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Turning the Tide on Trash

A Learning Guide on Marine Debris

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Overview

The vast oceans that cover over two-thirds of our planet are extraordinary resources. These waters provide a home for thousands of species of plants and animals. They are important to people because they yield an abundance of tasty and nutritious foods. In addition, we appreciate the oceans for the great beauty and recreational pleasures they offer.

The oceans of the world, however, currently are under considerable pressure. We expect oceans to support our fishing industries and coastal economies, provide recreational opportunities, and serve as a nurturing home for marine plants and animals. At the same time, we use these waters as a receptacle for our trash and other wastes.

Unfortunately, the vastness of the world's oceans seems to have caused people to overestimate their ability to safely absorb wastes. While it is true that oceans can safely absorb pollutants and wastes to some degree, this ability is limited. This is particularly true now, when part of our solid waste stream is made up of synthetic materials that can remain in the environment for many years. Also, as more and more people move near our nation's coasts, and the production of trash continues to increase, it is likely the amount of trash entering our oceans will rise. For these reasons, it is important that we act now to keep trash off our beaches and preserve the quality of the marine environment.

In the past, litter on beaches and in waterways was considered an eyesore—unpleasant to look at, but otherwise harmless. More recently, however, people have come to realize that in the marine environment such debris also has serious impacts on wildlife, the environment, and our economy. For example, thousands of marine animals are caught in and strangled by debris each year. Coastal communities also lose money when littered beaches must be closed or cleaned up, and the fishing industry must spend thousands of dollars annually for the repair of vessels that are damaged by debris.

People who litter are a significant source of marine debris. This litter sometimes directly becomes marine debris when it is discarded in the ocean or on the beach. Litter discarded hundreds of miles inland also can become marine debris when it is carried by streams, rivers, or sewers into the ocean. An important message of this learning guide is that any trash that is improperly disposed of potentially can get into the ocean or other waterways, and anyone who improperly disposes of trash can be a source of marine debris! It is our hope that once people are educated about the sources and effects of marine debris, they will be less likely to contribute to the problem.

The lessons in this learning guide are designed to increase students' awareness of the impacts of marine debris and to teach them about pollution prevention techniques. At the same time, the activities strive to inspire an appreciation of the ocean and a commitment to the preservation of its water quality, beauty, and wildlife.

Although this learning guide focuses on marine debris, trash is found in other aquatic environments (such as ponds, lakes, rivers, and streams) as well. Most of the concepts associated with marine debris apply to all aquatic debris. Therefore, the use of this learning guide should not be limited to coastal areas. Teachers in inland communities can replace the term marine debris with aquatic or waterborne debris.

Marine debris is not the only form of marine pollution. Marine pollution also includes things like sewage, oil, gasoline, toxic chemicals, and pesticides that are released or run into the ocean. Unlike most of these marine pollution problems and other environmental issues, children can play a direct and significant role in reducing the marine debris problem. Every child that learns to dispose of trash properly can be one less source of litter and marine debris. Every child that volunteers to participate in a beach cleanup campaign can help to improve the current marine debris situation.

Also, as with any complex problem, education is the first step to a lasting, effective solution. Since marine debris is an issue that will require constant attention for generations to come, it is essential that education start with the decision-makers of the future, our children. EPA hopes that this learning guide, along with your efforts, will help to ensure the future welfare of our oceans by instilling in our young people an environmental ethic that will last a lifetime.

How to Use This Learning Guide

Turning the Tide on Trash: A Learning Guide on Marine Debris is an interdisciplinary guide designed to provide maximum flexibility in the classroom. The guide can be used as a stand-alone teaching tool, or individual activities may be used to supplement work in other subject areas. The learning guide opens with an exercise, "Let's Talk Trash: A Litter Survey," that encourages students to think about their own behaviors and attitudes with respect to litter. This survey provides a basis for students to understand their contribution to the marine debris problem and will help teachers draw students into activities presented later in the guide that deal with the sources and effects of marine debris.

Following the litter survey are the learning guide's three teaching units:

I **The Definition, Characteristics, and Sources of Marine Debris.** In this unit, students will examine what marine debris is, where it comes from, and how it enters the marine environment.

II **The Effects of Marine Debris.** This unit explores the effects of marine debris on wildlife and coastal communities, and the potential hazards it poses to humans.

III **Developing Solutions and Spreading the Word.** In this unit, students will learn about steps they can take to prevent marine debris, investigate what individuals and organizations are doing about the problem, and explore ways to educate others about possible solutions.

Each unit is composed of the following parts:

Unit Opener. Each unit begins with a one-page opener that lists a series of questions conveying the concepts that will be covered in the unit. These questions will be answered in the course of reading the background material and performing the activities.

Background Information. Several pages of background reading present general information that will prepare the educator to present the activities that follow. Key points are summarized at the end of the background material.

Facts from the Deep. Throughout the learning guide, short features highlight interesting facts or statistics about the problems of marine debris in the ocean and coastal environment. Educators can use "Facts from the Deep" as additional background information or to stimulate thought-provoking classroom discussion.

Activities. Each unit contains three to six hands-on, interactive activities. Activities cover a range of academic subject areas and are cross referenced across units as appropriate. Each activity has the following parts:

Objective. A statement describing the learning goal of the activity.

Activity. A short description of what the activity will consist of and how it will be performed.

Vocabulary. A list of new words necessary to understand the concepts presented in the activity. These words are introduced and printed in boldface type in the background information and defined in the glossary.

Materials. A bulleted list of all materials, including suggested handouts, that will be needed to perform the activity.

Subjects. The academic subject areas the activity encompasses, including Art, Language Arts, Mathematics, Music, Science, and Social Studies.

Learning Skills. The cognitive or behavioral skills students will exercise by performing the activity.

Duration. Approximately how long the activity will take to perform.

Procedure. A description of how to perform the activity, including questions that guide discussion and any necessary handouts, illustrations, diagrams, or reproducible masters.

Other Directions. Suggestions for additional related activities that expand upon or enrich the concepts learned. Each activity has one to three "Other Directions," which often offer ways to present the concepts using different academic skills or disciplines.

The learning guide also contains additional tools, in the form of three appendices, to supplement instruction in the three teaching units and to provide additional resources. **Appendix A** is a glossary that contains definitions of the key terms that are introduced and printed in boldface type in the background information. These terms are also presented as new vocabulary at the beginning of activities. **Appendix B** is a listing of recent publications, posters, videotapes, and films that may enhance certain lessons or may be presented as additional background or enrichment. **Appendix C** contains Clip Art illustrating types of marine debris, sources, preventive efforts, recycling, and other examples of marine debris effects and solutions. These pages can be reproduced easily to use as graphics for certain activities or to design your own projects. Clip Art also can provide ideas from which students can develop their own illustrations.

The reproducible Clip Art found in Appendix C, as well as the masters of charts, tables, and illustrations found throughout the guide, can be used in a variety of ways. They are designed so that they can be photocopied easily for classroom distribution, but they also may be used as guides for displaying information on blackboards or whiteboards, flipcharts, or bulletin boards. Students also can create their own materials based on these masters.

As a final note, keeping a collection of different types of marine debris in a box in the classroom will come in handy when introducing students to the characteristics of marine debris and its effects. In addition, activities throughout the learning guide call for the use of actual items of marine debris, if they are available. For students who may not have the opportunity to visit aquatic environments, seeing and handling actual debris may give them a better understanding of its potential effects. Adding this hands-on aspect also gives activities a real-world focus and helps spur students' curiosity and motivate them to learn.

Activities by Learning Skill

	Unit I						Unit II			Unit III				
	Coming to Terms with Marine Debris	Trash Traits	A Degrading Experience!	Roots and Routes of Marine Debris	The Trails and Trials of Trash	Waste Inventory	Circle of Danger	All Tangled Up	How Harmful Is It?	Nations and Neighbors	Clean Sweep	Campaign for a Clean Future	Private Investigations	Circulating Solutions
Analyzing	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		
Calculating	✔					✔			✔					
Classifying	✔	✔	✔			✔			✔		✔			
Collecting Data	✔	✔	✔			✔					✔	✔	✔	
Comparing/Contrasting		✔	✔			✔			✔					
Decision-Making									✔	✔	✔	✔		✔
Experimenting		✔	✔					✔						
Hypothesizing		✔	✔	✔		✔								
Interviewing												✔	✔	✔
Observing	✔	✔	✔			✔				✔	✔			
Public Speaking							✔						✔	
Reading							✔						✔	✔
Researching												✔	✔	✔
Visualizing				✔	✔		✔	✔		✔		✔		✔
Working in Small Groups				✔	✔						✔	✔	✔	✔
Writing								✔		✔		✔	✔	✔

Activities by Subject

	Unit I						Unit II			Unit III				
	Coming to Terms with Marine Debris	Trash Traits	A Degrading Experience!	Roots and Routes of Marine Debris	The Trails and Trials of Trash	Waste Inventory	Circle of Danger	All Tangled Up	How Harmful Is It?	Nations and Neighbors	Clean Sweep	Campaign for a Clean Future	Private Investigations	Circulating Solutions
Art				✔								✔		✔
Language Arts	✔	✔	✔		✔	✔	✔	✔		✔		✔	✔	✔
Mathematics	✔					✔			✔		✔			
Music										✔				
Science	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔
Social Studies				✔	✔	✔			✔	✔	✔	✔	✔	✔

Let's Talk Trash: A Litter Survey

Students will learn in Unit I of this learning guide that litterers are a major source of marine debris. This survey will allow teachers to find out if and why students litter. At the same time, it will allow students to examine their own habits and attitudes with respect to littering.

Before teaching the first activity of the learning guide, ask students the questions on the Litter Survey. Use the spaces provided in the "before learning guide" section to note how many students answer each question "yes" or "no." After completing the learning guide, ask the students the same questions again and fill in the "after learning guide" section of the survey table. (Note: Another option is to photocopy enough copies of the survey for each student in the class. Have the students fill in the survey and hand it in anonymously after the learning guide has been completed. This way, the students can finish the survey without feeling pressured to answer in the "right" way.)

The "before learning guide" and "after learning guide" answers to the first two questions may not change for most students. Teachers therefore may opt to only ask those questions for the "before learning guide" section. However, students will learn during the learning guide that there are many types of littering. Students who never tossed trash on the ground but put it down a storm sewer, for example, may change their "before learning guide" answer to question #1 from "no" to "yes." Consequently, teachers may want to ask these questions again after the learning guide has been completed.

While teaching this learning guide, teachers can use the "before learning guide" survey answers to draw students into discussions of marine debris by emphasizing their direct role in the problem. In addition, teachers may compare "after learning guide" answers with "before learning guide" answers to determine if students' attitudes toward littering have been affected by this learning guide. Students also can compare these sets of answers to examine if and how their own attitudes have changed.

Once the "after learning guide" section of the survey has been completed, discuss with students if and how their attitudes about littering have changed. Ask the students if they will make more of an effort not to litter now that they have learned about marine debris.

Litter Survey

QUESTIONS	BEFORE LEARNING GUIDE		AFTER LEARNING GUIDE	
	YES	NO	YES	NO
1. Have you ever littered?	☐	☐	☐	☐
2. If yes, why?				
A. It was convenient.	☐	☐	☐	☐
B. Didn't think it was bad.	☐	☐	☐	☐
C. Didn't care.	☐	☐	☐	☐
D. It was an accident.	☐	☐	☐	☐
3. Have you ever made a special effort not to litter?	☐	☐	☐	☐
4. If yes, why?				
A. Litter is ugly.	☐	☐	☐	☐
B. Someone else has to pick it up.	☐	☐	☐	☐
C. Litter hurts animals and people.	☐	☐	☐	☐
D. It is illegal.	☐	☐	☐	☐
5. If you saw someone else litter you would . . .				
A. Tell him/her to stop.	☐	☐	☐	☐
B. Pick up the litter yourself.	☐	☐	☐	☐
C. Tell someone (like a teacher or a police officer).	☐	☐	☐	☐
D. Do nothing.	☐	☐	☐	☐

Unit I

The Definition, Characteristics, and Sources of Marine Debris

- What is marine debris?
- What characteristics of trash affect how easily it becomes marine debris?
- What characteristics affect how long debris remains in the marine environment?
- What are the sources of marine debris?
- How does debris get into the marine environment?
- What are some ways to reduce or prevent marine debris?

Tom O'Hara

Unit I

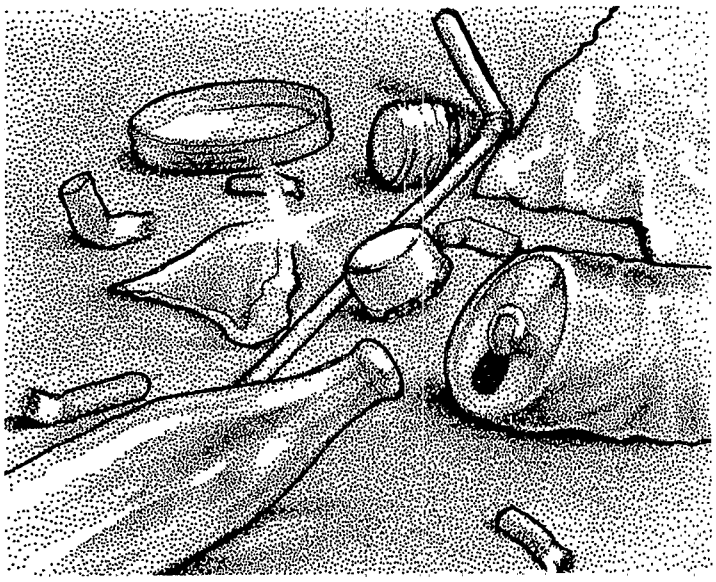
The Definition, Characteristics, and Sources of Marine Debris

Marine debris is trash that gets into the marine environment as a result of careless handling or disposal. Two characteristics of trash, its buoyancy and ability to be blown around, affect how easily trash becomes marine debris, while the ease with which trash degrades dictates how long it remains in the marine environment. There are several sources of marine debris, both on the ocean and on land. Careful collection, handling, and disposal of trash, as well as attempts to reduce the amount of trash that must be disposed of, can help to reduce the marine debris problem.

What Is Marine Debris?

Marine debris includes all the objects found in the **marine** environment (which consists of not only the ocean, but also salt marshes, estuaries, and beaches) that do not naturally occur there. Although items such as tree branches and the bones of land animals can be considered marine debris, the term generally is reserved for **trash** (articles that have been made or used by people and discarded). The most common categories of marine debris are plastic, glass, rubber, metal, paper, wood, and cloth.

Since 1988, the Center for Marine Conservation (CMC) has organized and sponsored an annual National Beach Cleanup Campaign. Volunteers in all of the coastal states, as well as some of the states bordering the Great Lakes, collect marine debris and record their findings. CMC compiles these data and publishes the results, which have shown that significant quantities of marine debris litter U.S. coastlines. In 1991, the 12 most frequently collected marine debris items were: 1) cigarette butts, 2) plastic pieces, 3) foamed plastic pieces, 4) plastic food bags and wrappers, 5) paper pieces, 6) glass pieces, 7) plastic caps and lids, 8) metal beverage cans, 9) glass beverage bottles, 10) plastic straws, 11) plastic beverage bottles, and 12) foamed plastic cups. Although plastic is the most common type of marine debris, all debris causes problems in the marine environment.

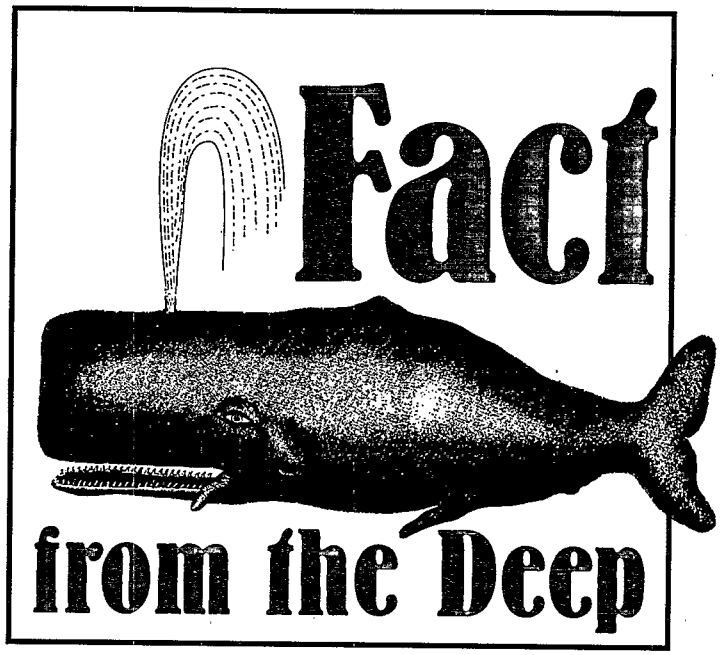


What Characteristics Affect Whether Trash Enters and Persists in the Marine Environment?

Two characteristics of trash, buoyancy and ability to be blown around, affect how easily the trash can enter the marine environment. Another characteristic, degradability, affects how long the trash will remain in the marine environment. The more likely it is that a piece of trash will enter and remain in the marine environment, the greater the threat it poses to people, wildlife, and vessels.

Sue Barnett, CMC

Buoyant objects are those that float in water. Buoyant objects are more likely to become marine debris than those that sink because they can be carried by water. Buoyant items can be washed into the ocean by heavy rainfall, carried out to sea by rivers and streams, or picked up off a beach by waves. In the ocean, buoyant debris causes problems because it can easily come in contact with marine animals, humans, boats, fishing nets, and other objects. Floating debris also can travel long distances over the ocean. Consequently, when these items get into the ocean they can cause problems over a wide-ranging area. The most buoyant types of debris are plastic and some types of rubber. Paper and wood



Balloons Can Be Dangerous!

Every year, thousands of helium-filled balloons are released into the air. Some of these balloons are released accidentally. Others are released in large numbers during weddings, mall openings, and other kinds of festivities because people think they look pretty when they are floating up into the air. Although the floating balloons look like they are disappearing, they ultimately lose their helium and fall back to earth. Some of these balloons can get in the ocean, where they may become a harmful form of marine debris. Some marine animals, especially sea turtles, have been known to eat balloons. The swallowed balloons can block air passages, possibly causing the animals to suffocate, or may lodge in intestinal tracts, where they may disrupt digestion. Either way, balloons can be dangerous!

If balloon releases are conducted in your school or community, consider suggesting ways that the spectacle can continue without littering and endangering wildlife. For example, balloons can be released in a gymnasium or ballroom rather than outdoors. Another idea is to rent a hot air balloon. The sight of such a large balloon rising into the air is impressive, and unlike the smaller helium balloons, you can ride in a hot air balloon!

initially float, but tend to sink once they become saturated with water. Glass, metal, and some kinds of rubber sink (unless air is trapped inside the article). Cloth items also tend to sink.

Items that are blown by the wind can easily find their way into the marine environment. Such debris can be blown directly into the ocean, or can be transported to the ocean if blown into a river or stream that empties into the sea. Objects that can be easily blown around are a particular problem because they can become marine debris even when they are originally disposed of in a proper manner. For example, a napkin that is thrown in a trash can at the beach can be blown out of the can and into the ocean. Paper, as well as some kinds of rubber, plastic, and cloth, can all be carried by the wind. During storms and other periods of high winds, almost any kinds of trash (including glass, metal, and wood) can be blown into the ocean.

The characteristics of buoyancy and ability to be blown around are generally correlated. Lightweight objects tend to float and also are the items that are easily blown around. Some lightweight objects will sink, however, if they become saturated with water.

An object is **degradable** if natural forces cause it to be broken down into smaller pieces. In nature, materials most commonly are broken down through a process called **biodegradation**. Biodegradation occurs when microorganisms (such as bacteria and fungi) decompose a material, causing it to be broken down into compounds (such as nutrients) that can be reused in the environment. Temperature and moisture levels affect the speed of biodegradation. Generally, the higher the temperatures (up to a certain point) and the greater the moisture level, the greater the rates of biodegradation. Natural materials usually are more biodegradable than synthetic materials. Plastic, glass, synthetic rubber and cloth, and metal typically are resistant to biodegradation. Natural rubber and cloth can biodegrade, but it takes a relatively long period of time. Paper also can biodegrade, unless it is coated with plastic or other nondegradable substances.

Debris that does not easily biodegrade, unless it can be broken down into smaller pieces through wave action or other environmental forces, remains in the environment for a long time and is therefore **persistent**. Plastic and synthetic rubber are the most persistent kinds of marine debris. Glass, foamed plastic, and metal are less persistent because even though they are not biodegradable, wave action and rusting can cause them to break into smaller pieces. Wood, natural rubber, and cloth are only moderately persistent because they can biodegrade. Paper is not persistent, because it is biodegradable and can be ripped easily.

Where Does Marine Debris Come From?

Marine debris comes from many different **sources** (places or activities that generate the trash that enters the marine environment). Any trash that is improperly disposed of, as well as any materials that are improperly transported or stored, can become marine debris. The main sources of marine debris are:

- Beachgoers
- Improper disposal of trash on land
- Stormwater sewers and combined sewer overflow
- Ships and other vessels
- Industrial facilities
- Waste disposal activities
- Offshore oil and gas platforms

Every year, thousands of people visit U.S. beaches. Many of these beachgoers leave behind materials that become marine debris, such as food packaging and beverage containers, cigarette butts, and toys like shovels, pails, and frisbees. This trash can be blown into the ocean, picked up by waves, or washed into the water when it rains.

