citizen's Guide to Plastics in the Ocean: More than A Litter Problem for additional background information
 8 bags containing 12 different "marine debris" objects
 8 copies of "Projected Life of Garbage in the Sea and On the Beach" marine debris posters from NOAA for display
- Activity 5 - 32 copies of the Puget Soundbook

NON-KIT MATERIALS

VCR and monitor

VOCABULARY

- contaminant - a substance that is not naturally present in the environment or is present in amounts that can, in sufficient concentration, adversely affect the environment
- runoff - water, including rain and snow melt, that runs off the surface of the land and into rivers, streams, and other water supplies. Runoff from farms, lawns, and other development often carries traces of fertilizers, pesticides, and other toxic substances.
- toxic - a poisonous substance
- point source - a source of pollution from a single point of conveyance, such as a pipe
- non-point source - pollution that enters water from dispersed and uncontrolled sources, such as surface runoff

TEACHER BACKGROUND

In the preceding lessons, your students have looked at the interactions between plants, animals, and the non-living environment of Puget Sound. "Sound Choices" looks at our role in Puget Sound including actions we can take to assure the health of this magnificent body of water.

A wide variety of materials get into surface water - from both point and non-point sources. As noted below, these materials can cause real problems.

Human Waste: When disease-causing organisms, such as bacteria and viruses get into surface water, they can spread hepatitis, dysentery, and other serious diseases. One of the major sources of these organisms is untreated human waste. In the urban areas of Puget Sound, water carrying human waste passes through sewage treatment plants before being released. Sewage treatment plants treat waste water to kill disease-causing bacteria and viruses. But during heavy storms, the waste water coming into the plants may back up and overflow directly into surface water without treatment. In the rural areas of the Sound, waste water is treated by septic systems instead of sewage treatment plants. Improperly maintained septic systems can be a source of non-point pollution.

Untreated human waste can also rob water of oxygen. Animal and food waste can have the same effect. Tremendous amounts of animal waste wash into surface water from feedlots and other agricultural land each year. And runoff from yards and streets often carries yard and pet waste. Bacteria and other organisms use oxygen to decompose waste. These decomposing organisms may use so much of the oxygen in the water that fish and other aquatic organisms cannot survive.

Fertilizers and Detergents: When nitrate-containing fertilizers and phosphate-containing detergents get into surface water, they can deplete oxygen supplies. The nitrates and phosphates in these products act as fertilizer for algae. The algae grows and reproduces at a tremendous rate, creating huge algal "blooms". As the algae grow, die, and decompose, they use up large amounts of oxygen in the water. Nitrates and phosphates can also cause other problems. Nitrates in drinking water can make the water unfit to drink.

Toxic Chemicals: There are more than 65,000 commercially available chemicals in the U.S. These chemicals are ingredients in many products we use every day and are also used in many industrial processes. Unfortunately many of them also end up polluting our water.

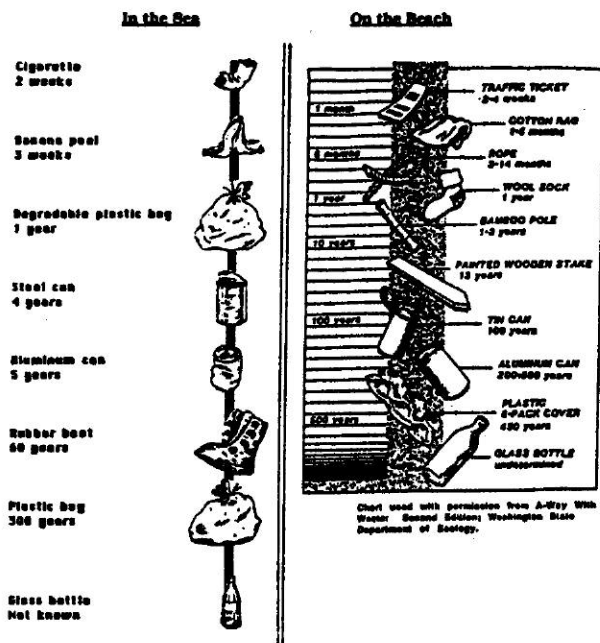
Each year industries legally dump more than 500 million pounds of toxic chemicals directly into surface water. Large amounts of chemicals get into surface water inadvertently. Household chemicals also add to the problem. Runoff carries tons of pesticides, heavy metals, and other chemicals into surface water each year.

