ADOPT-A-BEACH SCHOOL EDUCATION PROGRAM

Oceanic Society, San Francisco Bay Chapter

California Coastal Commission

California Coastal Commission

PROCEDURAL GUIDANCE MANUAL: ADDRESSING POLLUTED RUNOFF IN THE CALIFORNIA COASTAL ZONE

May 1, 1995

Exhibit 6d

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

STATEWIDE ADOPT-A-BEACH PROGRAM ORGANIZED BY

CALIFORNIA COASTAL COMMISSION

SCHOOL CURRICULUM AND PROGRAM DEVELOPED BY:

THE OCEANIC SOCIETY, SAN FRANCISCO BAY CHAPTER,

with assistance from the
SAN FRANCISCO RECYCLING PROGRAM

SUPPORTING ORGANIZATIONS:

California State Parks Foundation
Golden Gate National Recreation Area
Gulf of the Farallones National Marine Sanctuary
Norcal Solid Waste Systems
San Francisco Conservation Corps
San Francisco Recycling Program

Funding provided by the California Department of Conservation, Division of Recycling and National Oceanic and Atmospheric Administration.

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INTRODUCTION

California's Adopt-A-Beach program, organized by the California Coastal Commission, gives people of all ages the opportunity to learn about and actively participate in conserving coastal resources. The program encourages organizations all along our coast to 'adopt' a local beach, and to effect change through beach clean-ups, recycling and community awareness.

The year-round Adopt-A-Beach program is an outgrowth of the annual statewide Coastal Cleanup Day that has been organized by the Coastal Commission in the fall of each year since 1985. The Cleanup is a highlight of COASTWEEKS, a three week national celebration of the coast.

The Oceanic Society, San Francisco Bay Chapter, has been a leader in carrying out the Adopt-A-Beach program. As part of its adoption of San Francisco's Ocean Beach, it has developed a model Adopt-A-Beach School Education Program that combines an active environmental ethic with the study of biology, earth and physical science. The program provides teachers with meaningful activities, resources and training to make the Adopt-A-Beach Program a substantive part of their curriculum.

The Adopt-A-Beach School Education Program integrates conservation and marine science education. It provides an opportunity for students to observe how their actions directly impact the health and future of the environment. The program has been successfully tested in a variety of schools, including inner-city elementary and middle schools with diverse ethnic populations and large numbers of limited English proficient students.

Classes "adopt" a local beach by completing a simple application provided by the Coastal Commission. Students learn about the beach environment in the classroom through hands-on activities, and then take a field trip to participate in a beach clean-up and other field study activities. Recyclable trash collected at the beach is given to a recycling center for processing. In this way students actively learn science concepts and develop an appreciation for the environment which will help to ensure their wise use of our dwindling natural resources and the preservation of our fragile coastal habitats. Students personally tackle the problem of marine pollution, and get a chance to make a difference in resolving that problem.

This curriculum guide adapts the San Francisco program for use throughout California as part of the Coastal Commission's overall Adopt-A-Beach program.

The MANUAL section provides a step-by-step guide for carrying out a successful Adopt-A-Beach program in your school.

Welcome to Adopt-A-Beach, and thank you for becoming part of the solution to ocean pollution!

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ACKNOWLEDGEMENTS

Financial assistance from the California Department of Conservation, Division of Recycling, the California State Parks Foundation, and the National Oceanic and Atmospheric Administration, has enabled the California Coastal Commission and the Oceanic Society to adapt the model Adopt-A-Beach School Education Program and make it available for use by schools throughout California.

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FOCAL CONCEPTS

The following four focal concepts have been identified to help students understand the purpose of the Adopt-A-Beach School Education Program. Please use them to help guide your teaching and to share directly with your students.

1. **The beach** is a productive home for a great diversity of plants and animals. Humans use the beach in many ways, and must share this habitat with the other organisms.
2. **Human pollution,** especially plastics and oil, may harm or kill organisms living at the beach. Pollution also negatively affects the people who visit beaches.
3. **Natural resources** are limited and must be used wisely. Conserving resources both reduces pollution and insures that those resources will be available for future generations. We can conserve by reducing the waste we produce, re-using objects which can be re-used, and recycling objects which can be recycled.
4. **Everyone,** including children, and especially groups, can make a difference in protecting the marine environment.

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THE PLASTIC TIDE

By Maria Goodavage

Imagine something that has a lifespan of several centuries and bobs through the world's waters killing millions of creatures each year. It's the largest killer of marine mammals in the North Pacific. And it means death to countless millions of fish and sea birds unlucky enough to cross its path.

This marauding mauler may sound like a character from a bad science fiction novel, but unfortunately it's too real for that. It's plastic, the darling of the world of modern convenience, the demise of so many in the marine world.

While no one knows how much plastic is fouling our oceans, recent reports reveal some startling figures:

- The world's merchant and navy vessels jettison 690,000 plastic containers every day. The U.S. Navy dumps a sizable portion of this amount.
- More than 85% of the synthetic debris found off Northern Pacific beaches in 1985 was plastic.
- Commercial fishermen lose or discard 145,000 tons of plastic fishing gear each year.
- In Los Angeles County, beachgoers leave 75 tons of trash each summer week, much of it plastic, and much of it carried to the open ocean.

Plastic is leaving its unsightly mark all over the world. Because of its buoyancy, plastic is more easily distributed than other marine debris. Plastic discarded from ships at sea washes onto beaches with the tides. And beach litter, in turn, is carried to the open sea by tides, wind and storms. It's an ugly, never-ending cycle that leaves no part of the world unmolested.

Even in the San Francisco Bay Area, where the ocean looks pristine and the beaches better than average, plastic is a problem. Volunteers picked up approximately two-and-a-half tons of garbage at three beaches during a one-day beach cleanup in 1988. About half the debris was plastic. No firm scientific estimates of plastic pollution exist, although the Center for Marine Conservation in Washington D.C. is compiling data about the amount and type of trash collected at the coastal cleanups. Only recently has plastic in our oceans drawn concern of any consequence.

The widespread popularity of plastics began in the 1940s with the advent of cost-effective manufacturing techniques. The use of plastics has been growing exponentially since. Plastics have become ubiquitous in our society, replacing nearly all other materials. And as a result, common objects like fishing lines and nets, convenience food packaging and plastic plates and plastic bags have become some of the most lethal elements of the sea.

"Seemingly harmless, innocuous objects are posing a dangerous threat to marine life. And because they're plastic, they don't just go away. Every piece of plastic has the potential to choke or entangle a fish, bird, pinniped or turtle," said Joan Patton, conservation director of the Oceanic Society's San Francisco Bay Chapter.

Plastic's toll on marine life is devastating.

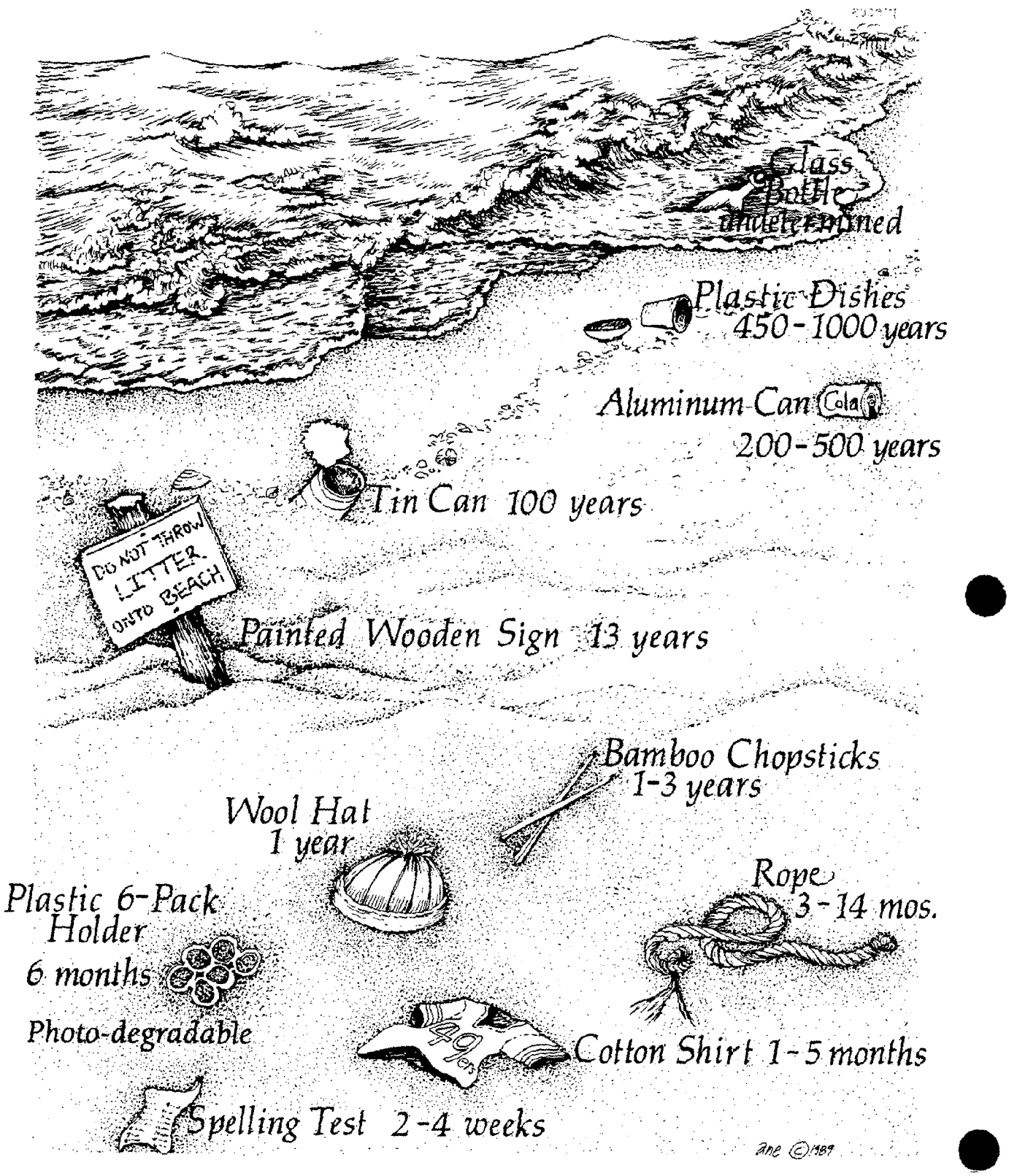
Abandoned or lost plastic drift fishing nets floating throughout the Bering Sea kill about 40,000 fur seals each year off the Pribilof Islands. The seals play with the nets, become tangled, and drown, starve or die from the deep gashes created when they grow too large for their plastic nooses.

The nets — 26 feet deep and as long as 30 miles — are highly effective curtains of death while in use. Sometimes an overnight "catch" on a salmon expedition can net dozens of sea lions, dolphins, porpoises and birds that get caught in the barely detectable plastic netting and drown — it's estimated that up to 750,000 birds die in drift nets set out by the salmon industry alone each year.

But the greatest damage is done after the catch. Sometimes, when a net becomes tangled or too worn to do its job, fishermen cut it loose and abandon it to the sea. These "ghost nets" may continue to snare victims for two years until they sink under the weight of their bounties. The death continues even then, as benthic (bottom living) organisms become trapped.

Even the large baleen whales — like humpback, gray, fin and right whales — don't escape the powerful grip of nets. In the last seven years, more than 90 whales were reported dead from entanglement off the coasts of North America.

Long-lasting Litter



The figure doesn't include the thousands of whales, other marine mammals, sea turtles and birds that perished because they choked or starved to death after eating floating plastic bags and other plastic debris. To the larger ocean dwellers, pieces of plastic can look like shimmering squid, jellyfish and schooling fish.

Many seabirds collect plastic fragments at sea and feed them to their chicks on island breeding colonies. Every year on the island of Laysan, in the South Pacific, thousands of albatross chicks die as a result of eating plastic. Their bodies decompose, leaving behind small piles of plastic in each nest. It's a macabre reminder of the reason for their demise.

The horror stories are endless: A South African scientist recently pulled enough plastic from the gut of a starving leatherback turtle to make a ball several feet in diameter. An endangered Florida manatee died from eating a piece of plastic sheeting. Thousands of sea birds and fish die painful deaths after nibbling too much plastic or becoming ensnared in six-pack yokes.

"Plastic could be the number one killer of marine life in the world," said Howard Levenson, senior analyst at Congress' Office of Technology Assessment. "About 100,000 marine mammals die each year by ingesting or becoming entangled in plastic debris. We probably can't begin to imagine the destruction on the lower levels, where animals are more vulnerable."

Many scientists and environmentalists believe it's not too late to create a healthy ocean environment. But some of the species affected most dramatically by plastics, like sea turtles, are already endangered.

"The ocean has a high tolerance for abuse. But polluting the ocean can't go on forever, or we may start losing some of the more susceptible species," said Dr. Edward Goldberg, a marine chemist at the Scripps Institute of Oceanography in La Jolla. "It's not something we'll be proud of."

Hope for the Future?

The world may finally be hearkening to distress signals from the deep. After years of lobbying from environmental organizations, an amendment to the international Marpol (Marine Pollution) Treaty went into effect in 1989. The amendment makes it illegal for any vessel to dump plastics into the ocean. The vessels of the world unload some 14 billion pounds of garbage into the oceans every year — plastic comprises at least one-half of the volume of all the refuse.

Environmentalists are hopeful but skeptical that the U.S. Marine Plastic Pollution Control Act will help curb the deadly impact of plastic. With fines of up to $50,000 and five years in jail, it should. But as always, enforcement of laws on the high seas is expensive and difficult to carry out.

Because of the cost and inconvenience of storing shipboard, many seafaring outfits, including the U.S. Navy, were resistant to the legislation. But local fishermen are grateful for its passage.

"It's our living out there. In a way, it's our home. We don't want it polluted with styrofoam cups, milk crates and fish nets," said Bill Mattlin, who owns a fishing party boat docked at Fisherman's Wharf in San Francisco.

Jack Liebster, of the California Coastal Commission, believes that the only way some vessels are going to learn not to dump plastic is by strict enforcement of the new law. Enforcement agencies such as the U.S. Coast Guard, the National Marine Fisheries Service and the Dept. of Fish and Wildlife will need greatly enhanced budgets and governmental support in order to even begin this huge task.

"It's one thing to have a law, it's another thing to obey it," said Liebster. "We're hoping that as more people become familiar with the problems, they'll be able to help curb plastic pollution. Good intentions probably will be much more effective than any law."

The Oceanic Society, San Francisco Bay Chapter, sponsors several major coastal cleanup events, which Joan Patton hopes will help bolster support for cleaner oceans. The Adopt-A-Beach School Education Program helps schools adopt, study and regularly clean up a beach of their choosing. The cleanup and Adopt-A-Beach programs are an outgrowth of a nationwide beach cleanup effort which takes place each fall during Coastweek.

Last year, the national average of garbage collected during coastal cleanup day was 550 pounds per mile of beach. California fared comparatively well, with 180 pounds per mile. At the other extreme, Texas averaged about 3500 pounds per mile. Currents in the Gulf of Mexico carry marine debris from all points to the Texas coast, giving those beaches a disproportionate share of everyone's trash.

Figures like these may be discouraging, but they have an impact. In the last few years, there's been a growing awareness of the damaging effects of plastic pollution. This awareness has reaped some tangible results: Many consumers are changing their shopping habits, opting for less plastic whenever possible. That stops the pollution before it starts; more plastic recycling centers are opening all over the country; a dozen states have banned non-biodegradable six-pack yokes; some cities, like Berkeley, Calif., have banned the use of plastic packaging from fast food restaurants.

Environmentalists believe the key to turning around the situation lies in education, especially education of children. And the effects of environmentally focused education start well before children grow up to implement what they learned earlier in life: They bring their new knowledge home with them, affecting adults directly. Witness the success of Smoky Bear's *"Only You Can Prevent Forest Fires,"* and the *"Just Say No"* and *"Don't be a Litterbug"* campaigns.

"We adults have grown up with some bad habits, and certainly a lack of awareness of the danger of living in a throw-away, convenience culture," said Craig Strang, director of the Oceanic Society's Project Ocean, which educates Bay Area teachers and students about the marine environment. "But it's not hard at all to teach children good habits right from the start. They represent our opportunity to bring about positive change. So it's on children that we must focus our accumulated energy, attention and trust."