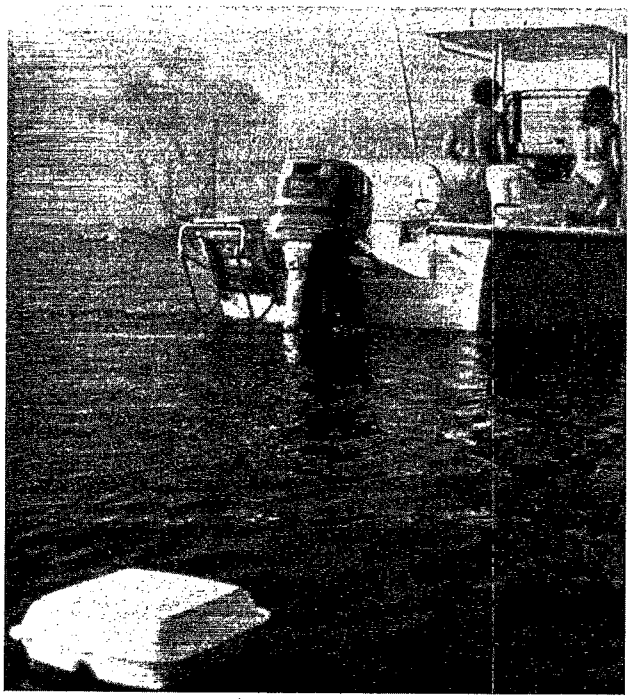
Landlubbers also can generate marine debris, however. Trash can be blown or washed directly into the ocean if it is littered or disposed of carelessly. Even trash that is generated hundreds of miles inland can become marine debris if it is blown or washed into rivers or streams and carried to sea.

Stormwater runoff (the water that flows along streets or along the ground as a result of a storm) can carry street litter into sewer pipes, which convey this water and debris to a nearby river or stream, or even directly to the ocean. In some areas of the country with older sewer systems, sewage (the wastes flushed down toilets or drains) also is carried in the same pipe system as stormwater runoff. Pipes that carry a combination of sewage and stormwater are known as **combined sewers**. Unlike independent storm sewers, combined sewer

pipes run to a **sewage treatment plant** rather than directly into a nearby body of water. At the sewage treatment plant, sewage is separated into **sludge** (solid waste materials) and water. The sludge is dried and either disposed of in a landfill or treated and sold as a fertilizer. The treated water is discharged into a river or other nearby waterway, free of solid waste.

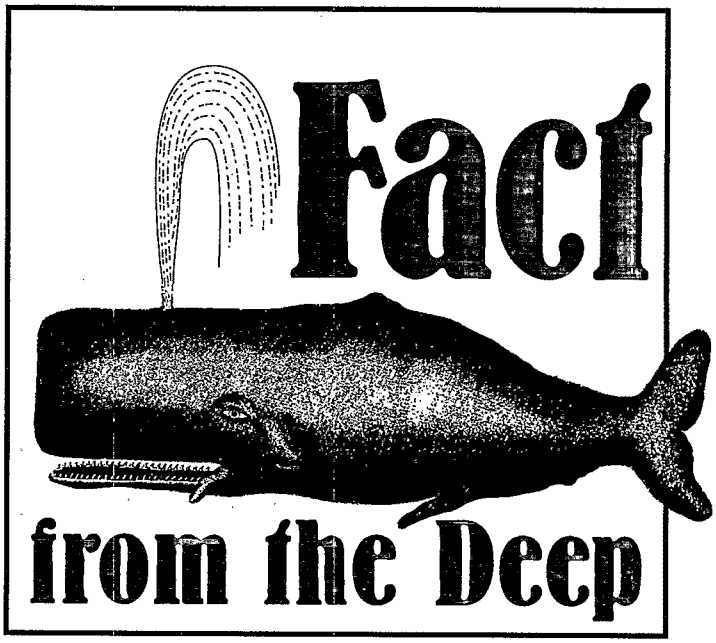
Combined sewer pipes cause problems when heavy rainstorms cause too much water to enter the sewer system. When this happens, the amount of water in the sewer pipes exceeds the sewage treatment plant's handling capacity. To prevent major operating problems at the plant, a safety overflow valve diverts the excess water from the plant into a nearby waterway. The problem with this system, however, is that untreated sewage and debris also are diverted into the waterway.

Boats of all kinds also are sources of marine debris. Sometimes, trash is purposefully thrown overboard. One major reason for the overboard disposal of trash is that there is limited storage space aboard these vessels. Most of the time, however, trash is



John J. Domont/CMC

disposed of in the ocean by people who are unaware of the problems this can cause. Trash can also accidentally fall, blow, or wash off of vessels into the water. In addition, fishing nets and lines, and other types of equipment, can be lost at sea accidentally and become marine debris.



Sunlight & Six-Pack Holders

Six-pack holders are a dangerous type of trash. Because they have holes in them, animals can get caught in these devices and get injured or even strangled. In order to reduce this problem, the manufacturers of six-pack holders have begun making them out of a photodegradable plastic. This plastic becomes brittle and breaks into smaller pieces when it is exposed to sunlight. Now, six-pack holders that become marine debris will degrade relatively quickly, preventing many marine animals from getting caught. You can help. Before disposing of six-pack holders at home, cut through the loops to help prevent entanglement of wildlife should the holder enter the marine environment.

Industrial facilities contribute to the marine debris problem when waste items generated by industrial processes (such as production scraps, flawed products, and packaging material) are improperly disposed of on land. Finished products also can become marine debris if they are lost during loading and unloading at port facilities, or they are lost when they are transported through waterways or over land. The Society of the Plastics Industry, Inc. is taking steps to control one of the most common types of marine debris generated from industrial facilities, **plastic resin pellets.** Plastic resin pellets are the small spheres that are produced as the raw form of plastic. They are used by manufacturing facilities to make plastic products. During plastic resin pellet production, transportation, and processing, some resin pellets can be released into the environment. As with other types of trash, wind and stormwater can carry these pellets to nearby water bodies.

Waste disposal activities can cause a problem when trash is lost during collection or transportation, or when trash blows or is washed away from disposal facilities. For example, **landfills** (which are specially engineered sites for disposing of solid waste on land that are constructed to reduce any hazards to public health and safety) can generate marine debris. The trash in landfills periodically is covered with soil so that it will not be released into the environment, but the trash can blow or be washed from the landfill before it is covered up.

Offshore oil and gas platforms are structures that are constructed in the ocean and form a base from which oil and gas drilling is conducted. Because offshore oil and gas platforms are surrounded by water, any items that are lost from these structures become marine debris. As with ocean vessels, trash has sometimes been purposefully discarded directly into the ocean from these structures. Efforts are being made by oil and gas companies, however, to prevent the disposal of trash into the ocean from oil and gas platforms. Typical debris generated from these platforms includes data-recording tape, items like drill pipes and drill pipe protectors, hard hats, gloves, and 55-gallon storage drums.

Once the debris has found its way into the ocean, it is very difficult to trace the source of the debris. A plastic cup, for instance, could have been left by a beachgoer, littered in a city street and been washed into a storm sewer and out to sea, blown off of a recreational boat, used on a shipping vessel and disposed of overboard, and so on. Clearly, marine debris is a complex problem whose answer will require that many sources of marine debris be controlled.

What Trash Management Practices Can Reduce the Marine Debris Problem?

The United States generates significant quantities of trash every year. In 1990, almost 196 million tons of trash were generated in this country. About 17 percent of this trash was recycled. Almost all of the rest was buried in landfills (67 percent) or burned (16 percent). **Disposal** means permanently storing or removing the trash from the environment. Landfilling and burning are considered disposal methods.

Recycling is one way to reduce the amount of trash that must be disposed of. **Recycling** is the collection and reprocessing of materials so they can be used again. Before materials can be processed for reuse, they must be separated into different types (such as plastic, glass,

K. Koski/NMFS

and metal). In 1990, over 8,000 recycling programs existed in the United States. Although recycling has become widespread, not every type of material currently can be recycled in every area of the country.

Currently, paper is the most frequently recycled type of trash. Three types of paper are recycled: high-grade paper (such as computer paper), newspaper, and corrugated cardboard. Metals also are commonly recycled, particularly aluminum cans (most soft drink and beer cans) and soup and fruit cans (which are made from tin-coated steel or aluminum and steel). All types of glass, except light bulbs, ceramic glass, dishes, and plate glass, currently can be recycled. Overall, very little plastic waste is recycled at the present time, with the exception of plastic milk jugs and soft drink bottles.

Even better than recycling is to adopt "pollution prevention" strategies that produce less waste in the first place. Ways to produce less waste include reusing materials, using reusable items rather than disposable ones, and reducing the amount of packaging that is used.

Steps also can be taken to keep the waste that is generated from getting into the ocean. Most importantly, littering should be prevented. Boaters and beachgoers should ensure that trash and other items are not blown or washed away. Before trash is left out for collection, it should be tightly secured in bags or trash cans. Garbage trucks should always be covered, and landfills should be fenced in to capture any trash that may temporarily escape. Industrial facilities that produce plastic resin pellets can modify handling processes to control the release of pellets into the environment. All of these methods can help to ensure that trash is put, and stays, in its proper place.

Key Points

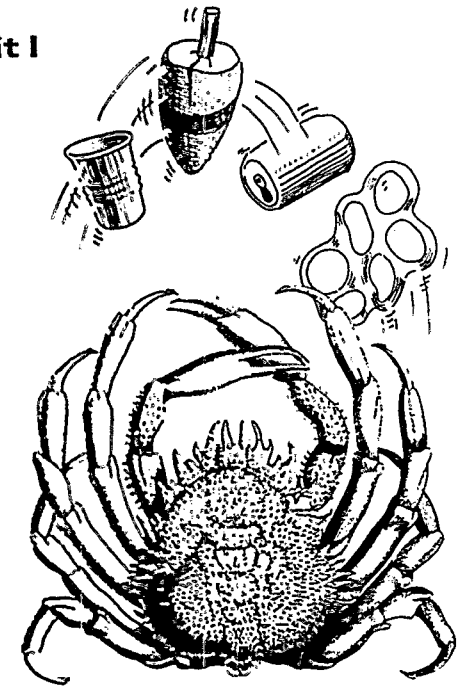
Marine debris includes all objects found in the marine environment that do not naturally occur in those areas.

Trash that is buoyant and/or easily blown around is more likely to become marine debris.

Biodegradable trash, which can be broken down by microorganisms, stays in the environment for a relatively short period of time.

There are several sources of marine debris, including beachgoers, landlubbers, storm sewers and combined sewer overflows, commercial and recreational vessels, industrial facilities, waste disposal activities, and offshore oil and gas platforms.

Proper handling of trash that is generated, as well as recycling and pollution prevention activities, will help to reduce marine debris.



Coming to Terms with Marine Debris

Objective: To define "marine debris" and to learn the types and amounts of marine debris found each year in national beach cleanups in the United States.

Activity: Students bring in different trash items and define "marine debris" through a discussion about these items. Students then categorize debris and use statistics and graphing to better understand the types and amounts of marine debris that are found each year.

Vocabulary: debris, foamed plastic, marine, marine debris, trash

Materials:

- Enough copies of the "1991 Beach Cleanup Results" handout for each student in the class
- A large box

Subjects: Language Arts, Mathematics, Science

Learning Skills: Analyzing, Calculating, Classifying, Collecting Data, Observing

Duration: 40 minutes

1 Ask every student to bring in a nonfood piece of trash. Tell students to be sure that the trash is clean and dry, does not have food stuck to it, and is not sharp. (Note: To prevent accidents, you may wish to tell students not to bring in glass. Instead, you can bring in a few glass articles so that the discussion of debris will be complete.)

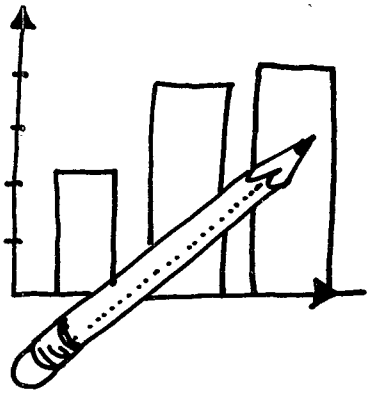
2 Have each student bring his or her piece of trash to the front of the room, display it to the class, and put it in the large box. Ask the students what these items have in common. Through this discussion, identify the characteristics of "trash" and develop a definition. Write the definition on the board. Then ask students to think of synonyms for "trash," and help them come up with the term "debris." List all of the synonyms on the board.

3 Now that "debris" has been defined, ask students what "marine" means. Write the definition on the board. Ask the students to list synonyms for marine and write them on the board.

4 Then combine the terms and discuss the meaning of "marine debris." Write this definition on the board. Use the lists of synonyms to come up with other terms that describe the concept of "marine debris" (such as "sea trash" and "ocean waste").

5 Take the pieces of trash out of the box one by one and ask the students to classify the type of debris they are (plastic, glass, metal, etc.).

6 Distribute the "1991 Beach Cleanup Results" handouts to the class. Inform the students that the Center for Marine Conservation (CMC) sponsors beach cleanup campaigns all over the country. Explain that volunteers record the items they find when they clean up beaches and send this information to CMC, which compiles these lists every year.



7 Ask the students to use the "1991 Beach Cleanup Results" handout to make a bar graph comparing the quantities of the different types of debris (plastic, glass, metal, etc.) collected in the cleanup. Have the students add the total number of plastic items, the total number of glass items, etc., to complete the handout. (Note: If students have difficulty adding such a long list of numbers, you can give them the totals: 3,464,216 plastic items; 495,083 glass items; 98,879 rubber items; 504,063 metal items; 472,711 paper items; 122,384 wood items; and 53,405 cloth items.)

8 Next, have students label the horizontal axis of the bar graph as "category of marine debris" and write the different categories under the horizontal axis in an evenly spaced manner. Have the students label the vertical axis "number of items collected" and mark the axis from 0 to 3,000,000. Finally, tell the students to use the totals from the "1991 Beach Cleanup Results" handout to complete the bar graph. (Note: As a class, you can create a three-dimensional bulletin board to display the bar graph. After drawing the bar graph on a large piece of paper, tack the paper to the bulletin board. Then glue or tape examples of the types of trash represented by the bar graph around it.)

Another option for illustrating the relative quantities of marine debris types is to have the students calculate the percentage each category represents. First, have the students find the grand total of items collected in 1991 by adding all the categories together. Then have students derive the percentage each marine debris category represents by using this total and the totals for each category. Finally, discuss with students which categories of marine debris are most common.

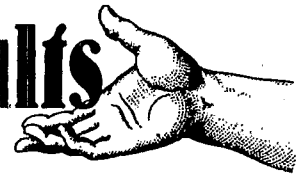
Other Directions

As a class, conduct your own cleanup activity at a seashore, lake, pond, stream, or river. Have students record the types and numbers of debris they find and compile a list similar to the "1991 Beach Cleanup Results" handout. (See Unit III for more information on conducting a beach cleanup.) Be sure the items you collect in the cleanup are recycled or properly disposed of. Also, you could clean up the same area periodically and compare the quantity of debris collected each time.

Use the "Trash Stats" handout to familiarize students with current waste management issues.

Either in class or as a homework assignment, ask students to use trash items to create a marine debris sculpture. Display the sculptures in the classroom or school library.

1991 Beach Cleanup Results



PLASTIC

Bags	347,263
Bottles	240,143
Buckets	10,335
Buoys	16,096
Caps/lids	212,852
Cigarette butts	940,430
Cigarette lighters	34,501
Cups/utensils	
Hard plastic	128,597
Foamed plastic	125,008
Diapers	12,686
Egg cartons	8,605
Fast-food containers	31,856
Fishing line	36,124
Fishing nets	9,496
Floats/lures	13,381
Foamed plastic packaging	44,025
Foamed plastic plates	23,729
Hard hats	1,777
Light sticks	16,020
Meat trays	16,532
Pieces	
Hard plastic	344,268
Foamed plastic	289,802
Pipe thread protector	8,033
Rope	88,862
Sheeting	19,750
Six-pack holders	34,492
Strapping bands	22,512
Straws	191,401
Syringes	8,280
Toys	21,770
Vegetable sacks	7,336
Write protection rings	9,148
Other	149,106

TOTAL = [ ]

GLASS

Bottles	235,224
Fluorescent light tubes	4,561
Light bulbs	11,766
Pieces	219,468
Other	24,064

TOTAL = [ ]

RUBBER

Balloons	36,164
Gloves	11,238
Tires	8,069
Other	43,408

TOTAL = [ ]

METAL

Bottle caps	106,626
Cans	237,287
Crab/fish traps	3,795
55-gallon drums	4,587
Pieces	41,204
Beverage can pull tabs	48,670
Wire	17,535
Other	44,359

TOTAL = [ ]

PAPER

Bags	38,427
Cardboard	33,450
Cartons	24,727
Cups	46,746
Newspapers	26,393
Pieces	225,297
Plates	21,235
Other	56,436

TOTAL = [ ]

WOOD

Crab/lobster traps	7,254
Crates	2,811
Lumber	76,830
Pallets	4,293
Other	31,196

TOTAL = [ ]

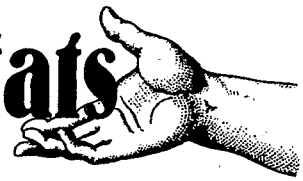
CLOTH

Clothing pieces	53,405

TOTAL = [ ]

Data were taken from *Cleaning North America's Beaches: 1991 Beach Cleanup Results*, Center for Marine Conservation, 1992.

Trash Stats



Americans are generating more and more trash every year. In 1990, each person in the United States produced over 4 pounds of trash each day! See if you can work out these trash math problems to learn even more.

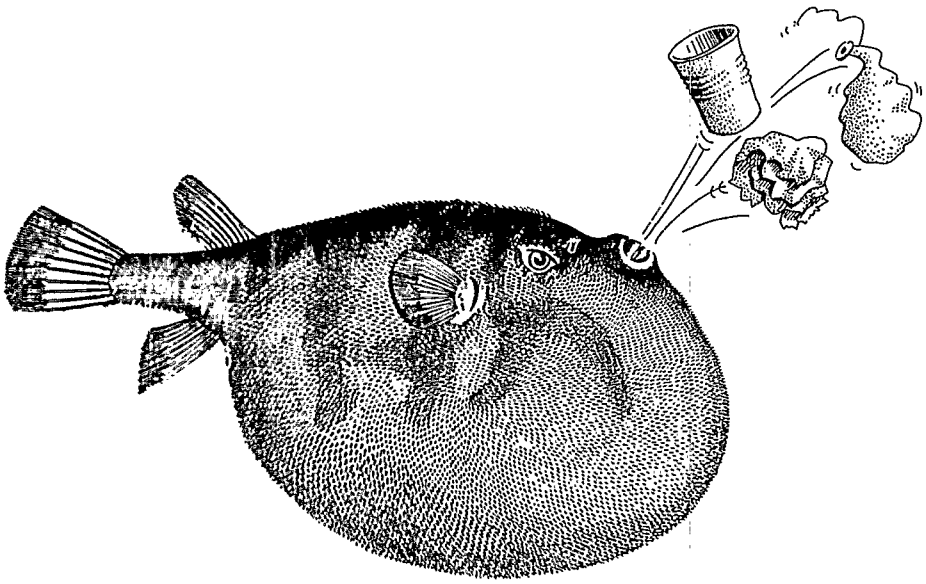
1. In 1960, Americans recycled about 5,900,000 tons of trash. In 1990, approximately 33,320,000 tons were recycled. By how many tons did recycling increase from 1960 to 1990?

2. If there are four people in a family, and each person throws away five soda cans a day, how many soda cans does the whole family throw away in a week?

3. Of the 196,000,000 tons of trash generated in the United States in 1990, about 16,000,000 tons were plastic. What fraction of the total trash generated was plastic? Reduce this fraction.

4. Americans produced 73,000,000 tons of paper waste in 1990. In that same year, Americans produced a total of 196,000,000 tons of trash. What percentage of the total trash generated did paper make up?

5. Of the 196,000,000 tons of trash generated by Americans in 1990, about 67 percent was landfilled. How much trash, by weight, was landfilled?



Trash Traits

Objective: To learn about certain characteristics of marine debris and how these characteristics affect where marine debris is found in the environment.

Activity: Students perform experiments to examine whether or not trash can float, blow around, or wash away. The effects of these characteristics on the presence of marine debris in the environment are then discussed.

Vocabulary: buoyant

Materials:

- Enough copies of the "Trash Traits Results" handout for each student in the class
- Several pieces of plastic, glass, rubber, metal, paper, wood, and food trash
- A bucket filled with water
- A fan
- A large, shallow container (such as a large dishpan)
- A watering can

Subjects: Language Arts, Science

Learning Skills: Analyzing, Classifying, Collecting Data, Comparing and Contrasting, Experimenting, Hypothesizing, Observing

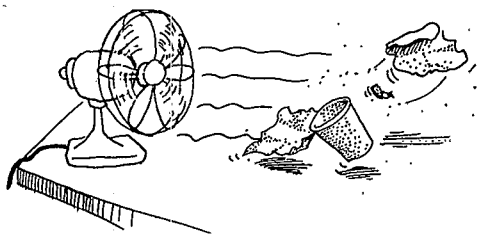
Duration: 40 minutes

1 Pass out the "Trash Traits Results" handouts. With the students, put the different types of trash (plastic, glass, rubber, metal, paper, wood, and food) into separate piles. Have the students name the pieces of trash. Write the names on the board and have the students fill in the "Item" and "Type" columns of their handouts.

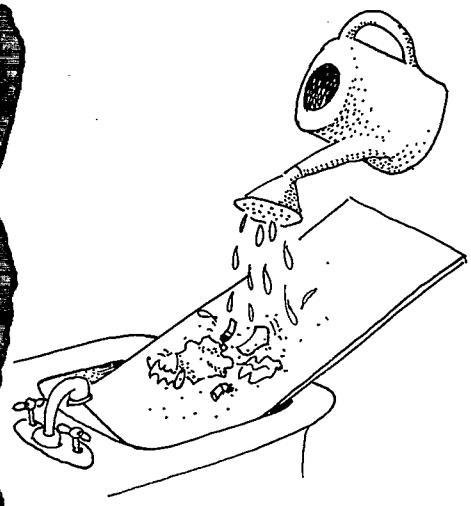
2 Fill the bucket with water. Place each trash item in the water and ask the students the following questions:

- Which items float? Which do not? (Make a list on the chalkboard and have the students fill in the "Does It Float?" column on their handouts.)
- What will happen to buoyant items when they get into the ocean? What could some of the problems be with buoyant marine debris?
- What will happen to items that don't float when they get into the ocean? Is there a tendency for all of the articles of the same type (plastic, paper, metal, etc.) to float or sink?

