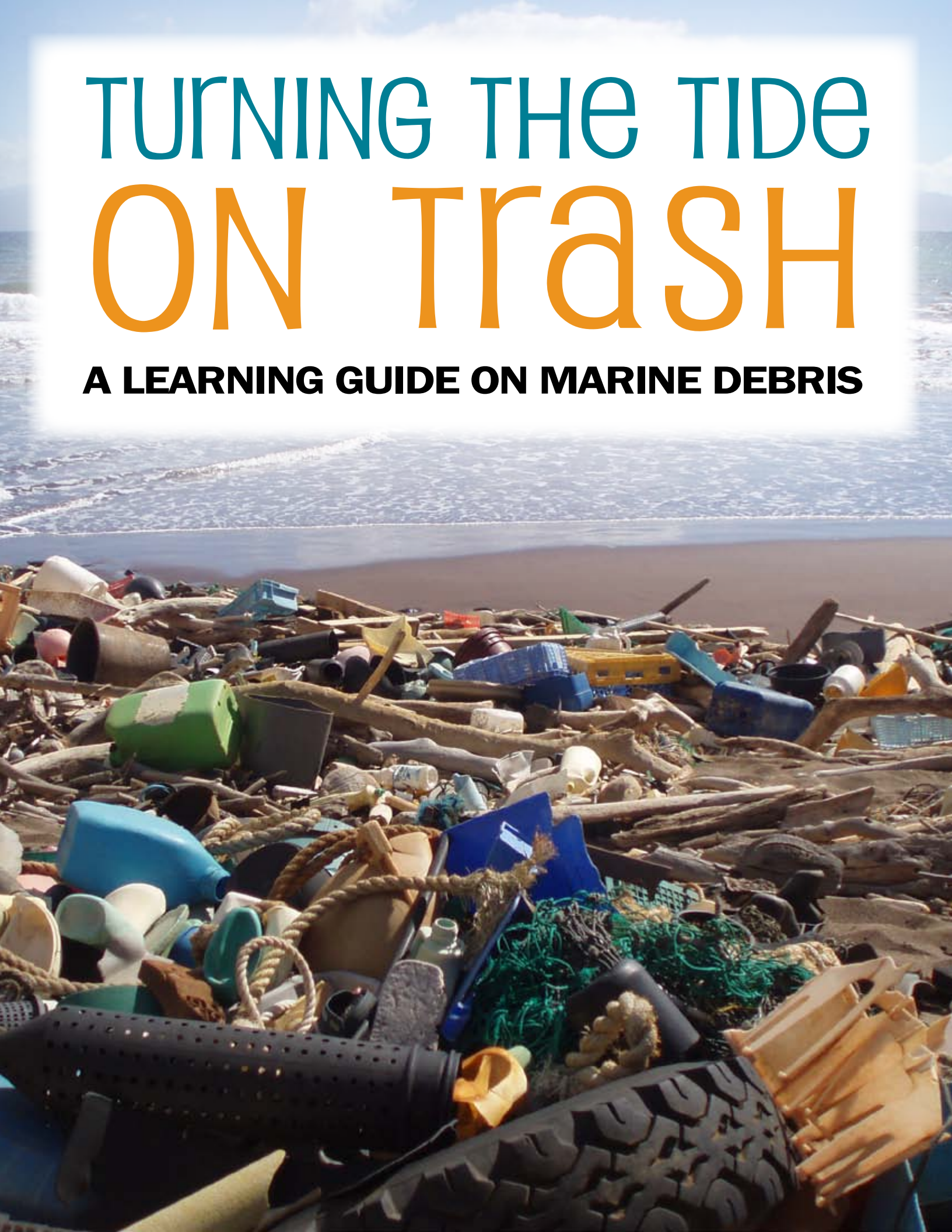
Turning the Tide on Trash

A LEARNING GUIDE ON MARINE DEBRIS



Turning the Tide on Trash

A LEARNING GUIDE ON MARINE DEBRIS

Floating marine debris in Hawaii

NOAA PIFSC CRED

Educators, parents, students, and researchers can use **Turning the Tide on Trash** as they explore the serious impacts that marine debris can have on wildlife, the environment, our well being, and our economy.

Covering nearly three-quarters of the Earth, the ocean is an extraordinary resource. The ocean supports fishing industries and coastal economies, provides recreational opportunities, and serves as a nurturing home for a multitude of marine plants and wildlife. Unfortunately, the ocean is currently under considerable pressure. The seeming vastness of the ocean has prompted people to overestimate its ability to safely absorb our wastes. For too long, we have used these waters as a receptacle for our trash and other wastes. Integrating the following lessons and background chapters into your curriculum can help to teach students that they can be an important part of the solution. Many of the lessons can also be modified for science fair projects and other learning extensions.

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- NOAA's Marine Debris Program website: www.marinedebris.noaa.gov
- EPA's Marine Debris website: http://water.epa.gov/type/oceb/marined-ebris/index.cfm

Acknowledgments & History of "Turning the Tide on Trash"

Litter cleanup

This document was originally developed in 1992 for the US Environmental Protection Agency's (EPA) Oceans and Coastal Protection Division by Eastern Research Group, Inc., of Lexington, Massachusetts. It was revised and updated in 2007 by Sheavly Consultants, Inc. of Virginia Beach, Virginia with support from the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program through Contract Number AB133F06CN0193, "Web-based Education Campaign for Marine Debris Awareness & Prevention." Portions of the curriculum were updated in 2012 by the NOAA Marine Debris Program.

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For Educators and Parents: 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 within the guide may be used to supplement work in other subject areas. Students searching for science fair projects can also adapt some of these lessons into research projects.

Educational Standards

The lessons in **Turning the Tide on Trash** provide understandings for various science-related personal and societal challenges as found in many states' educational standards. The lessons include scientific inquiry, pollution as an environmental problem, the role of technology and personal decisions in relation to environmental issues, as well as human impact on the survival of other species and habitat. These lessons will develop many skills, including writing, research, map reading, analyzing, classifying, data collecting, comparing and contrasting, experiment design, hypothesizing, and observing. Each lesson begins with a list of learning skills and subject areas. In addition to science, the lessons incorporate art, language arts, mathematics, and social studies.

Ocean Literacy Principles

The lessons also are be aligned to Principle 6, Essential Principle e of the Ocean Literacy Principles, which provide a framework to increase the literacy of students with respect to ocean science.

Ocean Literacy Principle 6: The oceans and humans are inextricably interconnected *Essential Principle e.* Humans affect the oceans in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shores, and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

For more information on Ocean Literacy, visit **http://oceanliteracy.wp2.coexploration.org/**

A Timely and Urgent Topic

In the past, litter on beaches and along inland waterways was considered primarily an eyesore – unpleasant to look at, but otherwise not all that harmful. Through research and education, people have come to realize that marine debris has serious impacts on the marine environment, marine wildlife, human health and safety, navigation, and the economy.

Abandoned fishing nets and related gear, plastic tarps, and other debris can smother and crush sensitive coral reef and seagrass ecosystems and their benthic (bottom-dwelling) species. Each year, thousands of marine animals are caught in, strangled by, or ingest various forms of debris. Medical and personal hygiene-related debris, including syringes and broken glass, pose obvious dangers to barefooted beach-goers when it washes ashore. Coastal communities lose revenue when littered beaches must be closed or cleaned up, and the fishing industry must absorb the annual costs to replace or repair vessels and gear damaged by floating and abandoned debris.

Fortunately, while marine debris is one of the most widespread pollution problems facing the world's ocean, it is also one for which

FOR INLAND CLASSROOMS

Although this learning guide focuses on marine debris, trash is found in other aquatic environments such as ponds, lakes, rivers, and streams. Most of the concepts associated with marine debris can 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.

individual citizens – including students and children – can become an immediate part of the solution. That's because all marine debris can be traced back to a single source – people. For the last few decades, a great deal of our solid waste stream has consisted of durable synthetic materials that can remain in the environment for many years, causing harm to wildlife and habitat along the way. With the world's coastal populations on the rise, it is likely that the amount of debris entering the oceans will also increase. Consequently, it is important that we act now to keep debris out of our oceans and waterways and preserve the quality of the marine environment.

Connecting People's Behavior to Marine Debris

Marine debris is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes. It can enter the environment either directly through human action or indirectly when blown or washed out to sea via rivers, streams, and storm drains. One of the learning guide's central messages is that any trash that is disposed of improperly can potentially enter the ocean or other waterways, and anyone who disposes of trash improperly can be a source of marine debris! Hopefully, when 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.

Other Pollution in the Ocean

Marine debris is not the only form of marine pollution. Marine pollution also includes forms of sewage, oil, gasoline, toxic chemicals, fertilizer, animal wastes, and pesticides that are released on land or empty into the ocean.

Education: The First Step

As with any complex problem, education is the first step to lasting, effective solutions. Marine debris is an issue that will require continued attention for generations to come. It is essential that education start with the decision-makers of the future – our children. Unlike many environmental issues, children can play a direct and significant role in reducing the marine debris problem. Every child who learns to dispose of trash properly can be one less source of litter and marine debris. Every child who volunteers to participate in a local beach cleanup campaign can help to improve the current marine debris problem. The US Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) envisions that this learning guide, combined with your personal efforts, will help to ensure the future welfare of our ocean by instilling in our young people an environmental ethic that will last a lifetime.

Diving Deeper

A wealth of additonal information and educational resources can be found on NOAA's Marine Debris Program website:
www.MarineDebris.noaa.gov

How This Learning Guide Is Organized

The learning guide has three teaching units, each of which opens with several pages of background information that will prepare the educator to present the following activities:

UNIT ONE: 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.

UNIT TWO: Effects of Marine Debris. In this unit, students will explore the effects of marine debris on wildlife and coastal communities and the potential hazards it poses to humans.

UNIT THREE: Working Towards Solutions. In this unit, students will learn 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.

The learning guide also contains a **Glossary** that contains definitions of the key terms that are introduced throughout the text in **orange-colored, bold type.**

As a final note, keeping a collection of different examples 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.

While the lessons include suggested grade levels, educators can use the "Extensions" found at the end of each lesson to vary the scope and make the lesson appropriate for younger or for more advanced students.

Lessons by Grade Level

UNIT ONE:
The Definition, Characteristics, and Sources of Marine Debris

Coming to Terms with Marine Debris	Grades 1-6
Trash Traits	Grades 1-6
A Degrading Experience	Grades 5-8
Marine Debris – Data Mining	Grades 6-8
Waste Inventory	Grades 3-9
Sources of Marine Debris – From Street to Surf, From Hand to Sand	Grades 5-9

UNIT TWO:
The Effects of Marine Debris

Marine Animals and Harmful Debris	Grades 2-4
All Tangled Up	Grades 1-4
How Harmful Is Marine Debris?	Grades 3-7

UNIT THREE:
Working Towards Solutions

Nations and Neighbors	Grades 4-7
A Scientific Cleanup	Grades 9-12
Communicating for a Clean Future	Grades 8-12
Taking Action	Grades 5-12

UNIT ONE

The Definition, Characteristics, and Sources of Marine Debris

A debris-littered beach in Hawaii

NOAA MDP

Marine debris is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes. Two characteristics of some types of marine debris – buoyancy and the ability to be blown around – affect how easily an item becomes marine debris, while the ease with which debris degrades dictates how long it remains intact in the marine environment. However, not all debris is buoyant, and some debris will sink underwater and out of sight. There are several sources of marine debris, both on the ocean and on land. Proper collection, handling, and disposal of trash, as well as reduction of consumption and packaging can help to reduce the marine debris problem.

WHAT IS MARINE DEBRIS?

Marine debris is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes. It may enter directly due to human action, or indirectly when washed out to sea via rivers, streams and storm drains. Marine debris has become one of the most pervasive pollution problems facing the world's oceans and waterways.[1]

[1] *U.S. Environmental Protection Agency, "Report to Congress: Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows" August 26, 2004, (EPA Publication 833-R-04-001), http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm*

Litter on beach

Marine debris includes objects that typically do not naturally occur in the marine environment (i.e., oceans, **salt marshes**, **estuaries**, and **beaches**). The most common materials that make up marine debris are cloth, glass, metal, paper, plastic, rubber, and wood. Another way to classify marine debris is by the type of activity that created the waste item and the associated behaviors that caused the waste to become marine debris. Some of these categories are "ocean and waterway activities," "illegal dumping," and "smoking-related activities." As you will see in **The Effects of Marine Debris** section, debris items differ in the potential impact they have on the environment and wildlife. Some debris items are much more harmful than others.

Since 1986, the Ocean Conservancy (formerly the Center for Marine Conservation) has coordinated the International Coastal Cleanup (ICC) – an annual volunteer cleanup of debris along coastlines, rivers and lakes. Volunteers collect debris items and complete a "Marine Debris Data Card" to record their findings. The information on these data cards contributes to a worldwide database that helps people understand the extent of the marine debris problem. The Ocean Conservancy compiles and analyzes the data and publishes the results, which have shown that significant quantities of marine debris litter US coastlines. According to the ICC, over a 25-year period (1986 – 2010), the 10 most frequently collected marine debris items were:

TOP 10 DEBRIS ITEMS

Item	25 Year Total
Cigarettes and Cigarette Filters	52,907,756
Food Wrappers and Containers	14,766,533
Caps, Lids	13,585,425
Cups/Plates/Utensils	10,112,038
Beverage Bottles (Plastic)	9,549,156
Bags (Plastic)	7,825,319
Beverage Bottles (Glass)	7,062,199
Beverage Cans	6,753,260
Straws/Stirrers	6,263,453
Rope	3,251,948
Total	**132,077,087**

Source: http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf

What Characteristics Affect the Presence of Debris in the Marine Environment?

Two well-known characteristics of some types of marine debris – buoyancy and the ability to be transported easily – affect how easily it can enter the marine environment. Another characteristic, **degradability**, affects how long debris will remain in the marine environment. The more likely it is that a piece of debris will enter and remain intact in the marine environment, the greater the threat it poses to people, wildlife, and vessels. However, not all debris is buoyant, and some debris will sink underwater and out of sight.

Buoyant Pieces of Debris

Buoyant objects are those that float in water. Buoyant objects are more likely to become marine debris than those that sink because they can easily be carried by wind, water, and waves. Buoyant items can be washed into the ocean by heavy rainfall, carried out to sea by rivers and streams, or carried off a beach by wind and waves. In the ocean, buoyant debris causes problems because it can easily come in contact with marine animals, people, boats, fishing nets, and other objects. Floating debris can also travel long distances over the ocean, far from its point of origin. Consequently, when these items get into the ocean they can cause problems over a wide-ranging area. The most buoyant types of debris are made of plastic and some types of rubber. Paper and wood initially float, but tend to sink once they become water-logged (**saturated** with water). Unless air is trapped inside, articles made from glass, metal, and some kinds of rubber will sink. Cloth items also tend to sink.

Fishing buoys

Easily Blown Pieces of Debris

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 may be blown out of the can, onto the beach, and eventually into the water. 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 also be blown into the ocean.

Plastic bag

The characteristics of buoyancy and the ability to be blown around are generally correlated. Lightweight objects tend to float and are also the items that are easily blown around. Some lightweight objects will sink, however, if they become saturated with water or become encrusted with living organisms that attach to hard surfaces, such as barnacles.

Degradable or Non-Degradable

An object is **degradable** if natural forces cause it to be broken down into smaller pieces. In nature, materials are typically broken down through a process known as **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

rate 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 are usually more biodegradable than synthetic materials. Plastic, glass, synthetic rubber, synthetic fabrics, and metal are typically resistant to biodegradation. Natural rubber and cloth can biodegrade, but it takes a relatively long period of time. Paper can also biodegrade, unless it is coated with plastic or other nondegradable products. In addition, some plastics can breakdown into small pieces when exposed to sunlight, a process called **photodegradation**.

Some materials can break down due to chemical interactions (for example, rust on steel), and others breakdown due to physical forces, including erosion or weathering, where the material actually falls apart into smaller pieces. It should be noted that debris made from natural materials, while potentially biodegradable, can still be considered a pollutant and can still be harmful to the marine environment.

Debris that does not easily degrade remains in the environment for a long time and is therefore **persistent**. Plastic and synthetic rubber are the most persistent materials that compose marine debris. Glass, **foamed plastic**, and metal are less persistent because even though they are not biodegradable, wave action and rusting can cause these materials 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 torn apart easily.

Diver in Florida

Debris made from natural materials, while potentially biodegradable, can still be considered a pollutant and harmful to the marine environment.

BALLOONS CAN BE DANGEROUS!

Every year, thousands of helium-filled balloons are released into the atmosphere. Some of these balloons are released accidentally, while others are released in large numbers during weddings, mall openings, and other kinds of celebrations. Some car dealerships have been seen cutting balloons off of sale cars at the end of the day. Although the floating balloons seem to disappear, they ultimately lose their helium and fall back to earth. Some of these balloons come down on the ocean, where they can become a harmful form of marine debris. Some marine animals, especially sea turtles, have been known to ingest balloons. It is believed that they mistake balloons for jellyfish, their natural prey. The swallowed balloons can block air passages, causing the animals to suffocate, or may lodge in intestinal tracts, where they may disrupt digestion. In 2004, a dying leatherback sea turtle (one of world's most **endangered** animals) was found in North Carolina. After it died, its stomach contents revealed a Mylar balloon and plastic bags.[2] The ribbons and strings that are often tied to balloons can last much longer than the balloons, and can lead to **entanglement**.