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THE SANDY BEACH HABITAT

On the sandy beach, the daily ebb and flow of the tides, and action of waves and currents keep water in constant motion. This water movement is the dominant physical factor which shapes this environment through the process of evolution; that is, adaptation by natural selection. Organisms, including the human organism, are a reflection of their environment. The two must always be examined together in order to understand the true complexity of either.

The abilities to move quickly to keep above the water line, and to burrow in the sand are common adaptations amoung sandy beach critters. Most beach animal make a living by filtering meals from the organic material which washes in with each wave. Again, they are tied to their environment and fined tuned to avoid its dangers and to use its resources.

Because beach organisms have adapted to their habitat over many millions of years, they vulnerable to human impact which often causes sudden changes in their physical environment. These changes can be the result of pollution, careless building or overuse. Because of the large numbers of visitors, many sandy beaches are negatively impacted by the growing amount of littrer. Litter also arrives daily on our beaches as a result of ocean dumping. The Adopt-A-Beach School Education Program gives students the chance to help with this problem, and contribute to the welfare and beauty of our national treasures, sandy beaches.

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FACT SHEETS

The Adopt-A-Beach fact sheets provide in-depth information, useful when using the activities in this guide. For easy reference, we have specified below the Adopt-A-Beach activities which relate directly to each of the four fact sheets that follow.

METALS AND GLASS FACTS

Garbage In Your Classroom

Oil on the Ocean

Sand Lab

GARBAGE FACTS

Garbage In Your Classroom

Scavenger Hunt

Beach Clean-up

Packaging Your Product

Paper To Pulp To Paper

PAPER FACTS

Sandcastles and Sunburns

Garbage In Your Classroom

Beach Clean-up

Paper To Pulp To Paper

Recycling In Your School

PLASTIC FACTS

Tidal Waves

Garbage In Your Classroom

Web of Life

Shorebird Flocking

Packaging Your Product

Oil on the Ocean

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METALS & GLASS—FACT SHEET

METALS:

Nearly three fourths (70%) of all metal is used just once and then discarded. ***23.**

Americans throw away enough iron and steel to continuously supply all the nation's automakers. ***4.**

Recycling steel reduces air and water pollution and requires 70% less energy than producing it from raw materials. ***29.**

American consumers and industries throw away enough aluminum to rebuild our entire commercial airfleet every three months. ***4.**

It takes 8,766 pounds of bauxite and 1,020 pounds of petroleum coke to produce one tone of aluminum from raw materials. ***29.**

Used aluminum can be melted down and reshaped into rolled sheets, which are then cut into new beverage containers, foil, rain gutters, window frames, etc. ***28.** Producing aluminum from recycled aluminum uses 90 to 95 percent less energy than making aluminum from bauxite ore. ***25.**

Each recycled aluminum can saves energy equivalent to half that can of gasoline; the energy saved will operate a television set for three hours. ***22.**

Each year approximately 200 million aluminum cans are thrown away in San Francisco, an amount equivalent to 1 can per day per person. ***26.**

GLASS:

Glass is made from numerous raw materials, chiefly sand, soda ash, and limestone. ***28.** It takes 1,330 pounds of sand to produce one ton of glass. ***29.**

Glass can never decompose. It can be recycled to make new glass, insulation, and asphalt in road paving. ***28.**

The 90 major glass bottle manufacturers in the United States produce a combined average estimate of 80,000,000 bottles a day. ***28.**

Recycled glass, crushed into cullet, can be used in place of raw materials to make new glass. Cullet melts at a lower temperature than the raw materials. Glass recycling will help to reduce the consumption of energy required to produce glass. ***28.**

The energy saved from recycling a glass bottle will light a 100 watt light bulb for four hours. ***22.**

The production of glass from recycled glass instead of from raw materials (primarily silica sand) produces 20% less air pollution and half the water pollution. ***22.**

*See Adopt-A-Beach **Fact Sheet Sources**

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GARBAGE—FACT SHEET

The lifetime garbage produced by the typical American will equal at least 600 times his or her adult weight. ***21.** Americans comprise about 5% of the world's population, and annually produce between 15 and 38 percent of the world's garbage. ***22.**

Americans generate about 160 million tons of garbage per year, more per capita than any other nation. ***1.**

In the United States, almost one ton of solid waste (garbage) per person is collected annually from residential, commerical, and institutional sources. At the present rate of disposal, about 500 new dumping locations must be found each year. ***20.**

The National Academy of Science estimates that commerical fishing fleets yearly dump 52 million pounds of packaging material into the sea and lose about 300 millions pounds of indestructible plastic fishing lines and nets. ***11.**

We are running out of places to put our waste. Our country is facing a garbage crisis. Landfills, where waste is disposed, are becoming more scarce and more expensive. ***22.**

Packaging from consumer goods comprises about one third of the nation's trash. Approximately 50% of the nation's paper, 8% of its steel, 75% of its glass, 40% of its aluminum, and 30% of its plastic are used solely for packaging. ***22.**

Packaging costs account for roughly 10% of the price of a bag of groceries. ***3.** San Francisco residents who pay for their garbage collection and dispose of more than one container a week can reduce their garbage costs by recycling. ***22.**

The EPA Agenda for Action recommends using the following hierarchy of "Integrated Waste Management" to solve the nation's solid waste problems:

1. Source reduction including reuse is favored to first reduce volume and toxicity of wastes produced.
2. Recycling and composting are preferred to reduce risks to human health and the environment, to slow depletion of non-renewable natural resources, and to divert wastes from the waste system.
3. Landfills and incinerators are recommended for some wastes, but are lower on the hierarchy because of potential risks and long-term management costs. ***1.**

*See Adopt-A-Beach **Fact Sheet Sources**

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PAPER—FACT SHEET

Paper is one of the most recyclable materials. It is made of cellulose fibers from trees. Cellulose is an insoluble, inert and stable complex organic compound. It can be repulped many times without disintegrating. ***22.**

Each year our nation uses 67 million tons of paper or 580 pounds per person. Nearly 42 million tons of that are disposed of after one use. ***3.**

Our waste paper can be turned into a useful and necessary resource — raw material for new paper and paper products. Recycled paperboard is already being used for the packaging of many consumer products — Nabisco animal crackers, cereals produced by Kelloggs, Post, General Mills, and Quaker companies, Arm & Hammer detergent, pet foods produced by Purina, Friskies and Ken'l Ration companies to name a few. ***34.**

Making paper from recycled paper uses 30 to 50 percent less energy than making paper from trees and reduces the air pollution involved in the production process by 95%. ***25.**

Every ton of recycled office paper saves approximately 380 gallons of oil. ***22.**

Newspaper can be recycled into products such as paperboard packaging for foods, household and other consumer items, newsprint and construction and building materials. ***22.**

Used corrugated boxes make up the largest single source of waste paper for recycling. ***22.**

High grades of paper (computer printouts, tabulating cards, and white papers) account for approximately 20% of all waste paper utilized by the recycling industry as a raw material and are more valuable in the marketplace than most other types of waste paper. ***22.**

U.S. paper mills often find it more economical to produce paper from tropical wood than domestic sources. The U.S. annually imports approximately 800 million pounds of paper from Brazil. ***3.**

Producing one ton of paper from discarded waste paper uses half the energy and half the water, results in 74% less air pollution and 35% less water pollution, saves 17 pulp trees, reduces solid wastes going to landfills, and creates five times more jobs compared to producing a ton of paper from virgin wood pulp. ***3.**

*See Adopt-A-Beach Fact Sheet Sources

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PLASTICS—FACT SHEET

In 1868 a printer maned John Wesley Hyatt mixed pyrolin (derived from cotton), nitric acid, and camphor, producing America's first plastic: celluloid. Celluloid became a common substitute for ivory in the production of billiard balls. ***13.**

Plastics are a petroleum based product (a non-renewable resource). Their production produces toxic waste. ***3.**

Plastics do not rot, rust, dissolve or biodegrade when exposed to the environment. Discarded polystyrene cups, plastic utensils and straws, used once, will remain a problem for centuries. ***11.**

In 1985, 48 billion pounds of plastics were produced in the U.S., more than copper, steel, and aluminum combined. ***13.**

Twenty-five percent of plastics produced are used for packaging. ***13.** Production of packaging uses nearly one third of the raw material used by the 138 billion dollar per year industry. ***7.**

Re-use of plastic is important because the raw materials used in plastic production, petroleum and natural gas, are two non-renewable resources. ***11.**

Every American uses about 190 pounds of plastic per year. ***11.** 75,000 metric tons of that are used to make disposable diapers. ***12.**

Some plastics are technically recyclable. In San Francisco you can recycle soda bottles, plastic film, saran wrap, water bottles, and milk bottles at many of the recycling centers. ***31.**

Americans go through 2.5 million plastic bottles every hour. ***4.** Twenty five two-liter soda bottles is equal to one polyester suit. ***30.**

Most plastics are considered nondegradable because they can last from 200 to 400 years buried in a landfill. ***31.**

Claims of "biodegradable" and "solar degradable" plastics are suspect. Definitions of these terms and criteria for their use have not yet been established. Very little testing of degradable plastics has been done. Their rate of degradation in the environment and the safety of the end products is virtually unknown. ***32.**

"Biodegradable" plastics are not wholly biodegradable. With one type, the plastic is mixed with biodegradable starch. When the starch biodegrades, the large plastic breaks into small plastic peices. The environmental hazards of billions of pieces of a petrochemical product diffused throughout the environment are unknown. Until more is known about the possible toxic effects of plastic debris from biodegradation, the San Francisco Office of Solid Waste Management will not support legislation encouraging the use of biodegradable plastics. Further, legislation which requires products to be recyclable will be supported and encouraged. ***6.**

Plastics have become a stubborn pollutant of oceans and our land. Plastic debris is responsible for the death of 100,000 marine mammals yearly, and have become a major contributor to the overflow of America's landfills. ***11.**

Each year, 352 million pounds of plastic are dumped into the sea. ***11.** Scientists estimate that 52 million pounds of that is packaging. ***8.**

Manufactured plastics found at sea are mainly refuse from vessels — transport, fishing, and recreational. ***10.** More than 50,000 ships sail the seas, with crews numbering one and a half million. ***9.**

Raw plastic pellets found at sea enter the ocean a number of ways: through waterways as discharges from firms that manufacture plastic, through deliberate dumping from ships at sea or spillage from the docks when loading or unloading, and through losses at sea. ***10.**

Researchers report plastic pellet concentrations in areas of the Pacific at 300 pellets per square kilometer. ***5.** In the 1970's, so many plastic pellets washed up in New Zealand that some beaches were literally covered with "plastic sand". ***10.**

To date (1988) 50 of the world's 280 species of seabirds are known to ingest plastic. 70% of the plastics eaten by seabirds are plastic pellets. ***15.**

In one study, eight out of fourteen species of fish examined in southern New England contained plastic pellets in their digestive tracts. ***15.**

Plastic pellets have been traced through a food chain from fish to blue-footed boobies to short eared owls. ***10.**

Plastic is almost indigestible. When ingested it may cause ulcerations in the stomach, damage organs, leach out toxins leading to reduced reproductive ability, and cause intestinal blockage and even death. ***10.**

Discarded plastics have resulted in the death of 50,000 to 90,000 northern fur seals, 1-2 million birds, and thousands of fish and other wildlife species annually. ***8.**

It is estimated that 100,000 tons of plastic fishing gear is lost or discarded in the world's oceans each year. ***13.**

Under the MARPOL Marine Plastic Pollution Research And Control Act of 1987, all U.S. Ships are required to stop disposing of plastics in any ocean as of December 30, 1988 (except the U.S. Navy, which was granted an extension until Dec. 30, 1992). ***33.**

*See Adopt-A-Beach Fact Sheet Sources.

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***26.** San Francisco Waste Composition Study memorandum, second quarter results, 1986.

***27.** News Report, Selected Environmental Milestones.

***28.** 1985 Annual Report, Rhode Island Department of Solid Waste Management.

***29.** "Bottle Bills", Resources, Summer 1986.

***30.** Readers Digest

***31.** Plastics Question and Answer Sheet, Debra Kaufman, San Francisco Recycling Program, Nov. 1988.

***32.** Degradable Plastics, Standards, Research, and Development, Sept. 1988, GAO/RCED-88-208, Washington, D.C.

***33.** July 4, 1988 Solid Waste report, pg. 214, San Francisco Recycling Program.

WHO'S WHO IN ADOPT-A-BEACH

Teacher *(Acting as the "Beach Captain")*

The teacher, school club advisor or participating administrator acts as the principal organizer and contact for a given cleanup, and makes sure everything comes together at the right time before, during and after the cleanup. This section helps you fulfill that responsibility.

Beach Manager

The official contact person representing the local, state, federal or private agency that owns or operates the beach. This is the person with whom you arrange the dates, location and logistics for your cleanups.

WAYS TO GET INVOLVED

COASTWEEKS: The annual three-week national celebration of the coast each fall! Environmental, educational and other organizations organize free and low cost programs and excursions that focus attention on the value of our coastal resources. You can enhance your Adopt-A-Beach experience by participating in these events. A calendar of activities is available from the Coastal Commission.

Coastal Cleanup Day

The statewide cleanup that is a highlight of COASTWEEKS. Make this date in the fall one of your cleanups!

During the annual statewide Coastal Cleanup Day in the fall, additional people help make the cleanups a success:

County Coordinator

The County Coordinators are responsible for overseeing the organization and implementation of the cleanups that occur on Coastal Cleanup Day. They work with Beach Managers and Beach Captains to identify the beaches that will be cleaned, organize Cleanup Day logistics, promote the Cleanup in their county, and direct additional volunteers to individual beaches.

Assistant County Coordinators

In many areas Assistant Coordinators help the County Coordinator by taking responsibility for specific aspects of organizing Cleanup Day and COASTWEEKS, such as countywide coordination of recycling, publicity, data collection or cleanup logistics.

Data Support Coordinator

This Assistant Coordinator organizes the data collection program within the county. S/he works closely with the Center for Marine Conservation, distributing data collection materials countywide and serving as a local source of information on the data campaign and the marine debris problem.

Beach Data Captain

The data captain organizes the data collection effort at a particular beach.

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

GLOSSARY OF KEY WORDS

abiogenic - from a non-living source; sand particles made up of bits of rocks which have been worn down by chemical (dissolving and rusting) and physical processes (weathering and wave action).

abiotic factors - physical (non-living) aspects of an environment which interact with the organisms of an ecosystem, e.g. light, salinity, density and temperature.

aluminum - A bluish silver-white light metal that can be bent or crushed easily. It is highly resistant to rust.

beachcombing - searching the beach for interesting treasures or evidence of life such as shells, feathers or seaweed.

beach platform - the solid substrate that forms the base of a sandy beach.

beach processes - the constant changing of a coastal shoreline due to sediment deposition and erosion, sea level fluctuation, and geologic factors.

benthic - animals living on the bottom of the sea (benthos).

biodegradable - any material that will decompose as a result of the action of micro-organisms.

biogenic - produced by the action of a living organism; sand particles made up of bits of shells, coral, bones, fecal pellets and coralline plants.

boobytrap - marine animals may be harmed by ingesting plastic which they mistake for food items or become entangled in fishing nets or packing bands while hunting for their food.