3 Set up the fan at one end of a table. Place each trash item in front of the fan, one at a time, to see if it is blown around. Ask the students these questions:



- Which items are easily blown around? (Make a list on the chalkboard and have the students fill in the "Can It Be Blown Around on Land?" column on their handouts.)
- What blows trash around in the environment?
- Is there a tendency for all of the articles of the same type (plastic, paper, metal, etc.) to be blown around in a similar way?



4 Fill the large, shallow container with water and place it in front of the fan. One at a time, put each article of trash in the container and turn on the fan. Ask the students:

- Which items are easily blown around in the water? (Make a list on the chalkboard and have the students fill in the "Can It Be Blown Around in the Water?" column on their handouts.)
- Is there a tendency for all of the articles of the same type (plastic, paper, metal, etc.) to be blown around in the same way?

5 Fill the sprinkling can with water. Take the sprinkling can and the trash pieces outdoors, and find a slightly sloped, smooth area (a paved surface on a slight hill would work well). Place the trash pieces on the sloped area, and sprinkle water on them one at a time. (Note: This part of the experiment also can be conducted in the classroom by elevating one end of a board and placing the lower end in a sink. Place the trash pieces on the elevated end of the board, and sprinkle water down the board.) Ask the students:

- Which items are easily moved by the sprinkled water? (When you get back inside make a list on the chalkboard and have the students fill in the "Can Sprinkled Water Move It?" column on their handouts.)
- What element in nature acts like the sprinkled water?
- Is there a tendency for all of the articles of the same type (plastic, paper, metal, etc.) to be affected by the sprinkled water in the same way?

6 Discuss how the characteristics examined (whether an item floats, is blown around, or is carried by sprinkled water) affect whether an item is likely to become marine debris. Also discuss how the natural environmental forces of running water, wind, and rain can cause trash to become marine debris.

Other Directions

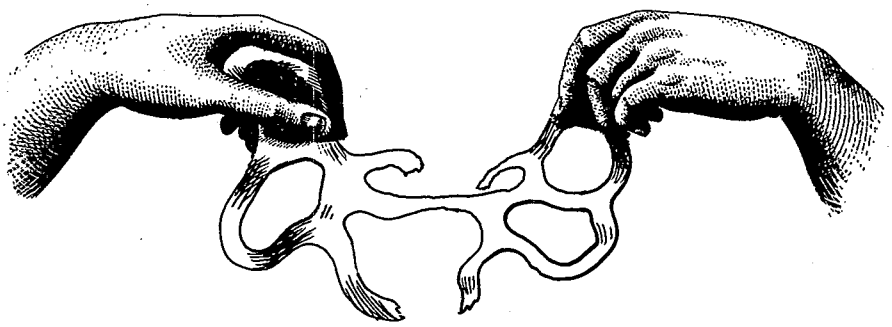
Try one of the following projects: 1) compare the types and amounts of trash found on rural versus urban beaches; 2) compare types and amounts of trash found in different locations on a beach; and, 3) compare types and amounts of trash found on a rocky beach compared to a sandy beach. For each project, speculate on why differences were observed.

Another approach would be to compare the types and amounts of trash found on an ocean beach versus the shoreline of a lake, pond, river, or stream in order to compare the impact of debris on marine and freshwater environments.

Trash Traits Results

ITEM	TYPE (PLASTIC, PAPER, METAL, ETC.)	DOES IT FLOAT?	CAN IT BE BLOWN AROUND ON LAND?	CAN IT BE BLOWN AROUND IN THE WATER?	CAN SPRINKLED WATER MOVE IT?

A Degrading Experience!



1 Explain to students that they will be performing an experiment to learn how trash degrades in the marine environment. Discuss the concept of degradation with students, and explain that some important signs of degradation are changes in shape, color, and size of an item. (Note: The loss of an item's ability to withstand being pulled apart also is an important sign of degradation, but this only should be evaluated at the end of the experiment so that the natural degradation process is not accelerated.)

2 Next, set up the experiment. Fill the containers half way with water. Put one of the pieces from every pair of trash in each container. Cover one container with netting or screening, and secure the covering with the rope or string. Take the covered container outdoors, and place it in an area that receives sun for as much of the day as possible. Keep the other container inside the classroom, and put it in an undisturbed area. (Note: You may want to put signs near the containers that say, "Science experiment — Do not touch!")

3 Every day, have a different student record the weather conditions in the "Weather Watch" handout. Record the outdoor temperature, the type of cloud cover there is (to determine how much sunlight the experiment is receiving), and whether or not there has been any rain or other precipitation.

4 Every week (for a minimum of 2 months) have the class observe the changes in the trash items, both in the indoor and the outdoor containers. Have different students fill in the "Degradation Data" handouts every week. (Note: You may want to use a camera to take pictures of the degrading trash on a weekly basis to monitor and display changes as accurately as possible. When taking pictures, place a card with the date on it in the upper right hand corner of the photograph to keep a precise record of when the photograph was taken.)

Objective: To examine the degradation of debris and learn how degradation affects the persistence of debris in the marine environment.

Activity: Students perform an experiment to learn how different types of debris degrade and how weather and sunlight affect the rate of degradation.

Vocabulary: degradable, persistent

Materials:

- Assorted pairs of trash (Note: The following pieces of trash are recommended: two six-pack rings, two plastic bags, two cardboard egg cartons, two apple cores, two soup cans, two glass bottles, and two pages of newspaper)
- Two large, shallow, containers (such as large dishpans)
- Two pieces of netting or screening
- Two pieces of rope or string
- An outdoor thermometer
- Newspaper
- One copy of the "Weather Watch" handout for every month of the experiment
- Two copies of the "Degradation Data" handout for every month of the experiment (one checked "outdoor" and one checked "indoor")

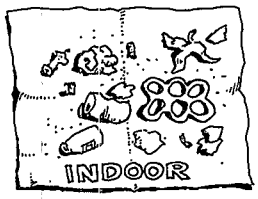
Subjects: Language Arts, Science

Learning Skills: Analyzing, Classifying, Collecting Data, Comparing and Contrasting, Experimenting, Hypothesizing, Observing.

Duration: Two 40-minute periods for discussion, set up, and clean up; 5 minutes every day (for at least 2 months) to record weather observations; 10 to 20 minutes every week (for at least 2 months) to record degradation observations (Note: The longer that the experiment is continued, the more dramatic the evidence that degradation has occurred will be.)

5 At the end of the experiment, spread newspaper over a large table. Divide the table into two sections and label one side "indoor" and the other "outdoor." Retrieve both containers and place them on the appropriate sides of the table. Take each pair of trash pieces out of the containers one at a time and compare the visible differences between the "indoor" and "outdoor" pieces of trash. Then have a student try to pull apart the pieces of trash to determine if there is a difference in strength between the "indoor" and "outdoor" pieces. Ask the students the following questions:

- Which pieces of trash have degraded?
- Does whether the piece of trash was indoors or outdoors affect how much it has degraded? How?
- Which types of trash are degradable? Which types are persistent?
- Does the ability of an item to degrade affect whether it is found in the marine environment? Based on this experiment, hypothesize how degradability affects marine debris.



6 Compare the completed "Weather Watch" and "Degradation Data" handouts. Ask the class the following questions:

- Did the weather seem to affect the rate of degradation? How?
- What weather conditions increase degradation rates?

Other Directions

Six-pack rings are now made of photodegradable plastic (plastic that degrades when exposed to sunlight). Conduct an experiment to observe photodegradation. (Note: This experiment should be conducted over at least a 3-month period.) Place 12 six-pack rings in an area of the classroom that will not be disturbed. Then, fasten the same number of six-pack rings outside in an area that is usually in the sun and will not be disturbed. Every week take a six-pack ring from both locations and compare how they look and how much they stretch when pulled. Discuss the differences.

If your school is near the coast or a body of freshwater, conduct an experiment to see if trash degrades faster in water or on land. Place several trash items in a plastic net. Take these netted items to a pier, marina, or other site where the net can be tied onto a fixed object so that it hangs in the water. Make sure the trash cannot escape and that the net is tied securely so that you are not generating marine debris! (Note: If the site is privately owned, be sure to check with its owner before proceeding.) Place identical pieces of trash in a plastic net and tie it to a post on land. Again, make sure the trash is securely fastened. Periodically compare the rates of degradation.

Degradation Data

DATES: _____ ❑ Indoor ❑ Outdoor

SIGNS OF DEGRADATION

ITEM	WEEK 1	WEEK 2
six-pack ring		
plastic bag		
egg carton		
apple core		
soup can		
newspaper		

SIGNS OF DEGRADATION

ITEM	WEEK 3	WEEK 4
six-pack ring		
plastic bag		
egg carton		
apple core		
soup can		
newspaper		

Weather Watch

WEEK 1

Date	Temperature	Cloud Cover	Precipitation

WEEK 2

Date	Temperature	Cloud Cover	Precipitation

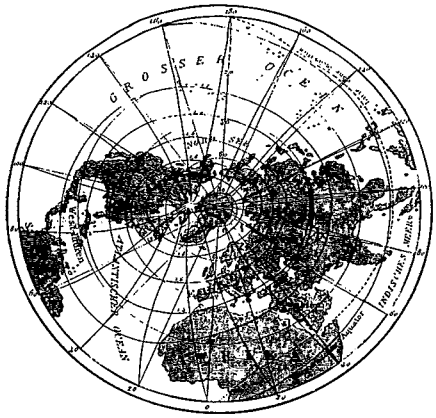
WEEK 3

Date	Temperature	Cloud Cover	Precipitation

WEEK 4

Date	Temperature	Cloud Cover	Precipitation

Roots and Routes of Marine Debris



1 Pass out the red markers or pencils to all students. Divide the class as closely as possible into groups of three students each. Have each group form a circle with their desks. Give each group a copy of all three "Roots and Routes" handouts, and have each student in the group take a handout. (Note: If there are only two students in a group, have one of the students take two handouts.)

2 Ask the students to circle one piece of marine debris (or one object that has the potential to become marine debris) on their handout with a red marker. Then have each student pass the handout to the student sitting to his or her right. The students should again circle one piece of marine debris before passing the handout to the student on their right. Continue this process until the students cannot find anything left to circle.

3 For each handout, ask a volunteer to list on the chalkboard all of the marine debris items his or her group circled. Then ask if any other groups found additional items, and write them on the board. Discuss how these items are or could become marine debris.

4 As a class, discuss how the different sources of debris contribute to the marine debris problem. Ask the students the following questions:

- What kinds of items become marine debris?
- How do they become marine debris?
- What can be done to prevent the generation of marine debris at each source depicted on the handouts?

5 Have each student in the group choose one of the "Roots and Routes" scenes and color it in. Display the colored pictures on a bulletin board.

Objective: To discover where marine debris typically comes from and how it commonly finds its way into the marine environment.

Activity: Students work in small groups to examine typical sources of marine debris as illustrated on three different handouts. The students circle the marine debris items shown on the handouts and then discuss as a class how marine debris is generated and how it gets into the ocean.

Vocabulary: landfill, offshore oil platform, outfall pipe, plastic resin pellet, source

Materials:

- Enough copies of the "Roots and Routes" handouts for each group of students to have all three scenarios
- Enough red markers or pencils for each student in the class
- Crayons or colored markers

Subjects: Art, Science, Social Studies

Learning Skills: Analyzing, Hypothesizing, Visualizing, Working in Small Groups

Duration: 40 minutes

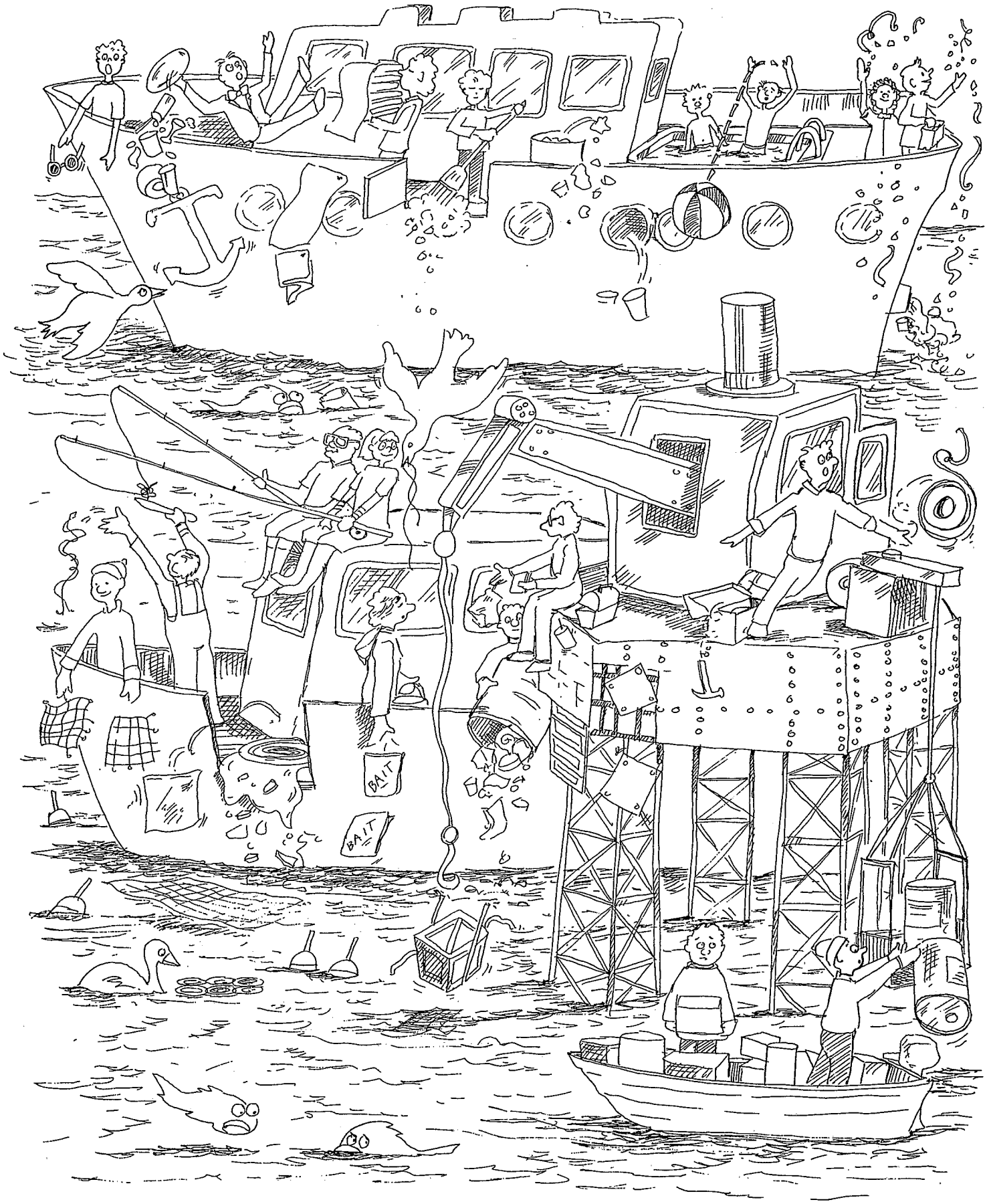
Other Directions

Have students draw their own "Roots and Routes" scene that shows where marine debris comes from and how it finds its way into the marine environment.

Ask students to write a paragraph about one source of marine debris, explaining what kinds of debris are generated by the source and how these items could enter the marine environment.

Have the students imagine they are an animal that lives in a marine or aquatic environment, like a fish, a crab, or a turtle. Ask them to write a story about what they would feel as they watched debris litter their "home." You can ask the following types of questions to help the students imagine the situation: How would you react to people throwing trash into the water from boats or from the shore? What would you think about a piece of net floating in the water? How would you feel about cans and bottles blocking the entrance to your favorite cave?

If there is a storm sewer nearby, show the students what it looks like. Ask them to count all the pieces of trash they find within about 25 feet of the sewer. Also have them look into the sewer to see if there is any trash inside. Ask the students what they think might happen to the trash around the sewer.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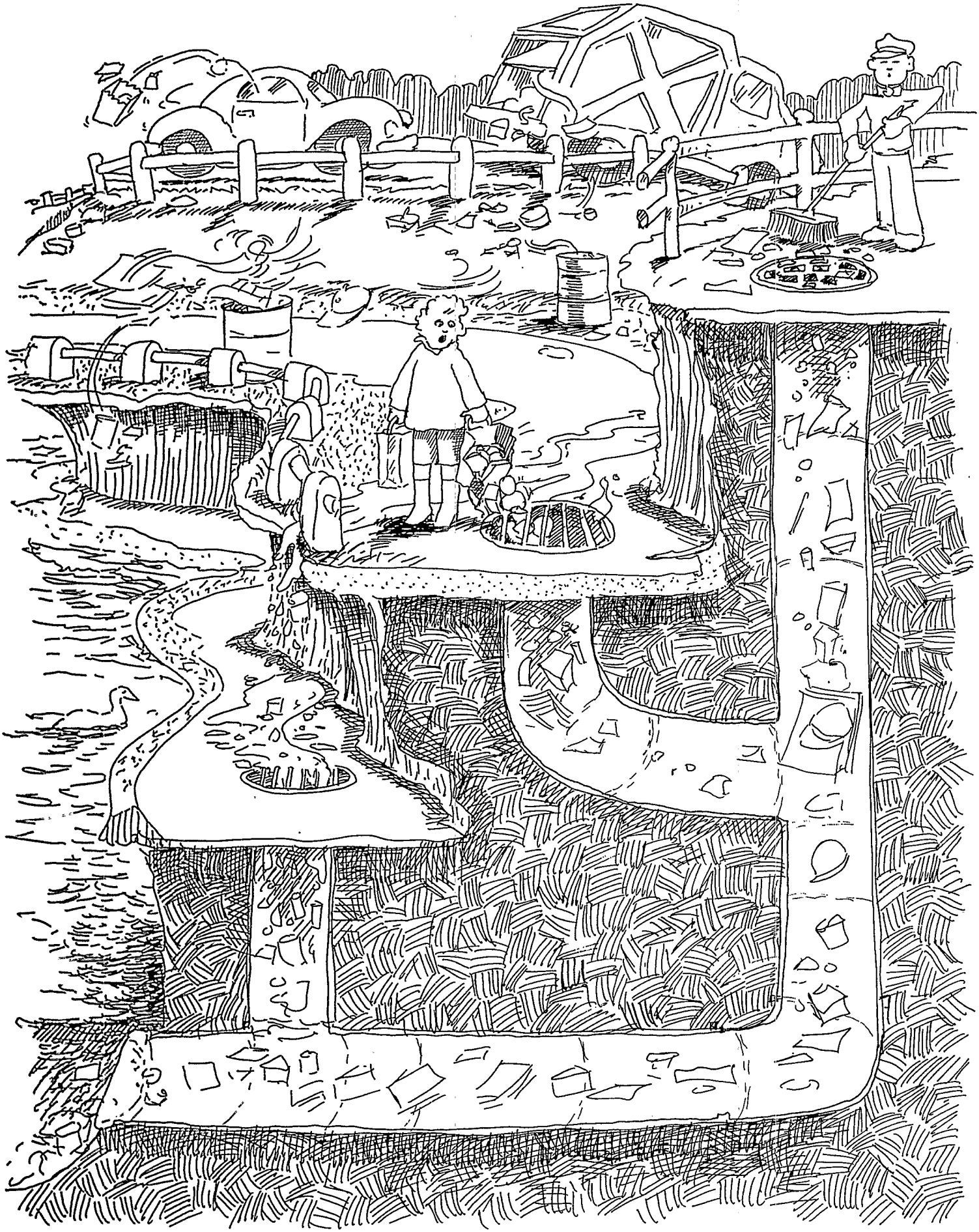
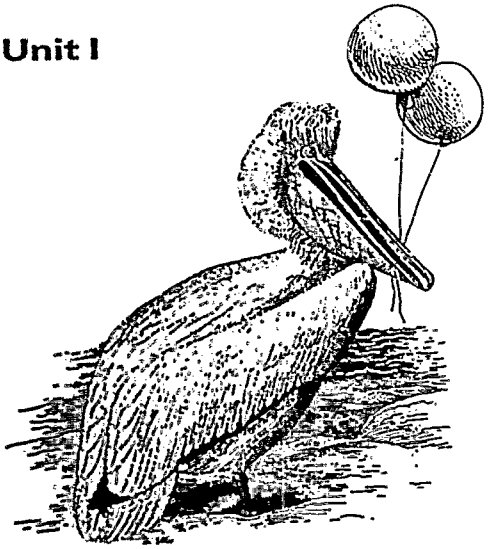




The Trails and Trials of Trash

Objective: To learn how trash that is not properly disposed of on land can become marine debris, and how marine debris can find its way back onto land.

Activity: Students play a board game that illustrates some ways that trash discarded on land gets into the sea, as well as how marine debris can get back to land. The object of the game is to successfully make it to the trash can at the end of the path.