Chemicals that get into surface water can poison fish and other animals outright. They can accumulate in the tissues of animals and be passed through the food chain, eventually reaching toxic levels. And these toxic materials can accumulate in bottom sediments, forming reservoirs of chemicals that can continue to affect aquatic life for 111 years.

Erosion: Dirt and silt are carried into surface water when rain runs off land that has been disturbed by bulldozers, logging trucks, or other equipment. Dredging operations can also dump sediment into surface water. An overabundance of sediment in the water can keep sunlight from reaching aquatic plants, clog fish gills, and smother bottom-dwelling organisms.

Oil Pollution: Every time a tanker runs aground and spills millions of gallons of oil into the sea, the event makes headlines. But the amount of oil spilled in tanker accidents represents only a fraction of the total amount of oil that contaminates our water resources each year. Tankers routinely dump oil into the oceans when they clean out their bilges, refineries pump oil-laced waste water into surface water, and oil from city streets washes into surface water, and improperly disposed of motor oil can end up in our waterways.

Projected Life of Garbage in the Sea and On the Beach



Tidal wave of trash

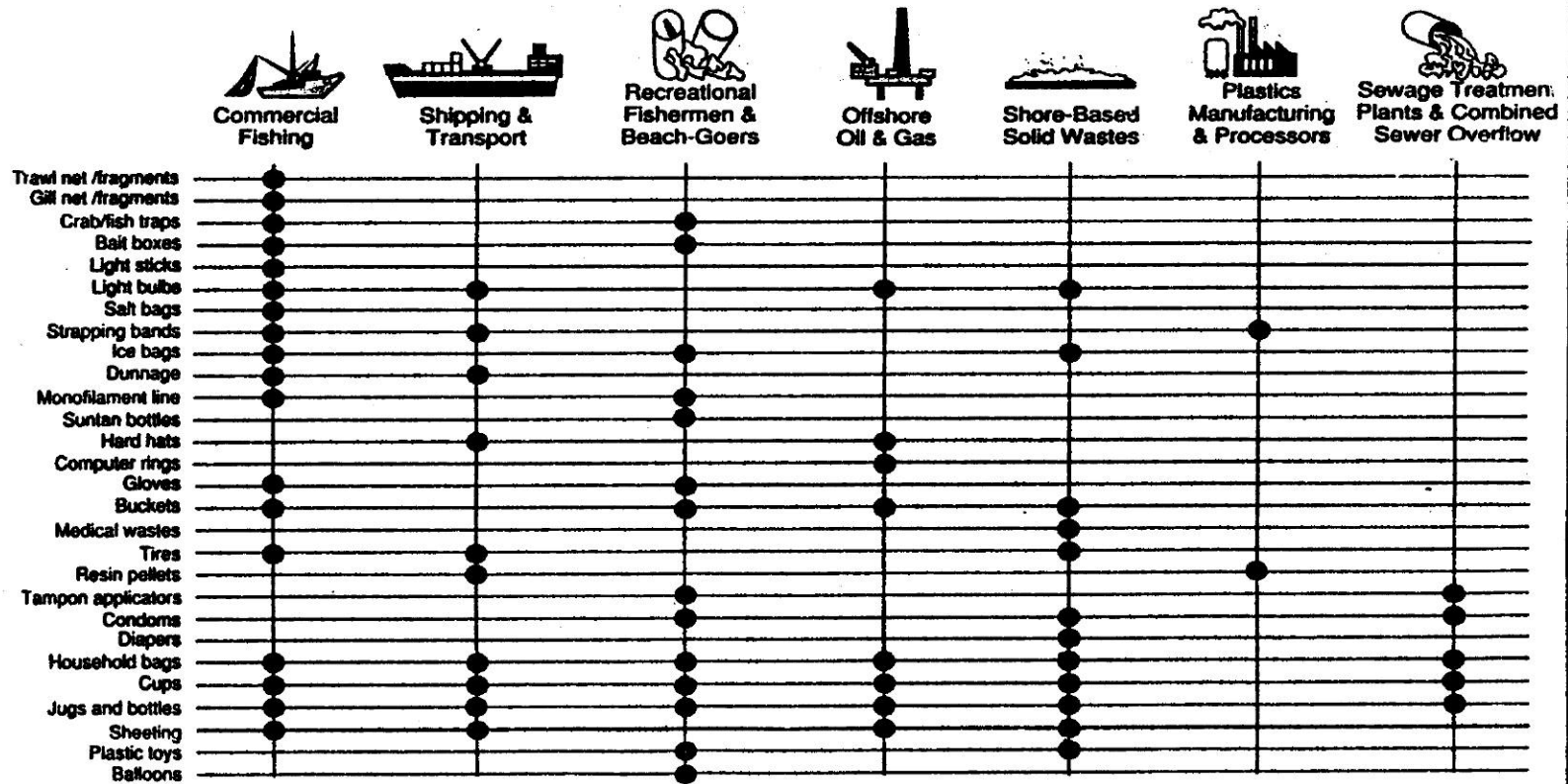
The Dirty Dozen—the twelve most common types of trash washed ashore across the country. This debris was found during the 1988 National Beach Cleanup by 65,000 volunteers who cleaned 3,200 miles of coast.