CA Redemption Value - Items which carry this stamp can be returned to a recycling center or large supermarket, which will reclaim them by paying a specified sum for them—in this case the sum is 1 cent per item.

carnivores - animals which prey on other animals.

cellulose - a tough, sinewy, thread-like material making up the chief parts of the cell walls of plants and of products from plants such as paper and cotton.

centrifugal force - the force on a body moving along a curve that is directed outwardly along the radius of the curve; one of the major tide generating forces.

competition - when two or more organisms have the potential for using the same resource.

compost - organic material that has decomposed into a dark, earth-smelling humus-like material.

conservation - planned management of a natural resource to prevent exploitation, destruction or neglect.

consumer - one who consumes; one that buys for personal use.

currents - horizontal movement of water.

cycle - a series of events which does not end, but which comes full circle so that they can be repeated, e.g. water cycle and animal migrations.

debris - the remains of something broken down or destroyed.

decompose - to undergo chemical and physical breakdown; to break into smaller and smaller parts.

detritus - an accumulation of dead plant and animal material found suspended in water; it is an important source of food for some animals.

disposable - designed to be thrown away or thrown out.

dynamic - movement or action; on a beach it refers to the movement of sand and water.

ebb tide - the outgoing tide.

ecology - The scientific study of the relations of living things to one another and to their environment. A scientist who studies these relationships is called an ecologist. From the Greek *"oikos"* — meaning house, or home. Ecology is the study of our "home" — the earth, air and water.

ecosystem - A system made up of a community of living things and the physical and chemical environment with which they interact.

entanglement - marine mammals, seabirds and turtles become caught in nets meant to catch fish or in those which have been lost by fishermen.

environment - All the conditions, circumstances, and influences surrounding and affecting the development or existence of people or nature.

erosion - process whereby materials of the earth's crust are worn away and removed by natural agencies including weathering: land destruction and removal of soil by running water, waves, currents, ice or wind.

evidence - used in this guide — material left by beach residents and visitors or transported from other areas by waves and currents. Examples include feathers, shells, seaweed and styrofoam.

fibers - tough, sinewy thread-like material making up the major portion of plant cell walls.

filter feeding - organism which actively filters suspended material out of the water column.

flocking - birds forming large groups moving in synchrony, possibly for protection from predators.

flood tide - the incoming tide.

food chain - the passage of energy and materials in the form of food from producers to consumers as organisms feed on one another.

food web - the interlocking pattern of food chains existing within an ecosystem.

garbage - originally, spoiled or waste food that was thrown away; now, any material considered worthless, unnecessary or offensive and usually thrown away.

gradient - rate of increase or decrease in elevation. The slope of a sandy beach.

gravitation - an attraction between two bodies that is proportional to the product of their masses and inversely proportional to the square of the distance between them, as in the attraction between the sun, moon and earth and the formation of tides.

habitat - the arrangement of food, water, shelter and space suitable to an animal's needs.

hazardous (dangerous) wastes - those wastes which provide special problems to living creatures or the environment because they are (a) poisonous, (b) explosive, (c) attackers or dissolvers of flesh or metal, (d) readily burnable — with or without flame, (e) carriers of diseases or, (f) radioactive. Some wastes cause only one problem. Others combine several of the above.

herbivores - animals which feed on plant material.

inert - not affecting other substances when in contact with them; chemically unreactive.

igneous - rocks that were once melted.

inorganic - made up of matter other than plant or animal e.g. mineral.

insoluble - incapable of being dissolved in a liquid.

interdependence - to depend on one another.

invertebrate - an animal having no backbone or internal skeleton; includes sea anemones, octopus, crabs and sea stars.

kelp wrack - plant material that has broken loose from the bottom and is moving with the water or deposited on shore.

landfill - site where garbage is stored or dumped.

leaching - the process of removing nutritive or harmful elements from the ground by water slowly filtering through the soil.

litter - A disorderly accumulation of objects, especially carelessly discarded human waste materials and scraps. Note: this word has many different definitions and meanings. Please refer to your dictionary for a complete definition.

longshore current - current in the surf zone moving parallel to the shore — generated by waves breaking at an angle to the shore.

metamorphic - rocks that have changed over time into different forms due to extreme heat, pressure or friction.

migration - the seasonal movement of an animal for feeding or breeding.

minerals - a solid, crystalline element or compound (like diamond or quartz) that results from the inorganic processes of nature.

natural resources - resources produced by nature, such as land, forests, minerals, water and air.

Neap Tide - lowest range of the tides, occurring at the first and last quarter of the moon.

nutrients - substances which provide energy for growth and maintaining metabolism.

nonrenewable resources - resources such as minerals, coal and oil that are found as fixed, depletable supplies on the earth.

organic matter - related to or derived from a living thing.

organism - a living thing.

packaging - the act, art, industry, process, or style of packing; containing a bundle of similar or identical items.

Pacific Flyway - the route from the Arctic polar region to the southern tip of Baja, Mexico traveled by many migratory waterfowl for the purpose of feeding and breeding.

photosynthesis - a process in which plants use CO_2, H_2O, inorganic salts (minerals) and sunlight to produce organic materials such as carbohydrates. O_2 is a by-product.

physical factors - *(see abiotic factors).*

phytoplankton - floating microscopic plants of the sea that make sugar using water, carbon dioxide, and sunlight.

plankton - free-floating (wandering) organisms of the sea.

plastic pellets - small particles of brightly colored plastic which will be processed further into various plastic items. These pellets are often lost or dumped by ships and may be mistaken by birds for food items.

pollution - harmful substances deposited in the air, water, or on land, leading to a state of dirtiness, impurity or unhealthiness.

predator/predation - an animal which eats other animals.

prey - an animal killed for food.

processors - one that processes agricultural products, foods or similar products.

pulp - a soft, moist, sticky mass of fibers made up of wood, straw and other plant materials and used to make paper.

quartz - a mineral consisting of a silicon dioxide usually found as a colorless, transparent crystal; one of the most common minerals.

recyclability - products which can be passed again through a cycle of changes or processed for further changes.

recycling - the collection and reprocessing of manufactured materials for reuse either in the same form or as part of a different product.

recycling center - a site where manufactured materials are collected and resold for reprocessing.

refuse - solid waste; things we throw out regardless of their reusability or recyclability.

renewable resource - a resource derived from an endless or cyclical source, such as the sun, wind, biofuels (petroleum), fish and trees.

reusable - a product which can be used over and over again, as is done with returnable bottles, which are washed and refilled.

rip current - a strong narrow surface current of short duration and high velocity flowing seaward through the breaker zone at nearly right angles.

scavenger - an organism that habitually feeds on refuse and carrion.

sedimentary - a kind of rock formed from sand and silt compressed together over time.

shelf life - the period of time during which a material may be stored and remain suitable for sale.

shorebird - a bird of the suborder Charadrii (as a plover, snipe or sandpiper) chiefly found along the seashore.

spawning ground - where an animal reproduces or deposits its eggs.

species - a population of individuals that are able to breed and produce healthy offspring under natural conditions.

Spring Tide - extra-high high tides and extra-low low tides occurring as the sun and moon line up and pull upon the earth together; occurs during new and full moons.

substrate - substance or base on which an organism lives.

surf zone - the region between the shoreline and the line of breakers where most wave energy is released.

tides - the ebb and flow of the ocean along the shore according to the motion of the sun and moon.

upwelling - movement of deeper water to the surface; usually associated with regions of richer productivity owing to the higher nutrient content of deeper water.

vertebrate - an animal with a backbone; five classes of animals including birds, reptiles, amphibians, fish and mammals.

volcanic - made of materials from volcanoes or influenced or changed by a volcano.

waste - something thought to no longer be of use and thrown away.

wave - an irregular disturbance over the surface of water caused by wind, earthquake activity, or the gravitational pull of the sun and moon.

weathering - to wear away or disintegrate due to atmospheric influences such as wind, waves and ice.

zooplankton - microscopic animals of the sea that mostly drift with the currents and graze on phytoplankton.

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

RESOURCES

MATERIALS LIST

The following is a list of multi-media educational materials which could support your classroom and field instruction during the Adopt-A-Beach School Education Program. Ordering information follows this list.

* materials which can be borrowed by local schools/groups from the Oceanic Society Library in San Francisco

** materials which can be borrowed by local schools/groups from the San Francisco Recycling Program

I. Audio/visual

A. Films:
1. Recycling Waste
2. The Drowning Bay
3. Go!
4. Recycling - It's Nature's Way

B. Slide Shows:
1. Plastics at Sea *
2. Plastic Pollution *
3. Life On The Sandy Beach *
4. Birds, Birds, Birds *
5. Elephant Seals *
6. The Fragile Web *
7. The Sandy Beach Habitat *

C. Filmstrips:
1. Life at the Seashore *
2. The Ocean: An Introduction *

D. Audio Tape:
1. Earth is a Water Planet/Marine Resources *

E. Video:
1. Baywatch *

II. Games
1. Endangered Species board game *
2. Coastal Food Web Cards *
3. Predator card game *

III. Posters
1. Pinnipeds of North America *
2. Mollusks and Crustacea *
3. Sea Turtles of the World *
4. Water Birds of Point Reyes and the Farallon Islands *
5. Acid Rain *
6. Oceanography from Space *
7. Marine Mammals of the Gulf of the Farallones *
8. Life in San Francisco Bay *
9. Plastics Pollution Poster *

IV. Activity Kits
1. Sand Kit
2. Rock and Mineral Sample Kits
3. Paper Making **
4. The Trash Monster: Environmental Education Program
5. Sand to Glass Simulation Kit **

V. Additional Curricula
1. Aquatic Wild *
2. ORCA: Ocean Related Classroom Activities *
3. The California State Environmental Education Guide *
4. Project Mer: Marine Ecology Research *
5. OBIS: Outdoor Biology Instructional Strategies *
6. Nature Scope - "Birds", "Endangered Species" *
7. Tortugas Marinas/Sea Turtles *
8. Science Alive! *
9. Wet and Wild *
10. Sea Sampler *
11. Bay Folder *
12. Monterey Bay Aquarium Education Materials *
13. Coastal Capers *
14. Here Today, Here Tomorrow **
15. Ohio Science Workbook **
16. Recycling Activities for the Classroom **
17. Toxics In My Home? You Bet! **

VI. Additional Resources
1. Orbiter (Earth-Moon-Sun model)
2. Magnifying Lenses and/or Bug Boxes
3. Binoculars and/or Spotting Scope
4. Tide Tables
5. Shell Collections

ORDERING INFORMATION

I. AUDIO/VISUAL

A. Films:

1. Recycling Waste (#0614.76 - MS2) 2. The Drowning Bay (#917.946)	Audio Visual Services 2145 McKinnon San Francisco, CA 94124 (415) 695-2420
3. Go! 4. Recycling - Its Nature's Way	San Francisco Recycling Coordinator (415) 554-6193

B. Slide Shows:

1. Plastics at Sea	Center for Marine Conservation 1725 DeSales St. N.W. Rm. 500 Washington D.C. 20036
2. Plastic Pollution	Natural Resources Consultants 4055 21st Street, Avenue West Seattle, WA 98199 (206) 285-3480
3. Life on the Sandy Beach	Western Marine Laboratory P.O. Box 4595 Santa Barbara, CA 93140-4595
4. Birds, Birds, Birds 5. Elephant Seals 6. The Fragile Web 7. The Sandy Beach Habitat	Not available for purchase

C. Filmstrips:

1. Life at the Seashore 2. The Ocean: An Introduction	National Geographic Educational Department 88 Washington D.C. 20036 (800) 368-2728

D. Audio Tape:

1. Earth is a Water Planet/ Marine Resources	Not available for purchase

E. Video:

1. Bay Watch	Available for purchase, Oceanic Society

II. GAMES

1. Endangered Species board game	Teaching Concepts Inc. P.O. Box 150 Jericho, NY 11753
2. Coastal Food Web Cards	Manomet Bird Observatory P.O. Box 936 Manomet, MA 02345
3. Predator card game	Ampersand Press Oakland, CA

III. POSTERS

1. Pinnipeds of North America	Center for Marine Conservation 1725 DeSales St. N.W. Room 500 Washington D.C. 20036
2. Mollusks and Crustaceans of the Coastal United States 3. Sea Turtles of the World	Government Printing Office 450 Golden Gate Avenue San Francisco, CA 94102
4. Water Birds of Point Reyes and the Farallon Islands	Point Reyes Bird Observatory 4990 Shoreline Highway Stinson Beach, CA 94970
5. Acid Rain: The Effects on Aquatic Species	U.S. Fish & Wildlife Services Publications Unit Room 148. Matomic Building 1717 H Street N.W. Washington, DC 20240
6. Oceanography from Space series	Oceanic Processes Program NASA Headquarters Washington, DC 20546
7. Marine Mammals of the Gulf of the Farallones	National Marine Sanctuary GGNRA, Fort Mason San Francisco, CA 94123 (415) 556-3509 OR Whale Center 3929 Piedmont Avenue Oakland, CA 94611 (415) 654-6621
8. Life in San Francisco Bay	Not available for purchase
9. Plastics Pollution Poster	North Pacific Fur Seal Commission Washington, D.C.

IV. ACTIVITY KITS

1. Sand Kit 2. Rock & Mineral Sample Kits	Math Science Nucleus 3710 Yale Way Fremont, CA 94538 (415) 490-MATH
3. Paper Making	S.F. Recycling Program City & County of San Francisco Room 2071, City Hall San Francisco, CA 94102 (415) 554-6193
4. The Trash Monster	California State Solid Waste Management Board P.O. Box 271 Sacramento, CA 95802
5. Sand to Glass Simulation Kit	Not available for purchase

V. ADDITIONAL CURRICULA

1. Aquatic Project Wild	Conservation Education Branch Department of Fish and Game 1416 9th Street Room 1236-8 Sacramento, CA 95814 (916) 445-7613
2. ORCA: Ocean Related Classroom Activities	Pacific Science Center 200 Second Avenue N Seattle, WA 98109
3. California State Environmental Education Guide	Alameda County Office of Education
4. Project Mer: Marine Ecology Research	Learning Resource Services 313 West Winton Avenue Hayward, CA 94544-1198 (415) 887-0152
5. OBIS: Outdoor Biology Instructional Strategies	P.O. Box M Nashua, NH 03061-8899
6. Nature Scope - Birds, Endangered Species	National Wildlife Federation 1412 Sixteenth Street NW Washington, DC 20036-2266
7. Tortugas Marinas/Sea Turtles	Center For Marine Conservation 1725 DeSales St. N.W. Rm 500 Washington, DC 20036
8. Science Alive!	Oceanic Society, Project OCEAN Fort Mason, Bldg E San Francisco, CA 94123 (415) 441-5970
9. Wet and Wild	Marine Education Program USC Sea Grant University Park Los Angeles, CA 90089-0341 (213) 743-6068
10. Sea Sampler	South Carolina Sea Grant Consortium 221 Fort Johnson Road James Island Charlestown, SC 29412
11. Bay Folder	Not available for purchase
12. Monterey Bay Aquarium Education Materials	Educational Department Monterey Bay Aquarium 886 Cannery Row Monterey, CA 93940-1085
13. Coastal Capers	University of North Carolina Sea Grant College Program P.O. Box 8605 Raleigh, NC 27695-8605 (919) 737-2454

14. Here Today, Here Tomorrow	Conservation and Environmental Studies Center, Inc. 20-13 Whitesbog Road Browns Mills, NJ 08015
15. Ohio Science Workbook.	The Ohio Academy of Science 445 King Avenue Columbus, Ohio 43201
16. Recycling Activities For the Classroom	1200 Chambers Road, 3rd Floor Columbus, Ohio 43212
17. Toxics in My Home? You Bet!	Golden Empire Health Planning Center 2100 21st Street Sacramento, CA 95818

VI. ADDITIONAL RESOURCES

1. Orbiter	Carolina Biological Supply Powell Laboratories Division Gladstone, OR 97027 1-800-547-1733 OR Ward's Natural Science Establishment P.O. Box 2567 Santa Fe Springs, CA 90670-0567 1-800-962-2660
2. Magnifying Lenses &/or Bug Boxes	Various
3. Binoculars &/or Spotting Scopes	Whole Earth Access Berkeley, SF, Marin OR Richardson Bay Audubon Society
4. Tide Tables	Bait or Longs Drugs stores
5. Shell Collections	Anna Broughton Company 711 Old Canyon Road, #46 Fremont, CA 94536

RESOURCES

CHILDREN'S BOOKS

BIRDS

Beach Birds
Vessel, M. & Wong, H. 32 pp. Chevron Chemical Corp.

Brown Pelican at the Pond
O'Reilly, E. 30 pp. Manzanita Press.