Vocabulary: stormwater runoff

Materials:

- One copy of the "Trails and Trials of Trash Game Board" handout for each group of three or four students in the class
- A penny for each student
- Scissors
- Tape
- One die for each group of three or four students in the class

Subjects: Language Arts, Science, Social Studies

Learning Skills: Analyzing, Visualizing, Working in Small Groups

Duration: 40 minutes

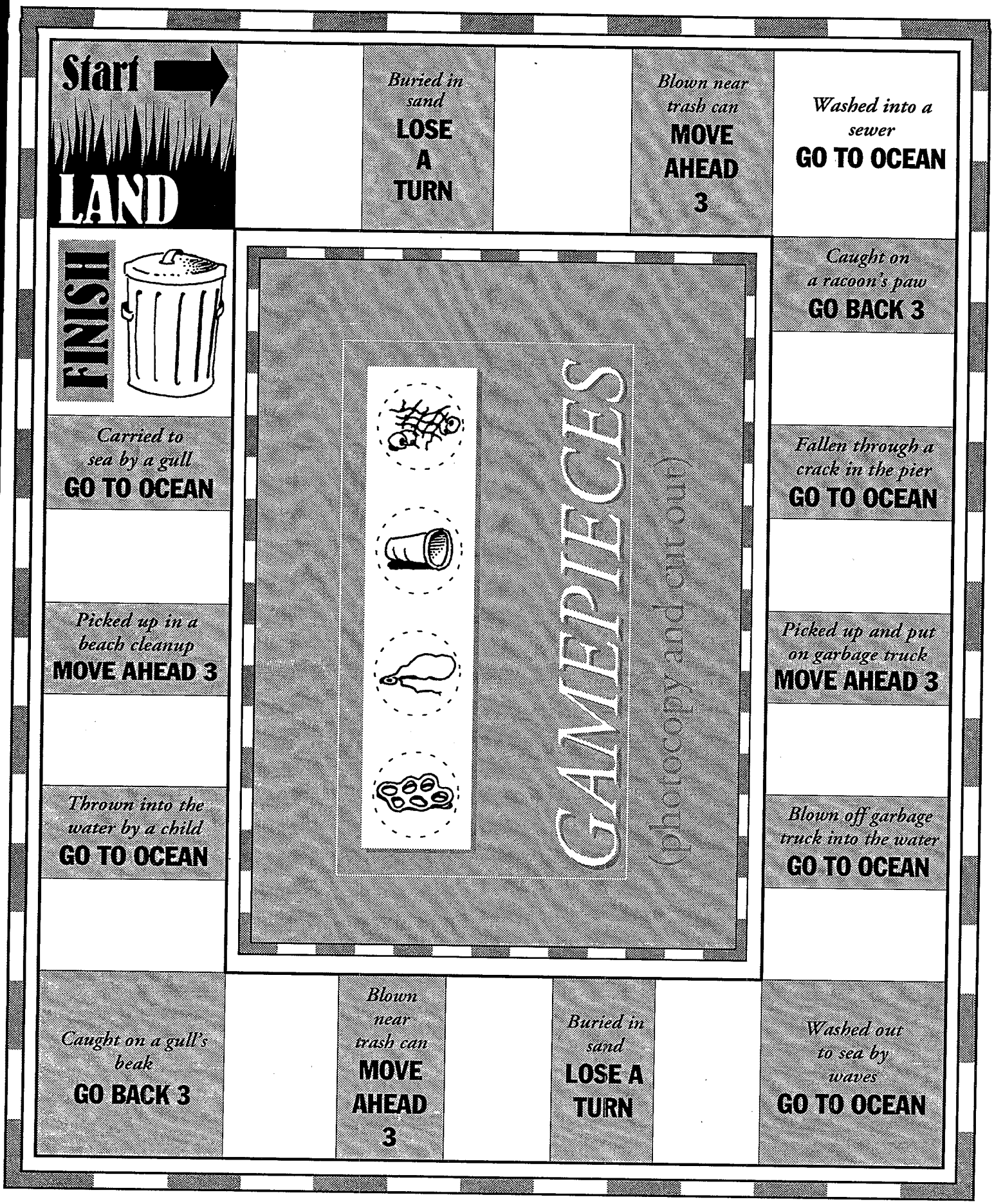
1 Divide the class into groups of three or four students. Pass out one copy of the "Trails and Trials of Trash Game Board" handout to each group. Have each student in the group choose one of the game pieces from the handout (the six-pack ring, the plastic cup, the balloon, or the fishing net), cut it out, and tape it to a penny.

2 After all of the students have assembled their game pieces, explain how the game is played. The game board is divided into two sections: the land section and the sea section. The object of the game is to be the first piece of trash to make it to the trash can at the end of the land section.

3 All players start on the "Land Start" space. Each player takes a turn rolling the die. The player with the highest number goes first, and the others follow in a clockwise fashion. In turn, each player rolls the die and moves the number of spaces indicated. If the player lands on a space without written instructions, the player remains on that space until his or her next turn. If the player lands on a space with instructions, the player must follow those instructions. If the player is on the land section of the game board and the instructions indicate that he or she has been washed to sea, the player moves his or her game piece to the "Ocean Start" space. If the player is in the ocean section of the game board and the instructions tell the player to move back to the land, the player moves his or her game piece to the "Land Start" space. The game continues until one of the players arrives at the trash can. (Note: Players need to land on the trash can with an exact roll of the die to finish the game.)

Other Directions

Ask the students to write a story, poem, or song about the "travels" of a piece of marine debris. The story, poem, or song should discuss where the marine debris began its journey, how it "travelled," where it "travelled," and where it ended up. Another option is to write, stage, and perform a play or puppet show that illustrates the "travels" of one or more pieces of marine debris.


Start
LAND
Buried in sand
LOSE A TURN
Blown near trash can
MOVE AHEAD 3
Washed into a sewer
GO TO OCEAN
FINISH
Caught on a racoon's paw
GO BACK 3
Carried to sea by a gull
GO TO OCEAN
GAMEPIECES
Fallen through a crack in the pier
GO TO OCEAN
Picked up in a beach cleanup
MOVE AHEAD 3
Picked up and put on garbage truck
MOVE AHEAD 3
Thrown into the water by a child
GO TO OCEAN
Blown off garbage truck into the water
GO TO OCEAN
Caught on a gull's beak
GO BACK 3
Blown near trash can
MOVE AHEAD 3
Buried in sand
LOSE A TURN
Washed out to sea by waves
GO TO OCEAN

Start

Lost in underwater cave
LOSE A TURN

Carried toward land by current
ROLL AGAIN

Carried by swimmer back to shore
GO TO LAND

BLOW ONTO LAND

Caught on a propeller
LOSE A TURN

Disturbed someone's ocean view
LOSE A TURN

Caught on surfboard and carried to land
ROLL AGAIN

Picked up in beach cleanup
GO TO LAND

Fishing net pulled you close to land
ROLL AGAIN

Tangled around a seal
LOSE A TURN

Picked up in beach cleanup
GO TO LAND

Washed ashore by waves
GO TO LAND

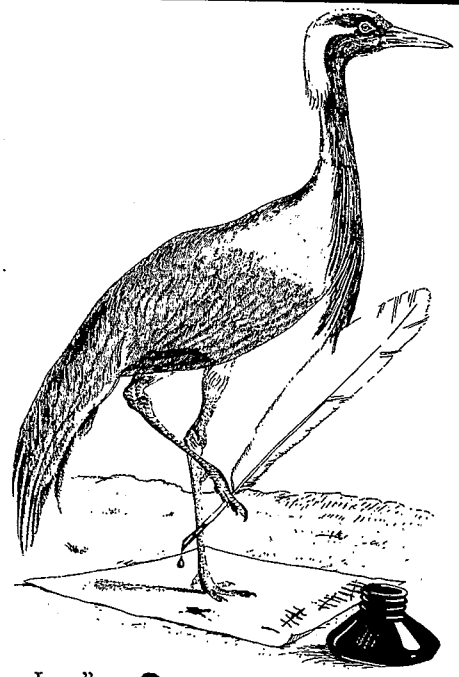
Lost in underwater cave
LOSE A TURN

Carried toward land by current
LOSE A TURN

Caught on fishing line and pulled in
GO TO LAND

CRASH CRAVELS

Waste Inventory



1 On a Friday afternoon, pass out copies of the "Waste Inventory Log" handout. Explain to the students that from Monday through Friday of the next week they will write down everything they throw away in the "Waste Inventory Log." Also explain what kind of information to record in the columns of the log. In the "Item" column, they should list every item they discard. In the "Number" column they should put a mark every time they throw away that type of item.

2 Ask students to predict how many items the entire class will throw away in one week. Write down the predictions and save them until the logs are completed.

3 Every morning, give the students 10 minutes to write down the items they disposed of that morning and the night before. Also give them 5 minutes after lunch and 5 minutes at the end of the day to write down the items they disposed of during the day.

4 At the end of the week, discuss the contents of the "Waste Inventory Logs." Have a few students read their lists of items to the class. Point out to the students which items are recyclable. Ask how recycling could affect the marine debris problem.

5 Tell the students to add the number of items they discarded each day, and then add the total number of items they threw away over the 5-day period. List these totals on the board. Have students calculate a grand total for the class. Compare this total with the estimates the students made at the beginning of the week. Discuss the differences between the estimates and the actual total.

Objective: To understand how our habits and activities can contribute to the marine debris problem, and how proper waste disposal methods and recycling can help prevent the problem.

Activity: Over the span of a week, students keep a log of the types and amounts of trash they generate, and how they dispose of that trash. Students also learn which items were (or could have been) recycled, and which items could become marine debris.

Vocabulary: disposal, recycling, waste generation

Materials:

- Enough copies of the "Waste Inventory Log" handout for each student in the class (Note: students may need extra paper to complete the log).

Subjects: Language Arts, Mathematics, Science, Social Studies

Learning Skills: Analyzing, Calculating, Classifying, Collecting Data, Comparing and Contrasting, Hypothesizing, Observing

Duration: 40 minutes for discussion; 20 minutes a day for a week for students to keep their logs.

6 Another option that can demonstrate the large quantities of trash people generate is to have the students carry around their trash with them. Ask each student to bring in a medium-sized trash bag from home. Have the students use their bags to dispose of their trash. (Note: Tell students not to put food waste, glass, or sharp objects in their bags.) Have the students carry their bags around with them everywhere they go. Continue this experiment for up to a week. At the end of the experiment, compare and discuss the quantities of trash each student has generated.

7 Finally, discuss the types of items that were discarded that could become marine debris. Ask students the following questions:

- What types of items can become marine debris? (Note: Emphasize that all items can become marine debris if improperly disposed of.)
- How could they become marine debris?
- How could you prevent these items from becoming marine debris?

Other Directions

Have students research recycling programs in their community. Conduct a survey to determine what kinds of materials are recycled, how much material is recycled, who participates in the program, and what the material is used for after it is recycled. Also have students think of ways to increase community involvement in recycling.

Set up a classroom or community recycling program. First, determine which types of items will be collected for recycling, making sure that there is a market for those items in your area. (Note: Contact the recycler you have chosen to handle your materials to confirm what types of materials can be collected, how the materials should be separated, and any other requirements that should be followed.) Second, designate a collection center, and be sure to obtain appropriate containers and other facilities. Third, arrange to have the items picked up and delivered to the recycler. If there is a great enough demand in your area for the types of recyclables you are collecting, you may receive payments for the material you deliver to the recycler. This money can be used to fund the recycling project or other educational initiatives in your school.

Waste Inventory Log

MONDAY		TUESDAY		WEDNESDAY		THURSDAY		FRIDAY	
Item	Number	Item	Number	Item	Number	Item	Number	Item	Number
Total =		Total =		Total =		Total =		Total =	

TOTAL FOR WEEK = _____

Unit II

The Effects of Marine Debris

Anthony Amos

- How can marine debris harm wildlife?
- What types of animals may be harmed by marine debris?
- What are some other effects of marine debris on coastal areas?
- How can marine debris pose a hazard to human health?

The Effects of Marine Debris

Marine debris can have serious consequences for both wildlife and humans. For wildlife, problems occur when animals get caught in or swallow debris. Although almost any species can be harmed by marine debris, certain species are more susceptible to its dangers than others. For humans, marine debris causes problems such as the aesthetic degradation of ocean waters and beaches, economic hardships for coastal communities and the fishing industry, and health and safety hazards.

What Is the Impact of Marine Debris on Wildlife?

The two primary problems that marine debris poses to wildlife are **entanglement** and **ingestion**. Entanglement results when an animal becomes encircled or ensnared by debris. Entanglement can occur accidentally, or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. For example, an animal may try to use a piece of marine debris for shelter, as a plaything, or as a source of food (if other plants and animals are already trapped in the debris or if the debris resembles prey that is a normal part of its diet).

Entanglement is harmful to wildlife for several reasons. Not only can entanglement cause wounds that can lead to infections or loss of limbs, but it may also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can cause drowning or difficulty in moving about, finding food, and escaping predators.

Ingestion occurs when an animal swallows marine debris. Ingestion sometimes happens accidentally, but generally animals feed on debris because it looks like food. Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract and make the animal feel "full," lessening its desire to feed. Ingestion of sharp objects can damage the digestive tract or stomach lining and cause infection or pain. Ingested items may also block air passages and prevent breathing, thereby causing death.

Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of marine debris. Many of the species most vulnerable to the problems of marine debris are **endangered** or **threatened**. Endangered species are plants or animals that are in immediate danger of becoming extinct because their population levels are so low. Threatened species are plants and animals that may become endangered in the near future.

It is estimated that approximately 100,000 marine mammals die every year from entanglement or ingestion of marine debris. Of the different types of marine mammals, seals and sea lions are the most affected (particularly by entanglement) because of their natural curiosity and tendency to investigate unusual objects in the environment. Packing straps and net fragments are a major problem for these animals. Some studies have linked the decline of the northern fur seal of Alaska and the endangered Hawaiian monk seal to entanglement in marine debris. Whales, including endangered humpback and gray whales, have been found entangled in fishing nets and line. Manatees, which are also an endangered species, have become entangled in crab-pot lines, and dolphins and porpoises may get caught in fishing nets. Ingestion of debris by marine mammals appears to occur less frequently, but it has been reported for elephant seals, sea lions, certain types of whales, and manatees. These cases are significant because they have usually

contributed to or resulted in the death of the animals due to suffocation or starvation.

Sea turtles also have become entangled in marine debris. All of the five species of sea turtles found in the United States are endangered species, and all have been found entangled in different types of marine debris, such as fishing line, rope, and fishing nets. Ingestion of marine debris is an even greater problem for these species. Sea turtles have been found to swallow plastic bags because they look like jellyfish, one of their favorite foods. This may cause the turtle's digestive tract to become blocked, leading to starvation. Cases of turtles swallowing balloons, tar balls, and debris that has become covered with algae also have been reported.

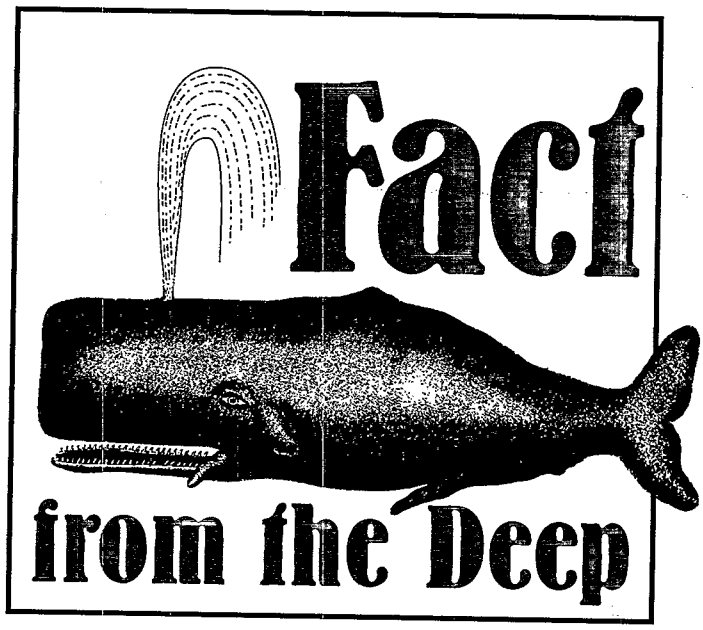
Nearly a million seabirds are thought to die from entanglement or ingestion each year. Since most seabirds feed on fish, they are often attracted to fish that have been caught or entangled in nets and fishing line. Entanglement in fishing line has been a particular problem for the brown pelican, which is an endangered species. Seabirds are some of the most frequent victims of abandoned nets. As many as 100 birds have been found in a single abandoned net. Many birds, including ducks, geese, cormorants, and gulls, have been found entangled in six-pack rings and other encircling debris. The ingestion of **plastic resin pellets** (small, round pellets that are the raw form of plastic and are melted and used to form plastic products) is a major concern. Many types of birds have been found to feed on these pellets, most likely because they mistake them for fish eggs or other types of food.

Fish and crustaceans (such as lobsters and crabs) are frequently caught in lost or discarded fishing gear, in a phenomenon known as **ghost fishing**. For example, a 1/2-mile section of nylon net was found in Lake Superior. It had been abandoned for an estimated 15 years and contained 100 pounds of fish, much of which was rotten. Lost traps also continue to attract fish and crustaceans, which enter them in search of food or shelter. In New England alone, it is estimated that nearly one-half million lobster pots are lost every year.

Wildlife also is affected when marine debris disturbs its environment. For example, lost or discarded fishing gear and nets can drag along the ocean floor or through coral reefs, disrupting the animals and plants that live there. In addition, debris can bioaccumulate in the food chain. **Bioaccumulation** occurs when organisms low on the food chain consume a substance that builds up in their bodies. When animals higher on the food chain eat those organisms, they also ingest that substance, and it accumulates in their bodies. The higher an animal is on the food chain, the greater the quantity of the substance that is consumed and accumulated. For example, eagles and other predators high on the food chain have been found with large concentrations of plastic pellets in their stomachs after preying on smaller birds, which previously ingested the material in fish.

What Is the Impact of Marine Debris on Humans?

Marine debris also can have serious consequences for humans. First, marine debris is visually unpleasant. Floating debris is an eyesore, and debris stranded on



Ghost fishing

When nets or other fishing gear are lost or discarded, they continue to "fish" for sea animals long after the fisherman has forgotten them. Many creatures are caught and most die if they cannot free themselves in time to prevent drowning or starvation. In the Pacific Ocean, one 1,500-meter long section of net was found that contained 99 seabirds, 2 sharks, and 75 salmon. The net was estimated to have been adrift for about a month and to have traveled over 60 miles.

beaches and shorelines degrades coastal aesthetics. Coastal communities lose millions of tourism dollars when large amounts of marine debris make their beaches unattractive to visitors. During the summers of 1987 and 1988, beaches in New York and New Jersey were closed when **medical waste**, including needles and bandages from hospitals, washed up on their shores. These beach closings caused many vacationers to go elsewhere. Not only does marine debris cost coastal communities lost revenues from tourism, but cleaning up beaches littered with marine debris can be very expensive.

Lost or discarded fishing gear can financially harm a region's fishing industry. In addition to the costs associated with replacing the missing gear, marine debris can cause costly or irreparable damage to boats. Fishing nets can wrap around propellers, plastic sheeting can clog cooling water intakes, and lost nets or lines can entangle vessels. In a 1987 survey in the Seattle area, almost two-thirds of the individuals who responded to the survey indicated that their boats had been damaged by marine debris in the previous 2 years. When lobster or crab traps are lost, they trap thousands of animals that consequently are never caught and sold. Ghost fishing also kills thousands of fish that may have found their way to market.

Marine debris also can endanger people's health and safety. Sharp objects, such as broken glass and rusty metal, may cause injuries when people step on them on the beach or ocean floor. Abandoned fishing nets and lines can entangle scuba divers, and some divers have barely escaped serious injury or death. Contaminated debris, including medical waste and sewage, may pose a public health hazard through disease transmission. Marine debris that wraps around boat propellers or punctures holes in the bottom of boats can disable vessels, thereby endangering human lives. This is especially serious if power is lost in a storm and the boat cannot return to shore or steering is hampered and the boat cannot avoid collision. Finally, submarines can be obstructed by abandoned fishing nets, making navigation and surfacing difficult.

Tom O'Hara

Key Points

All species of wildlife can be harmed by marine debris, but certain species are more susceptible to its dangers because their behavior patterns attract them to marine debris. The impact of marine debris on endangered or threatened species is particularly significant because the numbers of these species are already so low.

The entanglement of animals in marine debris can cause wounds and associated infections; strangulation; and impaired ability to swim, find food, and escape predators.

The ingestion of marine debris by animals can cause starvation, suffocation, and internal injuries and infections.

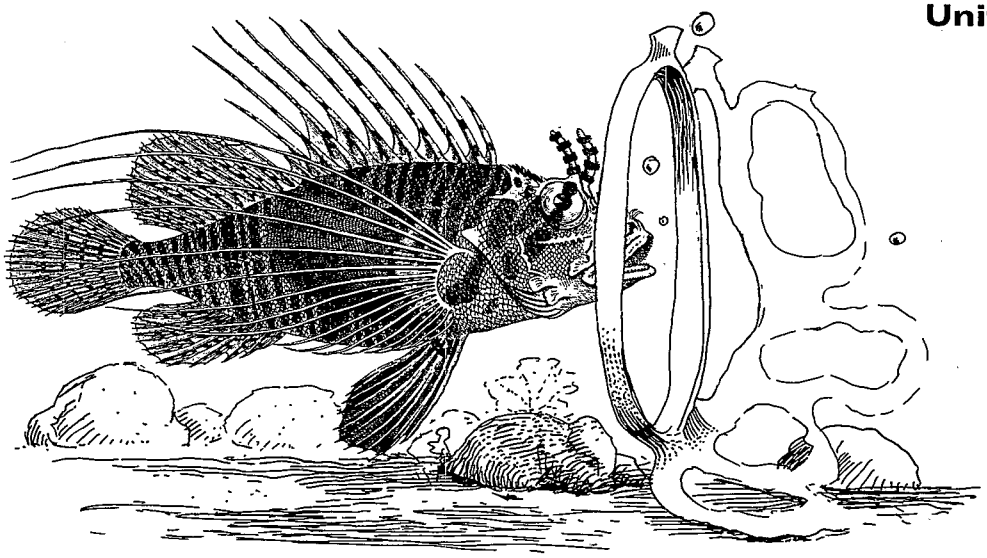
Marine debris is an eyesore that blights open ocean and beach environments.

Marine debris can cost coastal communities a great deal of money in lost tourist revenues. Cleaning up marine debris also can be expensive.

The impacts of marine debris on an area's fishing industry can be significant. Marine debris damages boats and can kill fish that otherwise would be sold.