If a balloon release is planned in your school or community, suggest other ways that the occasion can be celebrated without littering and endangering wildlife. For example, balloons can be released in a gymnasium or ballroom rather than outdoors. Or trees and bushes – which are helpful to wildlife and the environment – could be planted to mark the celebration.

Entangled loon

[2] *http://www.seaturtle.org/blog/mgodfrey/2004_05.html*

Where Does Marine Debris Come From?

Marine debris comes from many different sources. There are many places and activities that generate the debris that enters the marine environment. Any trash that is improperly disposed of, as well as any materials that are improperly transported or stored, have the potential to become marine debris.

The main sources of marine debris include:

- 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

Beachgoers

Beachgoers

Every year, thousands of people visit US beaches. Many of these beachgoers leave behind materials that can become marine debris, such as food packaging and beverage containers, cigarette butts, and toys like shovels, sand pails, and Frisbees. This trash can be blown into the ocean, picked up by waves, or washed into the water when it rains. Some of the most harmful debris includes discarded fishing line and nets, which fishermen lose, leave behind, or dispose of improperly.

Improper Disposal of Trash on Land

People **inland** from the oceans also can generate marine debris. 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. Rainwater can move litter from streets and parking lots into storm drains that empty into streams, rivers, and other bodies of water.

Stormwater Sewers and Combined Sewer Overflows

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 carry this water and debris to a nearby river or stream, or even directly to the ocean. In some older US cities, the stormwater runoff goes into storm drains, and then is carried in the same underground pipes as **sewage** (the **waste water** from homes and businesses, including what is flushed down toilets). 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.

Litter on a stormdrain

Ships, boats, and other vessels

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 are also diverted into the waterway. According to the Environmental Protection Agency, cities are spending millions of dollars to correct this problem.[3]

Ships, Fishing Boats and Other Vessels

Boats of all kinds can also be sources of marine debris. Sometimes, trash is thrown overboard on purpose, although ***it is illegal in the United States to put any type of plastic trash into the navigable waters of the US.*** On the Great Lakes, no trash is allowed from boats and ships, no matter how far you are from the shore. Sometimes people dispose of trash overboard on older ships because there is limited storage space aboard these vessels. Most of the time, however, trash is disposed of in the ocean by people who are unaware of the problems this can cause, or are unaware that it is illegal. Trash can also accidentally fall, blow, or wash off of vessels into the water.

In addition, fishing nets, crab pots, fishing lines, and other types of fishing equipment can be accidentally lost at sea or purposefully discarded and become marine debris. Lost or abandoned nets and fishing gear are referred to as **derelict fishing gear** and pose a dangerous threat to wildlife and essential habitats such as coral reefs and coastal nursery areas. For example, derelict crab pots, otherwise known as "ghost" crab pots, can be lost during storms, or can be accidentally cut loose from their buoys by boat motors. Studies show these crab pots have a detrimental effect on the Chesapeake Bay: the crab pots continue to catch blue crabs and other important living bay resources without ever being retrieved.[4]

More information about how anyone, including boaters, can reduce marine debris can be found on this web site: **www.MarineDebris.noaa.gov.**

According to MARPOL (an international treaty controlling marine pollution from ships) Annex V (referring to trash), it is illegal to put any type of trash into the water from a vessel that is on a US lake, river, or in coastal waters up to three miles offshore.

[3] *U.S. Environmental Protection Agency, "Report to Congress: Impacts and Control of Combined Sewer Overflows and Sanitary Sewer Overflows" August 26, 2004, (EPA Publication 833-R-04-001), http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm*

[4] *Identification, Mapping and Assessment of Derelict Fishing Gear in the Chesapeake Bay http://www.noaanews.noaa.gov/stories2006/s2693.htm and Abandoned, ghost crab pots haunt Bay's bottom, luring creatures to their doom http://www.bayjournal.com/article.cfm?article=2729*

Plastic resin pellets

Industrial Facilities

Industrial facilities can contribute to the marine debris problem when waste items generated by industrial processes (e.g., production scraps, flawed products, and packaging material) are disposed of improperly. Finished products can also become marine debris if they are lost during loading and unloading at port facilities, or if they are lost when they are transported through waterways or over land. Another common type of marine debris generated from industrial facilities is **plastic resin pellets.** Plastic resin pellets, or pre-production plastic pellets, which are small spherical particles, are the raw material form of most plastic resins. Plastic processing facilities use them to make plastic products. Plastic resin pellets are normally contained from their creation through processing into a plastic product, but they may be inadvertently released into the environment during transportation or handling. As with other types of materials, wind and stormwater can carry these pellets to nearby water bodies.

The Plastics Division of the American Chemistry Council and the Society of the Plastics Industry, Inc. work together to educate the plastics industry about the impact of released plastic pellets. Their joint program, called "Operation Clean Sweep," provides best management practices for plastic industry companies to effectively contain these materials. For more information, visit **www.opcleansweep.org.**

Plastic resin pellets

SUNLIGHT & SIX-PACK HOLDERS

Six-Pack holders (or **ring carriers**) can also become a dangerous form of debris when littered or carelessly discarded by consumers. Because the ring carriers have holes in them, it is possible for an animal to become entangled or even strangled. In order to reduce this risk, since 1988 ITW Hi-Cone (the world's largest manufacturer of six-pack holders) has made every ring carrier from **photodegradable** plastic. This special plastic becomes brittle and breaks into increasingly smaller and smaller pieces when it's exposed to sunlight. As a result, six-pack holders that become marine debris will degrade relatively quickly, preventing many marine animals from becoming entangled. You can also help alleviate the problem. Recycle your six-pack holders wherever #4 plastics are accepted. If you can't recycle #4 plastic in your community, you can always cut or tear the rings to prevent unintended harm to marine animals should the ring holder enter the marine environment before the photodegradable process can take effect. Classrooms and schools can help recycle six-pack holders by signing up to be a Ring Leader. Details on this free school recycling program can be found by contacting ITW Hi-Cone at **www.ringleader.com** or at **www.hi-cone.com.**

Waste Disposal Activities

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, trash can blow out of a dumpster, or a raccoon can knock over a trash can and scatter trash all around. **Landfills** (which are sites specially engineered for disposing of solid wastes on land while protecting water quality and reducing any public health and safety hazards) can also be a source of marine debris. The trash in landfills is periodically covered with soil so that it will not be released into the environment; however, the trash can blow or be washed from the landfill before it is covered up or can be unearthed due to high, gusting winds or a rain storm.

Offshore Oil and Gas Platforms

Offshore oil and **gas platforms** are structures that are built 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 can become marine debris. As with ocean vessels, trash has sometimes been purposefully discarded directly into the ocean from these structures. MARPOL Annex V prohibits the dumping of plastics and garbage containing plastics from these structures. Efforts have been made by oil and gas companies to prevent the disposal of trash into the ocean from oil and gas platforms. Typical debris generated from these platforms includes drill pipes and drill pipe protectors, hard hats, gloves, 55-gallon storage drums, and everyday regular trash items.

Because offshore oil and gas platforms are surrounded by water, any items that are lost from these structures can become marine debris.

Offshore Oil and Gas Platform

Tracing Sources

Once the debris has found its way into the ocean, it is **very difficult** to trace the exact source of the debris. A plastic drinking cup, for instance, could come from multiple sources; left on shore by a beachgoer, littered on a city street and washed into a storm sewer, blown off of a recreational boat, used on a shipping vessel and disposed of overboard, etc. Clearly, marine debris is a complex issue and its abatement requires that many sources of marine debris be controlled. Prevention of marine debris is preferred to just cleaning it up. Like most pollution problems, prevention is less expensive than a cleanup after the fact – pay now or pay much more later.

Plastic debris

What Trash Management Practices Can Reduce the Marine Debris Problem?

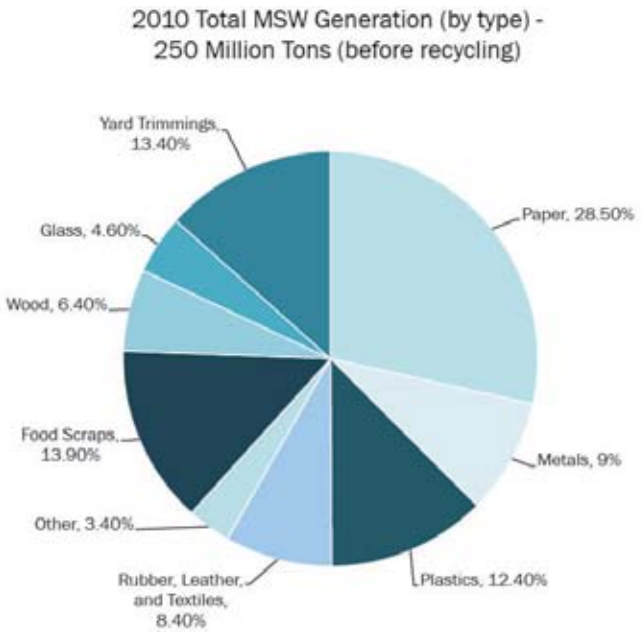
The United States generates significant quantities of trash – otherwise known as **municipal solid waste** or garbage – every year. According to the US Environmental Protection Agency (EPA), in 2010, US residents, businesses, and institutions produced more than 250 million tons of municipal solid waste, which is almost 5 pounds of waste per person per day. At 28.5%, paper and paperboard made up the largest component of generated solid waste.[5]

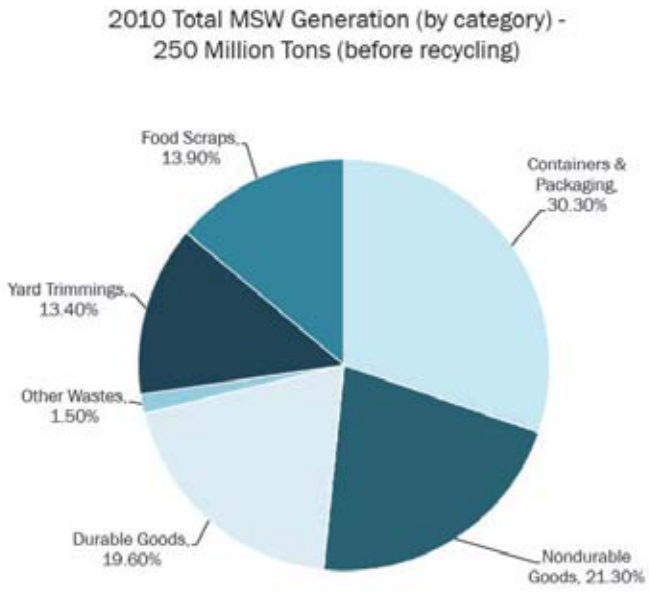
Practicing the "3 Rs" (reduce, reuse, recycle), plus proper disposal of trash will go a long way to reducing the amount of marine debris.

Recycling

In 2010, about 34% of trash in the United States was recycled or composted, up from 16% in 1990. Almost all of the rest was buried in landfills (54%) or burned (12%). **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. Recycling is the collection and reprocessing of materials so they can be used again. Recycling not only reduces the amount of solid waste going to landfills, but also prevents the emission of many greenhouse gases and water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for the future and reduces the need for new landfills and combustors.





[5] *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: 2010 Facts and Figures, Executive Summary. U.S. Enivronmental Protection Agency, Office of Solid Waste. 2011. http://www.epa.gov/waste/nonhaz/municipal/pubs/msw_2010_rev_fact-sheet.pdf*

Before materials can be processed for reuse, they must be separated into different types (such as plastic, glass, and metal). Although recycling has become widespread and is increasing in the United States, not every type of material can currently 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. In 2010, 62.5% of paper and cardboard was recycled in the United States. Metals, particularly aluminum soft drink and beer cans, are valuable and easily recycled, yet only 20% of aluminum cans were recycled in 2010, as was 34% of all steel waste (mostly food cans).[6]

Currently, all types of glass, except ceramic glass, dishes, and plate glass, can be recycled. In 2010, Americans recycled about 27% of glass waste. Florescent light bulbs, including the small compact ones that are used in homes instead of the energy-wasting incandescent bulbs, contain small amounts of mercury. These light bulbs should be recycled so the mercury can be recaptured, and not end up in our atmosphere or our waterways. Even florescent bulbs marketed as low-mercury should be recycled.

Plastic recycling, a growing industry in the United States, faces many challenges, including an unpredictable supply of plastic items to recycle and transportation costs. There are many types of plastic resins, each with different recycling requirements. Most plastic items, including beverage bottles, have a code number that tells consumers and recyclers which resin type was used in manufacturing the item.

The common plastic bottle resins, as listed in the resin identification code, are:

1. Polyethylene Terephthalate (PET)
2. High Density Polyethylene (HDPE)
3. Polyvinyl Chloride (PVC)
4. Low Density Polyethylene (LDPE)
5. Polypropylene (PP)
6. Polystyrene (PS)
7. Other

In 2010, over 2.6 billion pounds of post-consumer plastic bottles were recycled, according to the Plastics Division of the American Chemistry Council and the Association of Postconsumer Plastics Recyclers.[7] PET and HDPE plastics comprised 99.6% of these recycled pounds. There is high market demand for HDPE post-consumer plastic as it is a valuable raw material for many products. Examples of highly-used HDPE plastics include non-food bottles, pipe, lawn and garden products, plastic film and sheets, plastic lumber, auto parts, and pallets, crates, and buckets. Examples of PET plastics include fiber for carpet, pillows, and comforters, strapping, food and beverage containters, non-food containers, and plastic film and sheets. Despite the fact that there is high demand for recycled plastic resins, according to the EPA, about 13% of plastic waste was recycled in 2010, and this was mainly soft drink, milk, and water bottles.[8] Convenient access to plastics recycling collection programs, plus more consumer education, will hopefully raise the percentage of recycled plastic in the years to come.

In addition to post-consumer waste, many industries also recycle plastic. For example,

[6] *ibid – all the numbers in this section are from the same EPA document*

[7] *http://plastics.americanchemistry.com/Education-Resources/Publications/2011-National-Post-Consumer-Plastics-Bottle-Recycling-Report.pdf*

[8] *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: 2010 Facts and Figures, Executive Summary. U.S. Enivronmental Protection Agency, Office of Solid Waste. 2011. http://www.epa.gov/waste/nonhaz/municipal/pubs/msw_2010_rev_fact-sheet.pdf*

every winter thousands of recreational boats and yachts are wrapped in plastic sheeting to protect them. More and more shipyards and marinas are collecting the sheeting in the spring for recycling instead of disposing of it in a landfill. Most companies that create plastic items also recycle their own plastic waste.

"Reduce" and "Reuse": Ways to Produce Less Waste

Adopting pollution prevention strategies that produce less waste in the first place is an even better solution than recycling alone. There are many ways to produce less waste, including reusing materials, using reusable items rather than disposable ones, and reducing the amount of packaging that is used. For example, when shopping, use fabric bags instead of the plastic or paper bags provided by stores, and purchase items that have less packaging. Carry water in a reusable bottle rather than buying multiple bottles of water. Use cloth napkins and kitchen towels rather than disposable paper products.

Keeping Trash Out of the Ocean

Marine debris can only be truly managed by changing the behavior that causes it to enter the environment. Proper disposal of trash is the responsibility of every business, boater, and person. Most importantly, boaters should ensure that trash and other items do not blow away, and that they bring back all of their trash to shore to dispose of it properly. Before trash is left out for collection, it should be tightly secured in bags or trash cans with secured lids. Garbage trucks should always be covered, and landfills should be fenced in to capture any trash that may temporarily escape. Industrial facilities that produce, transport, or use plastic resin pellets can modify handling processes to control the accidental release of materials 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 intact in the environment for a relatively short period of time. Non-degradable trash will persist in the environment.
- There are several sources of marine debris, including beachgoers, litter from people living inland, 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 and practicing the "3 Rs" (reduce, reuse and recycle) are pollution prevention activities that will help to reduce marine debris.

Waste bins at beach

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris website: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

LESSON ONE

Coming to Terms with Marine Debris

Grade Level:
Grades 1 – 6

Subjects:
Language Arts, Mathematics, Science, Social Studies

Overview:
This lesson is designed to increase students' awareness of different kinds of debris in water environments and the impact it can have on animals, humans, and **aquatic habitats**. Students will first define marine debris, discuss its possible impacts, and then sort household trash items into different categories to learn about different sources of marine debris. Older students then use statistics and graphing to better understand the types of marine debris that are collected each year.

Objectives:
- Define "marine debris."
- Discuss the concept of debris and entanglement.
- Predict the effects different kinds of debris (litter) will have on animals in water.
- Describe specific examples of debris' hazardous impacts on wildlife.
- Classify different kinds of debris found in water, using several different categories.
- Create a poster with information gathered from the classification exercise (older students can produce charts and graphs).