COLORING BOOKS

Ano Nuevo - A Children's Guide
Beach-Balthis, Judy. 24 pp. Firehole Press. 1985

A Field Guide to Shells
Peterson, Roger Tory. 64 pp. Houghton Mifflin. 1985

North American Sea Life
Price/Stern/Sloan. 1985

Seashore Life
D'Attilio, Anthony. 46 pp. Dover. 1973

ENVIRONMENTAL ISSUES

Animals in Danger-The Seas
Gould, Gill. 28 pp. The Rourke Corp. 1982

Conservation and Pollution
Santrey, Laurence. 30 pp. Troll Associates. 1985

Oil Spills: Danger in the Sea
Brown, Joseph E. 123 pp. Dodd, Mean & Co. 1978

Worms: Eat My Garbage
Appelhof, Mary. Flower Press. 1982

Zoobooks: Endangered Animals
Wexo, John B. 16 pp. Wildlife Education Ltd. 1983

INTERTIDAL ANIMALS

Pagoo
Holling, Clancy Holling. 87 pp. Houghton Mifflin. 1957

Where the Waves Break
Malnig, Anita. 48 pp. Carolrhoda Books. 1985

MARINE BIOLOGY AND ECOLOGY

Amazing Creatures of the Sea
Ranger Rick. 93 pp. National Wildlife Federation. 1987

Ecosystems and Food Chains
Sabin, Francene. 30 pp. Troll Associates. 1985

Life in the Water
Porter, Keith. 48 pp. Schoolhouse Press. 1986

Nature Hide and Seek: Oceans
Wood, John Norris. Alfred A. Knopf. 1985

Nature's Hidden World: Animals of the Seashore
Chinery, M., Ed. 44 pp. Silver Burdett Co. 1984

Turtles and Tortoises
Serventy, Vincent. 24 pp. Scholastic, Inc. 1984

What Lives in the Sea
Seymour, Peter. 10 pp. Macmillan. 1985

MARINE MAMMALS

Amazing Animals of the Sea
104 pp. National Geographic Society. 1981

Elephants on the Beach
Brady, Irene. Scribner's Sons. 1979

The Sea World Book of Seals and Sea Lions
Evans, Phyllis Roberts. 112 pp. HBJ. 1986

Whales and Other Sea Mammals
Posell, E. 47 pp. Childrens Press. 1982

Wonders of Seals and Sea Lions
Brown, Joseph E. 80 pp. Dodd, Mead & Co. 1976

Zoobooks: Seals, Sea Lions and Walruses
Wexo, John B. 20 pp. Wildlife Education, Ltd. 1985

OCEANOGRAPHY

Our Amazing Ocean
Adler, David. 32 pp. Troll Associates. 1983

The Pacific Ocean
Heinrichs, S. 46 pp. Childrens Press. 1986

RECYCLING

Paper By Kids
Grummer, Arnold E. Dillon Press, Inc. 1980

How Glass is Made
Perrins, Lesley. Facts on File. 1985

How Paper is Made
Perrins, Lesley. Facts on File. 1985

RESOURCES

REFERENCE BOOKS

BIRDS

Audubon Society Book of Water Birds
Line, Les et. al. 252 pp. Harry N. Abrams. 1987

Birds of North America
Robbins, C. et. al. 280 pp. Golden Press. 1966

Field Guide to Birds of North America
464 pp. National Geographic Society. 1983

Life Histories of North American Shorebirds
Bent, A. 420 pp. Dover. 1967.

Ocean Birds
Lofgren, L. 240 pp. Nordbok. 1984

The Return of the Brown Pelican
Brown, J. 118 pp. Louisiana State University. 1983

Seabirds
Haley, D. 214 pp. Pacific Search. 1984

Shorebirds
Hayman, Peter, et. al. 412 pp.
Houghton Mifflin. 1986

ENVIRONMENTAL ISSUES

Living with the California Coast
National Audubon Society. 393 pp.
Duke University Press 1985.

The Lorax
Suess, Dr. (Theodore Geisel).
Random House Press. 1971

Plastics in the Ocean: More Than a Litter Problem
Center for Environmental Education.
128 pp. 1987

Silent Spring
Carson, R. 368 pp. Houghton Mifflin. 1962

FIELD GUIDES

Audubon Field Guide to North American Shells
Rehder, H. 894 pp. Alfred A. Knopf. 1981

Audubon Society Field Guide to
North American Seashore Creatures
Meinkoth. N. 799 pp. Alfred A. Knopf. 1981

Pacific Coast: Audubon Society Nature Guide
633 pp. Alfred A. Knopf. 1985

Pacific Intertidal Life
Russo, R. & Olhausen, P. 60 pp. Nature Study Guide. 1981

Seashells of North America
Abbott, R. 280 pp. Golden Press. 1968

MARINE BIOLOGY AND ECOLOGY

Basic Marine Biology
Fincham, A.A. 157 pp. Cambridge University Press. 1984

Golden Guide to Seashores
Zim, H. & Ingle, L. 160 pp. Western Publishing Co. 1955

Introduction to Seashore Life of the San Francisco Bay Region
Hedgpeth, J. 136 pp. University of California. 1962

Marine Biology Coloring Book
Nieson, Thomas M. 96 pp. Barnes and Noble. 1982

Marine Life: an Illustrated Encyclopedia
George, D. & J. 288 pp. John Wiley & Sons. 1979

The Ocean World
Cousteau, J. 446 pp. Harry N. Abrams. 1979

Pacific Seashores
Carefoot, T. 208 pp. University of Washington. 1977

OCEANOGRAPHY

Introduction to Oceanography
Thurman, Harold. 464 pp. Charles E. Merrill. 1981

1989 Tide Tables: West Coast of North and South America
234 pp. NOAA. 1986

MISCELLANEOUS

Sharing Nature with Children
Cornell, Joseph Bharat. 143 pp. Ananda Publications. 1979

RECYCLING

Materials Recycling: The Virtue of Necessity
Chandler, William. Worldwatch Institute. 1983

Mining Urban Wastes: The Potential for Recycling
Pollock, Cynthia. Worldwatch Institute. 1987

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

MANUAL

TEACHER PLANNING INFORMATION

This section provides a background and a step-by-step manual to carry you through an Adopt-A-Beach cleanup. It includes checklists and forms that will help your program run smoothly and help your school make its contribution to ending pollution of our beaches and ocean.

CONSERVATION

A field trip to the seashore can be an exciting experience as well as a valuable educational tool. Along the coast of North America we are fortunate to have such a variety and abundance of tidelands and marine life. This is a valuable natural resource and it is just as important to conserve seashore life as it is to conserve forests and other wildlife. The attitudes and practices that you, the teacher, display are important, as much of what our students learn about conservation is better "caught" than taught. Please take nothing from the beach. Please leave all life undisturbed, especially the dune grass. Dune grasses keep the beach from eroding and are extremely delicate. The saying "take only pictures and leave only footprints" is a good one to share with your students (well-maybe you can take a little garbage with you as well!).

SAFETY INFORMATION

1. HAVE ADEQUATE ADULT SUPERVISION. Take only a manageable size group to the beach. A group of 30 students or less is a reasonable size. One adult for every 5-10 students is a good ratio.

2. ASSIGN STUDENTS TO A BUDDY SYSTEM BEFORE LEAVING YOUR CLASSROOM. This provides the students with a working partner and eliminates the possibility of losing one student and not noticing it until faced with a distressed parent.

3. NO STUDENTS IN THE WATER! Climbing on rocks, playing near the water, wading and wave chasing where currents exist are all potentially dangerous activities and are prohibited.

4. CHECK WEATHER CONDITIONS BEFORE LEAVING SCHOOL. A stormy beach is not a good place to take students. Practice the phrase, "Never turn your back to the ocean" with your students before starting your field trip. Warn students to look for extra large "sneaker waves". Have buddies look out for each other.

5. DRESS WARMLY AND WEAR STURDY SHOES. Jackets are a must. It is usually a lot cooler at the beach, even on a sunny day. Dressing in layers works well.

6. BRING A FIRST-AID KIT WITH YOU.

PLANNING HINTS

The Coastal Commission works to provide logistical support and acknowledgement for schools participating in the statewide Adopt-A-Beach program. The Commission also helps put schools in touch with others in the Adopt-A-Beach network, including local community groups and the agencies that manage local beaches, who can help support a school's Adopt-A-Beach effort.

Schools can also enhance their Adopt-A-Beach program by taking advantage of the many ocean-oriented programs and activities and excursions that are part of COASTWEEKS each fall, and the Adopt-A-Beach poster and photo contest which is sponsored by the Commission in the spring.

Teacher training in the Adopt-A-Beach curriculum can be arranged with the Oceanic Society. The Oceanic Society's Project OCEAN also has a schoolwide marine science teacher training which has brought Oceans Week to dozens of schools in California, Nevada and Texas.

CHECKLIST FOR AN ADOPT-A-BEACH CLEANUP

This checklist show you all of the steps of an Adopt-A-Beach cleanup. We encourage you and your group to follow and complete all of these steps, as it will help to make your cleanup fun and productive.

The First Step

_____ 1) Identify a beach you'd like to adopt.
_____ 2) Complete a "Beach Adoption Application"
_____ 3) Begin Organizing For The Cleanup
_____ 4) Begin Assembling Supplies/Materials
_____ 5) Develop Marine Education Lesson Plan

One Month Before Cleanup

_____ 6) Scout the beach
_____ 7) Secure supplies
_____ 8) Arrange for trash recycling/pickup
_____ 9) Arrange for transportation

Two Weeks Before Cleanup

_____ 10) Reconfirm arrangements with Beach Manager
_____ 11) Send home "Parental Consent Forms".
_____ 12) Review with group and send home "Student Checklist"

One Week Before Cleanup

_____ 13) Review logistics with class
_____ 14) Review safety information with class
_____ 15) Collect "Parental Consent Form"
_____ 16) Do "Garbage in the Classroom" activity

Day Of Cleanup

_____ 17) Final check before leaving for the beach
_____ 18) Meet the Beach Manager
_____ 19) Make your safety arrangements
_____ 20) Do "At the Beach" Curriculum Activities
_____ 21) Review cleanup guidelines
_____ 22) Begin the cleanup
_____ 23) Do Data Collection activity
_____ 24) Ready bags for pickup
_____ 25) Congratulate all who participated
_____ 26) Do Follow-up Activities

Post-Cleanup Fun

_____ 27) Send Forms To California Coastal Commission
_____ 28) Send out thank you notes and acknowledgements
_____ 29) Do "Back in the classroom" Marine Science Activities
_____ 30) PAT YOURSELF ON THE BACK!

THE STEP BY STEP OF ADOPTING A BEACH

This section tells you what you need to do and when you need to start doing it.

IMPORTANT NOTE:

The steps below guide your individual cleanups throughout the year. They may be adjusted for the annual statewide Coastal Cleanup Day in the fall (scheduled for September 23 in 1989), when adopting groups and additional volunteers from the general public all join in on a massive one-day cleanup. Special County Coordinators organize that cleanup in each county; check with your County Coordinator (name and phone number available from the Coastal Commission) to plan your participation.

THE FIRST STEP

1. Identify a beach you'd like to adopt

2. Complete a "Beach Adoption Application"

- You most likely got this guide by completing our Beach Adoption Application, which establishes an agreement between your school and the Beach Manager. The Beach Adoption Application sets your cleanup schedule, and officially enrolls you as a beach "adopter".
- If you have not completed this application, call the Coastal Commission at (415) 543-8555 or toll free at 1-800-262-7848, and we will send you a Beach Adoption Kit, telling you what beaches are available for adoption in your area and how to adopt your chosen beach.

3. Begin organizing for the cleanup

- Plan to take only a manageable sized group to the beach. A group of 30 students or less per teacher is reasonable, especially if younger children are included. One adult for every 5-10 children is advised for adequate supervision.
- Use the "Checklist for an Adopt-A-Beach Cleanup" on previous page to check off the steps as you accomplish them.

4. Begin assembling the materials and support you need

- The Coastal Commission is working to provide cleanup bags, data cards, and other materials to you through your local Beach Manager. Check with the Beach Manager to see what supplies are available, and to reserve sufficient amounts for your cleanup. Make arrangements for the other supplies you need.
- The "Teachers Checklist" lists the minimum materials you will need.
- OPTIONAL: Enlist local businesses as sponsors for supplies, refreshments, souvenirs, etc.

5. Select and plan your educational activities

- Use the materials in the other sections of this guide.
- If possible, arrange for a park naturalist or interpreter to visit your classroom or meet students at the beach. The naturalist can acquaint students with the natural history of the beach and provide other interesting information.

ONE MONTH BEFORE THE CLEANUP

6. Scout the beach you have adopted

- Plan how you will physically organize the cleanup. Visit the beach at a time when the tides are similar to your scheduled cleanup time.
- Identify where you will park and assemble, which section of the beach you will clean, and where you will do your talks and activities. Check the availability of restrooms and washrooms (especially if you plan to have lunch at the beach after your cleanup).
- Note unsafe areas to avoid.

7. Begin to secure supplies for your cleanup

- Review and modify as necessary the "Students" and "Teachers" Checklists. These are found in the "Forms Wonderful Forms" section.

8. Arrange for trash/recycling pick-up

- Check with your Beach Manager on any existing arrangements.
- If necessary, contact your local recycling company and/or garbage service and ask if they will support your efforts by sending a truck to collect your bags.
- Call 1 (800) 553-2962 for information on recycling in your area.
- If a recycling center is located near your beach you could deliver your recyclables and take a tour of the center.

9. Arrange for transportation.

TWO WEEKS BEFORE CLEANUP

10. Reconfirm arrangements with Beach Manager

- The number of people participating
- The date and expected time of arrival, and meeting/assembly point
- The materials the beach manager will supply on cleanup day.
- Interpretive programs available for your students to participate in on the cleanup day.

11. Send the "Parental Consent Form" home with students to be signed and returned

- This is found in the "Forms Wonderful Forms" section.

12. Send the "Students Checklist" form home with students

- Let them know they are responsible for bringing everything on the list. Find out what items students do not have so that others can help out.

ONE WEEK BEFORE CLEANUP

13. Review trip logistics with students.

- This is critical. Preparing participants, especially children with this type of information is essential to the success of any field trip. Take care of the physical needs of your group by letting them know what to expect, and that you have carefully planned the trip. This will allow them to fully concentrate on the activities of the trip itself. Make sure they know:
  - Where to meet and at what time
  - What activities they will be doing throughout the whole day.
  - When and where you will eat lunch.
  - When there will be free time to play on the beach.
  - When and where restrooms will be available. If possible, give them a physical description of what the beach and surrounding area looks like.

14. Review safety information with class.

- You should have one adult for every 5-10 children. Let the group know who the adults will be.
- Describe the Buddy System you will use. Before leaving everyone will be assigned a Buddy who they will work with on the cleanup and be responsible for.
- No one will be allowed in or near the water on the trip.
- Let everyone know that if it is stormy, the trip will be cancelled.
- Dress warmly — the beach is usually cooler than inland, especially in Northern California.
- Begin reinforcing with everyone the importance of "never turn your back on the ocean!"

15. Collect Parental Consent Forms.

- Record each child's parents' home and work numbers on the "Important Phone Numbers" form.

16. Do "Garbage in the Classroom" activity

- This is located in your curriculum materials section. OPTION: Use the Data Card in the "Forms" section to count pieces of trash. Summarize those on the Tally Sheet included in the "Garbage Activity" section. Using the Data Card in the classroom will familiarize your students with the data collection process and enable them to contribute to the National Marine Debris Database by doing "Step 23."

CLEANUP DAY

17. Do final check before leaving for the beach

- Check weather conditions; cancel if beach is stormy.
- Bring along all items on your "Teachers Checklist."
- Assign buddy pairs. Double check that everyone has a buddy.
- Make sure everyone is dressed appropriately, and has all the items they need from the "Student Checklist."

AT THE BEACH

18. Meet the Beach Manager

- Get any materials they are providing, and confirm the day's arrangements. If you have so arranged, the beach manager or park interpreter can meet your class and provide an introduction to the beach and its wildlife.

19. Review safety precautions with entire class upon arrival

- No one goes in the water
- Never turn your back on the ocean.
- Maintain the buddy system.
- Call an adult immediately if a dangerous item (syringe, chemical container, etc.) or stranded animal is found.

20. Do marine science activities

- Send students on the "Scavenger Hunt" (see activity) to identify evidence of life and human impact on the beach. Focus students' attention on differentiating between natural and manmade objects.

CONDUCT YOUR ADOPT-A-BEACH CLEANUP!

- Instruct your class on how they will do the cleanup. We have included some suggestions below that may be helpful in organizing your class; but whatever you do, make sure everyone understands what will go on before you start.

21. Organize your class and review collecting guidelines

- Separate children into their buddy pairs, each pair will be responsible for collecting either trash or recyclables.
- Pass out cleanup bags. Check that everyone is wearing gloves.
- Assign each buddy pair to an adult supervisor.
- Remind your class not to remove wood or other natural materials (seaweed, shells, etc.) and to avoid disturbing dune grass or other vegetation.

22. Begin your cleanup

- Start in the middle of the area you will clean.
- Separate the group in half, with an equal mix of recycling and trash teams.
- Line up the two groups at the ends of the cleanup area facing one another.
- Spread the groups out across the beach, a safe distance from the water.
- The two groups should walk toward each other collecting beach debris, depositing bags at the location where the data collection activity will occur.