Marine debris can endanger the lives of people when the functioning of boats and other vessels is impaired. It may also cause injuries or transmit disease directly to humans.

Circle of Danger



1 Place the items of debris on the floor in the middle of the classroom and have students form a circle around them. Have a volunteer read the description of the seal on the "Animal Tales" handout. (Note: You might want to make copies of this handout and distribute them to all students so they can follow along.) Then choose a volunteer to be a seal and ask him or her to go into the center of the circle and pick up an item of debris that might harm a seal. Ask the "seal" to tell how and why it might become injured by this piece of debris.

2 Repeat this procedure for the remainder of animals on the handout. After you have finished, ask students if they can associate any other pieces of debris with one of the animals in a way that the class has not yet discussed.

3 Explain that many species of mammals, sea turtles, birds, and fish that encounter marine debris are endangered or threatened. Ask students how marine debris could pose special problems for these species. End your discussion by helping students to understand that *any* animal that lives in the water or on the coast can be affected by marine debris.

Other Directions

Have students locate photographs, artwork, or articles describing the effects of marine debris on wildlife. Students can work individually or in pairs to research a particular type of marine wildlife and develop a "photo essay" or brief presentation about how that species is harmed by debris. Students could also focus on a particular type of marine debris and its impacts on wildlife in general.

Take students on a field trip to an aquarium or coastal nature reserve, where they can learn about endangered and threatened species that might be harmed by marine debris. Contact the aquarium or reserve in advance to arrange for a guided tour that emphasizes the problems that marine debris poses for endangered and threatened species.

Objective: To learn about the characteristics of marine animals that make them susceptible to the hazards of marine debris.

Activity: Students listen to descriptions of marine animals, then identify items of marine debris that could harm them.

Vocabulary: endangered species, entanglement, ingestion, resin pellets, threatened species

Materials:

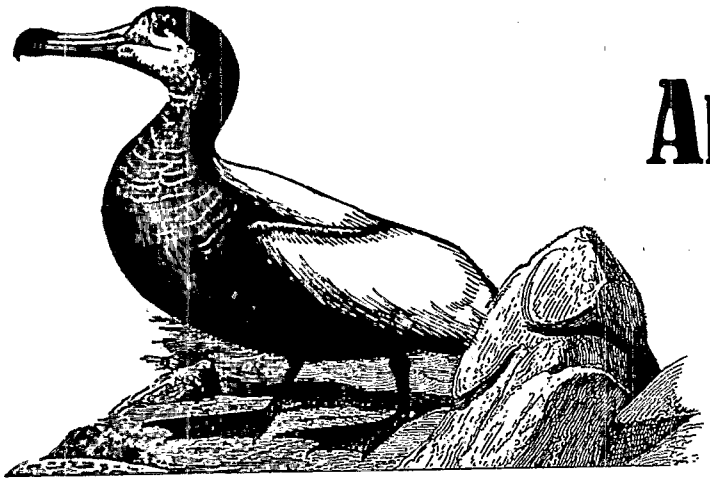
- One or more copies of the "Animal Tales" handout
- Resin pellets (or white jelly beans or marbles)
- A piece of net (or a mesh onion bag)
- Fishing line or rope
- Six-pack rings
- Plastic bag or sheeting
- Lobster or crab pot (or a wooden box or crate)
- Other types of debris (such as a plastic cup, a pull tab from a can, a balloon, a bottle cap, and a glass bottle)

Subjects: Language Arts, Science

Learning Skills: Analyzing, Public Speaking, Reading, Visualizing

Duration: 40 minutes

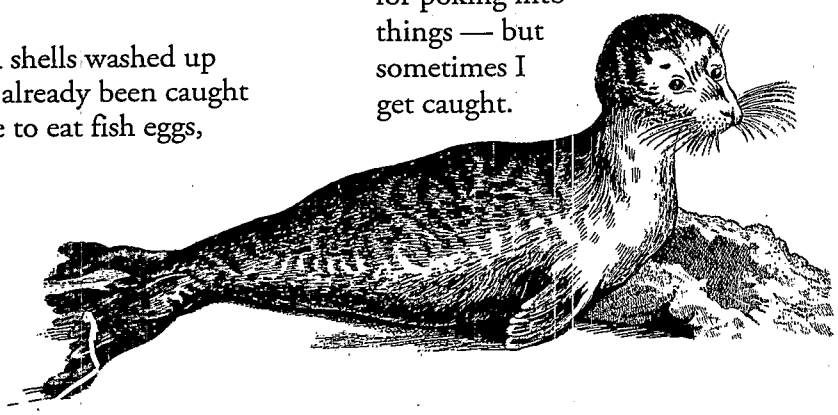
Animal Tales

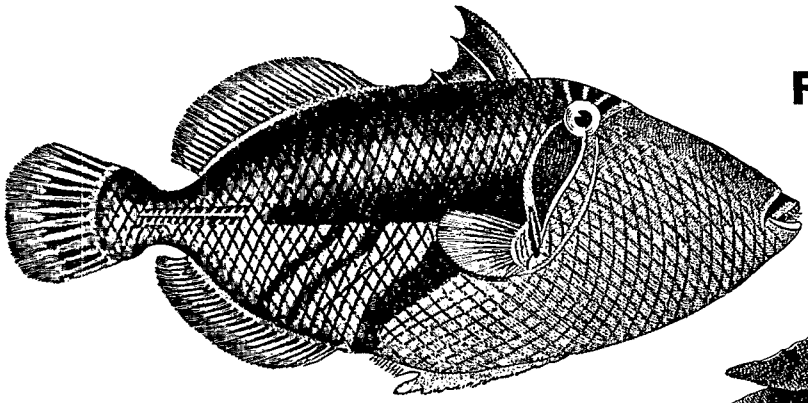


Seagull

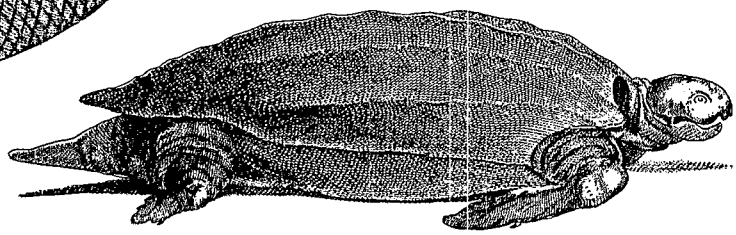
I look for food in the piles of seaweed and shells washed up by the tide. If I can, I'll eat food that has already been caught by someone or something else. I also like to eat fish eggs, which are round and clear.

Seal I am naturally curious and like to play with unusual objects, especially those that float. My nose is perfect for poking into things — but sometimes I get caught.



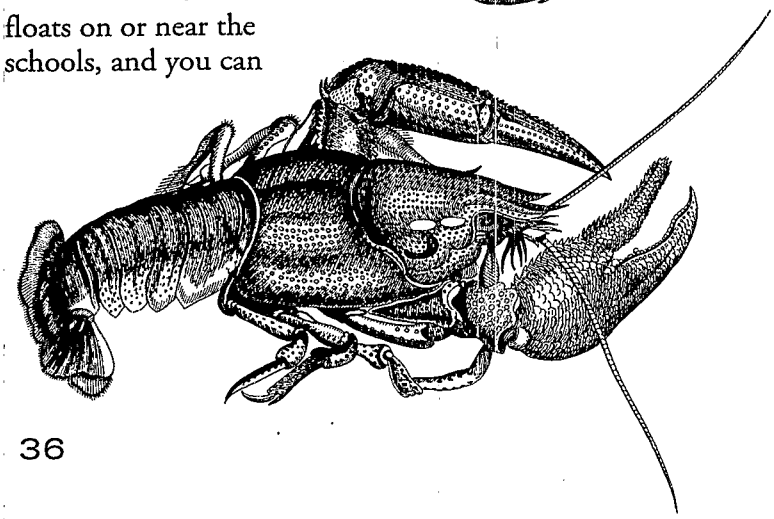


Fish I often swim into holes and near objects that offer shelter from my enemies. If a lot of smaller fish are gathered in one area, I may swim closer to see if I can eat them.



Turtle

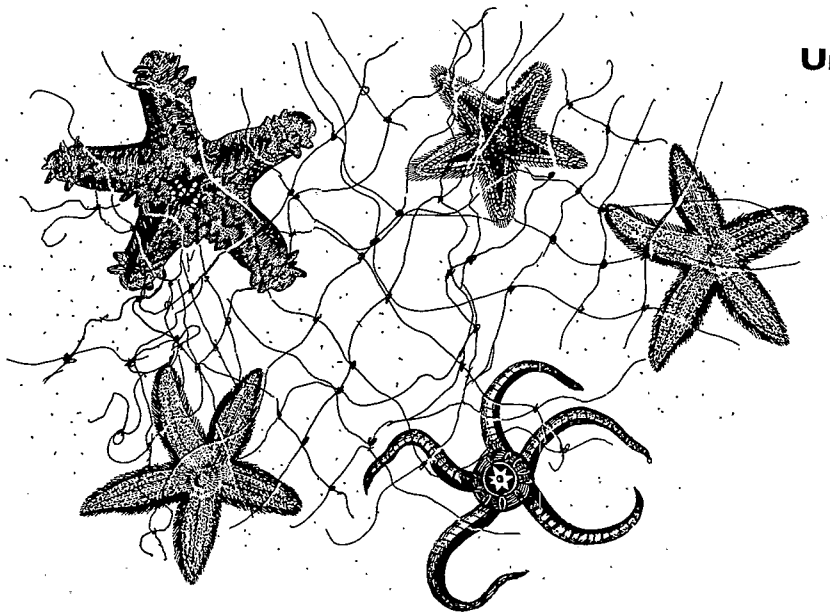
One of my favorite foods is the jellyfish, which floats on or near the surface of the water. Jellyfish swim together in schools, and you can see right through them!



Lobster

I crawl along the bottom of the ocean looking for food. Sometimes I find a tempting meal inside a wooden crate resting on the ocean floor — but once I get into the crate, I can't get out again.

All Tangled Up



1 Distribute the rubberbands to students and have them follow the procedure below. (Note: You may want to have one or two students come up to the front of the room to perform the exercise with rubberbands as a demonstration; then include the entire class in the discussion.)

- Hold your hands up in front of your face, with the back of your hands towards your face.
- Hold the rubberband in your right hand and hook one end of it over the little finger of your left hand.
- Hook the other end of the rubberband over the left-hand thumb. The rubberband should be taut and resting across the bottom knuckles on the back of your left hand.
- Place your right hand on the bottom of your left elbow, and keep it there.
- Try to free your hand of the rubberband without using your right hand, teeth, face, or other body parts.

2 While students are struggling, ask the class to imagine that they are seagulls that have gotten pieces of fishing line, abandoned net, or other debris wrapped around their beaks or necks. Tell them the birds would be unable to eat until they had gotten themselves free. Ask them the following questions:

- How would you feel after struggling like this all morning?
- How would you feel after missing breakfast?
- What would happen if you continued to miss meals and spent all of your strength fighting to get free?
- What would happen if a predator was chasing you?

Encourage students to share their thoughts and feelings about being entangled. Remind them that their experience is similar to that of a bird or other marine animal that becomes entangled in debris.

Objective: To learn about wildlife entanglement by experiencing what it might be like to be a marine animal trapped in debris.

Activity: Students perform an experiment in which they wrap a rubberband around their fingers and try to disentangle themselves. As a class, students discuss their thoughts and reactions and relate to real animals.

Vocabulary: abandoned net

Materials:

- A small- to medium-sized (thin) rubberband for each student
- One copy of the "Animal Entanglement" handout

Subjects: Language Arts, Science

Learning Skills: Analyzing, Experimenting, Visualizing, Writing

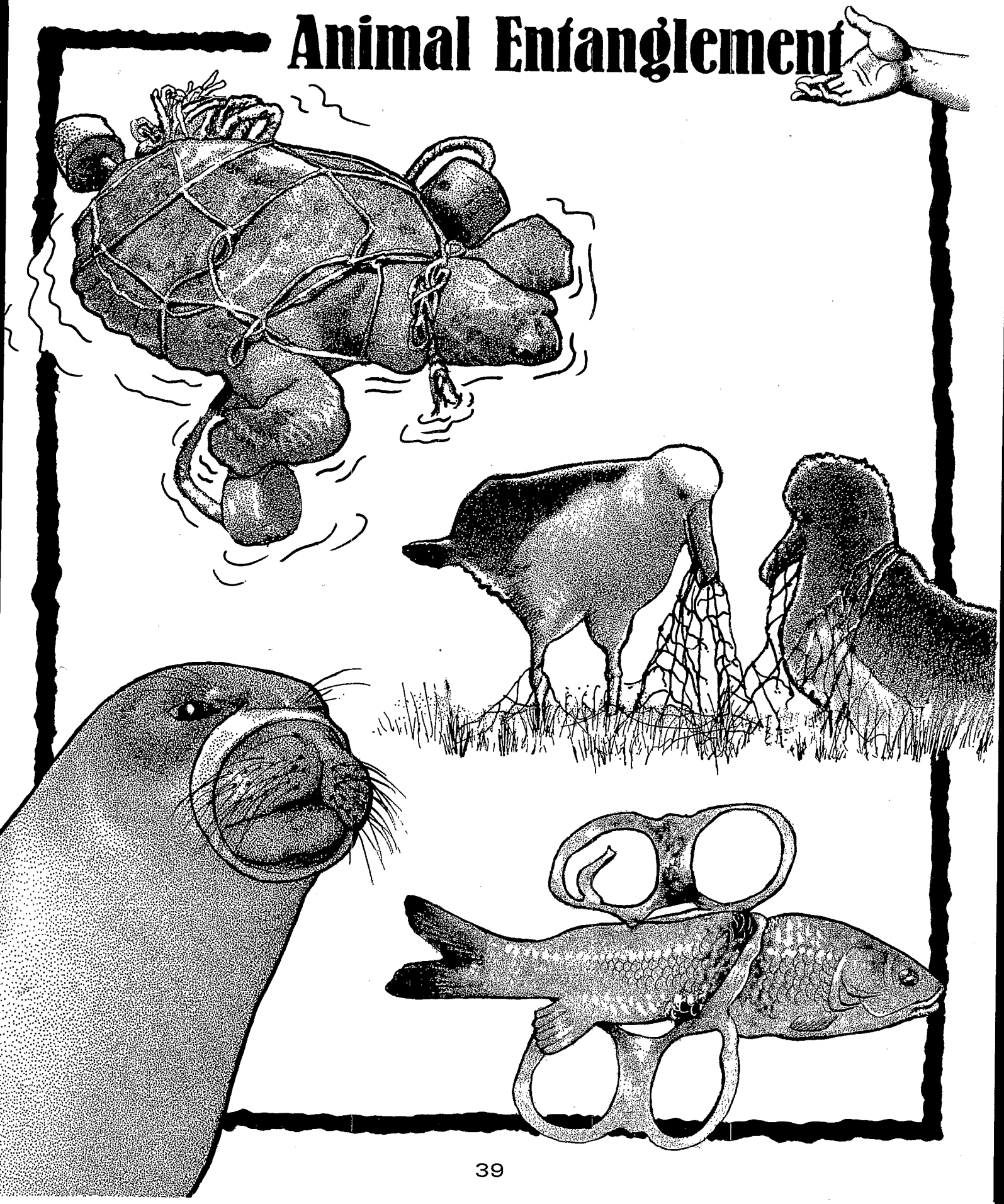
Duration: 20 minutes

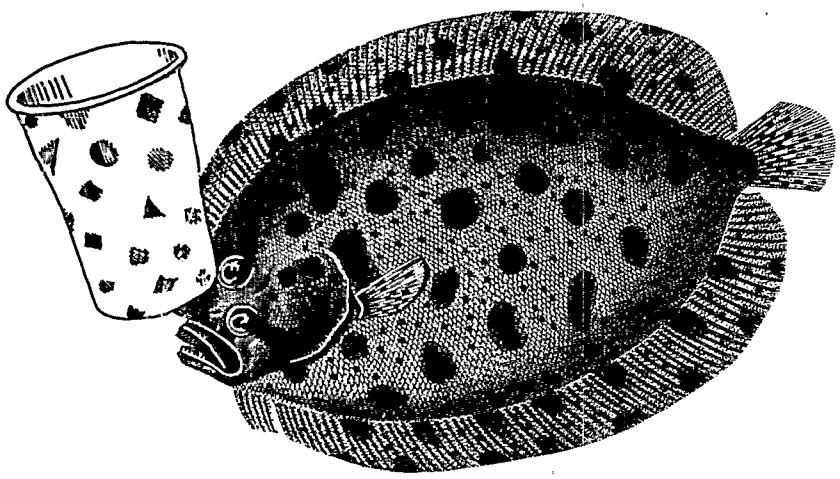
3 Post the "Animal Entanglement" handout at the front of the class. Ask students to choose one of the animals pictured and write a paragraph from that animal's point of view telling how it feels to be entangled in marine debris. Students should include as many details from the illustration as possible in describing their experience. Encourage students to use a range of senses and feelings in their descriptions, and to be as imaginative as possible.

Other Directions

Have a volunteer come up to the front of the room and experiment with entangling his or her hands or arms in a six-pack ring. This activity should be carefully guided by the teacher. Have the student remove the six-pack ring, or help him or her to do so. Then cut the loops of each ring with a scissors. Have another volunteer experiment with becoming entangled in the cut ring. Have students compare the two experiences. Then discuss why cutting six-pack rings is a good practice.

Animal Entanglement





How Harmful Is It?

Objective: To explore the effects of marine debris on people, animals, vessels, and communities.

Activity: Students complete a form that requires them to make decisions about how severely different types of marine debris affect people, animals, vessels, and communities. As a class, results are totalled and analyzed to determine which types of marine debris are most harmful to the different categories that could be affected.

Vocabulary: ghost fishing, medical waste

Materials:

- Enough copies of the "How Harmful Is It?" handout for the entire class

Subjects: Mathematics, Science, Social Studies

Learning Skills: Analyzing, Calculating, Classifying, Comparing and Contrasting, Decision-Making

Duration: 30 minutes to complete tally; 30 minutes (preferably the next day) to analyze and discuss results

1 Distribute the "How Harmful Is It?" handout to the class. Make sure students are familiar with the types of debris in the table. If possible, label and display examples of the actual debris. Review with students the instructions at the top of the page. Then have students fill out the table.

2 Collect the handouts and calculate class subtotals for each type of debris on the handout (add together the students' subtotals and divide by the number of students in the class). (Note: You can do this with the class or on your own and present the totals the next day.) Pass back to students their original handouts.

3 Write the class subtotals on the board. As a class, analyze the results of the tally. Initiate discussion by asking questions such as the following:

- According to class results, which types of marine debris are most harmful to seals? sea turtles? seagulls? Which type or types of debris seem to be most harmful to animals in general? (Repeat this series of questions for people, vessels, and places.)
- According to class results, which types of marine debris are the most harmful overall? Do you agree? Why or why not?
- According to these results, which type of debris is the least harmful? Do you agree? Why or why not?
- Are there any types of debris which received a low grand total, yet are very harmful to one or several of the items on the list? Which ones?

4 Discuss with students how their individual results might have varied from the class results. Help them to understand that people may have had different opinions about how harmful certain debris is based on their own attitudes. For example, one student might think that a paper cup on a beach has little effect on the appearance or attractiveness of that beach for wading or walking, yet another student might argue that litter can make a beach so ugly that people will no longer go there.

The discussion should also introduce the concept that the abundance of certain types of debris may make them more harmful on a large scale than other types that appear to be more dangerous. For example, while hospital needles are extremely dangerous, they are less common than debris such as fishing line and nets, and therefore may have less of an overall effect on marine and coastal animals and communities.

(Note: The numbers that students arrive at by doing this exercise do not represent objective data on marine debris effects. Instead, they help students explore the many ways that debris can harm the different components of marine and coastal communities. Students should come away with the knowledge that certain types of debris may have a greater effect on specific animals, people, vessels, and places, but that almost all marine debris can be harmful to some part of these communities.)

Other Directions

Have students design a "Most Wanted" poster for the type of marine debris that they think is the most dangerous. The poster should include an illustration of the debris and list some of its "crimes." Students might also mention a "reward" on the poster for the person who finds this type of debris and disposes of it properly or identifies it to the proper authorities for disposal.

Have students develop a bulletin board mural or model of a seaside community complete with swimming beach, fishing pier, restaurants, beachfront housing, and hotels. The community should also include people in different occupations and some wildlife. Then ask students to research one element of the community that can be affected by marine debris and prepare a brief presentation. When students have completed their reports, gather the class around the mural or model and have students get up one at a time, indicate the subject of their talk with a pointer, and give the presentation.

How Harmful Is It?

INSTRUCTIONS: Decide how harmful each type of marine debris would be if it came into contact with the animals, people, vessels, and places listed below. Write the number that best reflects your opinion in the appropriate box. (For example, if you think fishing line would be very harmful to a seal, write the number "3" in the space provided.) When you have completed the chart, calculate the subtotals for each type of debris. Then calculate the grand totals at the bottom of the page.

1 = RARELY or NEVER HARMFUL **2 = SOMETIMES HARMFUL** **3 = VERY HARMFUL**

ANIMALS	Fishing Line	Paper Cup	Lobster Trap	Six-Pack Ring	Resin Pellets	Plastic Bag	Hospital Needle	Lost Net
Seal								
Sea Turtle								
Seagull								
SUBTOTAL								
PEOPLE								
Diver								
Beachgoer								
Sailor								
SUBTOTAL								
VESSELS								
Motorboat								
Canoe								
Fishing Boat								
SUBTOTAL								
PLACES								
Pier								
Swimming Beach								
Seafood Restaurant								
SUBTOTAL								
GRAND TOTAL								

Unit III

Developing Solutions and Spreading the Word

- What steps are being taken to prevent marine debris?
- Who is working on the problem?
- What can concerned individuals do to help?