Plastic cups	242,118
Room plastic cups	167,221
Plastic drinking cups	370,305
Glass beer bottles	167,657
Clothes	64,441
Beer cans	145,320
Pharmaceuticals	42,610
Glass beer bottles	135,352
Aluminum cans	125,512
Plastic cups	106,301
Aluminum cans	98,078
Plastic cups	93,134

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NOTE: See the reference book, [A Citizen's Guide to Plastics in the Ocean: More than a Litter Problem](#) for additional and comprehensive background information on marine debris.

Kinds of marine debris and where it comes from



This lesson contains five activities. Activities 1-4 may take 30-45 minutes to complete. The time required for Activity 5 will be determined by the scope of the action project.

Explain that this last lesson will provide information that will help students and their families make **SOUND CHOICES**: those actions which conserve clean water and reduce the potential of point and non-point pollution entering the Sound. For example, something as simple as moving the family car onto the grass to wash it, rather than washing it in the driveway, prevents detergent laden runoff from entering storm drains.

ACTIVITY 1 - It Ends Up In the Sound

1. Refresh students' memories of the videotape, "Surface Water", from Lesson 4. Review the definitions of point and non-point pollution.

2. Divide students into working groups of 4-5 people. Distribute a "It Ends Up In the Sound" packet to each group.

Directions: Included is a diagram illustrating some of the ways contaminants enter the Sound. The small cards contain written descriptions of the sources. Students are to match each card to the portion of the diagram, illustrating the written description. After the matches are made, discuss the sources with students.

2. ANSWER KEY

PP = point pollution

NP = non-point pollution

The sources of contaminants pictured:

- PP 1. Industries pour a wide variety of pollutants into rivers and the Sound
- NP 2. Runoff from farming carries pollutants (fertilizers, pesticides, particles from erosion, and animal waste).
- NP 3. Runoff from cities contains pollutants (streets and motor traffic, business and industrial activities, and animals and humans).

- NP 4. Runoff from neighborhoods carries pollutants (fertilizers, pesticides, particles from erosion, animal waste, and human waste if septic systems fail).
- NP 5. Boating adds pollutants (fuel, sewage, and garbage dumping).
- NP 6. The exhaust from cars and trucks puts gases and particles that pollute into the air. They enter the water directly or are carried by runoff to the Sound.
- PP 7. Sewage treatment plants dump large amounts of treated waste water.
- NP 8. Landfills can pollute surface water and ground water.
- NOTE: Picture #9 does not have a description card for students to match. Explain to students that #9 shows a combined sewer overflow (CSO): a pipe that discharges untreated waste water during storms from a sewer system that carries both sanitary waste water and storm water. The overflow occurs because the system does not have the capacity to transport, store, or treat the increased flow caused by storm water runoff.