23. Do your Data Collection Activity using the data cards.

- Follow the directions in "Using Your Data Cards and Summary Sheet". After you've completed your data cards take some time to talk about what you and your group have learned about garbage and trash along the coast.

Some suggestions for topics to explore are:

- You can be paid money for any you return to a recycling center. What kind of litter was most often found?
- Do you think most of that litter was left here by people on the shore, or dumped from boats?
- How many recyclable beverage container did you find?
- Was any of the litter found on the beach cleanup packaging? Cans, bottles, and styrofoam ice chest are all packages.
- What could we ask politicians to do about the problem of pollution?
- How does it make you feel to see the litter along our beach?
- How does it make you feel to see the beach clean after your work?
- What can each of us do to minimize the problem of ocean pollution?
- This activity is helpful because it gives educational value to the data collection process. It also gives your students an opportunity to talk about how it feels to see their beaches polluted, and then see the difference each of them make.

24. Ready bags for pickup

- Keep the bags of recyclables and bags of trash separate. Follow arrangements worked out with Beach Manager, refuse company and local recycler for pickup of bags.

25. Celebrate your excellent team work

- Make three cheers for yourselves and take a last look at the amount of trash you collected in such a short time. If you planned it, have students wash up and have lunch.

26. Do follow up "At The Beach" marine science activities

- Gather students again and play the "Shorebird Flocking" Game (see activity). Remember to discuss the impact the beach debris might have on flocks of shorebirds. Give students time to enjoy the beach.

POST CLEANUP

27. Follow-up

- Send the California Coastal Commission the following to receive acknowledgement, and to contribute to the national marine debris data base:
- Completed cleanup summary sheet
- Data cards
- Evaluation sheet

28. Thank yous

- To drivers, chaperones, beach managers, recyclers, rangers, and anyone else who helped out. Students can divide up these responsibilities.

29. Do "Back In The Classroom" activities

30. Pat yourself on the back

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

PARENTAL CONSENT AND WAIVER OF LIABILITY

I give my permission for _____ (the "Participant") to take part in all activities associated with the Adopt-A-Beach Program. I know of no physical disorder which would keep him/her from participating in this program.

For myself and for the Participant, I waive any claim of liability against, and agree to hold harmless the State of California, the California Coastal Commission, and the sponsors of the Adopt-A-Beach Program, and any officer, agent and/or employee of any of them from any claim for injury to the Participant arising out of, or connected with the Adopt-A-Beach Program.

If the Participant should become injured while participating in the Adopt-A-Beach Program, I authorize any physician licensed in the State of California to perform any emergency or surgical treatment as in his or her sole judgment may be necessary.

PARENT #1 (or GUARDIAN) signature: _____

Phone number: (work) _____ (home) _____

Date: _____

PARENT #2 (or GUARDIAN) signature: _____

Phone number: (work) _____ (home) _____

Date: _____

If the Participant is under 18, both parents (or guardians, if any) must sign, unless there is only one parent or guardian, or unless only one has legal custody.

PARTICIPANT'S NAME _____ _____ _____
(Last) (First) (Initial)

ADDRESS _____

CITY _____

TELEPHONE (home) _____

GROUP/ORGANIZATION _____

LOCATION OF ADOPTED BEACH AND ACTIVITY _____

WHAT TO WEAR AND WHAT TO BRING TO A BEACH CLEANUP

STUDENTS' CHECKLIST

Clothing

_____ Windbreaker/nylon wind shell or jacket as the outer layer

_____ Sweater

_____ Long Pants

_____ Shorts/T-Shirt(for hot weather)

_____ Sturdy shoes

_____ Gloves

_____ Hat (sun or wool depending on weather)

Misc. —

_____ 1 quart liquids

_____ Sunscreen

_____ Sacklunch

_____ Sunglasses

DRESSING FOR SUCCESS ON A BEACH CLEANUP

Your beach cleanup will be a lot more fun if you have the right clothes and have brought what you need. It is important to remember that it will always be colder along the water, so bring additional warm clothes.

Here's a few things to remember:

- Even summer can be cool at the beach, so it's important to be prepared.
- If weather is especially cool, dressing in layers works well. (i.e. long pants, turtleneck, sweater, jacket, windbreaker and a hat, preferably wool.)
- If you run the risk of being caught in the rain, be sure to wear wool or pile clothing, as it will keep you warm even when it's wet.
- Wear gloves and sturdy shoes when doing a cleanup. Glass and other debris can be sharp.
- On hot/sunny days be sure to bring at least a quart of water, juice, or softdrinks. Working and playing in the sun can take a lot of energy, drinking fluids throughout the day can help you avoid getting overly tired or experiencing headaches.
- Be sure to bring and use sunscreen.

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

TEACHERS CHECKLIST FOR BEACH CLEANUP

Cleanup Supplies

_____ Gloves

_____ Paper/Pencils

_____ Bags (usually available from Beach Manager)

_____ Scale: Bathroom/Household

_____ First Aid Kit

_____ Clipboards

Items You Want To Include:

_____

_____

_____

Forms Wonderful Forms

_____ Cleanup Summary Sheet

_____ Important Phone Number

_____ Parental Consent Forms

_____ Data Cards

Items You want To Include:

_____

_____

_____

Materials for Educational Activities

_____

_____

_____

_____

Optional Items

_____ Barbeque Accessories

_____ Radio/Musical Instruments

_____ Binoculars

_____ Extra Film/Tape

_____ Camera (Still or Video)

_____ Field Guides

_____ Games

_____ Picnic Items — (remember to use reuseable or recylable items such as cloth or paper products)

A D O P T - A - B E A C H
SCHOOL EDUCATION PROGRAM

IMPORTANT PHONE NUMBERS

FOR MORE INFORMATION ON:

Adopt-A-Beach
California Coastal Commission
631 Howard St., 4th Floor,
San Francisco, CA 94105
(415) 543-8555

Adopt-A-Beach School Education Program Curriculum and Trainings
The Oceanic Society, San Francisco Bay Chapter
Bldg. E, Fort Mason Center
San Francisco, CA 94123 (415) 441-5970

Marine Debris
Center For Marine Conservation
321 Sutter Street
San Francisco, CA 94108
(415) 391-6204

Recycling
Information on Certified Recycling Centers
Department of Conservation,
Division of Recycling
1025 P Street, P.O. Box 944268
Sacramento, CA 94244-2680
1 (800) 327-9886

Listing of general recycling centers
California Waste Management Board
1-800-553-2962

General information on recycling
The California Waste Center
(916) 322-3330

FOR CLEANUP DAY

Beach Manager _____
(Name) (Phone Number)

Emergency Numbers

Police/Fire _____

Hospital _____

Additional Numbers	Home#	Work#

USING YOUR DATA CARDS AND SUMMARY SHEET

The information you record on the Data Cards will be used by the Center for Marine Conservation in a national marine debris study to help policy makers at the state, federal and international levels develop solutions to ending the serious marine debris problems facing all coastal states and countries.
DATA COUNTS! YOUR HELP WILL MAKE A DIFFERENCE!

See "Forms Wonderful Forms" for your sample data card

BEFORE YOUR BEACH CLEANUP

To make your data collection procedure fun, educational and trouble free it's advised that you do the "Garbage In The Classroom" activity, before you go to the beach.

AT THE BEACH

Materials Needed

Data Cards, Summary Sheet, Trash Bags (full with recyclables and trash), Gloves, Clipboards, Pencils, Household Scale

Filling out your summary sheet

- After your cleanup have class bring their recycling/trash bags to one central location.
- Count total number of bags.
- Weigh all the bags or a sample of each type, using your scale.
- Fill in the information on the Cleanup Summary Sheet

Filling out your Data Card

- Ask each buddy team to take one bag of debris.
- Hand out Data Cards, and pencils to each buddy team,
- When filling out cards, count items in groups of five (like this: **1111**) and record the **total** in box.
- Do not write the words "lots" or "many". Only numbers of items can be used.
- In the "Stranded animals" section, please list animals you find stranded or dead on the beach and, if possible, any entangling debris items.
- In the "Sources" section, please list foreign items found and country, if identifiable.
- Indicate on each data card whether what you collected was from a recycling or trash bag.

Follow-up

- Depending on your arrangements for recycling, separate out the recyclables as you go along. If you need to further segregate recyclables you can do it now.
- Collect the data cards once they are completed, combine with your "Cleanup Summary Sheet" and set aside to mail to the California Coastal Commission.

Do Data Collection Discussion Activity

- Review questions from Step #23.

BEACH CLEANUP DATA CARD

Thank you for completing this data card. Answer the questions and return to your area coordinator or to the address at the bottom of this card. This information will be used in the Center for Environmental Education's National Marine Debris Data Base and Report to help develop solutions to stopping marine debris.

Name _____ Affiliation _____

Address _____ Occupation _____ Phone (____)_____

City _____ State _____ Zip _____ M ____ F ____ Age: _____

Today's Date: Month _____ Day _____ Year _____ Name of Coordinator _____

Location of beach cleaned _____ Nearest city _____

How did you hear about the cleanup? _____

SAFETY TIPS

1. **Do not go near any large drums.**
2. **Be careful with sharp objects.**
3. **Wear gloves.**
4. **Stay out of the dune areas.**
5. **Watch out for snakes.**
6. **Don't lift anything too heavy.**

WE WANT YOU TO BE SAFE

Number of people working together on this data card _____ Estimated distance of beach cleaned _____ Number of bags filled _____

SOURCES OF FOREIGN DEBRIS. Please list all items that have foreign labels.

Country	Item Found
Example: Mexico	plastic bottle - "Clarisol"

STRANDED AND/OR ENTANGLED ANIMALS (Please describe type of animal and type of entangling debris. Be as specific as you can.)

_____

_____

_____

What was the most peculiar item you collected? _____

Comments _____

_____

Thank you!

PLEASE RETURN THIS CARD TO YOUR AREA COORDINATOR OR MAIL IT TO:

Center for Environmental Education
1725 DeSales Street, NW
Washington, DC 20036

A Membership Organization

Center for Environmental Education

EPA United States Environmental Protection Agency

ITEMS COLLECTED

You may find it helpful to work with a buddy as you clean the beach, one of you picking up trash and the other taking notes. An easy way to keep track of the items you find is by making tick marks. The box is for total items; see sample below.

egg cartons 𝍸 𝍸 𝍸 | Total 16

cups 𝍸 𝍸 𝍸 𝍸 | Total 22

PLASTIC

Total number of items

bags:
- trash
- salt
- other

bottles:
- beverage, soda
- bleach, cleaner
- oil, lube
- other

buckets
caps, lids
cups, spoons, forks, straws
diapers
disposable lighters
fishing line
fishing net:
- longer than 2 feet
- 2 feet or shorter

floats & lures
hardhats
light sticks
milk, water gallon jugs
pieces
pipe thread protector
rope:
- longer than 2 feet
- 2 feet or shorter

sheeting:
- longer than 2 feet
- 2 feet or shorter

6-pack holders
strapping bands
syringes
tampon applicators
toys
vegetable sacks
"write protection" rings
other (specify)

GLASS

bottles:
- beverage
- food
- other (specify)

fluorescent light tubes
light bulbs
pieces
other (specify)

STYROFOAM® (or other plastic foam)

Total number of items

buoys
cups
egg cartons
fast-food containers
meat trays
pieces:
- larger than a baseball
- smaller than a baseball

other (specify)

RUBBER

balloons
gloves
tires
other (specify)

METAL

bottle caps
cans:
- aerosol
- beverage
- food
- other

crab/fish traps
55 gallon drums
- rusty
- new

pieces
pull tabs
wire
other (specify)

PAPER

bags
cardboard
cartons
cups
newspaper
pieces
other (specify)

WOOD (leave driftwood on the beach)

crab/lobster traps
crates
pallets
pieces
other (specify)

CLOTH

clothing/pieces

(OVER)

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

CLEANUP SUMMARY SHEET

Your input is valuable to us! Please mail this form within 1 week of your cleanup, so we can keep up to date records on what kind of marine debris is accumulating along our coast. Thanks for your help!

GROUP LEADER

Name _____

Address _____

City _____ Zip Code _____ County _____

Phone _____ (home) _____ (work)

Schools Name: _____

Beach Cleaned: _____

County _____

Date _____

Number of Cleanup participants: _____

Statistics

Volume collected:	Recyclables	Trash
Number of bags	_____	_____
Average weight/bag*	_____	_____
Total Weight*	(_____)	(_____)

*You may weigh a typical random sample and multiply the average weight per bag to get the total,or actually weigh all the bags. Please indicate how you got your total:

( ) estimated weight
( ) measured weight

Most Unusual Items Found _____

_____

Suggestions/Comments

How can we make the Adopt-A-Beach cleanup program more successful?

_____

_____

_____

_____

Please mail this survey along with your completed data card(s) to the
Adopt-A-Beach, California Coastal Commission, 631 Howard St. 4th Fl., San Francisco, CA 95105.

MANUAL

ADOPT-A-BEACH

SANDCASTLES AND SUNBURNS

SUMMARY: Students make a class collage to show that people use the beach in many ways.

FOCAL CONCEPT: People value and appreciate the beach in many ways.

TRANSITIONS: In this activity students identify the many ways that they use and value the sandy beach. In the following activity, the "Web of Life," students discover that humans' careless use of this habitat may adversely affect the entire food web.

BACKGROUND: In the United States, many beaches are protected for public enjoyment. A protected status insures that private developers will never be allowed to build on or in any way restrict public use. In some states such as Oregon, all beaches are public and accessible to everyone. Some of the most beautiful stretches of beach have been designated as National Seashores or Parks — Point Reyes National Seashore, Olympic National Park, Cape Cod. In states like California, certain areas of the coastline are protected with State Beach status.

Beaches are important places for people to relax and enjoy the ocean. They provide the simplest, most direct, and least expensive access to the marine environment. The sheer numbers of people who visit a beach during the year can greatly increase the volume of debris left behind. The Adopt-A-Beach School Education Program was created to give students a chance to learn more about a sandy beach habitat while learning how to care for it. By giving students a first-hand look at the fragile nature of such an ecosystem, they discover how easily it can be impacted by human carelessness.

SCIENCE PROCESS SKILLS:

observing
communicating
comparing

KEY WORDS:

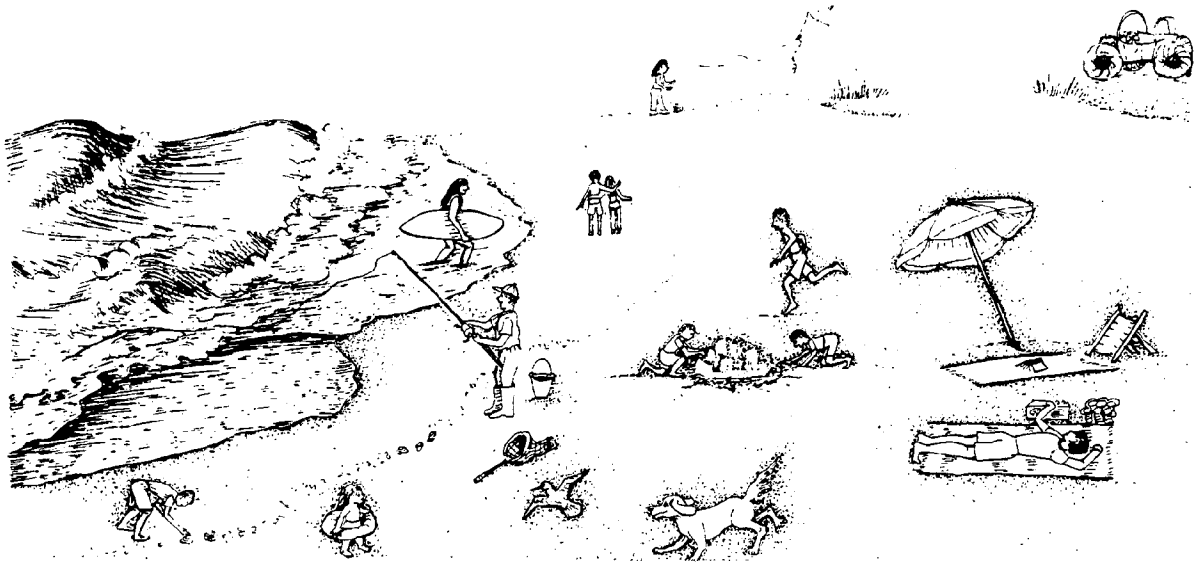
coast
ecosystem
protection
habitat
debris

TIME:

20-30 minutes for discussion (before and after field trip)
30-50 minutes for the collage

MATERIALS:

picture magazines
white glue or rubber cement
scissors, one pair per student
butcher paper



ACTION:

1. Ask the class to tell you what they like or would like to do at the beach. Brainstorm a list on the board. Try to list as many things as you can. The list might look like this:

swim	listen to the radio	go walking
picnic	go sailing	play frisbee
body surf	collect shells	get sunburned
build a sand castle	make a mobile	take pictures

Hold a brief discussion on why these activities are popular at the beach. Ask students which of them they would like to do at the beach most often. Choose several of the most popular of these activities and have students go to a designated area within the classroom that represents their favorite beach activity.