Tom O'Hara

Developing Solutions and Spreading the Word

Many governments, organizations, and individuals are actively working to develop solutions to the marine debris problem. Some of these groups are developing educational programs to encourage people to use ***prevention****, the most effective way to reduce marine debris. Other organizations are conducting projects aimed at removing debris from the marine environment through beach cleanups, adopt-a-beach programs, and other initiatives. In addition,* ***international*** *laws, as well as local, state, and federal legislation, have been established to regulate commercial and recreational activities that frequently result in the generation of marine debris.*

What Are Governments Doing to Address Marine Debris?

In 1973, the International Maritime Organization, the United Nations agency responsible for international shipping, formed an agreement addressing marine pollution known as MARPOL. This agreement consists of two **annexes** that regulate the disposal of oil and hazardous chemicals at sea. As of 1992, 50 nations had signed this agreement. MARPOL was amended in 1978 to include three additional annexes addressing hazardous materials, sewage, and trash. Under Annex V, the amendment regulating the disposal of garbage at sea, packing materials may not be dumped closer than 25 miles from land, and food wastes and other trash may be disposed of no closer than 12 miles from land. The disposal of plastic materials (including fishing nets, ropes, and bags) is prohibited under any circumstances. The 1978 annexes are "optional," meaning that nations may elect to adopt them or not. As of January 1992, 52 countries had signed Annex V.

In 1988, the Marine Plastics Pollution Research and Control Act (MPPRCA) was passed, requiring all U.S. ships to comply with the provisions of MARPOL Annex V. In addition to prohibiting U.S. ships from dumping plastic items in the sea, all such vessels are required to institute shipboard waste management plans. The law also banned the disposal of plastics within 200 miles of the United States by **foreign** nations, regardless of whether or not they are Annex V signatory nations. The U.S. Coast Guard (USCG) is responsible for enforcing these regulations.

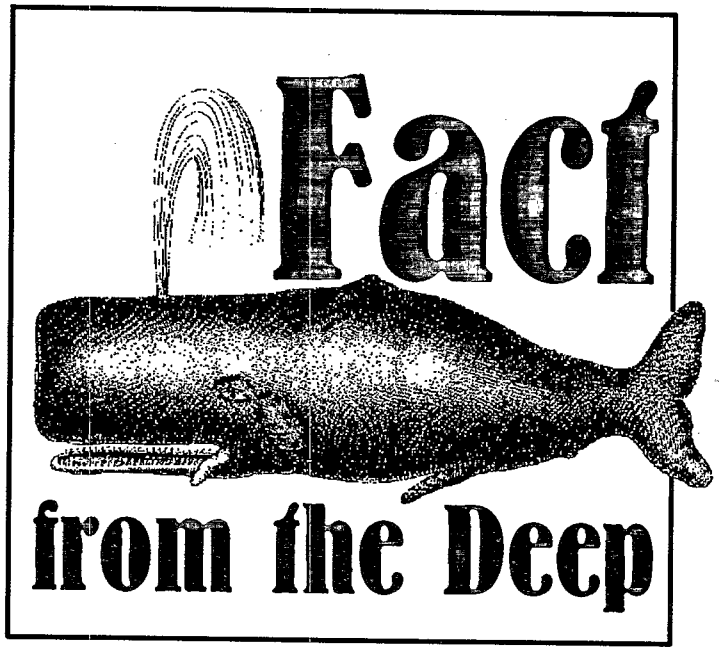
While government-owned vessels are currently exempt from MARPOL Annex V, MPPRCA required all U.S. public ships, including Navy vessels, to comply with the regulations by 1994. The Navy has already begun researching options for reducing shipboard waste and for separating and compacting plastics for disposal at ports. The Navy is also developing educational

programs to encourage all of their ships to take steps now to reduce waste generation.

Several other U.S. agencies also are engaged in efforts to address marine debris. Much of this activity has resulted from the work of an interagency task force on Marine Debris, which was formed by the White House and chaired by the National Oceanic and Atmospheric Administration (NOAA). In 1988, the task force published its final report, which recommended steps that the U.S. Government should take to reduce marine debris. The report recommended that government agencies, including the U.S. Environmental Protection Agency (EPA), NOAA, USCG, the Department of Interior (DOI), and the Navy, undertake a cooperative effort to deal with the marine debris problem. The report also recommended that industry and environmental groups, as well as local governments, be included in this cooperative effort.

One of the first steps taken by these federal agencies has been the identification of sources of marine debris. EPA, along with NOAA, are cosponsors of the Center for Marine Conservation's (CMC) National Beach Cleanup Campaign, during which volunteers record the types and quantities of marine debris they collect. EPA also has been conducting field studies at harbors and sewage treatment plants to record the types of debris that are found. In addition, EPA, NOAA, and the National Parks Service are all working with CMC to develop other marine debris monitoring programs to collect more precise data for statistical analysis. These data will be used to examine long-term trends in marine debris to determine which solutions are effective and which sources of marine debris will require further control efforts.

Activities already are being undertaken to target the sources of marine debris and reduce the quantity of debris they generate. For example, EPA, in cooperation with the plastics industry through the Society of the Plastics Industry (SPI), is examining the sources of plastic resin pellets in the marine environment. Once this research has been completed, EPA and industry representatives will recommend measures to control the release of pellets. In addition, EPA and USCG are developing guidelines to reduce the solid waste released into coastal waters during shipping operations. EPA also is regulating



High Seas Drifter

It seems that nowhere is free from marine debris. Even in Antarctica, one of the most isolated areas on earth, marine debris is commonly found washed up on the shore by researchers studying the area. Antarctica is visited by so few people that most of this debris could not have come from the local area. Instead, the debris enters the ocean hundreds or even thousands of miles away, and then drifts to these remote beaches. It is a disturbing thought that, if current trends continue, more marine debris than people will ever reach the shores of Antarctica.

stormwater sewer systems to reduce the quantity of debris that is released to the marine environment from these sources.

Finally, as a result of recommendations of the interagency task force, the federal government is sponsoring public educational campaigns on marine debris. A central effort to this campaign is NOAA's Marine Debris Information Office, which is operated by CMC and cofunded by EPA. Through this office, information is distributed on the problems associated with marine debris, as well as potential solutions. These federal agencies also are developing educational materials and initiating beach cleanup efforts to increase public awareness of the marine debris issue.

Several other federal activities were undertaken before the final report of the Interagency Task Force was completed. In 1984, under the Department of Commerce, NOAA's National Marine Fisheries Service created the Marine Entanglement Research Program to study the causes and effects of pollution on the marine environment and its inhabitants. Through the program, researchers investigate possible mitigation opportunities and educate debris generators about how they can help lessen the problem. In 1978, NOAA established the National Marine Pollution Program, which studies different types of ocean pollution. With the help of representatives of the shipping, plastics, and commercial fishing industries, conservation groups, the Navy, and academia, the program has established priorities for addressing the marine debris issue. These include improved techniques for handling shipboard waste, increasing people's understanding of the effects of plastics in the marine environment, and investigating ways to mitigate the effects of "ghost fishing" by lost or discarded nets.

Another federal effort is the Marine Mammal Commission, which was established in 1974 as part of the Marine Mammal Protection Act. The commission reviews federal agency actions or programs that may affect marine mammal protection and research efforts. The commission has been active in supporting the Marine Entanglement Research Program, studying marine debris effects in select U.S. waters, and helping start beach cleanups and data-gathering projects in several states.

On the state and municipal level, laws and ordinances are being passed to address the management of different types of trash, many of which can become marine debris. For example, many states have passed bottle-deposit laws to encourage the recycling of beverage cans and bottles. Data from CMC's 1990 Beach Cleanup show that there were significantly fewer bottles and cans on beaches in states with deposit laws, suggesting that these regulations are having an effect. Some states have also enacted legislation requiring the use of certain items such as photodegradable six-pack rings. Many states and communities also have implemented littering laws, which will help prevent trash originating on land from becoming marine debris.

What Are Private Organizations Doing to Address Marine Debris?

Private industry, non-profit research organizations, and **environmental groups** also are working to find ways to prevent and reduce marine debris. One of the most widely recognized efforts is the annual beach cleanup organized by CMC, which has been held annually each fall since 1986. Through the cleanup, CMC mobilizes thousands of volunteers in the United States and several other countries to scour the coast, recording **data** on the types of debris found on U.S. coastlines. The data are logged in the National Marine Debris Database, which is used by CMC and other researchers as a tool to study the nature of marine debris and measure the impact of attempts to reduce it. Beyond cleaning beaches, the program serves to increase **awareness** of marine debris and improve our understanding of the problem. Other environmental groups, including the

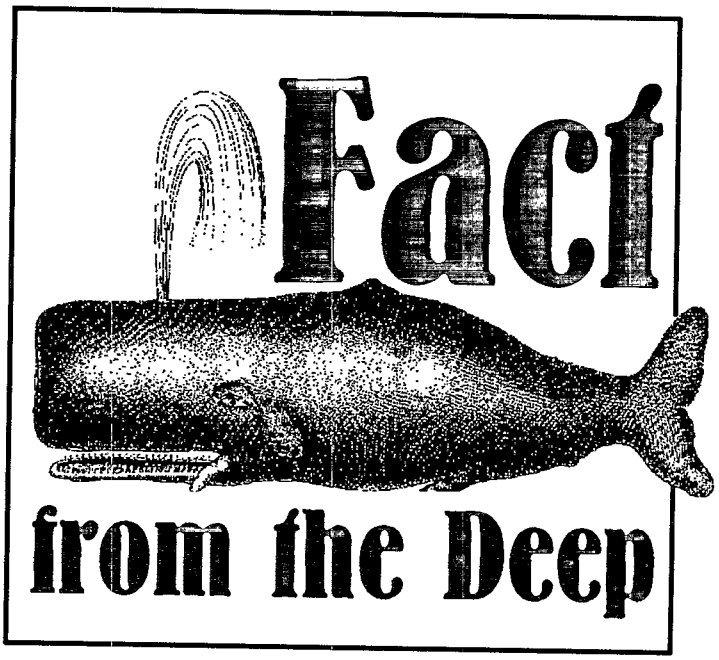
Clean Ocean Action – New Jersey

Natural Resources Defense Council and the World Wildlife Foundation, have established educational programs that outline steps that people can take to stop marine debris in their own communities.

In addition, several different **business and industry** groups have initiated projects aimed at reducing or preventing trash in the marine environment. In the 1980s, plastics manufacturers began to organize research and educational efforts aimed at minimizing the effects of plastics in the oceans, lakes, and rivers. To reduce the persistence of these items, photodegradable plastics have been developed for use in six-pack rings and other particularly harmful items. Additional work has been done to increase the feasibility of plastic recycling. Many frequently used plastic containers, especially beverage containers such as soft-drink bottles and milk jugs, can now be recycled.

The plastics industry, through the SPI, is also engaging in an education **campaign** aimed at both plastics producers and consumers alike. Information kits, industry briefings, and public service advertisements have been used to reach industry members to spread the word about plastic items that manufacturers can prevent from becoming marine debris, such as resin pellets. Educational efforts have also been directed at recreational boat owners, marinas, and commercial fishing operations. Finally, SPI supports other federal and private efforts to address the problems of marine debris, such as CMC Beach Cleanup Campaigns and EPA's plastic pellet study.

Other industry groups also have taken action to prevent their businesses from contributing to the generation of marine debris. In 1987, a coalition of Pacific Coast commercial fishermen sponsored the North Pacific Rim Fisherman's Conference on Marine Debris. The conference included representatives from commercial fishing fleets from all over the Pacific, and established a set of goals and recommendations for all fishing vessels to follow. The petroleum industry has initiated educational programs to encourage offshore oil platform operators and employees to properly dispose of all generated waste. Port authorities in the United States also have begun to address the issue, focusing on how to facilitate compliance with the provisions of Annex V requiring portside garbage disposal facilities.

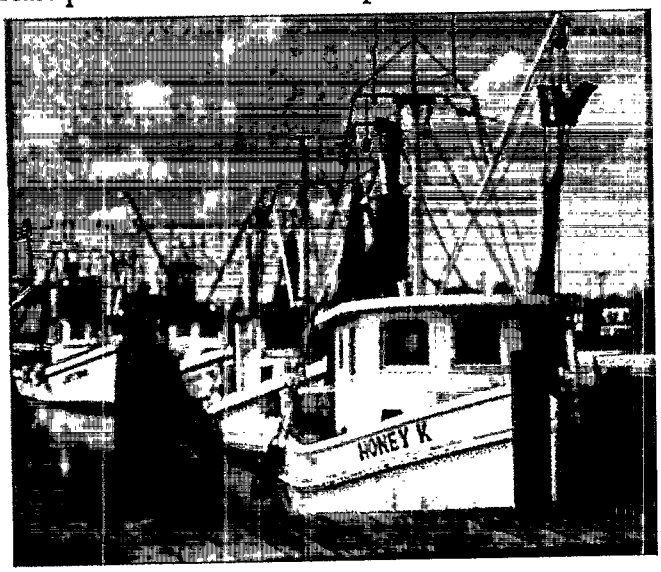


Beach Cleanups

The Center for Marine Conservation's 1990 Beach Cleanup covered 26 states and 3,656 miles of coastline in the United States, netting over $2^1/_2$ million pounds of trash. Over 100,000 volunteers took part in the effort. In addition to paper plates, plastic bags, and other trash, they found a rubber alligator, a sofa, two egg cartons complete with eggs—and 10 kitchen sinks! By the end of the cleanup, four sinks had been found in Florida, two each in New York and Maine, one in Delaware, and one in Virginia. While the presence of the sinks is proof that *anything* can become marine debris, the fact that they were found, recorded, and removed also demonstrates the resolve of dedicated individuals working to reduce the amount of trash in the marine environment.

What Can I Do?

While governments and private organizations have become increasingly active in combatting marine debris, individual initiative remains one of the best ways to tackle ocean pollution. By taking action, whether properly disposing of all waste, cutting down on the amount of waste produced, organizing local marine debris projects, or joining the efforts of larger organizations, citizens of all ages can help reduce marine debris and increase public awareness of the problem.



Linda Maraniss/CMC

There are often clear connections between our individual behaviors and the effect of these activities on the environment (for example, the candy wrapper littered on the street can easily be washed into a storm sewer and carried to the sea). Since prevention is the simplest and most effective way to reduce marine debris, individuals can begin by examining their **lifestyles**, considering how much garbage they generate, and where it all ends up. To reduce the possibility that any of their trash will become marine debris, people can make sure that all of their waste is properly disposed of. For example, when outdoors, especially at the beach or on a boat, preventing any litter from blowing away or being left behind will help. People also can recycle as much trash as possible and practice waste prevention techniques, such as reusing items like bags and containers rather than throwing them away.

The effectiveness of concerned individuals can be multiplied by organizing into groups to address marine debris in the **community** or region. For example, groups can come together out of concern for a nearby beach or other site, learning how it is being affected, cleaning the area periodically, and informing others about the project. Such "adopt-a-beach" programs can be very effective ways to educate the community about the impact of marine debris and what needs to be done to prevent it. Marinas can organize education campaigns to alert recreational boaters to the need to store waste for proper disposal on land. Boaters can also organize watchdog groups to observe and report any illegal dumping. One such group, the "Citizen Pollution Patrol," is a network of boaters committed to preventing the generation of marine debris. Organized after ratification of MARPOL Annex V by the United States, this group reports suspected violations of the regulations, and helps other boaters understand and comply with the law.

Established organizations working to stop marine debris are always looking for more people to help them organize and staff their programs. For example, individuals of all ages can **volunteer** for certain short-term projects, such as CMC's annual beach cleanups. Many young people take part in these cleanups every year. Not only do students get a chance to help protect the environment through such efforts, but they also can witness the marine debris problem firsthand. In addition to CMC, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service also oversee a network of volunteers that respond to marine animal strandings and entanglements. Many state and local environmental agencies also maintain a volunteer corps to help educate people about marine debris.

Young people can also take action to prevent marine debris and educate others about the problem through a variety of youth organizations, such as Kids Against Pollution and local chapters of Boy or Girl Scouts of the United States of America. Students can learn more about aquatic environments and the wildlife that lives there by visiting museums, aquariums, and nature reserves. They also can read books and magazines and watch television shows on these topics. In addition, young people individually can make a difference in their communities by organizing cleanups, by writing letters, and by talking about environmental issues with parents and friends.

At a time when many environmental problems seem beyond individual action, marine debris is an area where people of all ages can make, and have already made, a real difference.

Key Points

Prevention is the most effective way to stop marine debris. The United States and other countries, private organizations, and individuals are taking action to prevent debris from entering the marine environment. In addition, U.S. federal agencies are cooperating to address the marine debris problem.

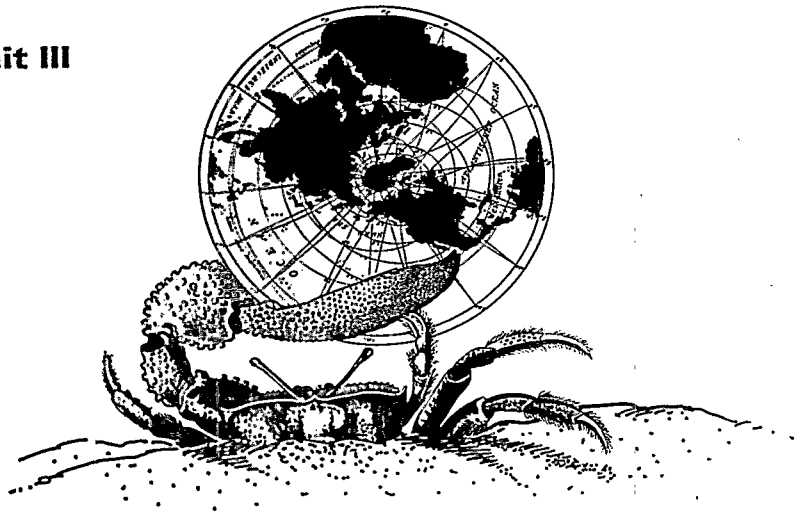
MARPOL Annex V is the first international legislation to regulate the disposal of garbage at sea. Federal, state, and local legislation also has been passed addressing ocean disposal, encouraging recycling, and banning particularly harmful plastic items.

Many conservation groups have been working to stop marine debris, developing educational programs and lobbying for additional U.S. and international legislation. Prominent among these is the Center for Marine Conservation's annual beach cleanup, which mobilizes thousands of volunteers to remove marine debris from the nation's beaches.

Industry groups are addressing the problem by educating their members about marine debris and sponsoring conferences and research projects.

Individuals can make a difference in their daily lives by reducing the amount of waste they produce and ensuring that the remainder is recycled or disposed of properly.

People who want to become more involved can let their elected representatives know how they feel, organize projects within their community, and join established marine debris prevention programs.



Nations and Neighbors

Objective: To understand that marine debris is a global issue and to learn about international efforts that can help pevent its generation, such as MARPOL Annex V.

Activity: Students find MARPOL signatory nations on a map and learn how marine debris can drift between these countries. As a class, students discuss how MARPOL Annex V regulates the disposal of garbage at sea. Students also learn how people in some of these countries say "Save Our Seas," and make up a song with the phrases.

Vocabulary: annex, foreign, international

Materials:

- A world map
- Three different colors of yarn
- Tape
- Scissors
- One "MARPOL Annex V Countries" handout for each student in the class
- One "I Am a Piece of Trash From..." handout

Subjects: Language Arts, Music, Social Studies

Learning Skills: Analyzing, Decision-Making, Observing, Visualizing, Writing

Duration: 40 minutes

1 Before the lesson, cut apart the names of the different MARPOL signatory nations from the "I Am a Piece of Trash From..." handout. Crumple up the pieces of paper and put them in a bag. (Note: This handout might be out of date, as some countries have changed their names or no longer exist.)

2 Provide each student with a copy of the "Marpol Annex V Countries" handout. Assign one of the signatory countries to each student in the class. Ask the students to imagine that they live in that country. Have them find their country on the map.

3 Then, pass around the bag with the crumpled up pieces of paper and have the students pick out one each. Tell the students that these pieces of paper represent pieces of marine debris from all over the world. Have the students open their piece of "trash," read where it came from, and identify the country on the map. (Note: If any students get a piece of trash from the country they "live" in, ask them to pick another.) Ask three volunteers to indicate on the map with a piece of colored yarn how their trash could have traveled from its original country to the country in which it ended up. Tape the pieces of yarn to the map. (Note: Have each student use a different color of yarn.)

4 For each example, ask the class if the trash could have drifted to any other coastal countries on the map. Which ones? Also ask if the trash could *not* have drifted to certain coastal countries. Which ones?

5 Also discuss with the class:

- Do oceans have borders as countries do? Why or why not?
- Can a country by itself stop all debris from washing up on its beaches?

6 Introduce the students to MARPOL Annex V. Tell them about its passage as a result of international concern about marine debris. Briefly discuss how it restricts the disposal of garbage (like food, metal, and paper waste) at sea and prohibits the ocean dumping of plastics. Emphasize that through this legislation many countries from all over the world joined together to stop ships from contributing to marine pollution.

7 Have the students learn the phrase "save our seas" in one of the following languages:

- Rettet Unsere Meere (German)
- Sauvons Nos Mers (French)
- Salvate i Nostri Mari (Italian)
- Salva Nuestros Mares (Spanish)

8 Help them put together a song made up of these phrases.

Other Directions

Ask students to write a story about the journey of their piece of trash. Students might imagine that they are a glass bottle or a soda can drifting through the oceans, or some other piece of trash (such as a toy or a piece of fishing line). Using their social studies book or an encyclopedia for reference, students should research the country where the trash started from, as well as the country on which it washed ashore. Compositions should include this information, as well as explain the ocean(s) the trash traveled through on its journey. Other countries the trash could have landed on during its journey can also be mentioned. The stories can finish by mentioning how the students would recycle or dispose of this piece of trash if they really found it on a beach.

Ask students to investigate local legislation concerning marine debris (such as local boating ordinances and littering laws) to learn how their own community is working on preventing marine pollution. The investigation can include use of the school or public library, as well as interviews with parents, faculty, town representatives, or other municipal officials. (Note: Students might like to tape their interviews to share with the class.)