Vocabulary:
debris, marine, marine debris, trash, entanglement, ingestion

Materials:
A large bag of assorted trash items (clean and safe), provided by the teacher. Items can include soda cans, bottles, candy wrappers, balloons and ribbons, six pack holders, plastic/paper cups, forks, straws, shopping bags, small toys, fishing line, rubber bands, scraps of paper, and other items that are often found littered.

Learning Skills:
Analyzing, Calculating, Classifying, Collecting Data, Observing. Can also include Graphing/ Charting, and Communicating.

Duration:
40 minutes

SAFETY PRECAUTIONS
All trash objects should be cleaned and checked by the teacher before being handled by students. Avoid any sharp objects or materials containing harmful chemicals.

Activity

1. Begin the lesson by asking students to define trash and litter. 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. Emphasize to the students that trash or garbage refers to generated waste. If the waste is improperly disposed, it then can become debris or litter.

LESSON ONE

2. 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.

3. 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"). Read the definitions and terms aloud along with the class, so they can practice the words by reading them out loud. Leave these descriptive words written up on the board to help the children as they classify the trash items into groups.

4. Ask the students how the trash their families produce might find its way into a stream, lake or the ocean. Ask the students if they have recently visited a river, lake, or the ocean, and what trash they may have seen on the shore or floating in the waterway.

5. Talk with the students about how different kinds of debris in water may affect the animals living in that habitat. Discuss the concepts of ingestion and entanglement. If time allows, ask children to work in groups to predict some effects that debris might have on different animals. After the groups have shared their suggestions, describe some specific examples of debris' hazardous effects on wildlife.

During the discussion, it is important that the students understand:

- Any trash that is improperly disposed of is considered debris (litter).
- Debris can potentially enter a waterway and have negative impacts there.
- Litter on our streets can enter **storm drains** when it rains, and become marine debris.

Assorted debris items J. Burger, PMRF

6. Provide the class with a collection of trash. For safety reasons, the teacher should provide this trash. Students should not bring trash from home. This allows the teacher to be sure that students will not come into contact with any harmful objects. The trash should also be washed clean before bringing into the classroom. A large plastic garbage bag can be filled with cleaned trash in advance, and emptied out in the classroom, either on the floor or on a large table.

7. Classifying Debris Items

Have the students work in small groups (four to six students) for the classification activity. Begin by having each of the small groups work together to sort their own collection of trash objects into separate groups of related items. Allow the students to select how they will separate the items into groups. Make sure to walk from group to group and ask a spokesperson from each group what it is that the objects grouped together share in common with each other. Young children will usually separate items into two groups, while older children tend to use several groups. Some items, including juice boxes, are made from several types of materials including foil, plastic and paper. Such items may generate questions from students as to how to classify these items.

LESSON ONE

Usually the students will group the objects based on the descriptive words that were used to communicate their earlier observations about litter and debris. When each group has sorted their objects, ask the group spokesperson to explain how the sorting was carried out. Then the groups of students should be instructed to reclassify the objects into groups again, this time using a different criteria for classification – they should not use a classification method that has already been used. This exercise teaches students that there are many different types of information (data) that can be learned from one situation.

Suggested Common Classification Categories

- By material (plastic, metal, glass, cloth, paper, etc.)
- By recycable versus non-recycable
- By different activities producing trash (fast food consumption, smoking, fishing, other sports and games, advertising with balloons, illegal dumping, etc.)
- By biodegradable or non-degradable
- By the type of impact they can have on the environment
- By color of trash items

8. Discuss with the class the different ways that groups have classified the trash, and tell students about some of the other possible ways that they may not have considered. Ask if some classification methods led to interesting observations, while other classification methods were not as useful.

9. For younger students: Have the students complete the classification activity with each group working together to create a poster showing how they chose to do their final classification. The students can glue the families of trash objects onto their poster board. They should label each of the families of objects that they create on the poster board with a descriptive word, and they should write a number for each family of objects.

For older students: Have the students complete the classification activity with each group working together to create a pie chart and bar graph showing how they chose to do their final classification. The charts and graphs can be created on a computer, and should be labeled with descriptive words and percentages for each category.

EXTENSIONS

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. 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. Also, you could clean up the same area periodically and compare the quantity of debris collected each time.

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.

For a long-term class activity, have students participate in an adopt-a-beach, -lake, -river, or -stream program.

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris website: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

LESSON TWO

Trash Traits

Grade Level:
Grades 1 – 6

Subjects:
Language Arts, Science

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

Objectives:
Learn about certain characteristics of marine debris and how these characteristics affect where marine debris is found in the environment.

Vocabulary:
buoyancy

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 items (such as banana peels, apple cores, etc.)
- A two- or three-gallon bucket filled with water
- A 15-inch round table fan (or similar)
- A large, shallow container (such as a large dishpan)
- A watering can

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

Duration:
40 minutes

SAFETY REGULATIONS
All trash objects should be cleaned and checked by the teacher before being handled by students. Avoid any sharp objects or materials containing harmful chemicals.

Activity

1. Pass out the "Trash Traits Results" handouts (see page 22). With the students, put the different types of trash into separate piles based on the material used to manufacture them (plastic, glass, rubber, metal, paper, wood, and food). 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. Set up the fan at one end of a table. Tell your students that the fan represents wind. Place each trash item in front of the fan, one at a time, to see if it is blown around. Ask the students the question: 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.)
- Have the students observe tendencies: 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?

3. 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?

LESSON TWO

(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? What could some of the problems be with marine debris that sinks? Is there a tendency for all of the articles of the same type (plastic, paper, metal, etc.) to float or sink?

4. Fill the large, shallow container with water and place it in front of the fan. Put each article of trash in the container one at a time 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 or a piece of vinyl (e.g., a piece of a residential rain gutter) 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.

EXTENSIONS

Have the students draw pictures that illustrate how a piece of trash (paper bag, coffee cup, soda can, etc.) on a street can be moved by rain into a storm drain, into a nearby stream, and then into the ocean. Or the picture can show a beach that is clean and free of trash, contrasted with a picture of a beach that has marine debris.

Students can write a short story about the journey a piece of litter takes as it is blown from land into the ocean.

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris 101: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

HANDOUT

Trash Traits Results

Item	Material (plastic, paper, metal, etc.)	Does it float?	Can it be blown around on land?	Can it be blown around in the water?	Can it be moved by sprinkled water?

LESSON THREE

A Degrading Experience

Grade Level:
Grades 5 – 8

Subjects:
Language Arts, Science

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

Objectives:
- To examine the degradation of debris and learn how degradation affects the persistence of debris in the marine environment.
- Students will learn that debris made from natural materials, while biodegradable, can still be considered a pollutant, and can still be harmful to the marine environment.

Vocabulary:
degradable, biodegradable, persistent, photodegradable

Materials:
Assorted pairs of trash items. The following pieces of trash are recommended: two apple cores, two paper bags, two plastic bags, two candy wrappers, two plastic cups, two waxed-paper cups, two drink boxes and straws, two paper egg cartons, two foamed plastic egg cartons, two pages of newspaper, two foamed plastic packing peanuts, two starch packing peanuts, two six-pack rings, two steel soup cans, and two glass bottles.

NOTE: All containers should be empty.

- Two large, shallow, containers (such as large dishpans)
- Two pieces of netting or screening (to cover the containers so that materials do not blow away)
- Two pieces of rope or string
- An outdoor thermometer
- Newspaper
- One copy of the "Degradation Data – Outside" handout for every month of the experiment (This includes a place to write weather observations.)
- One copy of the "Degradation Data – Inside" handout for every month of the experiment

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

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

SAFETY PRECAUTIONS
All trash objects should be cleaned and checked by the teacher before being handled by students. Avoid any sharp objects or materials containing harmful chemicals.

LESSON THREE

Activity

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!" Be sure to inform your school's employees about the importance of not disturbing the containers.)

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 two 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.)

Assorted microplastics

LESSON THREE

EXTENSIONS

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 three-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. Make sure all rings are separated, do not touch one another, and are not blocked from the sun. 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 mesh bag or sack. Take these netted items to a pier, marina, or other site where the mesh bag 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 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. Make sure the trash is securely fastened. Periodically compare the degradation using the procedure outlined in this lesson.

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 were degradable? Which types were 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?

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris website: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

HANDOUT

Degradation Data – Outside

Month: _____

Teachers: customize this handout based on the trash items you have in your experiment.

Item	Week 1	Week 2
Apple core		
Bag, paper		
Bag, plastic		
Candy wrapper		
Cup, Styrofoam		
Cup, waxed paper		
Drink box and straw		
Egg carton, paper		
Egg carton, foamed plastic		
Glass bottle		
Newspaper		
Packing peanut, foamed plastic		
Packing peanut, starch		
Six-pack holder		
Steel can		

Weather Watch - Week 1

Date	Temperature	Cloud Cover	Precipitation

Weather Watch - Week 2

Date	Temperature	Cloud Cover	Precipitation

HANDOUT

Degradation Data – Outside

Month: _____

Item	Week 3	Week 4
Apple core		
Bag, paper		
Bag, plastic		
Candy wrapper		
Cup, Styrofoam		
Cup, waxed paper		
Drink box and straw		
Egg carton, paper		
Egg carton, foamed plastic		
Glass bottle		
Newspaper		
Packing peanut, foamed plastic		
Packing peanut, starch		
Six-pack holder		
Steel can		

Weather Watch - Week 3

Date	Temperature	Cloud Cover	Precipitation

Weather Watch - Week 4

Date	Temperature	Cloud Cover	Precipitation

HANDOUT

Degradation Data – Inside

Month: _____

Teachers: customize this handout based on the trash items you have in your experiment.

Item	Week 1	Week 2
Apple core		
Bag, paper		
Bag, plastic		
Candy wrapper		
Cup, Styrofoam		
Cup, waxed paper		
Drink box and straw		
Egg carton, paper		
Egg carton, foamed plastic		
Glass bottle		
Newspaper		
Packing peanut, foamed plastic		
Packing peanut, starch		
Six-pack holder		
Steel can		

HANDOUT

Degradation Data – Inside

Month: _____

Item	Week 3	Week 4
Apple core		
Bag, paper		
Bag, plastic		
Candy wrapper		
Cup, Styrofoam		
Cup, waxed paper		
Drink box and straw		
Egg carton, paper		
Egg carton, foamed plastic		
Glass bottle		
Newspaper		
Packing peanut, foamed plastic		
Packing peanut, starch		
Six-pack holder		
Steel can		

LESSON FOUR

Marine Debris – Data Mining

Grade Level:
Grades 6 – 8

Subjects:
Language Arts, Mathematics, Science, Social Studies

Overview:
This lesson is designed to increase students' awareness of different kinds of debris in water environments, and the impact it may have on animals, humans, and aquatic habitats. Students learn about different trash items and define "marine debris" through a discussion about these items. Students then categorize debris and use statistics and graphing to describe the types and amounts of marine debris that are found each year.

Objectives:
- Define "marine debris."
- Learn how marine debris items are classified by activities that reflect how the debris found its way into water.
- Learn to create charts and graphs using raw data.
- Discuss results of charts and graphs.

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

Materials:
- Handouts with a table showing the "Top Ten" debris items found during the International Coastal Cleanup
- "Marine Debris: Raw Data 2001-2005" handout of from the International Coastal Cleanup (ICC)—a summary of items collected during cleanups

Learning Skills:
Analyzing, Calculating, Classifying, Graphing/Charting, Communicating, Percentages

Duration:
40 minutes

Activity

1. If the students have not learned about marine debris prior to this lesson, begin the lesson by reviewing the sources and impacts of marine debris. Highlight how most debris found in our oceans is preventable through proper handling and disposal of waste items.

2. Distribute the "Marine Debris: Raw Data 2001-05" handouts to the class, or make it available on classroom computers. Inform the students that the data are from The Ocean Conservancy, a U.S. marine conservation organization that sponsors annual beach cleanup events all over the country and the globe. Explain that hundreds of thousands of volunteers record the items they find when they clean up beaches each September and send this information to The Ocean Conservancy, which compiles, prepares, and analyzes the data each year.

3. Instruct the students to use the data from Ocean Conservancy to make a bar

LESSON FOUR

Beach cleanup data card

graph comparing the quantities of the debris in each of the categories shown on the chart of raw data. Show students how to make the bar graphs using Excel or a similar software program. Students will prepare a bar graph for each activity ("Shoreline and Recreation Activities," "Ocean and Waterway Activities," etc). All the charts should be titled (e.g., "Marine Debris from Shoreline and Recreation Activities," etc.), and the horizontal and vertical axis should be labeled.

4. Once the bar graphs are complete, have the students discuss the results.

- Ask if bar graphs are the best format to display the data.
- Were there any numbers on the data sheet that surprised the students?
- Looking at the data sheet, ask students to find the debris item with the lowest number of items found and the debris item with the largest number.
- Discuss alternative charting techniques that might be used for illustrating the relative quantities of marine debris types.

5. Have the students add up the number of items in each category. Students can use the software program to add up these items, or you can have them do it without computer help. Then, have the students add all the categories together for a grand total. Have students derive the percentage each marine debris category represents by using the category totals and the grand total.

6. Using these percentages, have the students create pie charts, again using Excel or similar software.

7. Using all the charts and graphs, discuss with students which categories of marine debris are most common.

8. Students can create a three-dimensional bulletin board to display the bar graph or pie chart. Examples of the types of trash represented by the bar graph could be glued or taped onto the board around the graph.

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris website: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

LESSON FOUR

EXTENSIONS

Trash Stats

Americans generate large amounts of household trash every year. In 2010, each person in the United States produced approximately 5 pounds of trash each day! See if you can work out these trash math problems to learn even more.

1. In 1990, Americans recycled and composted 34 million tons of trash. In 2005, approximately 79 million tons were recycled and composted. By how many tons did recycling and composting increase from 1990 to 2005? In the United States, a ton is a unit of weight equal to 2000 pounds or (907 kilograms). Recalculate the amount recycled and composted using pounds or kilograms instead of tons as the unit of measure.

2. Research the current population of your state or territory. How many aluminum cans or plastic bottles would be thrown away if everyone drinks two canned or bottled sodas a day for a week and for a year?

3. Of the 196 million tons of trash generated in the United States in 1990, about 16 million tons were plastic. What fraction of the total trash generated was plastic? Reduce this fraction. Of the nearly 246 million tons of trash generated in the United States in 2005, about 29 million tons were plastic. What fraction of the total trash generated was plastic? Reduce this fraction and compare to the 1990 number.

4. Americans produced 84 million tons of paper waste in 2005. In that same year, Americans produced a total of nearly 246 million tons of trash.

What percentage of the total trash generated did paper make up?

5. Of the nearly 246 million tons of trash generated by Americans in 2005, about 54 percent was landfilled (the rest was recycled, composted or burned for energy). How much trash, by weight, was landfilled?