Have students look around the room and notice their classmates' preferences. Why do people have different ideas about what to do on a beach?

2. Now ask the class to imagine that they become the following people (one at a time): tourist, fisherman, Native American, pilgrim, park ranger, etc. Which of these people use the beach mainly for food, shelter, fun?

3. Have students cut pictures out of the magazines showing people using the beach. Bigger pictures will work better for a large group collage; small pictures could make a "Beach Book" or album. Students might want to create a scrap book of their favorite beach activities.

4. After visiting your beach for the clean-up, have the class do action item number one again. This time your list may look a little different. Words that might show up on the list this time might include "clean-up", "litter" or "build fires". Have the students perceptions of the beach changed in response to the clean-up?

DISCUSSION:

1. Why do people like being at the beach? Elicit from students the way they feel when they are at the beach. Compare these feelings with how they might feel if they went to the beach during a bad storm. How would they feel if they found a dead whale or bird on the beach? How would it feel to be shipwrecked on a beach? How did they feel about seeing all the trash and garbage left by other people?

2. How many people is too many at the beach? What makes you feel crowded at the beach? Do you think people should be able to visit beaches for free? Would you go to a beach that has an entrance fee? How about a beach that allows food vendors to sell hot dogs and souvenirs (common to many East Coast beaches)? What is it that is important to you about the beach that ought to be protected?

TEACHING STRATEGIES:

1. When using the brainstorming technique to elicit information from your students, be sure that everything that is said makes it up on the board. Try not to edit your students responses.

2. This project can be used as a center activity or individual student project.

EXTENSIONS:

1. Have each student make a small collage or pages for a beach book. Have students label the pictures or even write a story to go with them. Pictures can even be laminated to give them a finished look.

2. Create a shoe box diorama of a beach scene illustrating the various activities listed from brainstorming together. Make a display of your projects for the school library.

3. Send away for park brochures from the National Seashores in the United States and post them around your room for students to see. Compare the wide beaches of the East Coast with the narrower beaches of the West Coast.

4. Look at a street map of your town with the class. Have the class make a list of all the street names that have something to do with the seashore. Be sure to include Spanish translations. Design an imaginary town by the seashore where all the names of the streets are beach words — like Jellyfish Lane, Sand Crab Court, Sanderling Street, etc.

5. Read out loud poems and stories inspired by the beach and have students write their own poems about the beach or their field trip.

6. Make a bulletin board of family photos taken at the beach, collected from students in the class.

7. Design an imaginary section of coastline allowing for beach use, recreational fishing, boating, docks, and other beach uses.

Activity taken from *Project Ocean Sandy Beach Habitat Guide* San Francisco Bay Chapter, Oceanic Society

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

WEB OF LIFE

SUMMARY: Students play a game that demonstrates the interconnections between sandy beach organisms and the roles they play within their habitat.

FOCAL CONCEPT: Living organisms are interconnected either directly or indirectly with everything within their physical environment. The action of one organism or change in one physical factor can affect all other organisms within that habitat and eventually impact other habitats.

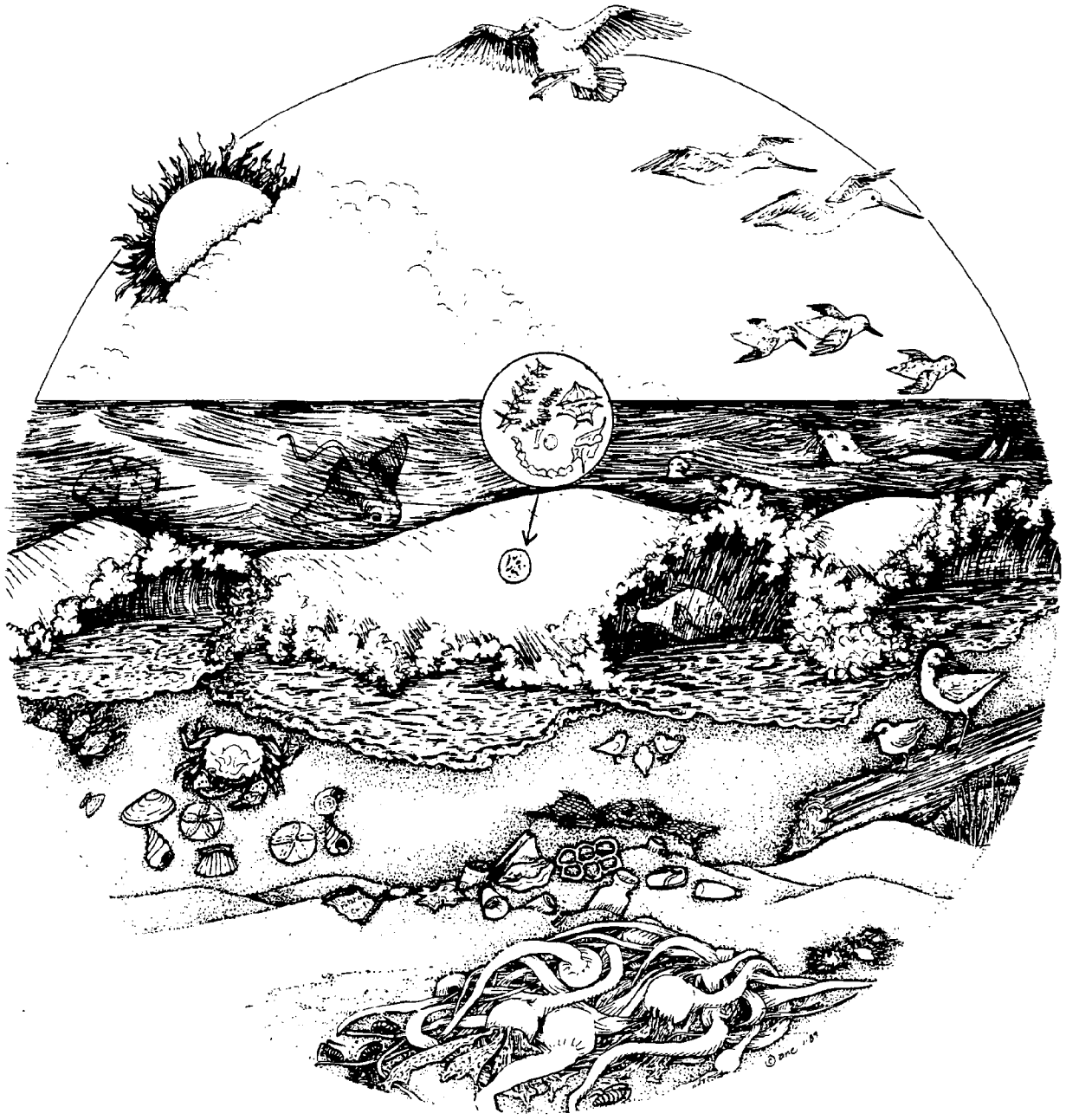
TRANSITIONS: In the activity **Sandcastles and Sunburns** the students demonstrated the many ways that they use and value the beach habitat. In the **Web of Life** activity, the students discover that humans careless use of this habitat may adversely affect the entire food web.

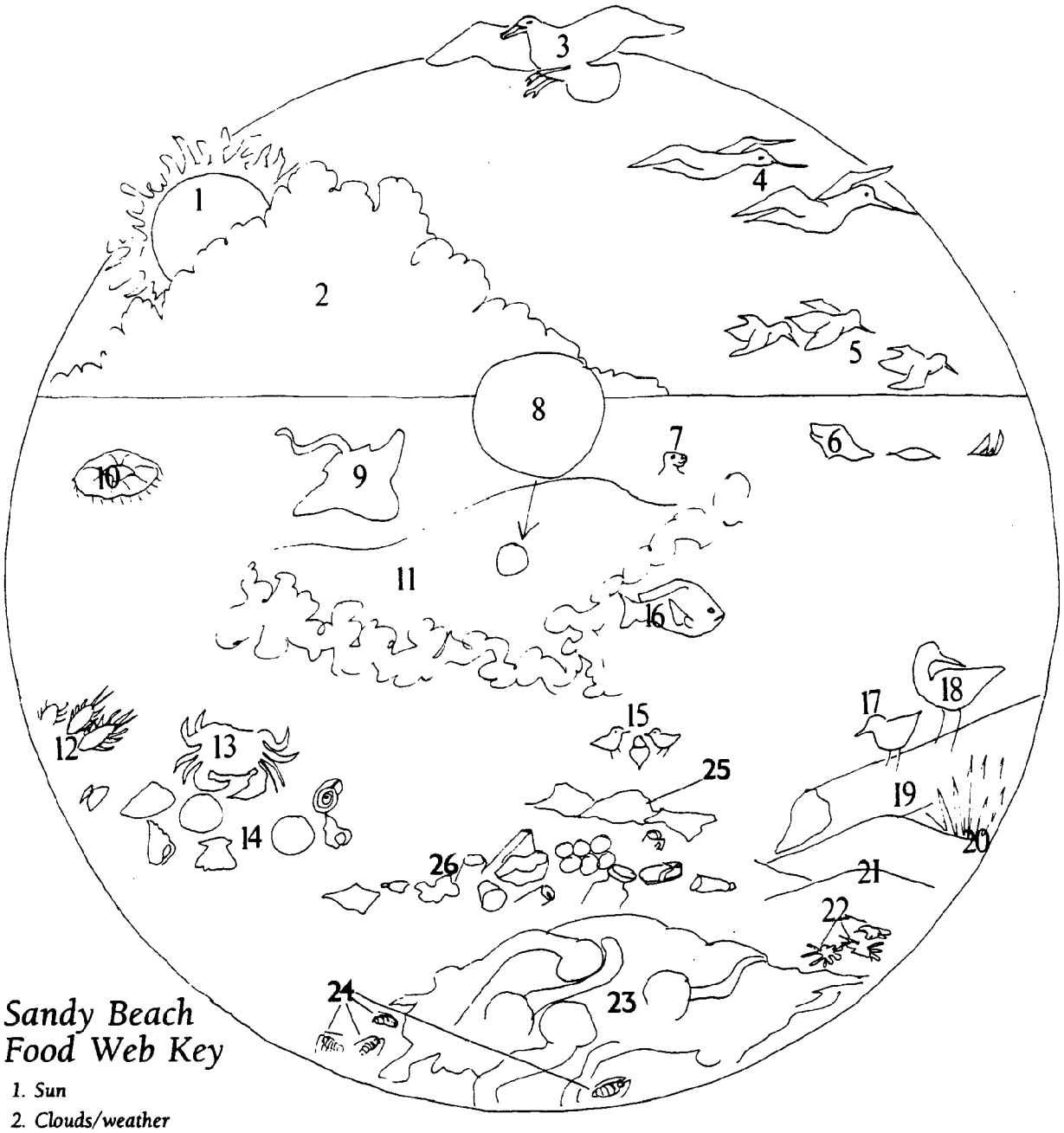
BACKGROUND: Living organisms are connected to one another within their physical environment. This interdependence takes a variety of forms from who eats whom (predator-prey relationships) to dependence on the habitat for a place to reproduce, attach, or burrow. Animals may also be dependent upon abiotic (physical) factors: inorganic nutrients (e.g., fertilizers like nitrates) and the energy from the sun for photosynthesis; waves to bring in oxygen; and current action to bring in food and disperse young.

Shorebirds, such as godwits, are dependent upon mole crabs buried in the sand for food; mole crabs eat phytoplankton and zooplankton which are brought to the beach by waves and currents; zooplankton eat other zooplankton and phytoplankton; phytoplankton are dependent upon inorganic nutrients (for raw materials) brought to the surface by upwelling and the sun for energy to make their own food through photosynthesis. These interconnections can be shown in the form of a food web where lines and arrows are drawn between predators and their prey.

Food webs are often complex, with animals eating more than one prey item. When a particular prey becomes scarce, the predator may still survive by eating the alternate food item. Many food webs, however, are fragile and the removal of even one link in the chain may ultimately result in the collapse of the entire food web. Such a case may occur for the above example if upwelling does not take place one year (e.g., during El Nino). Without upwelling, the phytoplankton which is the base of the food chain cannot "bloom", zooplankton cannot flourish, mole crabs then cannot find enough to eat, and ultimately the godwits will have to concentrate on some other food item, move to another beach, forego reproduction that year or starve.

Habitat reduction through careless onshore or offshore construction may also disrupt the food web. Pollution from oil spills may coat shorebirds so that they are no longer able to keep warm. Silt carried downstream from construction and agriculture can smother animals when it is brought back to shore by currents. Garbage dumping by ships offshore may also affect the beach in a number of ways. Entanglement in plastic packing straps or fishing nets create environmental "boobytraps". Animals may also mistakenly eat plastic pellets or bags and then starve. These are all potentially disruptive to the food web. (See **Action, Part 3** for specific "boobytrap" examples).





Sandy Beach Food Web Key

1. *Sun*
2. *Clouds/weather*
3. *Gull*
4. *Marbled Godwits*
5. *Dunlins flying*
6. *California Sealion*
7. *Harbor Seal*
8. *Enlarged plankton*
9. *Bay Ray*
10. *Jellyfish*
11. *Wave action*
12. *Mole Crabs*
13. *Shore Crab*
14. *Assorted shelled animals including sand dollar, clams, turbans, scallops and whelks*
15. *Sanderlings*
16. *Surf Perch*
17. *Sandpiper sp.*
18. *Willet*
19. *Log / driftwood*
20. *Dune grass*
21. *Sand dunes*
22. *Crab molts*
23. *Kelp (drift)*
24. *Beach Hoppers*
25. *Old fishing net*
26. *Assorted plastic and other garbage*

SCIENCE PROCESS SKILLS:

observing
communicating
comparing
relating
inferring

KEY WORDS:

food web
habitat
phytoplankton
predator
scavenger
inorganic
entanglement
boobytrap
filter feeder
food chain
physical factors
zooplankton
prey
herbivore
vertebrate
photosynthesis
producer
interdependence
abiotic factors
nutrients
detritus
carnivore
invertebrate
upwelling
silt

TIME: 45 MINUTES

MATERIALS:

masking tape or safety pins
ball of yarn
pictures of some of the following living/nonliving/boobytraps with a sentence or two description of each on the back
actual items from the following "boobytrap"/garbage list

LIVING	"NONLIVING"	"BOOBYTRAPS"/GARBAGE
PLANKTON	DRIFTWOOD	PLASTIC PIECES
KELP FLIES	SAND	PLASTIC BOTTLES
SURF PERCH	SUN	PLASTIC SIX-PACK RINGS
RAYS	WAVES	FISHING LINE AND NETS
PEOPLE	CURRENTS	PLASTIC BAGS
BEACH HOPPERS	CRAB MOLTS	GLASS BOTTLES
SEA TURTLES	DETRITUS	ALUMINUM CANS
BARNACLES	*VELLELLA*	STYROFOAM
MOLE CRABS (*EMERITA*)	JELLYFISH	SILT
SHORE CRABS	SHELLS	
GODWITS	SAND DOLLARS	
GULLS	KELP (DRIFT)	
DUNLINS		
SANDPIPERS		
WILLETS		
SEA LIONS		
HARBOR SEALS		

ACTION:

PART 1: WHO AM I?

1. Write the above list of names on the board (choose those you can find pictures of or information about).

2. Review vocabulary words such as herbivore, scavenger, predator, etc. with the students. Discuss which groups of animals have backbones and which do not.

3. Have students sit in a circle on the floor and pair up with someone sitting next to them.

4. Tape or pin a picture on the back of each student or have the pairs of students pin them on each other without letting their partner see the picture.