See the Teacher Background section for additional information.

ACTIVITY 2 - "Trashing the Oceans" videotape (requires VCR and monitor)

1. Marine debris is a serious pollution problem in the marine environment. Have students view the videotape, "Trashing the Oceans", to learn how debris gets into the marine environment and the problems it causes.
2. After viewing the video, allow time for students to express their feelings about what they saw in the video. Discuss the information presented, ask:

QUESTION "What problem is presented in this video?"

ANSWER *People are using the oceans as garbage dumps. Trash is showing up on shorelines all over the world, even on uninhabited islands.*

QUESTION "What are some of the ways this trash is getting into the oceans and Puget Sound?"

ANSWER *There are many ways. It is dumped from ships and boats and oil drilling rigs, or thrown down by people at the beach and then washed out with the tide. Some cities even put their garbage on barges, take it out to sea and then dump it!*

QUESTION "What types of trash have you seen washed up on the beach?"

ANSWER *Discuss students' observations.*

QUESTION "What is the material that makes up most of the trash in the world's oceans?"

ANSWER *Plastic.*

QUESTION "In what ways can marine debris be harmful to humans?"

ANSWER *Certainly it is aesthetically offensive. Hospital waste on beaches is potentially very hazardous. Additionally, debris may get caught in boat propellers or enter the intake systems of boats, causing boats to stop and threatening boater safety. Divers could be caught in "ghost nets" or other debris on the bottom.*

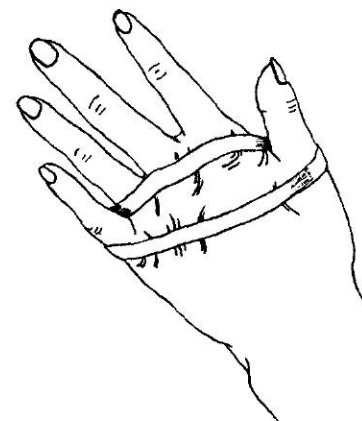
QUESTION "How can wildlife be harmed by the debris?"

- ANSWER**
1. *Eating trash. Plastic bags look like the jellyfish sea turtles eat. Plastic pellets look like bits of food and are eaten by seabirds and fish. The plastic may be toxic to the animal or fill their stomach, causing them to starve to death.*
 2. *Entanglement. Plastic nets or pots and traps may be lost while fishing. These "ghost nets and pots" are left floating around, trapping anything that swims into them. Curious marine mammals and birds may be attracted to discarded nets or plastic rings and become entangled, choking the animals as they grow.*

ACTIVITY 3 - Debris Entanglement Activity

1. Show students a 6-pack holder and ask them how it could be dangerous to wildlife. Explain that they will demonstrate how it could be harmful to a waterbird.
 - a. Distribute a thick rubberband to each student. Explain that the rubberband represents one of the holes in the 6-pack holder.
 - b. Explain that their left hand will represent the head and neck of a bird. Explain that their "bird" gets entangled in the 6-pack holder. To simulate this predicament, have them place the rubberband on their hand as shown in Helpful Hints. The rubberband should be taut and resting across the knuckles.

b.



- c. Have students place their right hand on the bottom of their left elbow.
- d. Have students free themselves from the rubberband without using their teeth, face or any other body part to help them. Ask what might happen to their entangled bird if it is not able to feed itself for a meal, two meals or a day?

Conclude this activity by explaining to students that one way to eliminate the harm of 6-pack holders is to cut each ring open with a pair of scissors.

- 2. Students have been discussing the problem of marine debris and the effects of the debris. Suggest that just as people are the cause, people can be the SOLUTION to this problem. Have students share their ideas about what can be done to solve the problem.

QUESTION "What can each of us do to help solve the problem of marine debris?"

ANSWER *Discuss their ideas. Certainly we can be responsible beach goers, disposing of litter properly. We can be responsible boaters and people who fish by STOWING IT and NOT THROWING IT. Beach cleanups also make a significant contribution to removing debris.*

ACTIVITY 4 - Washington's Dirty Dozen

- 1. Discuss with students the annual beach cleanups that happen in states all across the country in the fall (see Helpful Hints) . Explain that they will get a bag of "marine debris" that represents the 12 objects most commonly found on beaches in Washington State. Ask them to predict what those objects might be. List their predictions for comparison once the bags are distributed.