6. Create pie charts and bar graphs using the following data from the International Coastal Cleanup.

"Top Ten" Most Frequently Collected Marine Debris Items

Data collected by volunteers worldwide during the International Coastal Cleanup (1986 – 2010)

Item	25 Year Totals
Cigarettes/Cigarette Filters	52,907,756
Food Wrappers/Containers	14,766,533
Caps, Lids	13,585,425
Cups/Plates/Utensils	10,112,038
Beverage Bottles (Plastic)	9,549,156
Bags (Plastic)	7,825,319
Beverage Bottles (Glass)	7,062,199
Beverage Cans	6,753,260
Straws/Stirrers	6,263,453
Rope	3,251,948
Total	**132,077,087**

The International Coastal Cleanup is organized annually by the Ocean Conservancy.

www.oceanconservancy.org/our-work/marine-debris/

HANDOUT

Marine Debris: Raw Data 2001-2005

Shoreline and Recreational Activities	2001	2002	2003	2004	2005	TOTALS
Bags	221,647	190,477	170,053	158,037	131,758	3,346,666
Balloons	46,177	57,387	45,996	43,136	40,435	475,863
Beverage Bottles (Glass)	205,772	226,251	211,359	199,804	159,941	2,329,142
Beverage Bottles (Plastic) 2 liters	189,591	223,029	227,260	209,075	187,724	1,965,210
Beverage Cans	202,983	238,826	207,225	189,132	148,000	2,293,559
Caps, Lids	306,428	363,857	356,523	339,841	306,498	4,186,593
Clothing, Shoes	50,836	50,205	48,807	48,293	43,311	661,794
Cups, Plates, and Utensils	196,018	250,511	205,301	188,262	192,636	3,575,209
Food Wrappers & Containers	295,109	444,447	418,795	390,995	356,447	3,318,729
Pull Tabs	39,094	49,277	50,971	43,904	39,521	458,765
Shotgun Shells/Wadding	17,824	16,792	20,689	14,247	14,497	63,360
Six-Pack Holders	14,919	20,987	18,244	18,897	16,365	298,075
Straws, Stirrers	151,660	182,794	180,091	158,984	134,538	1,960,122
Toys	32,510	37,365	37,956	38,154	33,332	314,091
Ocean and Waterway Activities						
Bait Containers/Packaging	19,855	21,511	21,126	18,529	15,154	75,049
Bleach/Cleaner Bottles	10,842	14,263	11,743	11,290	8,220	195,111
Buoys/Floats	17,457	19,494	18,737	12,110	11,212	245,496
Crab/Lobster/Fish Traps	5,463	6,035	7,860	3,685	4,713	62,755
Crates	2,640	2,580	2,782	2,140	2,264	28,929
Fishing Line	27,828	32,741	32,862	25,981	27,741	416,456
Fishing Lures/Light Sticks	10,593	14,082	12,593	11,955	10,693	234,619
Fishing Nets	6,281	6,278	7,737	5,359	5,377	111,502
Light Bulbs/Tubes	4,980	5,520	4,854	4,614	3,389	114,174
Oil/Lube Bottles	11,582	14,120	10,838	10,331	8,605	203,465
Pallets	2,190	2,433	2,839	2,051	1,895	45,021
Plastic Sheeting/Tarps	41,268	44,163	47,247	40,436	40,567	316,170
Rope	57,591	57,099	61,379	47,871	41,970	925,301
Strapping Bands	20,367	18,829	22,730	16,858	13,833	249,521
Smoking-Related Activities						
Cigar Tips	57,792	67,649	72,078	56,551	54,433	236,425
Cigarette Lighters	22,856	21,369	21,362	17,845	22,903	344,411
Cigarettes/Cigarette Filters	1,286,116	1,345,833	1,426,613	880,807	1,008,288	12,848,255
Tobacco Packaging/Wrappers	48,786	51,090	49,564	39,353	35,859	175,088
Dumping Activities						
55-Gallon Drums	890	769	833	864	559	32,257
Appliances	1,234	1,606	2,061	1,788	1,510	6,138
Batteries	5,241	6,304	6,135	5,836	5,107	22,488
Building Materials	49,579	55,388	54,935	59,255	49,224	847,816
Cars/Car Parts	10,217	10,447	9,891	10,206	8,216	39,086
Tires	7,196	6,828	6,916	8,031	5,739	104,539
Medical and Personal Hygiene						
Condoms	7,339	8,209	7,576	7,329	6,818	83,694
Diapers	7,565	7,776	5,897	5,863	5,022	112,213
Syringes	2,245	2,529	2,910	2,937	2,837	48,405
Tampons/Tampon Applicators	10,261	11,435	10,155	11,874	8,617	179,555
TOTALS	**3,726,822**	**4,208,585**	**4,141,523**	**3,362,510**	**3,215,768**	**43,551,117**

Source: Ocean Conservancy, ICC Data Reports (2001-2005). www.oceanconservancy.org/our-work/marine-debris/

LESSON FIVE

Waste Inventory

Grade Level:
Grades 3 – 9 (older students can also do the charting and graphing portion of this lesson)

Subjects:
Language Arts, Mathematics, Science, Social Studies

Overview:
This lesson is designed to increase students' awareness of the waste they and their family produce. 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/should have been) recycled, and which items could become marine debris.

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

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.)

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.

SAFETY & REGULATIONS
Instruct students to ask their parents to help with the home inventory of waste.

Activity

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 five minutes after lunch and five 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 list of items to the class. Point out to the students which items are recyclable. Ask how recycling could

LESSON FIVE

Waste in a landfill

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 five-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.

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. Tell the students to 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 the experiment for 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 that all items can become marine debris if disposed of improperly.)
- How could they become marine debris?
- How could you prevent these items from becoming marine debris?
- How could you produce less waste?

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris website: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

LESSON FIVE

EXTENSIONS

Have students research recycling programs in their community by contacting municipal or county employees and officials. Learn 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.

If your school is not recycling, students can work with school officials to set up a recycling program for paper, cardboard, plastic bottles, aluminum cans or other materials. First, determine which types of items will be collected for recycling by contacting a local recycling company. Learn how the materials should be separated, and any other requirements that should be followed. Designate a collection center and be sure to obtain appropriate containers and other facilities. Then, arrange to have the items picked up and delivered to the recycler. The school 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.

Recycling Electronic Waste

Students and their schools can organize a day for everyone in the community to recycle old cell phones, computers, batteries, and other household electronic waste. Hazardous materials including lead, mercury, cadmium, and chromium are all present in electronic devices and lead to pollution when not disposed of properly. Computer monitors and television screens using cathode ray tubes are of significant concern as they contain an average of four pounds of lead. A major source of mercury in municipal waste systems comes from electronics. Many of these metals can be recovered and recycled. Contact the employees of your county or municipality to learn if they know of a company that accepts old electronics for recycling. If not, research and find one yourself. Once a recycling company has committed to help with a recycling event, you may have to raise some funding, as there usually are fees involved in recycling computer monitors and TVs. Local sponsors can pay these fees, or everyone dropping off a monitor or TV could be charged the appropriate amount. In addition to scheduling the recycling company and raising money, you will need to reserve a large parking lot for the event, recruit volunteers to run the event, and plan a promotional campaign to include newspapers, radio, and posters. After the event, write an article for the local newspaper letting the community know how many pounds of waste were saved from the landfill.

Electronic waste on beach

HANDOUT

Waste Inventory Log

Item Thrown Away	Number of Items (Tally ~~IIII~~)
1.	
2	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	

LESSON SIX

Sources of Marine Debris: From Street to Surf, From Hand to Sand

Grade Level:
Grades 5 – 9

Subjects:
Science, Social Studies, Language Arts,

Overview:
Many of us do not "see" litter in our surrounding environments. This exercise will increase students' awareness of litter problems, and guide them towards understanding how litter becomes marine debris, with potentially harmful effects on human health and safety, wildlife, and habitats. Students will observe and record litter they see in their neighborhood, reflect on how the litter came to be there, then make predictions on how the littered items might make their way to the ocean. Students will compare the litter they have observed with data collected during the International Coastal Cleanup.

Objectives:

- Discover where marine debris typically comes from and how it commonly finds its way into the marine environment.
- Learn how trash that is not properly handled or disposed of on land can become marine debris.

Vocabulary:
landfill, trash, waste, litter, marine debris, source, stormwater runoff, storm drain (storm sewer)

Materials:

- "Data Collection Form—Litter in Our Neighborhood" handout
- "Top Ten" Most Frequently Collected Marine Debris Items handout

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

Duration:
20 minutes to assign the project and provided background information
Three days for students to collect data
40 minutes to discuss results of data collection

SAFETY PRECAUTIONS
In this lesson, students should not be picking up the litter they see, but instead, they should just record what they observe.

Activity

1. If the students have not learned about marine debris prior to this lesson, begin the lesson by reviewing the impacts of marine debris. Highlight how most debris found in our oceans is preventable through proper handling and disposal of waste items. Ask students where they are most likely to find litter in their community.

LESSON SIX

2. Distribute the "Data Collection Form – Litter in Our Neighborhood" handouts to the class. Instruct the students to use the form to record the number of pieces of litter they see during the next three days. For example, if a student sees three beverage cans, he or she should write "3" in the total box for that item.

3. After three days of data collection, have the students bring their Data Collection forms to class. Ask each student to identify the three types of litter they found most frequently. Ask a few students to share their "top three" items with the class. Discuss how these items came to be litter. Point out that waste and trash become **litter only after** they have been disposed of improperly.

4. Ask two students to volunteer to compile the data from all the Data Collection Forms, and identify the "Top Ten" most frequently littered items in your community. Depending on class size, students might need a day or two to complete this compilation exercise.

5. Write the "Top Ten" most frequently littered items in your community on the board, and then distribute the "Top Ten Most Frequently Collected Marine Debris Items" handouts to the class. Inform the students that the Ocean Conservancy coordinates annual beach cleanup events all over the country. Explain that volunteers record the items they find when they clean up beaches and the shores of rivers and send this information to the Ocean Conservancy, which compiles these lists every year.

6. Compare and contrast the two "Top Ten" lists.

- What litter items are on both lists?
- In what ways does your community's "Top Ten" list differ from the US "Top Ten" list?
- Does your state have a "Bottle Bill" that requires a deposit on each bottle and can? If so, are bottles and cans on your community's "Top Ten" list? If your state does not have a bottle bill, are bottles and cans on your community's "Top Ten" list?
- Does your state have a curbside recycling program where citizens place recyclables in containers that are picked up for recycling? If so, are bottles and cans on your community's "Top Ten" list? If your state does not have a curbside recycling program, are bottles and cans on your community's "Top Ten" list?
- Ask students to share what surprised them about the two "Top Ten" lists.

Note: If you do this lesson every year, you can also have your class compare their "Top Ten" list with previous years in your community.

7. 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 could the litter found in their community find its way to the ocean and become marine debris? It is important that the students understand what stormwater runoff is and that stormwater drains deposit rain water into streams and other waterways.
- What can the community do to prevent the generation of marine debris?
- What can each of your students do to prevent the generation of marine debris?

LESSON SIX

EXTENSIONS

Have students draw a scene that shows where marine debris comes from and how it finds its way into the environment.

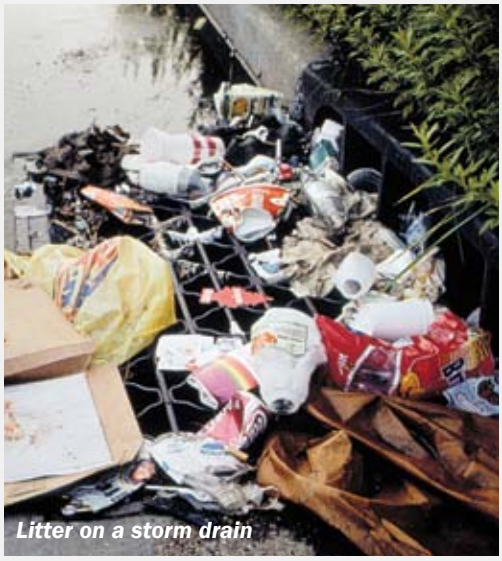
Ask students to write a paragraph about one source of marine debris explaining what kinds of debris are generated by the source and how these items could enter the marine environment.

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 and litter enter 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 out of a car or onto the street? 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 drain (sometimes called storm sewer) nearby, show the students what it looks like. Tell them the name of the stream or river that the drain empties into. (If you do not know the name of the stream, see the US Geological Survey web site for maps that will help: www.usgs.gov and www.nationalatlas.gov) Ask students to count all the pieces of trash they find within about 25 feet of the storm drain. Also have them look into the storm drain to see if there is any trash inside. Ask the students what they think might happen to the trash around the drain. Observe the trash around the storm drain before and after a heavy rain.

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 traveled, where it traveled, 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.

Storm drains can be labeled with a stenciled message, "Don't dump...this drains to the ocean" or other message so people can better understand that storm drains should be kept free of pollutants. Learn if a state agency or local nonprofit group has materials your students can use to apply this message to your community's stormdrains. Be sure to get permission before applying paint or signs.



Litter on a storm drain

LESSON SIX

Beach in Hawaii.

The Northwestern Hawaiian Islands became an American National Monument in 2006, and are now the world's largest protected marine area. Rich in diversity and beauty, these islands also suffer from marine debris that comes from thousands of miles away. Using the following web sites, explore the Northwestern Hawaiian Islands and the impact marine debris is having on the birds, seals, and other animals that call them home.

Voyage to Kure

On this website you will take a fascinating voyage to Kure, one of the Northwestern Hawaiian Islands, with Jean-Michel Cousteau and 20 experienced divers and scientists. Through pod casts, expedition diaries and games, you will explore an exciting part of our world, and learn how we can all help to protect it.

www.pbs.org/kqed/oceanadventures/episodes/kure

Northwestern Hawaiian Islands Marine National Monument

www.hawaiireef.noaa.gov

NWHI National Marine Sanctuary Encyclopedia

This resource includes natural history, video clips, images, and fact sheets about the marine life of the Northwestern Hawaiian Islands.

www8.nos.noaa.gov/onms/park/Parks/?pID=12

HANDOUT

Data Collection Form – Litter in Our Neighborhood

Student Name: _____

Shoreline and Recreational Activities	Tally (~~IIII~~)	Total
Bags		
Balloons		
Beverage Bottles (Glass)		
Beverage Bottles (Plastic) ≤ 2 liters		
Beverage Cans		
Caps/Lids		
Clothing, Shoes		
Cups/Plates/Utensils		
Food Wrappers & Containers		
Pull Tabs		
Shotgun Shells/Wadding		
Six-Pack Holders		
Straws/Stirrers		
Toys		
Ocean and Waterway Activities	**Tally (~~IIII~~)**	**Total**
Bait Containers/Packaging		
Bleach/Cleaner Bottles		
Buoys/Floats		
Crab/Lobster/Fish Traps		
Crates		
Fishing Line		
Fishing Lures/Light Sticks		

(Page 1 of 2)

HANDOUT

Ocean and Waterway Activities	Tally (~~IIII~~)	Total
Fishing Nets		
Light Bulbs/Tubes		
Oil/Lube Bottles		
Pallets		
Plastic Sheeting/Tarps		
Rope		
Strapping Bands		
Smoking-Related Activities	**Tally (~~IIII~~)**	**Total**
Cigar Tips		
Cigarette Lighters		
Cigarettes/Cigarette Filters		
Tobacco Packaging/Wrappers		
Dumping Activities	**Tally (~~IIII~~)**	**Total**
55-Gallon Drums		
Appliances		
Batteries		
Building Materials		
Cars/Car Parts		
Tires		
Other Items Found	**Tally (~~IIII~~)**	**Total**

Total Number of Litter Objects Collected in Our Neighborhood

Derived from ICC Data Card—Ocean Conservancy

(Page 2 of 2)

HANDOUT

"Top Ten" Most Frequently Collected Marine Debris Items

Data collected by volunteers in the United States during the International Coastal Cleanup (1986-2010)

Item	25 Year Totals
Cigarettes/Cigarette Filters	52,907,756
Food Wrappers/Containers	14,766,533
Caps/Lids	13,585,425
Cups/Plates/Utensils	10,112,038
Beverage Bottles (Plastic)	9,549,156
Bags (Plastic)	7,825,319
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Beverage Cans	6,753,260
Straws/Stirrers	6,263,453
Rope	3,251,948
Total	**132,077,087**

The International Coastal Cleanup is organized annually by the Ocean Conservancy.
www.oceanconservancy.org/our-work/marine-debris

The Effects of Marine Debris

Entangled sea turtle

J. Baker, NOAA

Marine debris can have serious impacts on both marine wildlife and humans. Debris can entangle, maim, and even drown many wildlife species. Animals can also mistake some debris for food; once ingested, these materials can cause starvation and/or choking. Although almost any species can be harmed by marine debris, certain species – including seals, sea lions, seabirds and sea turtles – are more susceptible to its dangers than others. For humans, marine debris can be a health and safety hazard. The impacts of marine debris can also result in economic hardships for coastal communities related to tourism and the fishing industry.

How Does Marine Debris Affect Marine Wildlife?

The two primary threats that marine debris poses to marine wildlife are **entanglement** and **ingestion**. Entanglement results when an animal becomes encircled or ensnared by debris. Some entanglement occurs 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 play with a piece of marine debris or use it for shelter. Some animals, such as seabirds, may see fish caught in a net as a source of food, and become entangled while going after the fish.

Entanglement is harmful to wildlife for several reasons:

- It can cause wounds that can lead to infections or loss of limbs.
- It may cause strangulation, choking, or suffocation.
- It can impair an animal's ability to swim, which may lead to drowning, or make it difficult for the animal to move, find food, and escape from predators.

Ingestion occurs when an animal swallows marine debris. Ingestion sometimes happens accidentally, but generally animals ingest debris because it looks like food. For example, a floating plastic baggie can look like a jellyfish, and resin pellets (i.e., small, round pellets that are the raw form of plastic, which are melted and used to form plastic products) can resemble fish eggs. Ingestion can lead to choking, 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, causing the animal to suffocate.

ENDANGERED AND THREATENED SPECIES

Marine debris can pose significant threats to threatened and endangered species.

Endangered species: A species of animal or plant that is in immediate danger of becoming **extinct**.

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.

In the United States and throughout the world, many species of plants and animals are in danger of going extinct. In the United States, these species and "... the **ecosystems** upon which they depend" are protected by the **Endangered Species Act (ESA)**.

The ESA is administered by two federal agencies:

- US Fish and Wildlife Service (FWS) **(www.fws.gov)**
- National Oceanic and Atmospheric Administration (NOAA) Fisheries, Office of Protected Resources **(www.nmfs.noaa.gov/pr/species/)**

Endangered green sea turtle

NOAA Fisheries deals with marine species, and the FWS has responsibility over freshwater fish and all other species. Lists of endangered marine animals (including whales, seals, sea turtles, and fish) can be found at **www.nmfs.noaa.gov/pr/species/esa/.**

There is also an international agreement called the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) that protects wildlife against over-exploitation by restricting international commerce in plant and animal species believed to be actually or potentially harmed by trade. This agreement between governments aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. For more information, visit **www.cites.org.**

Hawaiian monk seal with fish trap piece on muzzle

Affected Animals

Marine mammals, sea turtles, birds, fish, and crustaceans all have been affected by marine debris through enganglement or ingestion. Unfortunately, many of the species most vulnerable to the impacts 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 or animals that may become endangered in the near future.