5. Have the pairs of students play "20 Questions" by asking only "yes" or "no" questions to try to guess who he/she might be. Sample questions might include "Am I an animal?" "Do I scavenge?" "Am I alive?" "Do I have a shell?" "Am I an herbivore?" "Do I have a backbone?"

6. Once the student has guessed correctly, have them put the picture on their front and a check by the name on the board list.

PART 2: FOOD WEB GAME

1. Discuss interdependence, food webs/chains and ways in which animals can be dependent on one another within their physical environment. Use examples given in the background.

2. Have all the students form a circle holding their pictures so that everyone can see them. Designate one student to start and give them the ball of yarn. Ask who or what they are dependent upon and have them throw the ball of yarn to the student holding that picture. The second student then throws the ball of yarn to someone holding a picture of something they are dependent upon. Before they can toss the yarn to another student, they must be able to describe to the rest of the class how they are dependent on the pictured item to which they threw the yarn. (Example: "I depend on for ".) Remind each student that they must hold onto a piece of the yarn before they toss it and the yarn should be held taut between links in the web.

3. When every student has had the yarn tossed to them at least once, the game can be stopped. The class has now formed a complex food web wherein everyone is connected directly or indirectly to each other and the physical environment.

PART 3: ENVIRONMENTAL BOOBYTRAPS AND PITFALLS

1. Now introduce the boobytrap cards into the game. Select only one boobytrap at a time. Give a student holding either the jellyfish, surf perch (or another fish), crab or kelp the corresponding boobytrap card as follows: Replace Jellyfish card with plastic bag; fish card with fish entangled in a net; crab card with plastic pieces; drift kelp with fishing line, fishing nets or six-pack rings; plankton with silt.

2. Once a boobytrap card has been passed out, describe the corresponding scenario to the students as follows. The jellyfish now takes on its previously hidden form of a plastic bag, the sea turtles favorite food. Thinking the jellyfish was a food item, it actually swallowed a plastic bag and starved or choked to death. The sea lion was chasing a fish and did not see that the fish was caught in a net, the sea lion then became entangled in the net and drowned or strangled; birds feeding on crabs mistook the brightly colored plastic pieces for their food items, fed them to their chicks which then starved; gulls scavenging in the drift kelp became entangled in plastic six-pack rings, fishing nets or hooks and line and then were unable to fly or feed themselves; mole crabs and barnacles filtering the water for plankton were instead smothered by silt.

3. The student connected to the boobytrap card (e.g. sea turtle connected to jellyfish-plastic bag boobytrap) must drop their piece of the yarn because they have been removed from the food web.

4. Then have each student drop their piece of the yarn, one at a time, as they feel the slack in the yarn web.

5. After each student has dropped their piece of the yarn, review interdependence and the importance of each creature to a healthy food web and how different animals might be affected by the loss of one species.

DISCUSSION:

1. What would happen to the sandy beach food web if each of the boobytrap cards were introduced? (Answer: see Action, Part 3: -2)

2. What role(s) do people play in the sandy beach food web? Do people play only negative roles or are there some positive influences?

3. How does offshore building affect the sandy beach habitat? (Answer: jetties and harbors may change the longshore currents which carry sand to and from the beaches. Some beaches may disappear as the sand is carried away and not replaced.)

4. Why are our negligent actions out at sea, (e.g., oil spills or dumping) of concern when studying the sandy beach habitat? (Answer: currents transport substances dumped at sea over very long distances and both waves and currents deposit these materials on the beaches).

5. What would happen if people started using phytoplankton as a primary food source? What other organisms would this affect?

6. What is the difference between food webs and food chains? Give some terrestrial examples of each. How might these be interconnected with the sandy beach food webs?

7. Describe two different food webs found on the sandy beach. Do they overlap or are they independent of one another?

8. What are some of the physical factors affecting the sandy beach habitat? Are any sandy beach food webs independent of the physical factors?

TEACHING STRATEGIES:

1. The "Who am I?" game can be played with the entire group instead of in pairs. In this case have one student enter the circle at a time and have the students forming the circle take turns answering the questions.

2. Do Extension -1 below before playing the game, this gives every student a wealth of information with which to form complex food webs and to discuss their interrelationships.

3. Add prompts (clues) to the back of the pictures to help the students in guessing who they are in the "Who Am I?" activity. Decide on the number of questions they need to ask before they are given the first clue. For younger or LEP students, you may want to give them the clues right at the start.

4. This activity can be used to "check for understanding" by using the number of clues needed to guess who they are as a measure of their knowledge.

EXTENSIONS:

1. Have students choose one of the animals listed and use field guides or reference books to find out all they can about them. Then have the students give oral reports to the class.

2. Make 3-d creatures and habitats in your classroom or on bulletin boards. Be sure to add in the "boobytraps" and physical factors. Use yarn to connect the organisms and physical factors in food webs and to show their interdependence. Use differently colored yarn to show producers, herbivores, carnivores and scavengers.

3. Research how factors originating in other habitats, such as erosion upstream, El Nino and upwelling, may have significant effects on sandy beach habitats.

Activity adapted from *Project OCEAN Sandy Beach Habitat Curriculum Guide*, San Francisco Bay Chapter, Oceanic Society

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

TIDAL WAVES

SUMMARY: Students construct a mobile to illustrate the relationship between the movements of the earth, moon and sun and the formation of high and low tides. The students then act out the movement of the ocean tides and older students can go on to measure and record the daily changes in tidal height and time in relation to a dock.

FOCAL CONCEPT: Daily changes in height and time of the high and low tides follow the movements of the moon and earth in relation to the Sun.

TRANSITIONS: In the "Web of Life" activity the students discovered the interconnections between beach organisms and their physical environment. In "Tidal Waves" students learn about the tides, one of the most important physical factors affecting the animals living in this habitat.

BACKGROUND: The tides are the periodic rise and fall of the ocean which can be seen along coastlines. Tides are actually very long waves which are following the path of the moon across the ocean. High tide occurs as the crest of the wave passes a particular location; the passing trough or low point of the wave creates the low tides. Opposite sides of the earth experience high tides at the same time.

Tides are created by two forces — gravitational and centrifugal. The tidal bulge closest to the moon is caused primarily by the gravitational force between the earth and moon. The tidal bulge on the opposite side of the earth is caused primarily by centrifugal force. The centrifugal force on the ocean can be compared to water spinning off a bicycle tire or clothes sticking to the sides of a washing machine after the spin cycle. The centrifugal force is caused by the earth and moon revolving around a common point, so the side of earth farthest from the Moon travels farther and faster. The sun has only a slight effect on the tides though it is 27 million times heavier than the Moon. This is because it is 400x further away.

Spring tides occur at new and full moons when the Moon's and earth's gravitational fields line up. This happens twice a month all year. These tides rise higher and fall lower than at other times in the month. Neap tides occur at the first and third quarter moons when the sun, moon and earth are at right angles to each other. At this time, the gravitational fields of the sun and Moon somewhat cancel each other out. The difference between the water levels at high and low tides is much smaller at Neap tides compared with Spring tides.

Beach organisms are dependent on the tidal rhythms for activities such as reproduction and food gathering. Grunions spawn only during the highest Spring tides when they can bury their eggs high up on the shore, out of reach of most predators. Two weeks later at the next Spring tide when the water again reaches up that high on the shore, the eggs hatch and the young are able to swim back into the water. Invertebrates living in the sand are dependent upon food brought to the shore by the tides and wave action. Those invertebrates are in turn preyed upon by shorebirds and crabs as the low tide uncovers the shore.

Human interactions on the beach can have adverse effects on the organisms dependent on the tidal rhythms. For example, lights on shore disorient turtle hatchlings and they go towards the light and housing developments instead of towards the sea; collection of turtle eggs on the beaches reduces the number of individuals in this already endangered population; jetties offshore can affect sand flow along the beach and cause some beaches to disappear; tides deliver human debris onto the beach where birds and turtles may become entangled and then clears debris off, taking it out to sea where mammals and other animals can ingest it or become entangled; oil spills may suffocate turtle eggs buried in the sand or coat shorebirds so that they are no longer waterproof; dune buggies and clammers may crush or uncover shorebird and turtle eggs, making them easier to prey upon; and shorebirds in search of food at low tide are disturbed by people and their dogs.

SCIENCE PROCESS SKILLS: observing, communicating, comparing, relating.

SEA WORDS:

centrifugal force
gravitation
High tide
Low tide
Neap Tides
Spring Tides
cycle

TIME:

PARTS 1 and 2: 30-40 minutes each
PART 3: two 40 minute periods

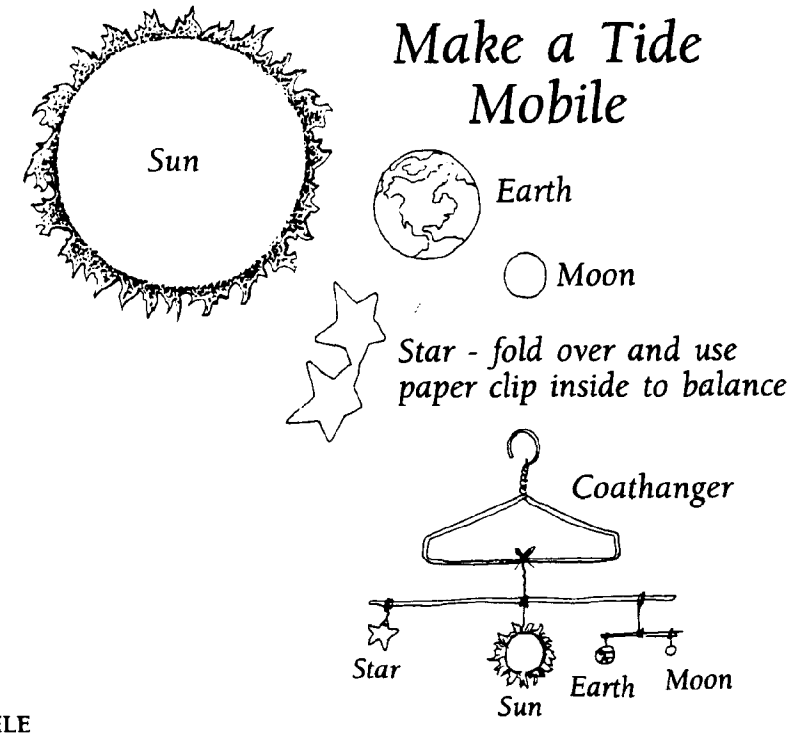
MATERIALS:

PART 1: clothes hanger
variously colored construction paper
scissors
glue
paper clips
fishing line or string
2 bamboo skewers or small garden stakes
tape
optional: globe and flashlight or Earth, Moon, Sun Model
(available from Scientific Supply Companies)

PART 2: optional: globe or Earth, Moon, Sun Model

PART 3: dock templates (1 per student)
daily tide charts (1 set per group)
data sheet (1 per group)
scissors
local tide tables

Make a Tide Mobile



ACTION:

PART 1 - TIDE MOBILE

1. Start this activity with a discussion of how the tides change at the seashore. Describe how the seashore looks at high tide and low tide using pictures and drawings on the board.

2. Introduce the ideas of how gravitation and centrifugal force of the earth, moon and sun result in the formation of the tides. Use examples such as water spinning off a bicycle tire.

3. Have students cut out their own stars, sun, moon and earth based on the relative sizes of each as shown on attached sheet.

4. Glue the stars together with a paper clip in the middle to act as a counterweight.

5. If bamboo skewers are used, tape two together for the long stick and cut another one in half for the short (earth-moon) stick.

6. Once the mobile is balanced, a small piece of tape can be used to hold their positions.

7. Have the students rotate the Earth-Moon around the Sun as the earth and moon rotate around one another. Students should be able to illustrate through manipulations of the mobile and through drawings what the earth, moon and sun alignment would look like to produce Spring and Neap tides.

PART 2 - MOVING WITH THE TIDES

1. Have the class form a tight circle, sitting on their knees or with legs outstretched and elbows interlocking.

2. Have one student act as the moon and walk slowly around the outside of the circle. The circle represents the waters covering the earth. As the moon passes by, the waters (students) bulge (lean) toward the moon. The water on the opposite side of the moon should also bulge out (representing the centrifugal force). After the moon passes, the waters return to an upright position.

3. To help students determine when they should bulge out, the teacher can stand in the middle of the circle and point to the portions of the circle that should be bulging out.

4. Have the moon stop at several points in the circle and let the class see where high and low tides are in relation to the orbit of the moon. Low tides are at the sides of the circle halfway between the high tide bulges.

5. Have students take turns being the moon until everyone is bulging at the correct times. Check for understanding by watching each student bulging correctly.

PART 3 - WHAT'S UP DOCK?

1. Divide the class into 4 groups and distribute a set of the daily tide charts to each group. Give each student a dock template and give instructions on how to prepare it. First, fold the dock drawing in half on the dashed (- - - -) line. Then cut out the three slash marked (/ / /) sections. Then cut the paper in two along the dotted (. . . .) line.

2. Have students find the tide height by laying the dock drawing on one of the daily tide charts and lining up the circle cut-out on the desired clock. Now read the height of the tide on the dock piling (the bottom cut-out).

3. Have students look at their own tide chart and find the height of the tide at 9 am, 3 pm and 12 midnight. Have them write their answers down. What time of day is the lowest tide? the highest? Then have the students describe the tidal changes they measured for the other members of their group. Create a group data sheet and collect data from each person in the group.

4. Distribute a local tide table to the students and have them locate their birthday and the date of their field trip and determine where and when the highest high and lowest low tide would be located on the dock.

5. Then using the local tide table, help students find the phases of the moon and then find the lowest and highest tides for the month. How do these match up?

DISCUSSION:

1. Why does the ocean bulge out on both sides of the Earth at the same time? (Answer: see BACKGROUND)

2. Have you noticed the difference at the beach between high and low tide? How did the beach look at high tide? at low tide? When do you most like to go to the beach – at high or low tide? What things have you seen on the beach that may have been carried there by the tide?

3. Have the students predict what phase(s) of the moon would be best for looking at organisms living low on the sandy shore.

4. Have the students hypothesize how the changing tidal levels affect the organisms living in or on the beach. Use specific examples.

5. Why do we need to be able to predict the times and heights of high and low tides?

6. How many high tides and low tides occur in one day? (Answer: 2) How many times does the tide go in and out in 1 day? (Answer: 4) What happens to the time of high tide each day? (Answer: 50 minutes later).

7. What is the relationship between tide pattern and moon phases?

8. Some animals depend on the beach habitat and tidal cycles to reproduce and/or feed. What environmental or human-made hazards may affect their ability to survive? (See **Background**)

TEACHING STRATEGIES:

PART 1:

1. This activity can be done as a group project with each student making part of the mobile. They can then take turns manipulating the mobile to check for understanding.

PARTS 1 and 2:

1. These activities are good for LEP and special education students, since physical models and large motor movements are used to present concepts rather than written language. You can build understanding by giving students signs for the moon, for High Tide, and for Low Tide to show with words what is happening.

2. Demonstrate the movement of the earth and moon using a globe and a flashlight for the sun or a model of the earth, moon, sun to clarify what is happening.

PART 3:

1. Use this activity to incorporate math into the science curriculum. Students gain practice with reading numbers in tables and gain pre-graphing skills.

2. Use cooperative learning roles in the groups-data collector, scribe, checker for understanding, etc.

EXTENSIONS:

1. On your field trip to the beach, place a tide stake in the sand marking the tidal height when you first arrive and note the difference in level when you leave the beach. Also look for evidence of high tide at the beach by noting the location of the drift piles of algae and beach debris. Be sure to look at the tide tables and relate the numbers listed to the way the beach actually looks at that moment.

2. The moon completes one revolution around the earth each 24h 50m. In addition, as earth completes 1 rotation (24 hours), the moon changes its position as it revolves around earth, causing the moon to rise 50 minutes later each day; the tides also occur 50 minutes later each day. This can be illustrated by having each student being assigned a day to record time of moon rise and high and low tides. These can be placed on a large bulletin board calendar. The tide mobiles can be manipulated throughout each day to represent these changes. A solar system model or globe and smaller ball (or even appropriately sized fruit) can also be used.