Ask students to think about what other types of laws could help reduce or prevent marine debris. Then have students write a letter to their congressperson or senator expressing their concern about marine debris, along with their ideas on how the United States can become part of the solution. (Note: Students can also write letters to other individuals or officials, from the mayor of their community to the President of the United States).

Conduct a poster contest in which students design posters for recreational boaters. The posters should explain the types of damage that marine debris can cause vessels, as well as the requirements that pertain to boaters under MARPOL Annex V. Posters can be placed around town and in the local marina. (Note: Be sure to check with the appropriate authority before displaying the posters.)

MARPOL Annex V Countries

Algeria
Antigua and Barbuda
Austria
Bahamas
Belgium
China
Colombia
Cote d'Ivoire
Cyprus
Czechoslovakia
Denmark
Ecuador
Egypt
Finland
France
Gabon
Gambia
Germany
Greece
Hungary
Iceland
Italy
Jamaica
Japan
Lebanon
Lithuania
Luxembourg
Marshall Islands
Netherlands
North Korea
Norway
Oman
Panama
Peru
Poland
Portugal
Russian Federation
St. Vincent and Grenadines
Spain
Suriname
Sweden
Switzerland
Togo
Tunisia
Turkey
Tuvalu
United Kingdom
United States
Uruguay
Vanuatu
Yugoslavia

"I am a piece of trash from . . ."

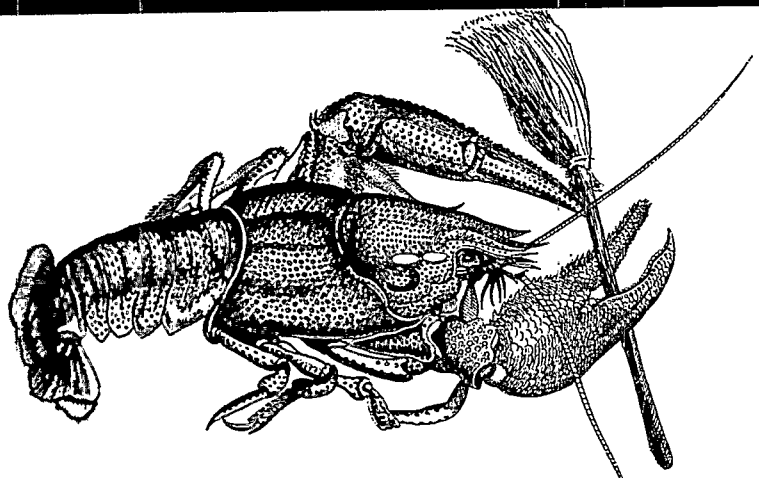
ALGERIA	ANTIGUA AND BARBUDA	AUSTRIA
BAHAMAS	BELGIUM	CHINA
COLOMBIA	COTE D'IVOIRE	CYPRUS
CZECHOSLOVAKIA	DENMARK	ECUADOR
EGYPT	FINLAND	FRANCE
GABON	GAMBIA	GERMANY

"I am a piece of trash from . . ."

GREECE	HUNGARY	ICELAND
ITALY	JAMAICA	JAPAN
LEBANON	LITHUANIA	LUXEMBOURG
MARSHALL ISLANDS	NETHERLANDS	NORTH KOREA
NORWAY	OMAN	PANAMA
PERU	POLAND	PORTUGAL

"I am a piece of trash from . . ."

RUSSIAN FEDERATION	ST. VINCENT & GRENADINES	SPAIN
SURINAME	SWEDEN	SWITZERLAND
TOGO	TUNISIA	TURKEY
TUVALU	UNITED KINGDOM	UNITED STATES
URUGUAY	VANUATU	YUGOSLAVIA



Clean Sweep

Objective: To experience how marine debris can affect a community and to discover that by taking action people can make a difference.

Activity: As a class, students organize and conduct a cleanup of a local beach, lake, or stream. Students keep track of the types and amounts of trash picked up and analyze this information in the classroom. As a class, students discuss the marine debris problem in their community and consider ways to prevent it.

Vocabulary: community, data, lifestyle, prevention, volunteer

Materials:

- One kitchen-sized garbage bag for each pair of students in the class (Note: If collected items will be separated for recycling, additional kitchen-sized garbage bags will be necessary)
- One pair of latex gloves for each student in the class
- One "Cleanup Card" handout for each pair of students in the class

Subjects: Mathematics, Science, Social Studies

Learning Skills: Analyzing, Classifying, Collecting Data, Decision-Making, Observing, Working in Small Groups

Duration: Two 40-minute periods

1 Select a nearby public beach for the class cleanup. Public land adjacent to a local stream or lake also can be used. (Note: The appropriate municipal or state agency responsible for the site should be notified prior to the cleanup.)

2 To prepare for the cleanup, explain the "Cleanup Card" handout to the students and demonstrate how to record the items they find. (Note: You may want to use this as an opportunity to show recycling in action. Have the students separate easily identifiable recyclable materials, such as bottles, cans, and newspapers, into bags for recycling.) Be sure to explain carefully safety procedures to be observed while collecting debris, including wearing safety gloves and not handling sharp objects or items they don't recognize.

3 Once on site, have students pair up. One student in the pair should carry the bag for trash (and a bag for recyclables, if they will be separating these), and actually gather the debris. As the first student collects the trash, both students should try to identify the item. The second student then records the information on the "Cleanup Card." Ask students to record the sources of the debris whenever possible. At the end of the cleanup, be sure that all the debris is properly disposed of.

(Note: The Center for Marine Conservation operates annual beach cleanups across the country. You may want to incorporate its program with this lesson, allowing the class to work with adults to clean up a site. The beach cleanups are scheduled for late September/early October and take about 3 hours. The Center for Marine Conservation also publishes a pamphlet entitled "All About Beach Cleanups," describing how people can organize their own beach cleanups. See the "Resources" section at the back of this guide.)

4 Back in the classroom, have the students total the amounts of debris found for each category listed on the "Cleanup Card." They should also add all of these numbers and put the total number of items found in the space provided on the bottom of the card. (Note: You might write these numbers on the board to come up with a class total for each category, as well as a grand total for all of the pieces of debris found.) Discuss any trends found:

- Was there a prevalence of certain types of items? Where might these items have come from (for example, from boaters, from sewers, from people who threw their trash on the ground, or other sources)?
- What were some of the most unusual types of debris found? Where might these items have come from?
- Which types of debris could pose problems to area wildlife? How?
- Will beach cleanups solve the marine debris problem? Why or why not?
- What are some steps we can take to prevent marine pollution in the first place?

5 Ask the students to consider how the lifestyles of the community residents may have contributed to the collected debris. Did they find any items that they or their parents use every day? Have them consider ways they could prevent these items from appearing on their beach, including recycling, proper disposal, and other pollution prevention techniques.

Other Directions

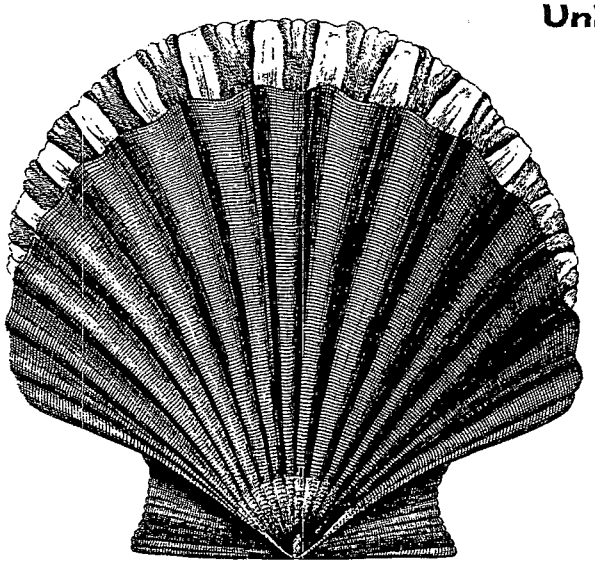
Have the class publicize its cleanup day or prepare an exhibit after the event. (Note: If this option is selected, be sure to save a few samples of marine debris from the cleanup.) See the "Campaign for a Clean Future" lesson in this unit for more details on these and other publicity activities.

Have the class adopt the cleanup site or another area for the semester or the school year. This will involve making regular tours to the site to keep it clean, as well as educating the community about the site, its natural inhabitants, and how to keep it clean.

Cleanup Card

	ITEM	NUMBER	TOTAL
PLASTIC	Bags		
	Bottles		
	Fishing line/nets		
	Six-pack holders		
	Cigarette filters		
	Straws		
	Other		
		Total Plastic:	
FOAMED PLASTIC	Cups		
	Fast-food containers		
	Other		
		Total Foamed Plastic:	
PAPER	Cups		
	Bags		
	Newspaper/magazines		
	Other		
		Total Paper:	
GLASS	Bottles		
	Pieces of glass		
	Other		
		Total Glass:	
METAL	Cans		
	Bottle caps		
	Other		
		Total Metal:	
RUBBER	Balloons		
	Tires		
	Other		
		Total Rubber:	
MISCEL-LANEOUS	Pieces of wood		
	Pieces of clothing		
		Total Miscellaneous:	
		Total:	

Campaign for a Clean Future



1 Introduce the class to the idea of a public education campaign by comparing it to a political campaign such as an election or a fundraising event for a local church or civic group. Indicate that while those campaigns seek to win votes or raise money, the campaign the students will develop will help prevent pollution and protect the environment.

2 As a class, decide whether the campaign will be directed at the faculty, staff, and students of the school or all the members of the community. (Note: Most of the projects can be tailored for either the school or the entire community.) If possible, use the campaign to promote an actual beach cleanup, community cleanup campaign, recycling campaign, or other event.

3 Have the class create a slogan for the campaign, such as "Save Our Seas—Stop Marine Debris," or "Join the Partners for Pollution Prevention." The slogan should attract the interest of the intended audience and reflect the goal of the campaign. Students may want to design an icon or symbol to accompany the slogan, such as a drawing of a seal pup or a gull. The slogan and symbol should appear in all campaign materials and events. Depending on available time and the interests of the class, some of the following projects can be undertaken to publicize the event:

- **Posters.** Divide the class into pairs, and have them design and paint a poster about marine debris. The poster should incorporate the campaign slogan, provide facts about marine debris, and suggest ways to prevent it. If the campaign is promoting an actual event, the students also should include on the posters the most important details about the project (such as the date of the event, the location, and the time scheduled). Students may want to contact the municipal office that handles marine pollution issues or the local Department of Public Works to ask if they can include a phone number for people to call for more information. The posters can then be displayed in the school, at the beach, or in town. (Note: Be sure to check with the proper authority before displaying the posters.)

Objective: To educate the community about marine debris and how to prevent its generation.

Activity: Students develop a public education campaign on marine debris to raise the awareness of the school or the whole community. Students develop campaign slogans, buttons, posters, bumper stickers, press releases, and other materials. The campaign can be used in conjunction with an actual community litter cleanup day, a beach cleanup, a storm sewer stenciling activity, or other community event.

Vocabulary: campaign, press release

Materials:

➢Will vary with activity

Subjects: Art, Language Arts, Science, Social Studies

Learning Skills: Analyzing, Collecting Data, Decision-Making, Interviewing, Researching, Visualizing, Working in Small Groups, Writing

Duration: Two to three 40-minute periods

- **Bumper Stickers/Buttons.** Have students individually or in pairs design and produce bumper stickers or buttons. Simple buttons can be made of white or colored card stock and worn using a safety pin. Bumper stickers can simply be strips of paper that are then posted on a wall (not actually put on cars). These items should include the campaign slogan and icon and, if possible, a brief point or two about marine debris.
- **Flyers.** As a class, design a campaign flyer. Start with the campaign slogan and then develop the text of the flyer. The text can include interesting facts about marine debris, as well as simple steps people can take to help reduce or prevent marine debris. Once the flyer is produced, it can be copied and distributed in the school. If the campaign seeks to include the whole town, students can distribute it to stores, libraries, and supermarkets. (Note: Be sure to check with the appropriate manager or authority first.) Also be careful not to produce more flyers than needed!
- **Library Exhibit.** Have the students design a table or bulletin board exhibit about marine debris to be displayed in the school or town library. Students can assemble posters, flyers, buttons, and other items they have made. In addition, pictures or photographs of entrapped or entangled animals can be displayed to illustrate the potential dangers of marine debris. Actual samples of marine debris also can be used, and students can ask the librarians to add some relevant books to the exhibit. Exhibit tables or booths also can be set up at school fairs or similar community events. Campaign materials can be displayed on the table, and the class can discuss with booth visitors the types of actions people can take to prevent marine debris. (Note: Before developing any exhibit or booth, check with the proper authority to obtain permission and to get information about size and format restraints for exhibit/booth setup.)
- **Article for the School Newspaper.** Ask the class to compose an article about the marine debris education campaign for the school newspaper. The article should include what students have done and what they hope to achieve, as well as discuss what their schoolmates can do to help. Or, invite a reporter from the school newspaper to a "press conference" at which the class can give a presentation on marine debris. The reporter can then write an article on the campaign.
- **Newspaper Articles/Letters to the Editor.** Have the class write a press release on the campaign for the local paper that discusses what students have accomplished. A reporter from the paper could also be invited to talk to the class. Alternatively, have each student compose a letter to the editor briefly explaining the effects of marine debris, what their class is doing to prevent it, and steps that people in the community can take to support the campaign.

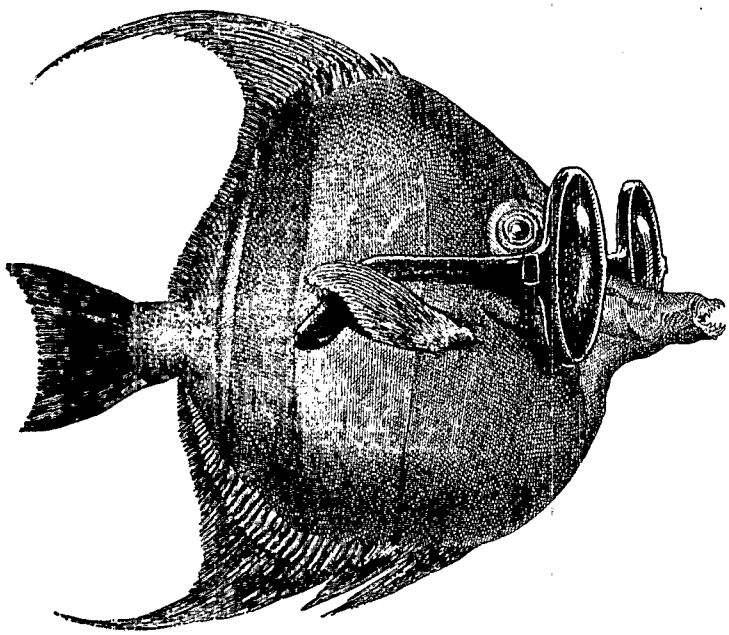
4 After the campaign is over, discuss with the class how well it worked. Have the students think about how much or how little people seemed to know about marine debris. Ask them to consider how changing people's attitudes can be effective in the effort to reduce marine debris.

Other Directions

Make a class video advertising the campaign or illustrating some of the ways marine debris could adversely affect the community. The video also should demonstrate ways that people can prevent ocean pollution. The videotape could be shown in school and then placed in the library for members of the community to borrow.

Develop a public service announcement in conjunction with a local radio station or community access television/local cable television channel advertising the campaign.

Have the class present a play for parents/the community about marine debris. The play can center on a day in the life of a marine animal such as a seal pup or sea turtle. The animal might be shown feeding or swimming with its family, becoming entangled or entrapped, and getting saved by passing boaters. The play can end with a "monologue" by the animal about not polluting the seas, or with the same message in a song sung by the class.



Private Investigations

Objective: To learn about the efforts of private organizations and individuals, both locally and nationally, to prevent marine debris.

Activity: Students investigate what different groups (such as business and industry, environmental groups, and other civic and private organizations) are doing in their area or across the nation to prevent marine debris. Students3 present an oral report on their findings. The class then writes a letter asking a representative of one of these groups to come to the school to discuss the group's efforts.

Vocabulary: business, environmental group, industry

Materials:

➢No special materials needed

Subjects: Language Arts, Science, Social Studies

Learning Skills: Collecting Data, Interviewing, Public Speaking, Reading, Researching, Working in Small Groups, Writing

Duration: One 40-minute period for first library visit; one to two 40-minute periods for additional research; one 40-minute period for oral presentations

1 To get the investigation started, take the class to the library. With the librarian, introduce the students to likely sources of information, including books, encyclopedias, periodicals, telephone books, and directories. (Note: The "Resources" section at the back of this learning guide lists many organizations, and may provide enough information for your needs. An additional reference tool is the *Encyclopedia of Associations,* which is a book found in most libraries that contains the addresses and phone numbers of many kinds of organizations.)

2 Using these resources, have each student develop a list of organizations whose work focuses on the prevention of marine debris and related issues (such as wildlife entanglement and protecting endangered species). Student lists should include government agencies such as EPA and NOAA, industry groups such as the commercial fishing and plastics industries, non-profit organizations including environmental groups and research institutions, and civic or local groups such as recreational boaters and sport fishermen. Assist any students that are having difficulty, so that each student has discovered projects or activities from at least two or three organizations. Students should record the name, address, and phone number of the organizations, as well as a short description of the group and its work.

3 Back in the classroom, list all of the different organizations identified by the students on the chalkboard. Ask student volunteers to briefly describe what each organization does.

4 Divide the class into small groups for further research. Assign each group two or three organizations and have them research the projects their organizations have developed to reduce or prevent marine debris. The school and town libraries will be a primary source of information. Other potential sources of information include environmental organizations, the local newspaper office, and other teachers or parents. The students also can contact the organizations directly, requesting that literature

about the organization be sent to the students by mail. In addition, students can call or visit local officials that are responsible for public health or environmental issues, asking them for more information about the work of their organizations.

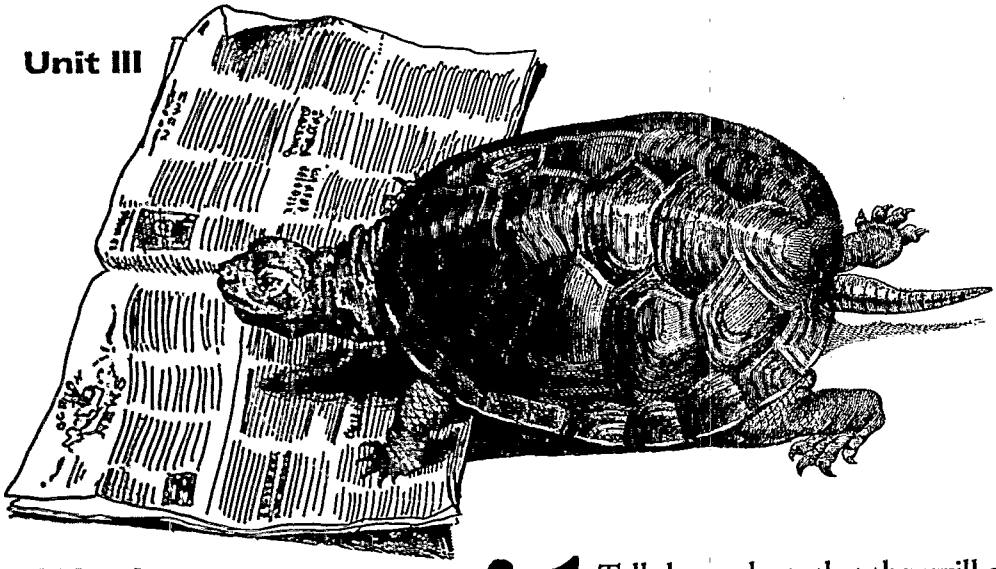
5 When the students have completed their research, have each group present short oral reports to share what they found with the class. Afterward, discuss the variety of things that people are doing to prevent marine debris. Have the students consider which methods they think will be most effective and why.

Other Directions

Choose an agency, organization, or business that the students found interesting and have the class compose a letter asking a representative to visit the class. Afterward, have the students write a two- or three-paragraph report on the representative's presentation. The report should describe the organization and what the representative does. The students can also include suggestions for how to implement some of the organization's prevention techniques in the community.

Have the class investigate what their peers may be doing individually or in organizations to protect the oceans or combat marine debris (the *Encyclopedia of Associations* contains a number of children's groups working to protect the environment). Have students develop a report or profile on their findings.

Ask students to research careers in the environment. The students can interview individuals that hold environmental jobs (such as scientists, writers, environmental lawyers, organic farmers, park rangers, town planners, and people in businesses, environmental groups, the government). Students can also look in the library for books, magazine articles, and pamphlets about environmental careers. One book that describes a variety of environmental jobs is entitled *A Complete Guide to Environmental Careers.* Have the students report to the class on their findings. (Note: If students interview a person who works for the environment, they might want to record their interviews on tape to be played for the class.)



Circulating Solutions

Objective: To review the lessons of the guide, as well as to spread the word about marine debris and the solutions that are being developed to reduce or prevent ocean pollution.

Activity: Students compile work from previous lessons to produce books or newspapers to inform people about the issue of marine debris. The books and newspapers address what marine debris is; how it affects people, wildlife, and the environment; and what individuals can do about the problem.

Vocabulary: awareness

Materials:

- "Clip Art" from Appendix C of this learning guide
- For newspapers: one piece of poster board (at least 24 x 36 inches) for each group
- For books: several pages of white or colored construction paper for each student

Subjects: Art, Language Arts, Science, Social Studies

Learning Skills: Decision-Making, Interviewing, Reading, Researching, Visualizing, Working in Small Groups, Writing

Duration: Two to five 40-minute periods

1 Tell the students that they will each be making a book showing all that they have learned about marine debris, including types of debris, sources, and potential dangers. (Note: Students also can work together as a class on this activity, collecting samples of their work from the lessons and compiling them into a single book.) To get started, have each student gather the materials he or she made in the previous lessons, including any charts, essays, drawings, or poems.