- 2. It is illegal for any vessel to dump plastic trash anywhere in the ocean or navigable waters of the United States. Annex V of the MARPOL TREATY is an international law that went into effect in U.S. waters on July 31, 1990. The regulations require all vessels over 26 feet to display this placard describing the restrictions of Annex V:

- 1. In September or early October every year, there is an extensive beach cleanup effort in our state. These beach cleanups happen in numerous states around the nation. The Center for Marine Conservation (CMC) has promoted a common data collection form to better understand the problem and try to identify sources of the trash items. Participants in the annual event use these forms and the data is combined. The National 1989 Cleanup results are shown in the 118 Teacher Background.

2. Divide students into working groups of four students. Distribute a bag of the marine debris objects to each group. Have each group sort the "trash" into piles. The following challenges can be given to groups one at a time, to help them think about the impacts of the debris:
- the ways it can affect wildlife: entanglement or eating;
 - Did the debris arrive on the beach from the land or from the water?

2. * The twelve objects most commonly found on beaches in Washington State are:
- metal pull tabs
 - small foam plastic pieces (styrofoam)
 - plastic caps and lids
 - paper pieces
 - glass beverage bottles
 - metal bottle caps
 - metal beverage cans
 - plastic trash bags
 - plastic cups, spoons, forks, straws
 - miscellaneous plastic bags (bait bags, sandwich bags, etc.)
 - plastic beverage bottles
 - glass pieces

* The above list is data collected from Washington ocean and Puget Sound beaches on September 16, 1989. The 2900 participants cleaned up 105 miles of beach and collected 200,000 pounds of trash.

For obvious health reasons, the objects included in the sorting bags in the kit are not actual marine debris collected from the beach. These objects are clean and safe for students to manipulate in the ways suggested.

- 2b. Some of the objects could be appropriate for both piles: originating on land or from the water. The Teacher Background contains a chart which may provide useful information as students try this task.

3. When groups have completed the sorting, ask:

QUESTION "Why do you think it is important to try to identify the source of the debris?"

ANSWER *Knowing the source of the debris may help target groups which can benefit from education about the issue. Additionally, source information may help identify violators of the law. The Coast Guard holds the regulatory power to stop illegal or accidental dumping.*

4. Students are probably aware that the long life of plastic creates a great concern about plastic trash in the marine environment. Challenge students to place the 12 objects in a line according to the time it takes for each object to degrade.
5. When students have completed their predictions, distribute to each group a copy of "Projected Life of Garbage in the Sea and On the Beach". Have students use this information to compare their predictions of how long it would take the 12 objects to degrade.

ACTIVITY 5 - Take Action!

DON'T STOP NOW! Students need to know they can make a difference. They and their families can be part of the solution to these environmental problems. The choices each of us makes EVERY DAY, can make a difference for Puget Sound.

1. Distribute copies of the Puget Soundbook, included in the kit. Have students turn to pages 40-41. Explain that these are actions they and their families can take to help protect our environment. Have students read these pages.
2. Call attention to "A Sound Start" on pages 5-6 of the Puget Soundbook. Explain that students may take home a copy of the Puget Soundbook. Encourage them to use the book for reference with the help of adults in the household. With their families, have students:
 - a. generate a list of actions their family is currently doing that are environmentally sound choices;
 - b. list at least one behavior their family will change or an action they will take to help in caring for Puget Sound.

3. For example, the commercial fishing industry was targeted for education about marine debris and now some of the ports in Washington have stations for fishermen to recycle their waste netting, as well as other debris. The program has been quite successful. Recreational boaters are another group that has been targeted. It is hoped that in future beach cleanups the efforts of those sharing information about marine debris will pay off with less trash collected.

2. Establish a check-out system for students to take home a copy of the Puget Soundbook for use with their families. The books are to be returned to the kit.

Students may enjoy sharing with the class their family's lists of "Sound Choices" and changes they will make.