Marine Mammals and Debris

A conservative estimate is that more than 100,000 marine mammals die every year from entanglement or ingestion of marine debris.[1] Of the different types of marine mammals, seals and sea lions are the most affected (primarily by incidents of entanglement) because of their natural curiosity and tendency to investigate unusual objects in the environment.[2] Fishing nets, fishing line, ropes, plastic sheeting and packing straps can be major problems for these animals. Some studies have linked the decline of the northern fur seal of Alaska and the endangered Hawaiian monk seal partially due to entanglement in marine debris.[3] Whales, including endangered humpback and gray whales, have been found entangled in derelict fishing nets and line, and some **stranded** (run aground) whales have been found with nets and other forms of marine debris in their stomachs. Manatees (another endangered species) have become entangled in crab-pot lines, and dolphins and porpoises can also get caught in abandoned or active 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 contribute to or result in the death of the animals due to suffocation or starvation.

Entangled manatee

[1] *David Laist, Marine Mammal Commission, private communication, March 22, 2007.*

[2] *Marine Mammal Commission Annual Report to Congress, 2002, http://mmc.gov/reports/annual/welcome.shtml (accessed May 25, 2007)*

[3] *Marine Mammal Commission Annual Report to Congress, 2002, http://mmc.gov/reports/annual/welcome.shtml (accessed May 25, 2007)*

Sea Turtles and Debris

All six species of sea turtles found in the United States have been found entangled in different types of marine debris, such as fishing line, rope and fishing nets. However, ingestion of debris is an even greater problem for these species, as they are indiscriminate feeders. Sea turtles have swallowed plastic bags because they look like jellyfish, one of their favorite foods. Cases of turtles swallowing balloons, **tar balls**, and other debris that has become encrusted with algae and other marine forms have also been reported. Ingesting debris can block a sea turtle's digestive tract, leading to starvation and a painful death.

SEA TURTLES

Entangled loggerhead sea turtle

Sea turtles are air-breathing reptiles that are well adapted to life in the marine environment. They inhabit tropical and subtropical ocean waters throughout the world. Of the seven species of sea turtles, six are found in US waters: green, hawksbill, Kemp's ridley, leatherback, loggerhead and olive ridley. All of these species are listed as endangered or threatened under the US Endangered Species Act. Learn more about sea turtles at **www.sefsc.noaa.gov/seaturtleSTSSN.jsp**

Seabirds and Debris

Entangled shearwaters

Thousands of seabirds are thought to die from entanglement or ingestion each year. Since many seabirds feed on fish, they are often attracted to fish that have been caught or entangled in nets and fishing line. Unfortunately, when birds prey upon entangled fish, they can become entangled themselves. Entanglement in fishing line has been a particular problem for the brown pelican, which has been listed as 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.[4] Ducks, geese, cormorants, terns, plovers, gulls, and even penguins have been found entangled in debris. The ingestion of resin pellets and other small, colorful plastic pieces can also be a problem for wildlife. 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.

Plastic debris eaten by adult birds can be regurgitated as food for **hatchlings**. In 2006, teachers and scientists involved with the Northwestern Hawaiian Islands Multi-Agency Education Project found a dead Laysan albatross chick with 306 pieces of indigestible plastic in its stomach, some as long as six inches. Normally, the chick's diet consists of pieces of fish, fish eggs, squid and octopus.[5]

[4] *US Environmental Protection Agency, Assessing and Monitoring Floatable Debris, August 2002. EPA Document EPA-842-B-02-002. www.epa.gov/owow/oceans/debris/floatingdebris (accessed May 25, 2007)*

[5] *Patricia Greene, Northwestern Hawaiian Islands Multi-Agency Education Project, "Death of a Laysan Albatross Chick," July 2006, www.hawaiianatolls.org/research/June2006/albatross_death.php (accessed April 17, 2007).*

Fish, Crustaceans and Debris

Fish and crustaceans (such as lobsters and crabs) are frequently caught in lost or discarded fishing nets and fishing line (also referred to as **derelict fishing gear**). This phenomenon is known as **ghost fishing** (see below). For example, a 1/2-mile section of nylon net was found in Lake Superior. The net had been abandoned for an estimated 15 years and contained 100 pounds of fish, much of which was rotten. It is estimated that coastal fishermen in the state of Washington have lost an estimated 150 to 300 **gillnets** per year over a 30 year period. These nets can measure 1,800 feet long and 100 feet deep, resulting in a dangerous ghost fishing situation.

Entangled crab

GHOST FISHING

When fishing nets, fishing line, crab and lobster pots or other fishing gear are lost or discarded, they continue to "fish" for sea animals long after they have been forgotten by fishermen. Fishing nets and fishing lines from commercial fishing boats can be very long and can be transported by currents and waves for long distances. This ghost fishing catches seabirds, fish, sharks, sea turtles and other creatures and most die if they cannot free themselves in time to prevent drowning or starvation.

Lobster traps

Fishing nets collected in Hawaii

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.[6] Over 900 derelict crab pots were observed during five days of sonar surveying in the northern Puget Sound, Washington, and studies show that derelict crab pots have a detrimental effect on the Chesapeake Bay – they continue to catch blue crabs and other important living bay resources without ever being retrieved.[7]

In addition to killing marine animals, derelict fishing gear can smother or scour many sensitive aquatic habitats such as **coral reefs**, **sea grass beds** and shallow areas of an **estuary**.

More information about how anyone, including boaters and fishermen, can reduce marine debris can be found at **www.MarineDebris.noaa.gov.**

[6] *US Environmental Protection Agency, Assessing and Monitoring Floatable Debris, August 2002. EPA Document EPA-842-B-02-002. www.epa.gov/owow/oceans/debris/floatingdebris (accessed May 25, 2007)*

[7] *NOAA Office of Response and and Restoration, "NOAA, Virginia Institute of Marine Science Announce Plans to Aid Chesapeake Bay Cleanup," Sept. 5, 2006, www.noaanews.noaa.gov/stories2006/s2693.htm (accessed April 17, 2007)*

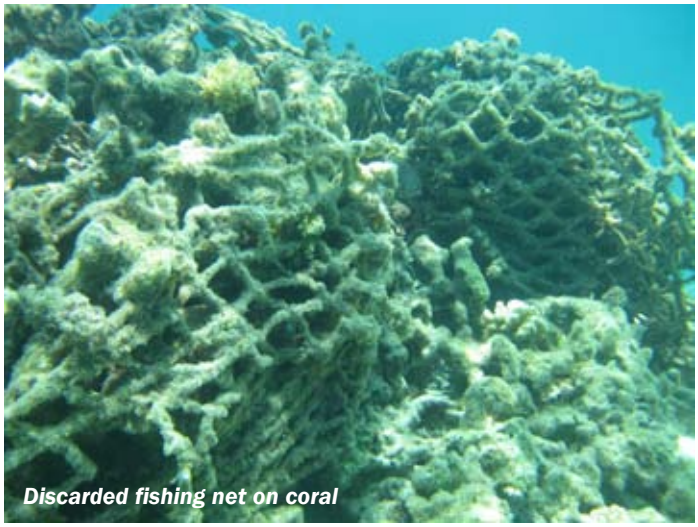
MARPOL ANNEX V

MARPOL Annex V is an international treaty controlling marine pollution from ships. Countries which ratify MARPOL, including the United States, must pass laws that make it illegal to put ***any*** type of trash into the water from a vessel that is on a US lake, river, or in coastal waters up to three miles offshore. This includes fishing gear such as nets, crab pots, lobster pots, fishing line, and bait containers.

www.imo.org

Other Impacts on Wildlife

Marine and coastal animals are also affected when their feeding grounds, nesting sites and other **habitats** are harmed by marine debris. For example, lost or discarded fishing gear and nets can drag along the ocean floor or through coral reefs, damaging the animals and plants that live there. Tarps and sheets of plastic can smother large areas of the ocean floor, coral reefs and other sensitive habitats.



Discarded fishing net on coral

Pelican caught in fishing line

As mentioned earlier, many marine animals ingest small pieces of marine debris (primarily made of plastic) that can accumulate in their bodies. **Zooplankton** and other small organisms have been found to ingest micro-particles of plastic. According to a report by the US Environmental Protection Agency, when animals higher on the **food chain** eat those small organisms, they also ingest the debris those organisms have eaten. The debris accumulates in their bodies.[8] The higher an animal is on the food chain, the greater the quantity of the debris 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 ingested the pellets in fish they consumed. This accumulation is called **bioaccumulation**. **Biomagnification** refers to the tendency of pollutants to concentrate as they move from one feeding level (also called trophic level) to the next.

[8] *US EPA, "Assessing and Monitoring Floatable Debris," August 2002, Publication number EPA-842-B-02-002. Full Document at www.epa.gov/owow/oceans/debris/floatingdebris/ (accessed April 17, 2007).*

How Does Marine Debris Affect Humans?

Economic Impacts of Marine Debris

Marine debris also can have serious consequences for humans. Marine debris is visually unpleasant both on shore and floating on the water. Marine debris seen and found on beaches and shorelines degrades the quality of coastal areas and lifestyles. Coastal communities can lose millions of tourism dollars when large amounts of marine debris make their beaches unattractive and unsafe to visitors. In addition to the lost revenue, it can also be very expensive for coastal communities to clean up beaches littered with marine debris. Some beach communities spend thousands of dollars purchasing beach-cleaning machines and hiring people to operate the machines.

Lost or discarded fishing gear can financially harm a region's industries in several ways. 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 and bags can clog cooling water intakes and lost nets or lines can entangle vessels – possibly endangering the ship's crew. Marine debris that wraps around boat propellers or puncture 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. Even submarines can be obstructed by abandoned fishing nets, making navigation and surfacing difficult.

Entangled propellor

When lobster or crab traps are lost, they can trap thousands of animals that consequently are never caught and sold. Ghost fishing also kills an untold number of fish that may have found their way to market or would have spawned the next generation. In 2004, the Northwest Straits Commission worked with local partners to survey derelict gear in Port Gardner, in northeast Washington. Their survey found 842 derelict gear items, with a density of 136 items per square kilometer. When some of the derelict crab pots were retrieved, researchers found that one-third were still actively capturing and killing Dungeness crab, an important commercial species.

The continual loss of animals from ghost fishing can impact populations of commercial and noncommercial species. Ghost fishing can also alter the **species diversity** (the number of species in a community) and the relative abundances of those species. Marine ecological communities, like terrestrial ones, are very complex. Death of wildlife due to ghost fishing is one more factor that affects species interactions in communities.

Debris on mangroves

[9] *Northwest Straits Marine Conservation Initiative, "Derelict Fishing Gear Removal," Not Dated, www.nwstraits.org/PageID/142/default.aspx (accessed April 17, 2007).*

ENSNARED SUBMARINE

In 2005, a Russian submarine sank off Russia's eastern coast after becoming ensnared in a discarded fishing net and cables, which were wrapped tightly around the submarine's propeller and hull. An international rescue effort was launched to rescue the seven-man crew. The vessel's air supply was getting dangeroulsy low when the British Royal Navy cut the entangling debris and released the submarine. All Russian crew members survived. For more information, visit **www.cnn.com/2005/WORLD/europe/08/06/russia.sea/**

Health and Safety Impacts of Marine Debris

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, with some divers barely escaping serious injury or death. Contaminated debris, including medical waste may pose a public health hazard through disease transmission.

Debris on a Hawaiian beach NOAA PIFSC

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, associated infections, strangulation and the impaired ability to swim, find food, and escape predators. Entangled marine mammals and sea turtles can drown if they cannot reach the water's surface to breathe.
- The ingestion of marine debris by animals can cause starvation, suffocation, internal injuries, and infections.
- Marine debris is an eyesore that litters 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 and other important commercial species that otherwise would be sold.
- It can also impact marine ecological communities by changing the diversity and relative abundance of commercial and noncommercial species.
- 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.

LESSON ONE

Marine Animals and Harmful Debris

Grade Level:
Grades 2 – 4

Subjects:
Language Arts, Science

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

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

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

Materials:
- One or more copies of the "Animal Tales" handout
- Foamed plastic cup/plate/bowl pieces
- A piece of fishing net (or a large mesh onion or vegetable bag)
- Fishing line or rope
- Six-pack ring
- Plastic shopping bag or piece of plastic sheeting
- Lobster or crab pot (or a wooden box or crate)
- Balloon and its ribbon
- Other types of debris (such as a plastic cup, a pull tab from a can, a metal bottle cap and a glass bottle)

Entangled sea lion

Learning Skills:
Analyzing, Public Speaking, Reading, Visualizing

Duration:
40 minutes

Activity

1. Place the items of debris on the floor in the middle of the classroom and have students form a circle around the items. Read the description of the seal on the "Animal Tales" handout, or ask one of your students to read it to the class. (NOTE: You might want to make copies of the handout and distribute it to the students so they can follow along.)

LESSON ONE

Sleeping monk seal NOAA NMFS

2. 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. Encourage students to think about how animals could become entangled in the debris items, plus how the animals might eat the items, mistaking the debris for food.

3. Repeat this procedure for the remainder of animals on the handout. After you have finished, ask the 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.

4. 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 ocean or along the coast can be affected by marine debris.

EXTENSIONS

Have students locate photographs, artwork or articles describing the impacts 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 marine debris harms a particular species. 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 nature center/reserve, where they can learn about endangered and threatened species that might be harmed by marine debris. Contact the aquarium or nature center/reserve in advance and ask for a guided tour that emphasizes the problems that marine debris poses for endangered and threatened species.

HANDOUT

Animal Tales

SEABIRD

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

SEA LION

I like to play in the water and I am curious about new things. I like to investigate objects that float on the surface of the ocean. My nose is perfect for poking into things – but sometimes I can get caught.

FISH

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

SEA TURTLE

I am a turtle that lives in the ocean. One of my favorite foods is jellyfish. Jellyfish float near the surface of the water and you can see right through them!

LOBSTER

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

LESSON TWO

All Tangled Up

Entangled green sea turtle

Grade Level:
Grades 1 – 4

Subjects:
Language Arts, Science

Overview:
Students perform an experiment in which they wrap a rubber band around their fingers and across the back of their hand and try to disentangle themselves. As a class, students discuss their thoughts and reactions and relate to real animals. Older students will write a short story about an entangled animal.

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

Vocabulary:
abandoned net, entanglement

Materials:
- A small- to medium-sized (thin) rubber band for each student
- One copy of the "Animal Entanglement" Handout

Learning Skills:
Analyzing, Experimenting, Visualizing, Writing

Duration:
20 minutes

Activity

1. Discuss how animals need a healthy environment in which to live, just like we do. This includes a habitat that is free from pollution. Litter that becomes marine debris can harm the animals that live in or near the ocean.

2. Distribute the rubber bands to students and have them follow the procedure below. (Note: As an alternative, you may want to have one or two students come up to the front of the room to perform the exercise with rubber bands 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 rubber band in your right hand and hook one end of it over the little finger of your left hand.
- Hook the other end of the rubber band over the left-hand thumb. The rubber band should be taut and resting across the bottom knuckles on the back of your left hand (see photo above).
- Place your right hand on the bottom of your left elbow, and keep it there.

LESSON TWO

All tangled up

- Try to free your hand of the rubber band without using your right hand, teeth, face or other body parts.

3. 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 are unable to eat until they are free from the debris. Ask the students 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 were 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.

4. For Grades 3 and 4: Post the "Animal Entanglement" handout at the front of the class. Ask students to select 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.

EXTENSIONS

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.

Have students discuss how balloons and balloon ribbons can present problems to fish, birds, turtles and seals. Using the Internet, older students can investigate whether your state has a law against the mass release of balloons. Students can make posters, or write letters to the editors of newspapers to help increase knowledge about the need to keep balloons and balloon ribbons from becoming marine debris.

HANDOUT

Animal Entanglement

LESSON THREE

How Harmful Is Marine Debris?

Grade Level:
Grades 3 – 7

Subjects:
Language Arts, Science, Social Studies

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

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

Vocabulary:
ghost fishing, medical waste

Materials:

- Enough copies of the "How Harmful Is It?" handout for the entire class. This is a three-page handout.
- Examples of the different types of debris to be discussed (to accompany the handout above):
  - -Fishing line
  - -Paper cup
  - -Lobster or crab pot
  - -Six-pack ring
  - -Resin Pellet
  - -Plastic grocery or trash bag
  - -Broken glass bottle [CAUTION – use care when handling this material]
  - - Section of a fishing net

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

Activity

1. Distribute the "How Harmful Is It?" (three-page) handout to the class. Make sure students are familiar with the types of debris presented in the handout. If possible, label and display examples of the actual debris or use sample debris images provided at the end of this lesson. Review with students the instructions at the top of the handout. Then have students complete 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:

LESSON THREE

- 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 habitats.)
- According to class results, which types of marine debris are the most harmful? Do you agree? Why or why not?
- According to class results, which type of debris is the least harmful? Do you agree? Why or why not?
- Are there any types of debris that received a low grand total, yet are very harmful 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 and experiences.