2 Next, have the students glue or tape their work onto sheets of construction paper. Students might develop a title page for each major group of activities they have studied (for example, one title page for types and sources, one for effects, and one for solutions). Also, provide copies of the "Clip Art" to the students to help them illustrate the lessons. When all the lessons have been compiled and illustrated, have the students punch holes in the sheets of paper and stitch them together with yarn.

Students also can write a one-page introduction to their books. Ask them to include their personal feelings about marine debris and what potential solutions they think would be most effective. Students might conclude their introduction with a pledge to take specific steps to help prevent marine debris.

When the books have been completed, have the students use them to spread the word about marine debris and how it can be prevented. Books can be shown to friends, parents, neighbors, or they can be "exhibited" in the school library or in the community.

3 Alternatively, have the students work in small groups to develop a newspaper to help inform members of the school and the community about marine debris and what is being done to reduce or prevent it. Discuss with the class what newspapers are for and what kinds of articles, from news stories to editorials, are found in them. Encourage the students to think of themselves as reporters and graphic artists, gathering information on stories they thought up, collecting work from previous lessons, and producing images to tell a story or illustrate one of the articles.

Divide the class into groups of two to four students, and ask each group to design, write, and assemble its own newspaper. (Note: If preferred,

students can produce a single newspaper as a class.) Newspapers should contain features from each of the following categories:

- **Articles.** These comprise the "news" portion of the paper. Articles can have either a light or a serious tone, as long as they convey a marine debris message. The lessons in this guide can be used as a starting point to get the groups thinking about what types of events or activities would make good articles. For example, groups could write a story about the board game from the "Trails and Trials of Trash" lesson, an article about the beach cleanup from the "Campaign for a Clean Future" lesson, or include one of the stories written about the journey of the piece of trash from the "Nations and Neighbors" lesson. Also, encourage the groups the come up with their own ideas for articles.
- **Editorials.** These are the "opinion pieces," in which students describe how they feel about marine debris and discuss what they think should be done to prevent it. Groups might include letters to a congressperson or senator regarding their concerns about marine debris or their compositions from the "All Tangled Up" lesson describing how it would feel to be a marine animal entangled in debris.
- **Illustrations/Cartoons/Photographs.** These are the graphic contributions to the newspaper that illustrate the stories or stand on their own. Examples of such graphics include an advertisement telling readers about the public education campaign conducted in the "Campaign for a Clean Future" lesson, a reproduction of the "Most Wanted" type of marine debris poster created by the class in the "How Harmful Is It?" lesson, or cartoons about marine debris and steps people can take to prevent it.

4 Once all the articles have been written and the graphics prepared, the groups can write headlines for the stories and captions for the illustrations. Then, provide each group with a piece of poster board and copies of the "Clip Art." (Note: You may want to provide both the "Clip Art" and the poster boards in a variety of colors.)

5 Using the clip art, have the students design a masthead at the top of the poster board (clip art graphics can be enlarged with a copier where necessary). Under the masthead, have the students divide the board into three columns (each approximately 8 inches wide). Students can then arrange their articles and illustrations in these columns. Additional clip art illustrations can be arranged between the stories and at the margins. When the layout is complete, have the students glue all the items in place. The finished newspapers can be posted around the classroom, in the hallways, or on bulletin boards around school, as well as in the community.

Appendix A

Glossary

abandoned net: A lost or discarded fishing net, or a piece of a fishing net.

annex: An addition to an established structure or document. The annexes in the MARPOL regulations are the sections containing the specific provisions of the law.

awareness: To be acquainted with an issue or fact.

bioaccumulation: The process by which animals higher on the food chain accumulate quantities of a substance by consuming organisms lower on the food chain that have ingested this substance. The higher the animal is on the food chain, the greater the amount of the substance that is consumed and accumulated.

biodegradation: A process by which microorganisms break materials down into compounds that can be reused in the environment.

buoyant: Capable of floating in water.

business/industry: Relating to companies, groups of companies, and their representatives engaged in commerce or trade in specific products or services.

campaign: An organized effort with a specific goal, such as electing a candidate or informing a group of people about a particular subject.

community: A set of people living in the same town, area, or region sharing similar values, customs, and mores.

data: Individual facts or information about a particular subject, or a set of such facts, which can be analyzed to learn more about the subject.

degradable: Capable of being broken down into smaller pieces by natural forces.

disposal: The permanent storage or removal of trash from the environment.

endangered species: A species that is in immediate danger of becoming extinct.

entanglement: The looping of a piece of debris around part of an animal's body. Entanglement may impair swimming and feeding, cause suffocation, decrease ability to elude predators, and cause open wounds.

environmental group: An organization of individuals concerned with reducing and preventing environmental degradation.

foamed plastic: A type of plastic that is generally made from polystyrene and consists of small spheres that are fused together. Foamed plastic is very light and easily breaks into smaller pieces.

foreign: Situated in or relating to a country other than one's own.

ghost fishing: The capability of lost or discarded fishing gear, such as nets, traps, or fishing line, to continue to catch fish, shellfish, or other marine life.

ingestion: The consumption of a piece of debris by an animal. Ingestion may cause clogging of the digestive tract, suffocation, or a false feeling of fullness that can lead to malnutrition or starvation.

international: Concerning relations or connections between countries.

landfill: A specially engineered site for disposing of solid waste on land that is constructed to reduce any hazards to public health and safety.

lifestyle: The way a person conducts his or her life and how this impacts other people, animals, and the surrounding environment.

marine: Relating to the ocean.

marine debris: Objects that are found in the marine environment but do not naturally occur there.

Appendix A—Glossary

medical waste: Waste that comes from hospitals or other medical institutions and that may be infectious. Medical waste includes needles, bandages, glassware, and other items.

offshore oil and gas platform: A structure in the ocean that forms a base from which oil and gas drilling is conducted.

outfall pipe: A pipe that discharges water and other materials into a receiving water body.

persistent: Capable of remaining in the environment for long periods of time without being broken down into smaller pieces.

plastic resin pellets: Small, round pellets that are the raw form of plastic. Resin pellets are melted down and used to form plastic products.

press release: A brief report intended to provide news organizations with the basic facts of an event or issue and encourage them to cover it.

prevention: An effort to hinder or forestall an event or process.

recycling: The collection and reprocessing of materials so they can be used again.

source: A place or activity that generates trash that enters the marine environment.

stormwater runoff: The water that flows along streets or along the ground as a result of a storm.

threatened species: A species whose numbers are low or declining. A threatened species is not in immediate danger of extinction, but is likely to become endangered if it is not protected.

trash: Articles that have been made or used by people and discarded.

volunteer: To offer to work for a service or cause without pay, generally because the cause is deemed important and in need of support.

Appendix B

Resources

There is a wide variety of sources of information on marine debris and other issues related to aquatic environments. This resource list is provided to give educators an idea of where to get further information. Many useful organizations, learning materials, audiovisual materials, and publications are listed here, however. This is not meant to be a complete and exhaustive list of all relevant resources, however.

Organizations

Adopt-A-Beach Program
General Land Office
Stephen F. Austin Building
Room 620
1700 N. Congress
Austin, TX 78701
(512) 463-5052

The Adopt-A-Stream Foundation
P.O. Box 5558
Everett, WA 98206
(206) 388-3487

Big Sweep
c/o KAB
P.O. Box 550
Raleigh, NC 27602
(919) 856-6686

Bullfrog Films
P.O. Box 149
Oley, PA 19547
(800) 543-FROG

California Coastal Commission
45 Fremont Street
Suite 2000
San Francisco, CA 94105-2219
(415) 904-5200

Center for Marine Conservation
1725 DeSales Street, NW.
Suite 500
Washington, DC 20036
(202) 429-5609
and
312 Sutter Street
Suite 606
San Francisco, CA 94108
(415) 391-6204

Clean Ocean Action
P.O. Box 505
Sandy Hook Highlands, NJ 07732
(908) 872-0111

Educational Images Ltd.
P.O. Box 3456, West Side
Elmira, NY 14905
(800) 527-4264

Friends of Animals
1623 Connecticut Avenue
Washington, DC 20009
(202) 483-8998

The Fund for Animals
850 Sligo Avenue
Suite LL2
Silver Spring, MD 20910
(301) 585-2591

Greenpeace USA, Inc.
1436 U Street, NW.
Washington, DC 20009
(202) 462-1177

Institute for Environmental Education
32000 Chagrin Boulevard
Cleveland, OH 44124
(216) 464-1775

The Izaak Walton League of America
1401 Wilson Boulevard
Level B
Arlington, VA 22209
(703) 528-1818

Keep America Beautiful, Inc.
9 West Broad Street
Stamford, CT 06902
(203) 323-8987

Marine Entanglement Network
c/o Defenders of Wildlife
1244 19th Street, NW.
Washington, DC 20036
(202) 659-9510

Marine Mammal Commission
1825 Connecticut Avenue, NW.
Room 512
Washington, DC 20009
(202) 606-5504

National Wildlife Federation
Fisheries and Wildlife Section
1400 16th Street, NW.
Washington, DC 20036
(800) 432-6564

NOAA/National Marine Fisheries Service
Marine Entanglement Research Program
7600 Sand Point Way, N.E.
Seattle, WA 98115
(206) 526-4009

Mississippi/Alabama Sea Grant College Program
P.O. Box 7000
Ocean Springs, MS 39564-7000
(601) 896-3355
(Note: Sea Grant has many different programs at colleges and universities across the country.)

Project WILD
P.O. Box 18060
Boulder, CO 80308-8060
(303) 444-2390

Seattle Aquarium
Pier 59
Waterfront Park
Seattle, WA 98101
(206) 386-4339

The Society of the Plastics Industry, Inc.
1275 K Street, NW.
Suite 400
Washington, DC 20005
(202) 371-5200

U.S. Coast Guard
Boating, Public and Consumer Affairs
2100 2nd Street, SW.
Washington, DC 20250
(202) 267-2229

U.S. Environmental Protection Agency
Public Information Center
PM-211B
401 M Street, SW.
Washington, DC 20460

Washington State Department of Ecology
Waste Reduction, Recycling, and Litter Control Program
P.O. Box 47600
Olympia, WA 98504
(206) 459-6000

Curricula and Other Learning Materials

Adopt-A-Beach, School Education Program, Curriculum Guide
Project OCEAN, Ocean Alliance, San Francisco, CA. This curriculum guide contains lessons that teach about the problems of marine debris and other marine pollution. Available from the California Coastal Commission for a small fee.

Aquatic Project WILD, 1987
Project WILD, Boulder, CO. A curriculum with lessons on aquatic environments and the impact of people on those environments. It includes a lesson on the effect of plastic wastes on aquatic organisms. Only available through Project WILD workshops. Call Project WILD for information about the workshops and state workshop coordinators. Workshops are generally free of charge, and accompanying printed materials are free of charge.

Don't Teach Your Trash to Swim!
NOAA's Marine Entanglement Research Program, Seattle, WA. A marine debris coloring book with an anti-litter theme. Available from NOAA's Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Earth Notes, for Educators, Grades K-6
U.S. Environmental Protection Agency, Washington, DC. This quarterly newsletter presents ideas in environmental education for students in grades K-6. Available from EPA's Public Information Center, free of charge.

Environmental Education Materials for Teachers and Young People (Grades K-12), 1991
U.S. Environmental Protection Agency, Washington, DC. This publication provides a comprehensive list of environmental education curricula and other materials. Available from EPA's Public

Information Center, free of charge. Limit 1 per request.

Get the Drift
Project WILD, Boulder, CO. An educational packet that includes a 24-page teacher's guide, four posters, and six activities on marine debris. Available from Project WILD for a small fee.

Let's Reduce & Recycle: A Curriculum for Solid Waste Awareness, 1990
U.S. Environmental Protection Agency, Washington, DC. EPA/530-SW-90-005. This curriculum presents lessons and activities about solid waste generation and management for students in grades K-12. Available from EPA's Public Information Center, free of charge. Limit 1 per request.

Marine Debris Educational Materials List
A comprehensive list of educational materials on issues related to marine debris. Available from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Marine Education: A Bibliography of Educational Materials Available from the Nation's Sea Grant College Programs
Sea Grant College Program, Ocean Springs, MS. This publication contains a listing of curricula, publications, films, filmstrips, and other educational materials from 29 Sea Grant College Programs across the country. Many of these materials are specific to marine debris. Available from Mississippi/Alabama Sea Grant College Program for a small fee.

Plastic Debris in Puget Sound
A curriculum guide that teaches the effects of plastic debris in Puget Sound. Includes activities and directions for assembling a floor board game. Available from the Seattle Aquarium for a small fee.

Plastics and Marine Debris: Solutions through Education
A teacher's guide that explains how to minimize plastic marine debris by educating the public on how to properly dispose of such wastes. Available from the Society of the Plastics Industry. Individual copies are free of charge but there is a small fee for multiple copies.

Ranger Rick's NatureScope, Diving Into Oceans, 1989
Volume 4, Number 2
Item No. 75042
National Wildlife Federation, Washington, DC. A curriculum aimed at students from grades K-7 containing lesson plans on ocean-related topics, including the impact people have on oceans. Available from the National Wildlife Federation for a small fee.

Ranger Rick's NatureScope, Pollution: Problems & Solutions, 1990
Item No. 75045
National Wildlife Federation, Washington, DC. A curriculum for students from grades K-8 with lessons on many aspects of pollution, including trash generation and wastes in aquatic environments. Available from the National Wildlife Federation for a small fee.

Ripples: A Big Sweep Elementary Activity Guide
Big Sweep and University of North Carolina Sea Grant College Program, Raleigh, NC. An activity guide to teach elementary school students the problems associated with litter in aquatic environments. Available from Big Sweep for a small fee.

Save Our Streams, Teacher's Packet
A teacher's packet that gives information on how to protect rivers and streams from debris and other pollution. Available from the Izaak Walton League of America for a small fee.

School Recycling Programs: A Handbook for Educators, 1990
U.S. Environmental Protection Agency, Washington, DC. EPA/SW-90-023. This handbook describes different options and step-by-step instructions for establishing a school recycling program. Available from EPA's Public Information Center, free of charge.

Storm Drain Stenciling Packet
Clean Ocean Action, Sandy Hook Highlands, NJ. Educational cards that describe a unique and community-oriented project for preventing marine debris by discouraging the disposal of trash and other materials in storm drains. Available from Clean Ocean Action, free of charge.

Publications

50 Simple Things Kids Can Do to Save the Earth, 1990
John Javna, The Earth Works Group. Andrews and McMeel, A Universal Press Syndicate Company, Kansas City, MO. This book describes 50 projects that children can do to help solve environmental problems, such as wildlife entanglement in plastics and the buildup of marine debris. Widely available at bookstores.

Adopting a Stream: A Northwest Handbook, 1988
Steve Yates, Adopt-a-Stream Foundation. University of Washington Press, Seattle, WA. This book discusses the effects of people on the wildlife of a stream. Available from the Adopt-A-Stream Foundation for a small fee.

Adopting a Wetland: A Northwest Guide, 1989
Steve Yates, Adopt-a-Stream Foundation. University of Washington Press, Seattle, WA. This publication examines the impact humans have on wetlands. Available from the Adopt-A-Stream Foundation for a small fee.

Adventures of the Garbage Gremlin: Recycle and Combat a Life of Grime, 1990
U.S. Environmental Protection Agency, Washington, DC. EPA/530-SW-90-024. This comic book introduces students in grades 4-7 to the benefits of recycling. Available from EPA's Public Information Center, free of charge.

A Citizen's Guide to Plastics in the Ocean: More Than a Litter Problem, 1988
K.J. O'Hara, S. Iudicello, and R. Bierce. Center for Marine Conservation, Washington, DC. This handbook explains the problems associated with plastic marine debris. Available from the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

All About Beach Cleanups: A Helpful Guide to Planning a Beach Cleanup, 1989
Center for Marine Conservation, Washington, DC. This pamphlet gives ideas on how to plan and conduct a beach cleanup. Available from the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Coastal Connections
Center for Marine Conservation, Washington, DC. This quarterly newsletter promotes beach cleanups and other activities to remove marine debris from the environment. Available from the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Don't Mess with Texas Beaches
Adopt-a-Beach Program, Austin, TX. A coloring book that teaches children about marine debris and the problems it causes. Available from the Adopt-a-Beach Program, free of charge.

Driftwood, 1985
Michael Glaser. Knickerbocker, Fiskdale, MA. A 32-page book telling the story of the travels of a tree that falls into the ocean and ultimately becomes driftwood on a beach. Available at bookstores.

Entanglement Network Newsletter
Center for Marine Conservation, Washington, DC. A newsletter that presents information and legislative initiatives on wildlife entanglement in trash. Available from the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Preserving Our National Heritage: A Stewardship Guide for Public Resources
Keep America Beautiful, Inc., Stamford, CT, and Take Pride in America, Jessup, MD. This publication discusses ways to preserve public lands, including litter reduction campaigns. Available from Keep America Beautiful, Inc., free of charge.

Save the Earth: An Action Handbook for Kids, 1991
Betty Miles. Alfred A. Knopf, New York, NY. This publication explains a wide variety of environmental problems to children and suggests ways children can help to solve those problems. It includes a section on water pollution and beach cleanups. Widely available at bookstores.

Brochures, Factsheets, and Informational Packets

10 Tips for Boaters
A leaflet describing how boaters can minimize marine debris. Available from Clean Ocean Action free of charge.

10 Tips for a Cleaner Beachfront
A leaflet discussing how beachgoers can reduce plastic marine debris. Available from Clean Ocean Action free of charge.

Informational Packets
Informational packets are available for many different groups, including the general public, beach cleanup participants, beach cleanup organizers, teachers or other educators, elementary school students, recreational boaters or fishers, and press or media representatives. These packets are available from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Marine Debris Facts and Figures
A summary of statistics concerning the use of plastics and their presence in the ocean. Available from NOAA's Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Our Water Planet is Becoming Polluted with Plastic Debris
A brochure for the general public on the problems of marine debris. Available from NOAA's Marine Debris Information Office through the Center for Marine Conservation. Small quantities are free of charge.

This Discarded Line Is Done Fishing. But It's Not Done Killing
A brochure on marine debris for those involved in recreational fishing. Available from NOAA's Marine Debris Information Office through the Center for Marine Conservation. Small quantities are free of charge but there is a small fee for multiple copies.

Tossing This Trash Overboard Could Leave Death in Your Wake
A brochure on marine debris for recreational boaters. Available from NOAA's Marine Debris Information Office through the Center for Marine Conservation. Small quantities are free of charge.

Audiovisual Materials

Coastal Cleanup Slide Show
A slide show that details data collection techniques for beach cleanups and gives background information on the marine debris problem. Available from the Center for Marine Conservation. Available on loan or for sale.

Journey of the Blob
A 10-minute film (in both VHS and 16mm formats) about a boy who thinks about disposing of a green glob in a stream. Also includes a study guide. Available for rent or sale from Bullfrog Films.

Marine Debris and Entanglement Slide Show
A 15-minute show containing 48 slides that present an overview of the problems associated with marine debris. Available from the Center for Marine Conservation. Available on loan or for sale.

Protecting Our Waters
Order No. 011-2112. A slide show containing 40 slides showing the effects of pollution from sewage, solid wastes, industrial wastes, and other sources on inland and coastal waters. Includes a guide and a cassette. Available from Educational Images Ltd. for a fee.

Trashing the Oceans and Port of Newport Video
A video that discusses marine debris and one innovative solution. Available for loan or sale from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office through the Center for Marine Conservation.

Posters and Stickers

Don't Splash Your Trash
A black and white poster that can be colored in, showing boats dumping trash overboard into a sea full of marine life. Available from the Washington State Department of Ecology, free of charge. Limit 1 per request.

Don't Teach Your Trash to Swim
A color poster showing a fish entangled in a six-pack holder. Available from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Don't Teach Your Trash to Swim
A color sticker showing a fish entangled in a six-pack holder. Available from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Information Office through the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Litter Is Not for the Birds
A black and white poster that can be colored in, showing birds surrounded by trash. Available from the Washington State Department of Ecology, free of charge. Limit 1 per request.

Marine Debris, Get a Grip on It
A poster of an octopus picking up trash and putting it in a trash can. Available from the Pacific Science Center.

MARPOL Boating Sticker
A color sticker that outlines the MARPOL regulations for boaters. Available from NOAA's Marine Debris Office through the Center for Marine Conservation. The sticker is available in English, Spanish, and Vietnamese. Individual copies are free of charge but there is a small fee for multiple copies.

Popeye
A full-color poster with Popeye the Sailor saying "I hope ya swabs won't be throwin' no PLASTICS overboard!" Available from the Center for Marine Conservation. Individual copies are free of charge but there is a small fee for multiple copies.

Ride the Wave of the Future: Recycle Today!
A colorful poster that promotes recycling. Available from the U.S. Environmental Protection Agency. Available from EPA's Public Information Center, free of charge.

Silent Killers
A poster showing the effects of plastics on wildlife. Available from Clean Ocean Action.

Appendix C

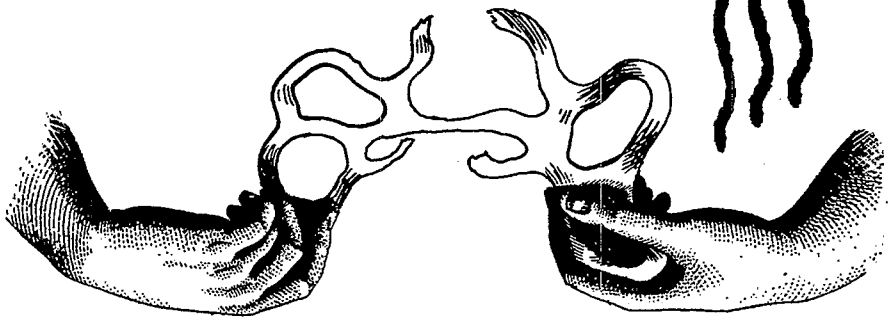
Clip Art

OCEAN NEWS

OCEAN NEWS

Ocean News

Ocean News



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