3. Help your student develop an action project for the class. In action projects, STUDENTS solve a problem or improve a situation. Help students select action projects that are realistic, positive and possible. To begin thinking about an appropriate action project, have students brainstorm: problems, causes, and solutions.

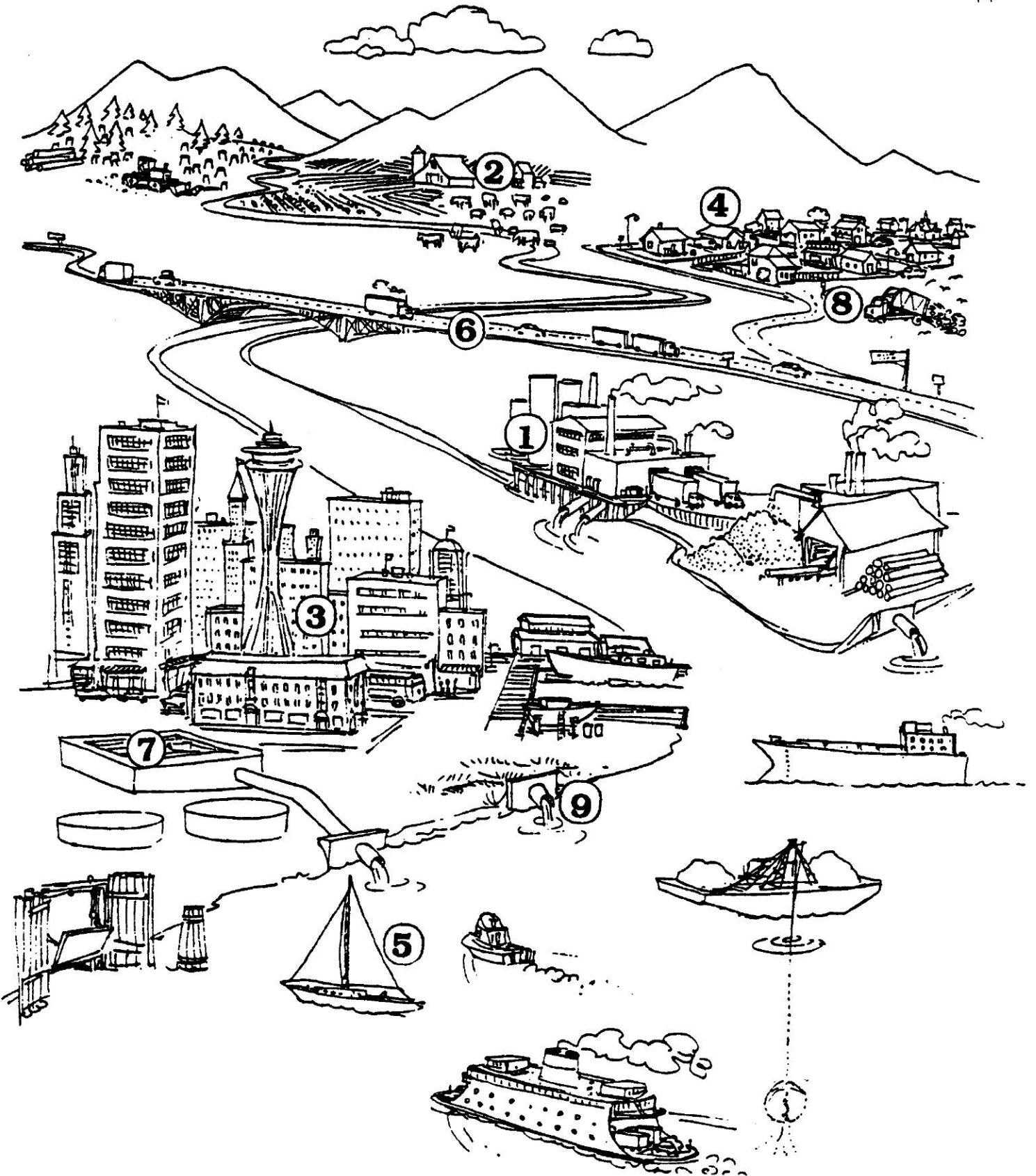
3. The action project enables your students to employ their knowledge in a manner which can really make a difference. While reaching beyond your classroom may seem intimidating, success stories are many. The benefits make the risks worthwhile. The ideas presented on pages 5-6 and 40-41 in the Puget Soundbook may be useful. The best projects may come from your students. A simple comment from one student voicing concern about the school or community environment might lead to a satisfying project that holds personal meaning for the entire class. Other water-related action projects include:

- a. adopting a stream, lake, river or beach:
- | | |
|---------------------|-------------------|
| Adopt-A-Stream Fdn. | Adopt-A-Beach |
| P.O. Box 5558 | P.O. Box 21486 |
| Everett, WA 98306 | Seattle, WA 98111 |
| (206) 388-3313 | (206) 624-6013 |
- b. educating your community about the effects of dumping waste down drains and into waterways.

The following field trips/investigations may help students learn more about your community's pollution problems and potential solutions:

- a local water department
- a sewage treatment plant
- recycling center
- industrial plant
- major development project or site of a proposed project
- power plant
- landfill
- incinerator
- community's engineering department
- create a model to explain how septic systems work

It Ends Up in the Sound



**DESCRIPTOR CARDS for
*It Ends Up In the Sound***

Industries pour a wide variety of pollutants into rivers and the Sound.

Runoff from farming carries pollutants (fertilizers, pesticides, particles from erosion, and animal waste.

Runoff from cities contains pollutants (streets and motor traffic, business and industrial activities, and animals and humans).

Runoff from neighborhoods carries pollutants (fertilizers, pesticides, particles from erosion, animal waste, and human waste if septic systems fail).

Boating adds pollutants (fuel, sewage, and garbage dumping).

The exhaust from cars and trucks puts gases and particles that pollute into the air. They enter the water directly or are carried by runoff to the Sound.

Sewage treatment plants dump large amounts of treated wastewater.

Landfills can pollute surface water and ground water.

Projected Life of Garbage in the Sea and On the Beach

In the Sea

Cigarette
2 weeks

Banana peel
3 weeks

Degradable plastic bag
1 year

Steel can
4 years

Aluminum can
5 years

Rubber boot
60 years

Plastic bag
300 years

Glass bottle
Not known



On the Beach

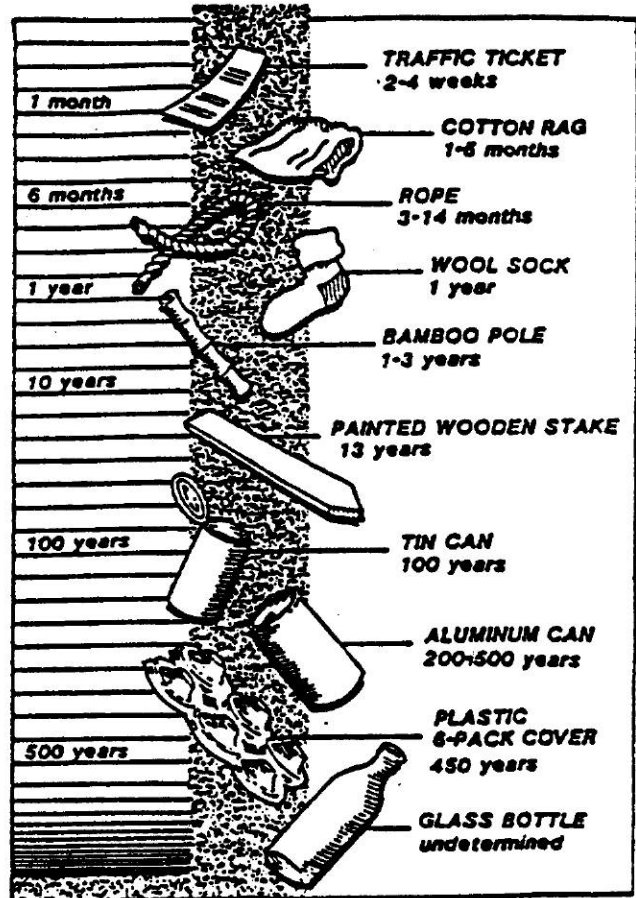


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