The discussion also should 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, bottles and cans may be abundant forms of debris, but they are not as potentially harmful as other forms of debris such as discarded fishing line and abandoned nets. One fishing net can continually maim or kill unsuspecting wildlife, while a hundred soda cans on the beach are primarily an eyesore and will not intentionally harm 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 habitats, but that almost all marine debris can be harmful to these different communities.

EXTENSIONS

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 find articles and papers about marine debris written by scientists, and compare the data in these publications with the results from the class exercise. Have the students compare and contrast the two sets of information, and indicate what they found most interesting from the scientific publications about marine debris.

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris 101: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

HANDOUT

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 habitats 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 spaced 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

Animal	Fishing Line	Paper Cup	Lobster Trap	Six-Pack Ring	Resin Pellet	Plastic Bag	Broken Glass Bottle	Lost Fishing Net
Crab or Lobster								
Fish								
Sea turtle								
Seagull								
Seal								
Subtotal								

People	Fishing Line	Paper Cup	Lobster Trap	Six-Pack Ring	Resin Pellet	Plastic Bag	Broken Glass Bottle	Lost Fishing Net
Beachgoer								
Boater								
Diver								
Fisherman								
Subtotal								

HANDOUT

How Harmful Is It?

1 = rarely or never harmful
2 = sometimes harmful
3 = very harmful

Vessels	Fishing Line	Paper Cup	Lobster Trap	Six-Pack Ring	Resin Pellet	Plastic Bag	Broken Glass Bottle	Lost Fishing Net
Boat with motor								
Canoe or Kayak								
Personal watercraft (example: jet ski)								
Sailboat								
Subtotal								

Natural Environments	Fishing Line	Paper Cup	Lobster Trap	Six-Pack Ring	Resin Pellet	Plastic Bag	Broken Glass Bottle	Lost Fishing Net
Beach								
Coral reef								
Oyster bed								
Open water								
Wetland or Marsh								
Subtotal								

Grand Total								

(Page 2 of 3)

HANDOUT

How Harmful Is It?

Fishing Line

Paper Cup

Lobster Trap

Six-Pack Ring

Resin Pellet

Plastic Bag

Broken Glass Bottle

Lost Fishing Net

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UNIT THREE

Working Towards Solutions

Derelict fishing nets collected from reefs and shorelines in the Northwestern Hawaiian Islands.

NOAA PIFSC

Many people are focused on solving the marine debris problem. Working through governments, organizations, and research institutions, people are actively developing solutions. Some of these groups are developing educational programs to encourage people to prevent 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. Scientists conduct research to better understand the sources, movement, and fate of marine debris, and to develop tools that will help decrease marine debris impacts in our oceans and coastal habitats. In addition, local, state, federal, and international laws have been established to regulate commercial and recreational activities that frequently result in the generation of marine debris.

Working through governments, organizations, and research institutions, people are actively developing solutions.

What Governments Are Doing To Address Marine Debris

Many nations are engaged in multiple efforts to prevent marine debris, including passing laws, conducting or funding research, and working cooperatively with industry and **environmental groups.** In the United States, the Interagency Marine Debris Coordinating Committee – including the National Oceanic and Atmospheric Administration (NOAA), the US Environmental Protection Agency (EPA), the US Coast Guard, the Department of the Interior, the Department of State and several other federal agencies – addresses marine debris issues (**http://marinedebris.noaa.gov/about/imdcc.html**). Since marine debris is a global problem that has no political boundaries, many groups are working to address these issues, including the United Nations Environment Programme (UNEP) through their Regional Seas initiative for marine litter.

MARINE DEBRIS LEGISLATION AND POLICY

In the United States there are many laws that regulate litter and debris both on land and in the sea. The following are some of the major laws addressing marine debris. For more information on any of these laws, visit **http://marinedebris.noaa.gov** and the websites listed.

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972

Established in 1972 and amended in 1977, this law became commonly known as the Clean Water Act, which established pollution discharge regulations for US waters, set water quality standards, and gave the country's Environmental Protection Agency (EPA) authority over pollution control programs
http://cfpub.epa.gov/npdes/cwa.cfm

COASTAL ZONE MANAGEMENT ACT

Established in 1972, the Coastal Zone Management Act authorizes the National Oceanic and Atmospheric Administration to approve and fund state programs that regulate land-based pollution discharges and works to preserve, protect, develop, restore and enhance the United States' coastal zone resources through state coastal management planning.
http://coastalmanagement.noaa.gov/czm/czm_act.html or **http://www.nature.nps.gov/water/policies/coastalzonemanagementact.cfm**

MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT (MPRSA)

Established in 1972, the Act gives the US Coast Guard and EPA domestic authority to implement the London Convention in regulating the dumping of materials into ocean waters. This legislation distinguishes between ships' normal operational discharges [regulated in MARPOL and implemented domestically through APPS (see below)] and dumping of wastes from vessels (covered by the London Convention and implemented domestically by the Ocean Dumping Act).
http://www.epa.gov/regulations/laws/mprsa.html

INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS (MARPOL)

Established in 1973 and modified in 1978, the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) created international guidelines to prevent ship pollution. MARPOL has six annexes covering oil discharge, hazardous liquid control, hazardous material transport, sewage discharge, plastic and garbage disposal and air pollution. Annex V controls the disposal of plastics and garbage into the oceans from ships.
http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx

ACT TO PREVENT POLLUTION FROM SHIPS (APPS)

Mandated in 1983, this act gives the US Coast Guard the authority to develop

regulations and enforce MARPOL Annex V, including the discharge of garbage and plastics from ships. The Act applies to all US flag ships anywhere in the world and to all foreign flag vessels operating in navigable US waters or while at a port or terminal under US jurisdiction. The Act also establishes regulations for operational discharges and dumping of wastes from vessels.
http://epw.senate.gov/atppfs.pdf

Litter in the nation's capitol

MARINE PLASTIC POLLUTION RESEARCH AND CONTROL ACT (MPPRCA)

The US Congress passed the Marine Plastic Pollution Research and Control Act (MPPRCA) in 1987 to implement Annex V. Under MPPRCA, it is illegal to throw plastic trash off any vessel within the US Exclusive Economic Zone (within 200 nautical miles of the shoreline). It is also illegal to throw any other garbage overboard while navigating in US waters or within three miles of shore.
http://www.csc.noaa.gov/legislativeatlas/lawDetails.jsp?lawID=730

SHORE PROTECTION ACT

The Shore Protection Act of 1994 provides controls on transport vessels to prevent the release of municipal or commercial solid wastes into coastal waters.
www.epa.gov/fedrgstr/EPA-GENERAL/1995/December/ Day-13/pr-755.html

BEACHES ENVIRONMENTAL ASSESSMENT AND COASTAL HEALTH ACT (B.E.A.C.H. ACT)

The B.E.A.C.H. Act of 2000 amends the Clean Water Act, requiring adoption of minimum health-based water quality criteria, comprehensive water testing and public notification when water contamination levels are unsafe.
http://www.epa.gov/lawsregs/laws/spa.html

CORAL REEF CONSERVATION ACT

The Coral Reef Conservation Act of 2000 authorizes NOAA to provide assistance to any US state, territory or possession that contains a coral reef ecosystem within its seaward boundaries in removing abandoned fishing gear, marine debris and abandoned vessels from coral reefs.
http://coris.noaa.gov/activities/actionstrategy/08_cons_act.pdf

MARINE DEBRIS RESEARCH, PREVENTION AND REDUCTION ACT

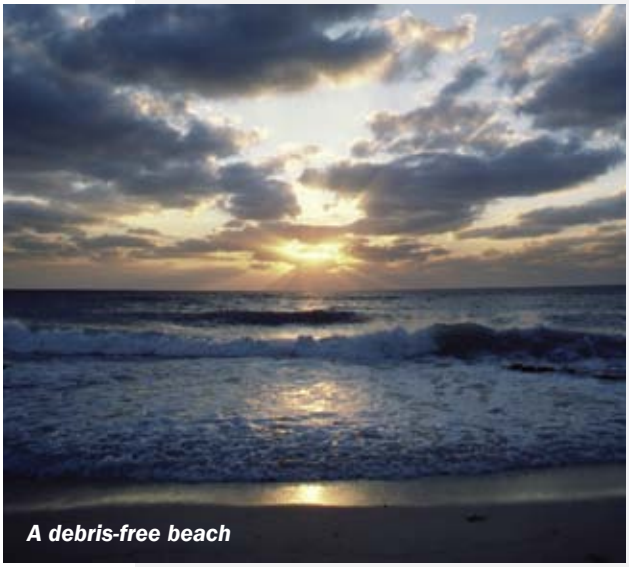
Signed into law in 2006, the Marine Debris Research, Prevention and Reduction Act establishes a program within NOAA to identify, assess, reduce and prevent marine debris and its effects on the marine environment. The Act also directs NOAA to reestablish the Interagency Marine Debris Coordinating Committee, work with the US Coast Guard to establish a definition of "marine debris," develop a federal marine debris information clearinghouse, emphasize the importance of outreach and education and work with the international community to address marine debris on a global scale.
http://marinedebris.noaa.gov/about/act.html

Compliance With Laws

Unfortunately, laws do not guarantee compliance. In addition to enforcement and penalties, a sense of environmental stewardship among ocean users is essential for these laws to be effective. Education and outreach to boaters, fishermen, industries, and the general public is critical to fostering this sense of stewardship and reducing the impacts of marine debris.

NOAA MARINE DEBRIS PROGRAM

Established in 2005 by the Marine Debris Research, Prevention, and Reduction Act, the NOAA Marine Debris Program (MDP) leads national and international efforts to research, prevent, and reduce the impacts of marine debris. The MDP is the federal government's authority on marine debris and a coordinating body for activities in the United States. Its staff of regional coordinators, scientists, and educators support projects that increase the understanding of debris, reduce its impacts, and prevent it from entering the marine environment. To learn more about NOAA's role in preventing marine debris, visit **www.MarineDebris.noaa.gov.**



A debris-free beach

Governments Supporting Research

NOAA, EPA, and other government agencies provide grants to fund research on marine debris. Research topics include creation or improvement of port and marina **best management practices** that decrease the threats marine debris poses to marine life and navigational safety; work with the fishing industry and/or fisheries councils and organizations to develop better solutions to reduce the occurrence and impacts of **derelict fishing gear** in the marine environment; increase understanding of the impacts marine debris has on marine mammals, sensitive habitats, tourist and fishing industries, and navigational safety; and investigating the physical and chemical properties of marine debris. Other research includes monitoring programs that help to assess the status of marine debris on our nation's beaches and waterways.

State and Local Level

On the state and municipal level, laws and ordinances are being passed to address the management of different types of trash, much of which can become marine debris. For example, multiple states have passed bottle deposit laws to encourage the **recycling** of beverage cans and bottles. States and communities have implemented laws requiring that dumpsters and trash trucks be covered, which will help prevent land-based trash from being blown or carried into the water and becoming marine debris. Some municipalities have established bans or fees on the use of plastic bags at grocery or convenience stores. Coastal states and communities often devote resources to educating citizens about **stormwater runoff** and how it can carry litter into waterways.

THE HONOLULU STRATEGY

In March 2011, Government agencies, industry representatives, non-profit organizations, and leading marine researchers came together for the Fifth International Marine Debris Conference in Honolulu, Hawai'i. The National Oceanic and Atmospheric Administration and the United Nations Environment Programme co-organized this conference, which brought together representatives from 38 countries. Participants of the conference agreed on a new set of commitments aimed at combatting the global marine debris problem, known as the Honolulu Commitment, and began the development of a global framework to reduce marine debris, known as the Honolulu Strategy.

The Honolulu Strategy is a framework for a comprehensive and global effort to reduce the ecological, human health, and economic impacts of marine debris. It is intended for use on multiple levels—global, regional, national, and local—involving the full spectrum of civil society, government and intergovernmental organizations, and the private sector. The framework aims to reduce, prevent, and manage marine debris from at-sea and land-based sources and includes the removal and processing of marine debris.

To learn more about the Honolulu Strategy, visit **www.MarineDebris.noaa.gov**

What Organizations and Industries Are Doing To Address Marine Debris

Private industry, universities, non-profit research organizations, and **environmental groups** bring new ideas, financial resources, and educational opportunities to prevent and reduce marine debris.

Their efforts are focused on:

- changing the behaviors that lead to marine debris;
- increasing awareness and a better understanding of the problem;
- finding alternative materials; and
- increasing recycling of waste items.

Changing the Behaviors That Lead to Marine Debris

Laws and regulations are just one method to help people change their behavior to prevent marine debris. Education can also encourage behavioral changes. People are more likely to change their habits when there are easy ways to properly and responsibly dispose of waste items. Several coastal states offer debris abatement resources for boaters and the owners/operators of marinas, fishing piers, commercial fishing operations, and other coastal businesses. The US Coast Guard and its Auxiliary offer pollution prevention education through the Sea Partners program, which aims to develop community awareness of maritime pollution issues and to improve compliance with marine environmental protection laws and regulations. The Ocean Conservancy's Good Mate Program is another national program that promotes environmentally responsible boating and marina operations.

To learn more about these programs, visit the US Coast Guard's Sea Partners Program at **www.uscg.mil/hq/g-m/nmc/seapart.htm** or the Ocean Conservancy's Good Mate Program at **http://www.oceanconservancy.org/do-your-part/green-boating/.**

NO BOUNDARIES FOR DEBRIS

Litter on beach

It seems that no place is free from marine debris. Even in Antarctica, one of the most isolated areas on Earth, researchers with the Australian Government Antarctic Division commonly find marine debris washed up on the shore. So few people venture to Antarctica 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.

The problem is also acute in Hawaii. With many of the Pacific currents circling around the island state, the Northwestern Hawaiian Islands act as a filter for the entire Pacific, collecting thousands of tons of refuse and debris every year. The global nature of this problem calls for international cooperation to find solutions.

For more information on the Australian Antarctic Research Human Impacts program, visit **http://www.antarctica.gov.au/environment/human-impacts-in-antarctica**

Industry Efforts to Change Behavior

In addition, several business and industry groups have initiated projects aimed at educating industry employees and consumers about the problems of marine debris. Since the 1980s, plastics manufacturers – through the Society of the Plastics Industry and the American Chemistry Council (previously known as the American Plastics Council) – have organized research and educational efforts aimed at minimizing the effects of plastics in the oceans, lakes, and rivers. The Society of the Plastics Industry, a trade association of nearly 2,000 members representing all segments of the plastics industry in the United States, implements an educational effort aimed at industry members to prevent plastic resin pellets from entering the environment, waterways, and oceans. Pellet loss is an environmental concern for plastic resin producers, as well as a financial concern – even a loss of one tenth of 1 percent of the pellets could result in over 114 million pounds of pellet loss per year. This could equal 12 railroad cars full of resin pellets being emptied into the environment each year. Well trained employees who correctly transport and handle resin pellets could eliminate pellet presence in the environment.[1]

The 2004 US Ocean Commission on Ocean Policy Report identified marine debris as one of the major threats to the nation's marine resources and human health and safety along the coasts.

To learn more, visit www.oceancommission.gov

[1] *United Nations Environmental Programme – Caribbean Environmental Programme, 2006, Marine Litter in the Wider Caribbean.*

A beach cleanup in the Hawaiian Islands NOAA MDP

Increasing Awareness and a Better Understanding of the Problem

One of the most widely recognized efforts to raise awareness and increase our understanding of marine debris is the Ocean Conservancy's International Coastal Cleanup (ICC), which has been held annually each fall since 1986. Each year, the Ocean Conservancy mobilizes thousands of **volunteers** in the United States and multiple countries to scour the coast, picking up debris and recording data on the types of debris found on coastlines. The **data** are logged into the national marine debris database, which the Ocean Conservancy and other researchers use to study the nature of marine debris and measure the impact of efforts to reduce it.

Finding Alternative Materials

Researchers and industries are currently searching for alternative materials that are less invasive or harmful to the environment, and exploring steps to successfully integrate these materials into the economic mainstream. For example, researchers are examining how to minimize packaging and modify fishing gear to prevent loss or decrease impacts.

Increasing Recycling of Waste Items

Additional work has been done to increase the feasibility of plastic recycling. Most frequently used plastic containers – especially beverage containers such as soft-drink bottles and milk jugs – can and should be recycled. In fact, there is a great demand from manufacturers

for the resins from recycled bottles. Some recycled resins are used in plastic lumber materials, a growing industry.

The recovery of shrink wrap used for transporting new boats and for cold weather protection is another example of how industry has been proactive in dealing with the disposal of plastic materials. The plastics industry supported a shrink wrap recovery pilot program at 44 marinas in Massachusetts and Rhode Island that collected and recycled three tons of material.

Working Together

Nonprofits groups working with local, tribal, state, federal, and community representatives operate many projects to remove derelict fishing gear from the environment. In northwest Washington, from the Strait of Juan de Fuca and northern Puget Sound to the Canadian border, the Northwest Straits Marine Conservation Initiative sponsors a joint effort to remove derelict gear, which includes public outreach and education about derelict fishing gear removal and its impacts on the marine environment. In Hawaii, a private-public partnership supports a yearly removal of derelict nets from the shores and reefs of the Northwestern Hawaiian Islands Marine National Monument.

Removing derelict nets from the Northwestern Hawaiian Islands NOAA PIFSC

BEACH CLEANUPS: COLLECTING DEBRIS AND DATA

The Ocean Conservancy's annual International Coastal Cleanup (ICC) is a testament to the resolve of dedicated individuals around the globe who are working to reduce the amount of debris in our oceans and waterways. Each year, volunteers remove marine debris from the world's shorelines, recording the types and quantities of items they collect. EPA and NOAA are sponsors of these cleanup events in the United States.

ICC participants

In addition, the Ocean Conservancy's trained volunteers have collected more precise data as part of a multiple-year study called the National Marine Debris Monitoring Program, which was funded by the EPA. Data collected through these efforts was analyzed 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. For more information on the these efforts, visit **http://www.oceanconservancy.org/our-work/marine-debris/** and **http://water.epa.gov/type/oceb/marinedebris/nmdmp.cfm.**

What You Can Do

While governments, industry groups, and private organizations have become increasingly active in preventing marine debris, individual initiative remains one of the best ways to tackle ocean pollution. Whether properly disposing of 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.

There are often clear connections between our individual behaviors and the effect these activities have on the environment (e.g, 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 ensure that all of their waste is properly disposed of. For example, when outdoors, especially at the beach or on a boat, people should make efforts to prevent any litter from blowing away or being left behind. People should also recycle as much trash as possible and practice waste prevention techniques, such as reusing bags and containers rather than throwing them away. When individuals make purchases, they should select items made from recycled content.

Concerned individuals can multiply their effectiveness by organizing into groups to address marine debris in communities or regions. For example, groups can learn how marine debris affects a nearby beach, clean the area periodically, and inform 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 how to prevent it.

Beach cleanup NOAA Restoration Center

Learn if your state or community offers an "Adopt-a-Beach," "Adopt-a-Stream," or similar stewardship program.

Marinas can organize education **campaigns** to alert recreational boaters to the need to store waste for proper disposal on land. Boaters can also start a network committed to helping others understand and comply with marine debris laws and reporting suspected regulation violations.

Established marine debris prevention organizations are always looking for people to help them organize and staff their programs. Individuals of all ages can volunteer for certain short-term projects, such as the Ocean Conservancy's International Coastal Cleanup (ICC). 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.

If you are a scuba diver, you can participate in underwater cleanup projects through Project AWARE, which coordinates the underwater portion of International Cleanup Day in cooperation with the Ocean Conservancy. To learn more about underwater cleanups, visit **www.projectaware.org**

Volunteers are also needed to respond to marine animal **strandings** and **entanglements** through the NOAA National

Marine Fisheries Service, the US Fish and Wildlife Service, and regional programs. Many state and local environmental agencies also maintain a volunteer corps to help educate people about marine debris.

Young people can also help prevent marine debris and educate others about the problem through a variety of youth organizations, such as the Boy or Girl Scouts of America. Students can learn more about aquatic environments and their wildlife 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, writing letters to elected representatives, and talking about environmental issues with parents and friends.

Solving this global problem will require the engagement of governments, nonprofit groups, academic researchers, industries, and citizens to increase awareness, establish debris abatement programs, and change behaviors. Fortunately, 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!

"Reducing and controlling debris in the marine environment is a significant – but achievable – challenge."

Seba Sheavly, UNEP Marine Litter Report

Key Points

- Prevention is the most effective way to stop marine debris. Multiple countries, private organizations, industries, federal agencies, and individuals are taking action to prevent debris from entering the marine environment.

- MARPOL Annex V is the first international legislation to regulate the disposal of trash at sea. US federal, state, and local legislation also has been passed addressing ocean disposal and management of solid waste, encouraging recycling, and banning particularly harmful plastic items.

- Many conservation groups have been working to stop marine debris by developing educational programs and lobbying for additional US and international legislation. One prominent effort is the Ocean Conservancy's International Coastal Cleanup (ICC), which mobilizes thousands of volunteers to remove marine debris from the world's beaches, rivers, and streams.

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

- 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 in preventing marine debris can organize projects within their community, join established marine debris prevention programs, and alert their elected representatives to the importance of the marine debris issue.

LESSON ONE

Nations and Neighbors

Grade Level:
Grades 4-7

Subjects:
Language Arts, Social Studies, Geography

Overview:
Students learn how marine debris has no international boundaries. Students will develop map skills by locating various nations on a globe or map, and by identifying various oceans. As a class, students discuss how an international treaty about marine pollution (MARPOL Annex V) regulates the disposal of garbage at sea.

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

Vocabulary:
annex, foreign, international

Materials:
- A world map or large globe
- Bag with pieces of paper, each with the name of a country on it for the "I Am a Piece of Trash From..." exercise.

Learning Skills:
Analyzing, Map Reading, Observing, Visualizing and Writing

Duration:
40 minutes

Activity

1. Before the lesson, cut apart the names of the nations from the "I Am a Piece of Trash From..." handout. Crumple up the pieces of paper and put them in a bag.

2. Explain that we all live in a watershed (an area of land that drains to a common water body). With your students, learn the "watershed address" for your school. This includes the name of the small stream near your school, all rivers that the stream flows into, and an ocean, lake or other larger body of water that the river flows into. Learn if your state agency has a web site that will help you learn the watershed address. EPA's "Surf Your Watershed" website is a also helpful tool: **http://water.epa.gov/type/watersheds/index.cfm.**

3. No matter where your school is located, have the students find the nearest ocean and the nearest beach to your school.

4. Pass around the bag with the crumpled up pieces of paper and ask 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 or globe.

5. Ask students to describe how their trash could have traveled from its original country to the beach that is nearest your school. Each body of water involved with this journey should be identified. If you wish, this could be a written assignment (see

LESSON ONE

Removing derelict fishing nets from the Hawaiian Islands NOAA PIFSC

Extensions on page 77).

6. 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? Point out how all the world's oceans are interconnected.

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?

Tell the students that there is an international agreement called MARPOL that was passed as a result of international concern about marine debris. One section of this international agreement, Annex V, 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.

LESSON ONE

EXTENSIONS

This lesson can be adapted if your class is studying ocean currents to include an understanding of the major ocean currents, **gyres**, etc.

Ask students to write a story about their piece of trash's journey. 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 other 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 debris traveled through on its journey. Students can also mention other countries the trash could have reached during its journey. Students can finish the stories by mentioning how they would recycle or dispose of this piece of trash if they really found it on a beach.

Ask students to investigate local legislation concerning litter, solid waste management, and 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.

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 Congressional representatives 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 their mayor 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 to 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.)

Abundance of debris

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris 101: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

HANDOUT

I Am a Piece of Trash From...

Afghanistan	Bolivia	Cuba
Angola	Brazil	Czech Republic
Argentina	Canada	Ecuador
Australia	Chile	Egypt
Azerbaijan	China	El Salvador
Bangladesh	Colombia	Ethiopia
Belgium	Costa Rica	France

HANDOUT

I Am a Piece of Trash From...

Germany	Israel	Liberia
Greece	Italy	Malawi
Greenland	Japan	Malaysia
Iceland	Kenya	Mali
India	Laos	Mexico
Iran	Latvia	Monaco
Ireland/Eire	Lebanon	Mongolia

HANDOUT

I Am a Piece of Trash From...

Morocco	**Norway**	**South Africa**
Namibia	**Pakistan**	**Spain**
Nepal	**Panama**	**Sudan**
Netherlands	**Portugal**	**Syria/Syrian Arab Republic**
New Zealand	**Puerto Rico**	**United Kingdom** (England, Scotland, Wales, Northern Ireland)
Nicaragua	**Russia – Russian Federation**	**Vietnam**
Nigeria	**Saudi Arabia**	**Zambia**

LESSON TWO

A Scientific Cleanup

Grade Level:
Grades 9-12

Subjects:
Science, Social Studies, Language Arts

Overview:
This lesson helps students understand the effects of natural events and human influences on ecosystems. The lesson also teaches students several science process skills, including forming questions and answering questions by experiments, carrying out research to validate or challenge ideas, and designing experimental tests. 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.

Objectives:
- To understand how marine debris can affect a community and to learn that people can make a difference.
- Discuss problems associated with aquatic debris.
- Identify testable questions relating to litter distribution at a local water site.
- Design an experiment to investigate litter distribution at the site.
- Make predictions of litter distribution at site.
- Participate in a cleanup at the site.
- Compile data on litter collected.
- Analyze data and make conclusions relating to litter at the cleanup site.
- Make conclusions relating litter to the local ecosystem as well as human health and safety.
- Communicate findings from investigation.
- Recommend actions for remediation and pollution prevention.

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
- Bucket for sharp items
- Scissors to cut fishing line
- Digital camera to record cleanup
- First aid kit
- One 'Cleanup Checklist' handout for each pair of students in the class
- One "ICC Data Collection Card" handout for each pair of students in the class
- Clipboards and pencils

Learning Skills:
Analyzing, Classifying, Collecting Data, Decision Making, Observing, Working in Small Groups and Experiment Design

Duration:
This lesson will involve a field trip to participate in a cleanup. In addition, up to two class periods could be used before the

trip. Another period will be needed after the trip.

SAFETY & REGULATIONS

See Cleanup Checklist for Students, and also refer to your school's guidelines for planning a safe field trip.

Activity

1. Discuss with the students some problems associated with litter and marine debris. Ask students about different water sites they are familiar with, including ocean beaches, lakeside beaches, and river banks and streams. Ask students what they like to do at these sites and what they have seen other people doing. Activities will include playing and relaxing, swimming, fishing, canoeing, and using larger boats. Also ask students to think about animals that live in or around the water. Both humans and other animals depend on the water being litter-free and unpolluted. Ask students to name examples of what they consider to be litter, and what kinds of litter they have seen around water sites. Ask the students how they think these kinds of litter can create problems.

2. Before students begin planning any details of their experimental cleanup, you should determine where the cleanup site will be. Several groups organize volunteer cleanups and are happy to include school groups. The Ocean Conservancy coordinates the International Coastal Cleanup throughout the world every fall. 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 can be scheduled for September through October and take about three hours. Several states have "Adopt-a-Stream," "Adopt-a-Beach," and other programs that encourage cleanup events. Have students participate in a pre-planned local cleanup event or select a nearby public beach for the class cleanup. Public land adjacent to a local stream or lake also can be used. (Note: Notify the appropriate municipal or state agency responsible for the site prior to the cleanup.) A park or beach manager may also be able to provide you with cleanup supplies and arrange for trash collection after the cleanup.

Marine debris in Hawaii NOAA MDP

3. Have students work in small groups to identify possible testable questions for the class to study. After each group has identified a possible question, the class will need to decide which they will study. They could vote on this, but you must make sure they choose a "doable" question. Students are likely to choose a question relating different locations on the beach to the amount of debris collected. Different areas on the beach could include open water areas, areas influenced by a river, and areas influenced by a dock or harbor. Students also can also look at high tide, mid tide, and low tide parts of the beach.

LESSON TWO

A large-scale map of the beach can be used to assign different areas for different groups of students. Groups of students can walk "transects" on different areas of the beach, and different groups of students covering similar areas of the beach will represent replications in the experiment or "repeated trials." The amount of debris collected by each group of students will be recorded on the ICC data card. Most likely, the amount of debris will be recorded as number of items. It also could be recorded as estimated weight. Students can be assigned to carry out background research on their chosen question. This could be done using computers in class time at school, or students could be asked to do their research as an out-of class assignment.

4. To prepare for the cleanup, explain the ICC data 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 carefully explain the necessary safety procedures while collecting debris, including wearing safety gloves. Sharp objects should not be put in the trash bags, but instead should be put in a bucket.

5. Once your class arrives at the cleanup site, help the students translate their experimental design into a working plan at the site. Depending on the exact nature of the experiment, students may need help measuring off distances along the beach or stream. 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 data card.

Inland cleanup

6. At the end of the cleanup, be sure that all the debris is disposed of properly. Park rangers and beach employees can show you where the bags of trash should be left for pick up. Remind students not to eat any food until after they have washed their hands.

7. Back in the classroom, have the students total the amounts of debris found for each category listed on their "Cleanup Card." Students should be encouraged to use spreadsheet and database software to organize their data. They should produce data tables and graphs using computers. The students should be able to compare the number of pieces or estimated weight of debris collected by different categories of debris. Either bar graphs or pie charts will be effective. Have the student groups share their data and graphs with the other students. Discuss any trends found:

- Was there a prevalence of certain types of items? Where might these items have come from (e.g., from boaters, from sewers, from people who threw their

LESSON TWO

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? Could some debris pose threats to humans?
- Will beach cleanups solve the marine debris problem? Why or why not?
- If the litter is not picked up, what do you think will happen to it in the next five years?
- What could we ask lawmakers to do about the problem of pollution?
- What are some steps we can take to prevent marine pollution in the first place?

Ask the students to consider how community residents' lifestyles have contributed to the collected debris. Did they find any items that they or their families 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.

Students can analyze their data to make conclusions about the litter collected at the water site. They should write a conclusion about their experiment. The conclusion should summarize the purpose of the experiment, the major findings, whether the original hypothesis was supported, a comparison with other people's findings, a possible explanation for the findings, and suggestions for extending the experiment. Students should try to include conclusions relating the litter collected at the water site to the local ecosystem. Encourage students to link their conclusions to important local water quality issues.

This lesson was adapted from "A Scientific Beach Cleanup" in the "Save Our Seas" curriculum and "A Scientific Cleanup" in Clean Virginia Waterways' "Virginia's Water Resources: A Tool for Teachers".

- ***www.coastal.ca.gov/publiced/aab/saveourseas.pdf***
- ***www.longwood.edu/cleanva/images/sec6.scientificclean.pdf***

EXTENSIONS

Students can make a short oral presentation of their work to the class. These oral reports can include summaries of the question tested, background information collected, the experimental design, data tables and graphs, and final conclusions.

The class could work together to make a poster display of their findings. They could also display some of the litter and debris that was collected. If the students contributed to a larger cleanup effort, they may be able to prepare part of a summary report by the organization leading the cleanup.

Have students write letters to organizations that support cleanup activities or to local appointed and elected officials. Students can describe their cleanup and state their positions on litter-related legislation.

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.

HANDOUT

Cleanup Checklist for Students

CLOTHES TO WEAR

- Windbreaker or jacket (waterproof jacket if rain is forecasted)
- Sweater
- Long pants
- Sturdy shoes (no sandals or open toed shoes)
- Gloves (gardening gloves, dish gloves, or disposable gloves)

ITEMS TO BRING

- Drinks (On hot or sunny days, you should have at least a quart of water, juice, or soft drinks per person)
- Sunscreen
- Sunglasses
- Change of clothes (in case of getting wet)
- Hat (depending on the weather)

SAFETY DURING THE CLEANUP

- Stay with your group members at all times.
- Do not go near or into the water.
- Keep your shoes on at all times to protect your feet.
- Keep out of dunes and do not step on any plants.
- Do not touch any wildlife that you find or taste any water or plants.
- Learn what poison ivy and poison oak look like, and avoid these plants.
- Call an adult immediately if you find any stranded animal.
- Call an adult immediately if you find any dangerous item, such as a syringe, large drum, chemical container, or medical waste.
- Do not eat any food without first carefully washing your hands.

Beach cleanup

HANDOUT

Marine Debris Data Collection Card

Please pick up all debris that you find. Only record information for the items listed below.

Keep a count of your items using tick marks and enter the item total in the box.

Example: [8] **Beverage Cans** 𝍸 III

SHORELINE AND RECREATIONAL ACTIVITIES

(Debris from fast food, beach-goers, sports/games, festivals, litter from streets/storm drains, etc.)

- [ ] Bags (paper or plastic) _____
- [ ] Balloons _____
- [ ] Beverage Bottles (plastic) 2 liters or less _____
- [ ] Beverage Bottles (glass) _____
- [ ] Beverage Cans _____
- [ ] Caps, Lids _____
- [ ] Clothing, Shoes _____
- [ ] Cups, Plates, Forks, Knives, Spoons _____
- [ ] Food Wrappers/Containers _____
- [ ] Pull Tabs _____
- [ ] 6-Pack Holders _____
- [ ] Shotgun Shells/Wadding _____
- [ ] Straws, Stirrers _____
- [ ] Toys _____

OCEAN/WATERWAY ACTIVITIES

(Debris from recreational/commercial fishing and boat/vessel operations)

- [ ] Bait Containers/Packaging _____
- [ ] Bleach/Cleaner Bottles _____
- [ ] Buoys/Floats _____
- [ ] Crab/Lobster/Fish Traps _____
- [ ] Crates _____
- [ ] Fishing Line _____
- [ ] Fishing Lures/Light Sticks _____
- [ ] Fishing Nets _____
- [ ] Light Bulbs/Tubes _____
- [ ] Oil/Lube Bottles _____
- [ ] Pallets _____
- [ ] Plastic Sheeting/Tarps _____
- [ ] Rope _____
- [ ] Strapping Bands _____

SMOKING-RELATED ACTIVITIES

- [ ] Cigarettes/Cigarette Filters _____
- [ ] Cigarette Lighters _____
- [ ] Cigar Tips _____
- [ ] Tobacco Packaging/Wrappers _____

DUMPING ACTIVITIES

- [ ] Appliances (refrigerators, washers, etc.) _____
- [ ] Batteries _____
- [ ] Building Materials _____
- [ ] Cars/Car Parts _____
- [ ] 55-Gal. Drums _____
- [ ] Tires _____

MEDICAL/PERSONAL HYGIENE

- [ ] Condoms _____
- [ ] Diapers _____
- [ ] Syringes _____
- [ ] Tampons/Tampon Applicators _____

DEBRIS ITEMS OF LOCAL CONCERN

(Identify and count 3 other items found that concern you)

- [ ] _____
- [ ] _____
- [ ] _____

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LESSON THREE

Communicating for a Clean Future

Grade Level:
Grades 8 – 12

Subjects:
Art, Language Arts, Science, Social Studies, Communication, Technology Literacy

Overview:
This activity introduces students to the concept of community service and public education as they develop public education materials to raise the school's or community's awareness of the marine debris problem. The students will research, write, and create materials to educate the community about marine debris – its sources, impacts, and solutions. Students will share their research by creating a web site, newspaper, podcast, or television show (depending on the resources available at your school). This public education effort can be used in conjunction with an actual community litter cleanup day, a beach cleanup, a storm sewer stenciling activity, or other community event.

Objectives:

- To integrate technology with the creation of materials that will educate the community on marine debris, the threat it poses to ocean fisheries, and how to prevent the problem.
- To review the lessons of the "Turning the Tide on Trash" curriculum, and to spread the word about marine debris and the solutions being developed to reduce or prevent ocean pollution.

Vocabulary:
awareness, public education

Materials:
Will vary with activity

Learning Skills:
Analyzing, Collecting Data, Decision Making, Interviewing, Researching, Visualizing, Working in Small Groups, Reading, Writing, Language Arts, Science, Social Science, Technology Literacy

Duration:
This project could be done in conjunction with several different subject areas, and could take anywhere from several weeks to a full semester.

Activity

1. Introduce the concept of a public education campaign by having the students share examples of public education campaigns they have seen. What have they learned from these public education campaigns that has changed their behavior?

2. Explain that they will be researching and creating a public education campaign focused on the issue of marine debris. The campaign's goals will be to educate the audience about:

- types and sources of debris;
- the impact of marine debris on wildlife, humans, and habitat; and actions people can take to reduce marine debris and be part of the solution.

LESSON THREE

- Depending on the resources available at your school, students will be creating a web site, podcast, a newspaper, or TV show. All projects will start with research and writing.

3. As a class, decide whether the campaign will be directed at the school's faculty, staff, and students 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 related event.

4. Divide the students into groups and assign to each group one of the following topics:

- Types and sources of marine debris;
- Effects of marine debris on wildlife, habitats, and humans; or
- Solutions to reduce the amount of marine debris.

5. Students should research their topic using the Internet, scientific journals, magazines, newspaper articles, and interviews with local people (fishermen, marina owners, government employees who work on these issues, aquariums, etc.) Within each group, the students will be responsible for writing and critiquing each other's articles. This portion of the project can be incorporated into several different subject areas, including writing, social sciences, etc.

6. After each group has researched and written its contribution, the class should start to work on the finished product (a web site, podcasts, a newspaper, or TV show). Consult your school's advisor on technology literacy to coordinate use of your school's technology, or to gain access to resources in the community.

Student artwork depicting marine debris impacts NOAA MDP

For web site and newspaper projects: Remind students that in addition to the written portion of the project, there should be graphic contributions that illustrate the stories or stand on their own. The web site or newspaper can be illustrated with photographs, drawings, charts, graphs, and cartoons.

7. 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.

LESSON THREE

Divers remove submerged debris

EXTENSIONS

Write an 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 where the class can give a presentation on marine debris. The reporter can then write an article on the campaign.

Write 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.

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.

Research how to make an effective Public Service Announcement (PSA) for radio stations, then develop a PSA in conjunction with a local radio station or community access television/local cable television channel advertising the campaign.

LESSON FOUR

Taking Action

Grade Level:
Grades 5-12

Subjects:
Language Arts, Mathematics, Science, Social Studies

Overview:
This lesson is designed to increase students' awareness of volunteer activities they and their families can participate in that will promote cleaner, healthier oceans and waterways. Students will learn about the efforts of private organizations and individuals, both locally and nationally, to prevent marine debris and take steps to become involved in a stewardship activity.

Objectives:
- Identify volunteer activities in the community that assist with preventing marine debris.
- Participate in one of these events or programs.
- Reflect on the experience.

Vocabulary:
civic and environmental organization, stewardship, volunteerism

Materials:
Varies based on the activity selected.

Learning Skills:
Public Speaking and other skills (based on the activity selected)

Duration:
Varies (based on the activity selected)

SAFETY & REGULATIONS
Varies (based on the activity selected)

Activity

Students investigate environmental groups, local governments, business and industry, and other civic and private organizations to learn what they are doing to prevent marine debris. Students learn about local volunteer stewardship events, participate in the event, and present an oral report on their activity. 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.

1. Tell the students that they will be researching local, state, and national groups and government agencies and learning about events and activities that involve volunteers in either preventing marine debris or cleaning up litter and debris. This research can be done on the Internet, by looking in the local telephone book, or by contacting your local conservation district (see sidebar).

The students can obtain much of this information from the Internet, or they can contact the organizations directly and request that literature be sent to the students by mail. In addition, students can call or visit local officials who are responsible for public health or environmental issues, asking them for more information about their organizations. Students can also contact their municipal or county government employees to learn if there are local Keep America Beautiful or Clean Community programs.

LESSON FOUR

CONSERVATION DISTRICTS

Across the United States, nearly 3,000 conservation districts – almost one in every county – help people conserve local land, water, forests, wildlife, and related natural resources. Known in various parts of the country as "soil and water conservation districts," "resource conservation districts," "natural resource districts," "land conservation committees," and other similar names, they all share a single mission: to coordinate assistance from all available sources – public and private, local, state and federal – in an effort to develop locally driven solutions to natural resource concerns. Employees of conservation districts are knowledgeable about local and regional nonprofit groups that conduct clean up events along rivers and beaches. They also are aware of Adopt-a-Stream, Adopt-a-Beach, and storm drain stenciling programs in which your school can get involved. To find your local conservation district, check in your local phone book or visit the National Association of Conservation Districts' web site at **www.nacdnet.org/.**

Using these resources, have each student develop a list of organizations whose work focuses on marine debris prevention and related issues (such as wildlife entanglement and protecting endangered species). Student lists should include government agencies such as the US Environmental Protection Agency and the National Oceanic and Atmospheric Administration, 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. There are also a number of children's groups working to protect the environment. 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. Students will learn that litter and debris prevention is a concern of many people and groups from the local to the national level.

A recycling bin for monofilament fishing line

LESSON FOUR

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

3. With the students, discuss and select one of the projects as a class project. Examples of projects include:

- Adopt-a-Beach, Adopt-a-Stream, or similar program where your school or class will "adopt" a location, and then plan cleanup activities and other stewardship actions.
- Participate in a cleanup event already planned for a local beach, river, or stream.
- Stencil storm drains with "Do Not Dump" messages to help people understand that storm drains often drain directly into steams.
- Start an ecology club or recycling program in your school.
- Participate in the "Ring Leader" program that recycles six-pack holders. For information, visit **www.ringleader.com/.**
- Volunteer to assist with a community-wide environmental event, such as Earth Day celebrations, recycling of small electronic items (also called "e-cycling"), and other events that educate people about the correct and responsible ways to dispose of waste.

4. Alternatively, students can select different volunteer activities to participate in if there are multiple events in your community.

5. After participation in the event, each student can give an oral presentation on what they did, what they observed during the event, the role of volunteers in such events, and lessons they learned through their participation.

EXTENSIONS

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 to implement some of the organization's prevention techniques in the community. This report can be printed in the school newspaper.

Ask students to research careers in the environment. The students can interview individuals who hold environmental jobs (such as scientists, writers, environmental lawyers, organic farmers, park rangers, town planners, government and environmental group staff, and business people). Students can also look in the library for books, magazine articles, and pamphlets about environmental careers. Have the students report to the class on their findings.

DIVE DEEPER:

Other Resources on Marine Debris

- NOAA's Marine Debris 101: www.marinedebris.noaa.gov
- EPA's Marine Debris site: http://water.epa.gov/type/oceb/marinedebris/index.cfm

GLOSSARY

Turning the Tide on Trash

abandoned fishing gear: See derelict fishing gear.

abandoned net: See derelict fishing gear.

abandoned vessels: Lost or discarded ships, boats, or other watercrafts.

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.

aquatic habitats: Freshwater or marine home or environment of a plant or animal; examples include streams, rivers, bays, salt marshes, sea grass beds, oyster beds, coral reefs, and oceans.

awareness: To be acquainted with an issue or fact.

beach: The part of a coast that is washed by waves or tides, which cover it with sediments of various sizes and composition, such as sand or pebbles.

best management practices (BMPs): A method, activity, maintenance procedure, or other management practice for preventing or reducing the pollution resulting from an activity. The term originated in the Clean Water Act. Specific BMPs are defined for each pollution source.

bioaccumulation: An increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. The accumulation process involves the biological storage of substances that enter the organism through respiration, food intake, epidermal (skin) contact with the substance, and/or other means.

biodegradable: A process by which microorganisms (bacteria) break materials down into compounds that can be reused in the environment.

biodiversity: Short for biological diversity, which refers to the diverse forms of life on Earth and involves three main components:
1. Genetic diversity – diversity within a species, including individuals, eggs, sperm, etc.
2. Species diversity – the different kinds of organisms and their numbers and distribution within an ecosystem.
3. Ecosystem diversity – the variety of habitats and communities of various species that interact in complex, interdependent relationships.

biomagnification: An increase in concentration of a pollutant from one link in a food chain to another; the tendency of pollutants to concentrate as they move from one trophic (feeding) level to the next.

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 informing a group of people about a particular subject.

combined sewer overflow: 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. During heavy rainstorms sewage treatment plants can be overwhelmed by the volume of water and discharge raw sewage directly into the receiving water body, bypassing the treatment plant. See outfall pipe.

coral reef: Limestone formations produced by living organisms, found in shallow, tropical marine waters. In most reefs, the predominant organisms are stony corals. Reef-forming corals do not grow at depths of over 100 ft (30 m) or where the water temperature falls below 72°F (22°C). Reefs are under numerous environmental pressures, including damage from derelict fishing gear.

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

debris: Discarded items; trash and litter; man-made materials and solid wastes that are released accidentally or intentionally into the environment.

degradable: Capable of being broken down into smaller pieces by natural forces. See biodegradable and photodegradable.

derelict fishing gear: Fishing gear that has been lost or abandoned at some point during use; capable of catching marine life as it continues to float throughout the water column or trap animals. Also capable of smothering sensitive habitats such as coral reefs and sea grass beds. Examples of derelict fishing gear include: nets, crab pots, lobster traps, coils of abandoned or discarded monofilament fishing line.

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

diversity: A measure that combines the number of species in a community with the relative abundances of those species.

ecosystem: A natural community composed of biotic (living) creatures that live in connection with each other and abiotic (non-living) elements like sun, soil, and water. An ecosystem can be as big as a planet or as small as a puddle.

endangered species: Any species that is "in danger of extinction throughout all or a significant portion of its range," according to the Endangered Species Act of 1973.

Endangered Species Act (ESA): A 1973 Act of Congress that mandated that endangered and threatened species of fish, wildlife, and plants and their habitats be protected and restored.

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.

estuary: A body of water at the lower end of a river which is connected to the ocean and semi-enclosed by land. In an estuary, sea water is measurably diluted by freshwater from the land.

extinct: A species that is no longer in existence. In biology and ecology, extinction is the ceasing of existence of a species. The moment of extinction is generally considered to be the death of the last individual of that species.

fishing gear: Equipment used for fishing (e.g., gillnet, handline, harpoon, seine, longline, midwater trawl, purse seine, rod-and-reel, trap, trawler, etc. but not vessels).

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. It is frequently used in disposable cups for hot beverages.

food chain: A series of animals and plants, each depending on the next for food. A food chain usually forms part of a much larger, more complex food web.

food web: A network of living things that depend on each other for food.

garbage: Spoiled or waste food that is thrown away, generally defined as food waste. It is also a general term for all products discarded.

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.

gillnets: A type of large fishing net designed so fish can get their head into the holes in the net, but not their bodies. Fish become caught by their gills.

gyre: A circular pattern of currents in an ocean basin.

habitat: The area in which a plant or animal naturally lives, grows, and reproduces that provides adequate food, water, shelter, and living space.

hatchling: A bird, fish, or reptile (including a turtle) that has just hatched.

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

inland: Land areas away from the coast, associated with watersheds.

landfill: A specially engineered site for disposing of solid waste on land that is constructed to reduce any hazards to public health and safety. Landfills usually have liner systems and other safeguards to prevent groundwater contamination.

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

litter: Improperly discarded wastes; see debris.

marine: Relating to the ocean.

marine debris: Any man-made object discarded, disposed of, or abandoned that enters the coastal or marine environment.

marine ecosystem: A salt-water ecosystem, including oceans and shorelines. Ocean ecosystems include pelagic (sea surface) and benthic (sea floor) communities. Shoreline ecosystems range from rocky and sandy beaches to tidal pools and salt marshes.

MARPOL Annex V: MARPOL refers to the International Convention for the Prevention of Pollution from Ships, a set of international conventions concerned with the prevention of pollution (oil, hazardous substances, sewage, plastic, and garbage) from ships. Annex V is the section of this convention that addresses prevention of pollution by garbage from ships.

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.

municipal solid waste: Garbage or refuse that is generated by households, commercial establishments, and industrial offices; includes durable goods, non-durable goods, containers and packaging, food wastes, and yard trimmings.

navigable waters: generally speaking navigable waters are streams, rivers, lakes and other bodies of water that can be used for commercial transportation.

nondegradable: Incapable of being broken down into simple compounds or components.

offshore oil and gas platform: A structure in the ocean or a bay 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: In the environment this refers to the ability of a substance or material to remain in the environment for long periods of time without being broken into smaller components.

photodegradable: The ability to degrade due to exposure to ultraviolet radiation where the chemical bonds or links in the polymer or chemical structure of a plastic are broken.

plastic resins: Material used in making plastics; usually petrochemical-based.

plastic resin pellets: Small, round pellets that are produced as the raw form of plastic. Resin pellets are melted down and used to form plastic products. During plastic resin pellet production, transportation, and processing, some resin pellets can be released into the environment. The pellets resemble fish eggs, and can be mistaken for food by marine animals and sea birds.

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.

recycling: The collection and reprocessing of materials so they can be used again in a similar or different form.

ring carrier: See six-pack holders.

salt marshes: Low coastal grassland frequently overflowed by the tide. A maritime habitat found in temperate regions, but typically associated with tropical and subtropical mangrove.

saturated: Thoroughly wet; unable to absorb any additional liquid. Some marine debris items will float until they become saturated, and will then sink out of the water column to the bottom.

seagrass beds: Communities of grass-like marine

plants, usually on shallow, sandy or muddy bottoms of sea. Because these plants require sunlight to photosynthesize, they are limited to growing in shallow and sheltered coastal waters anchored in sand or mud bottoms. Highly diverse and productive ecosystems, seagrass beds are home to hundreds of associated species.

sewage: Used water and water-carried solids from homes that flow in sewers to a wastewater treatment plant. Also referred to as wastewater.

sewage treatment plant: See combined sewer overflow.

six-pack holders: Plastic rings that group a set of beverages and other liquids into a package for shipping and purchase.

sludge: Solids that remain after the wastewater treatment process that settle to the bottom of a septic tank or a treatment plant pond. Current regulations require that these materials are disposed of through land applications, incineration, or are land-filled.

solid waste: Any solid, semi-solid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, or agricultural operations, and from community activities. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, or air pollution control facilities, and other discarded materials.

species diversity: See biodiversity.

storm drain: A pipe system which includes grates, gutters, underground pipes, streams, or open channels designed to transport rain from developed areas to a receiving body of water.

stormwater: Runoff in the storm drain system.

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

stormwater sewers: See storm drain.

stranded: Run aground. See strandings.

strandings: A behavioral phenomenon where marine wildlife species that normally live in deeper waters swim into shallow waters or ashore when ill or affected by changes in their environment; species commonly known to strand include sea turtles, whales, and dolphins.

tar balls: Crude oil from seeps and spills often form tar residues or tar balls that become stranded on the shoreline.

threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. A threatened species is not in immediate danger of extinction, but is likely to become endangered if it is not protected.

trash: Materials that have been made or used by people and discarded. Also referred to as waste, garbage, and solid waste.

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

waste water: Used water and water-carried solids from homes that flow in sewers to a wastewater treatment plant. Also referred to as sewage.

zooplankton: Small, usually microscopic animals that are suspended or swim in the water column, including larvae of many fish and benthic invertebrates; the animal component of plankton; the first consumers in a marine food chain.