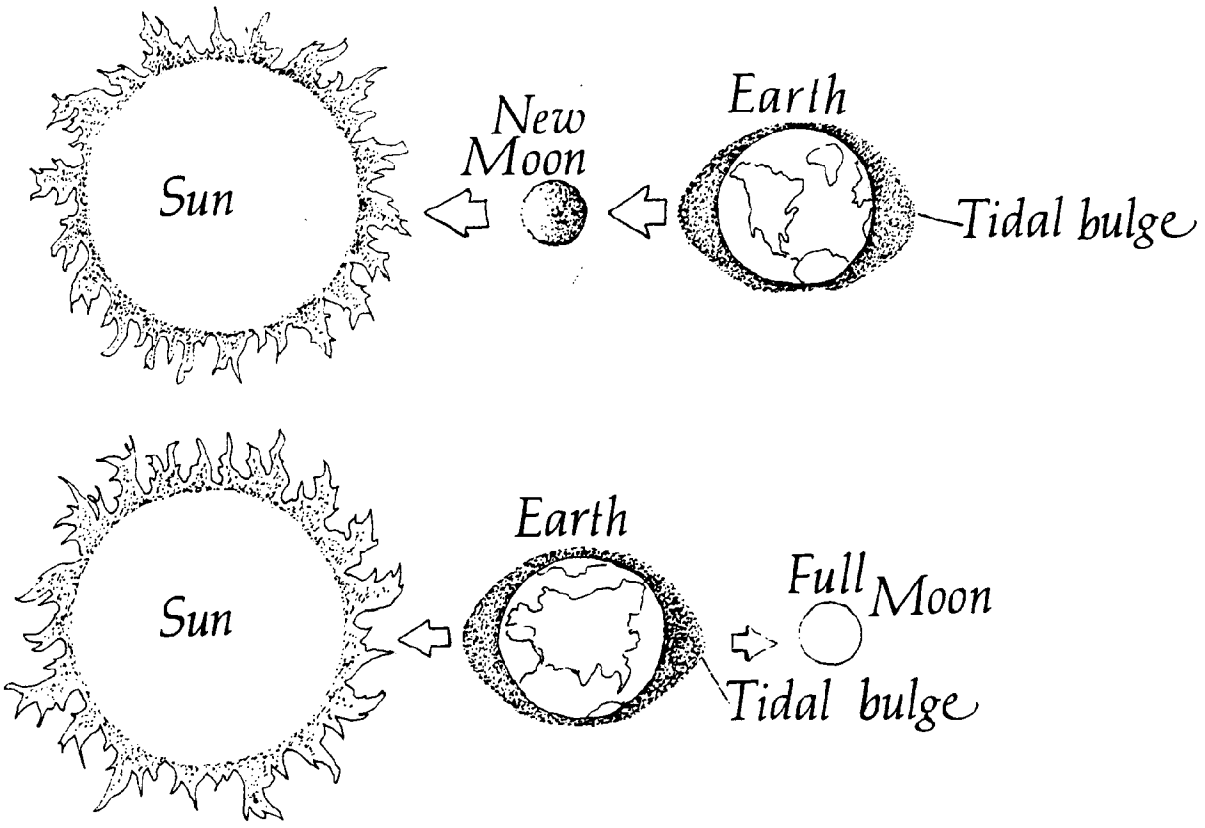
3. Have students graph the tides using large grid graph paper. Assign students one day in the month and have them plot the four tidal heights listed. Have students include a drawing of the phase of the moon on their graph. Place the completed graphs in order around the room. The tidal ranges, times and phases of the moon can be easily seen and their interactions discussed. (Label the x-axis TIME and the y-axis TIDAL HEIGHT).

4. Tides vary depending on where on earth they are measured. The differences are due to geographical features of the planet such as location of continents and islands, the topography of the ocean floor and the contours of the coastlines. Look for examples of the tides from various parts of the world, e.g., East Coast (2 equal highs and 2 equal lows), Gulf of Mexico (1 high and 1 low), West Coast (2 highs and 2 lows, but large differences in height of successive high and low tides), Bay of Fundy (40 ft. tidal range).

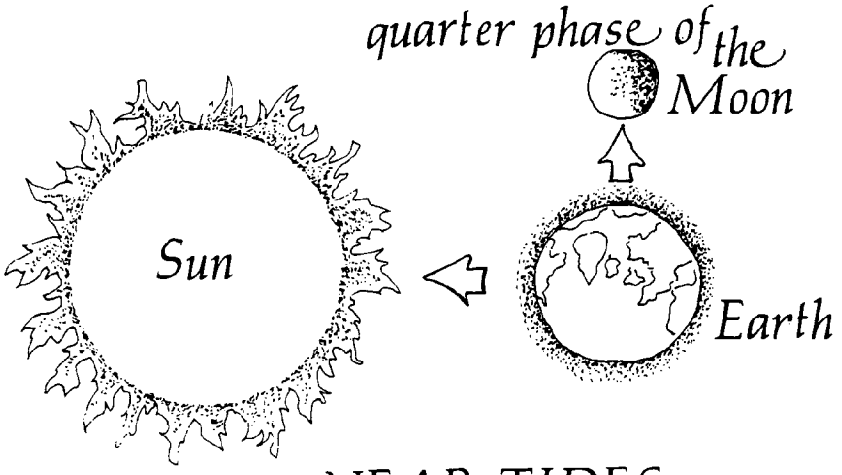
5. Do reports on animals that use the tidal cycles at the beach to reproduce (e.g. grunion and sea turtles). Include what environmental and human-made hazards may affect their ability to reproduce successfully.

6. Collect newspaper articles about damage from high tides and coastal construction of jetties and harbors. Discuss what may be done to lessen the damage. Were environmental impact reports done?

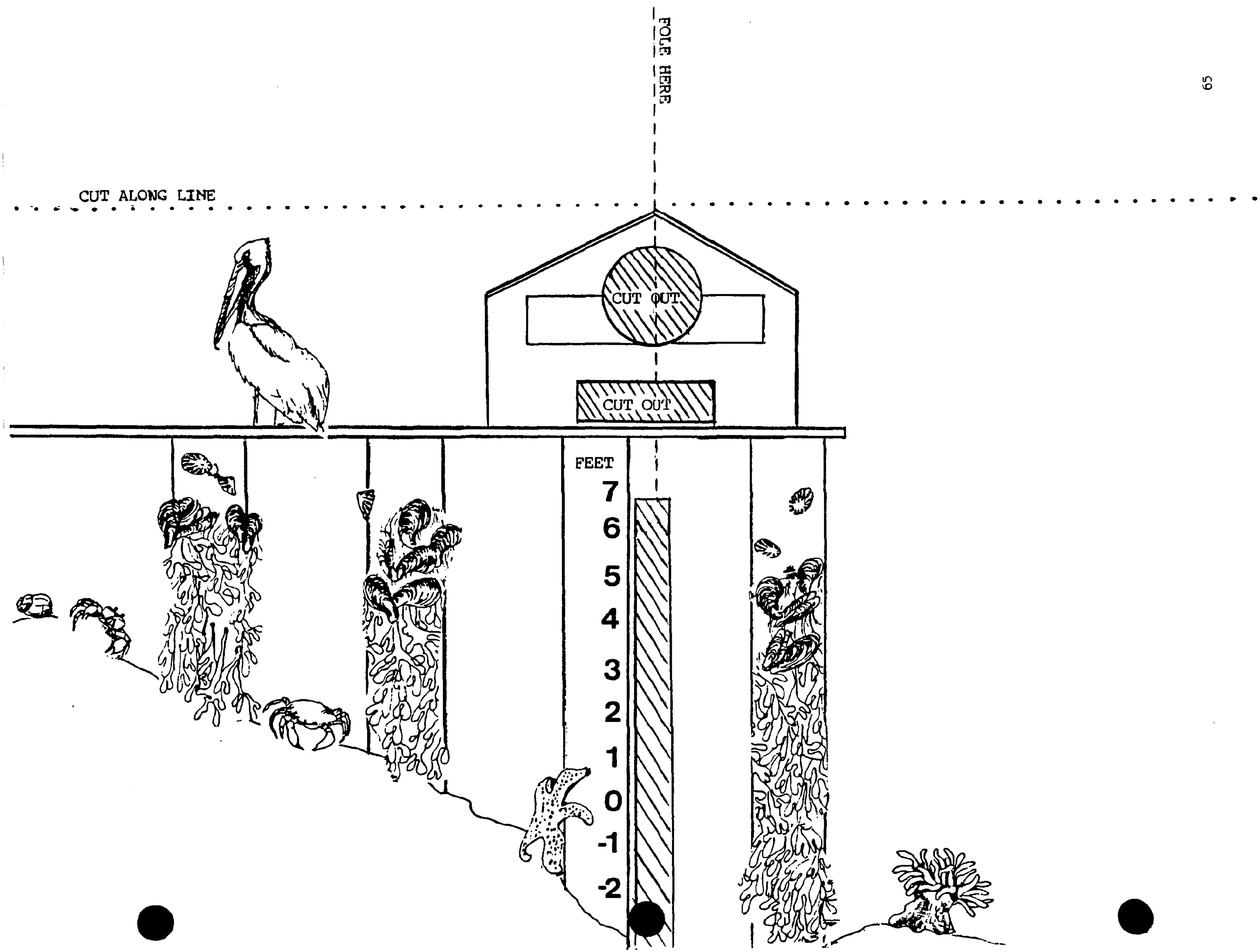
Adapted from: *The Ocean: Consider the Connections,*
Wet and Wild: Unit 1 The Physical Ocean,
FOR SEA Grade 2,
Project OCEAN Habitat Curriculum Guides
San Francisco Bay Chapter Oceanic Society



SPRING TIDES



NEAP TIDES


CUT ALONG LINE
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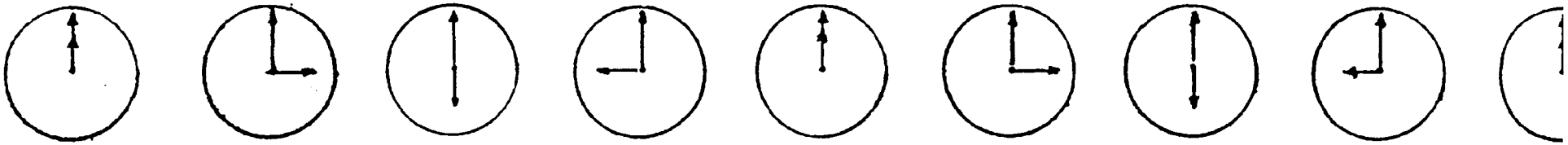
MONDAY



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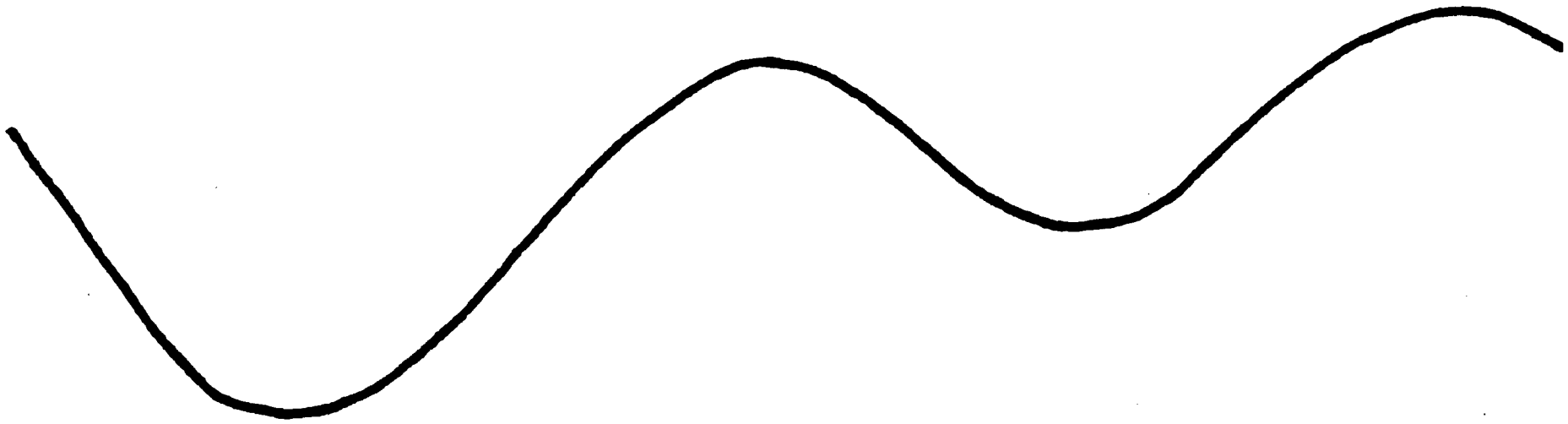
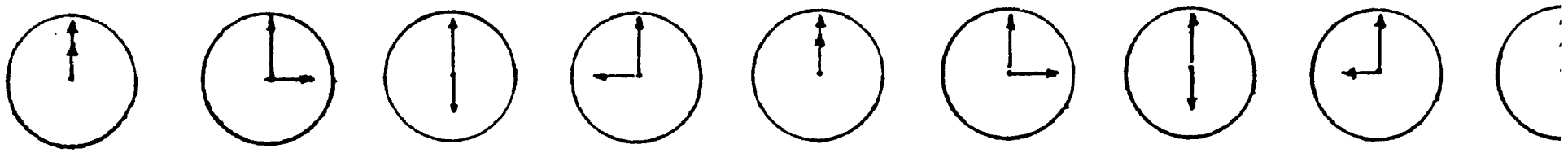


TUESDAY



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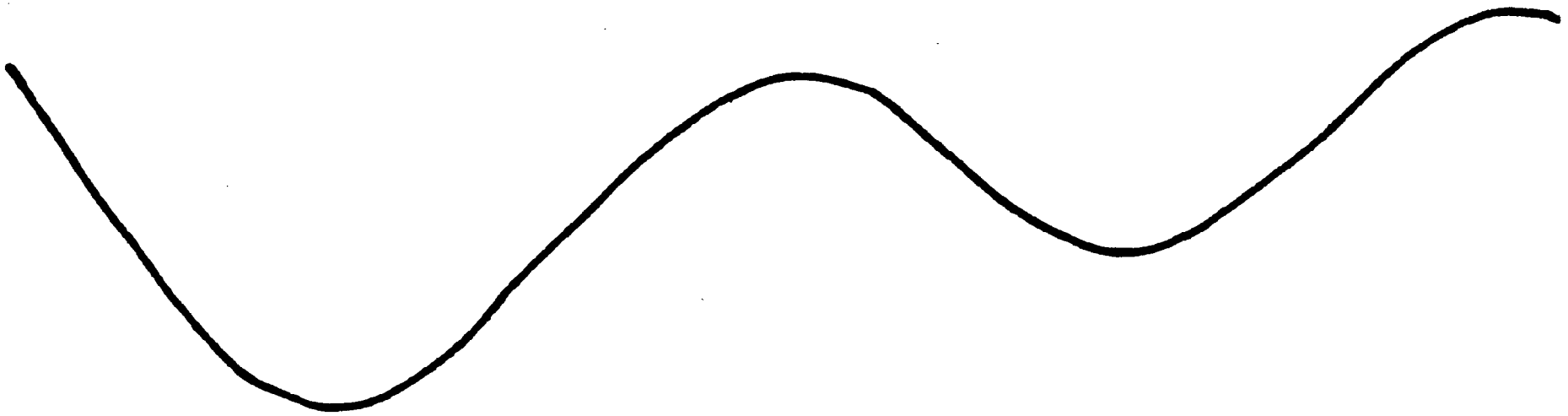
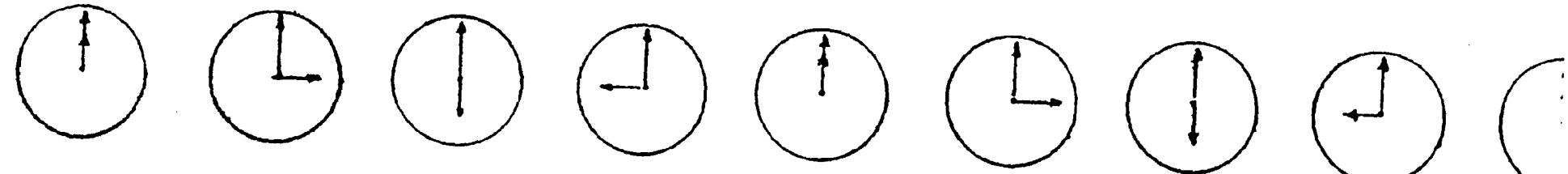


WEDNESDAY



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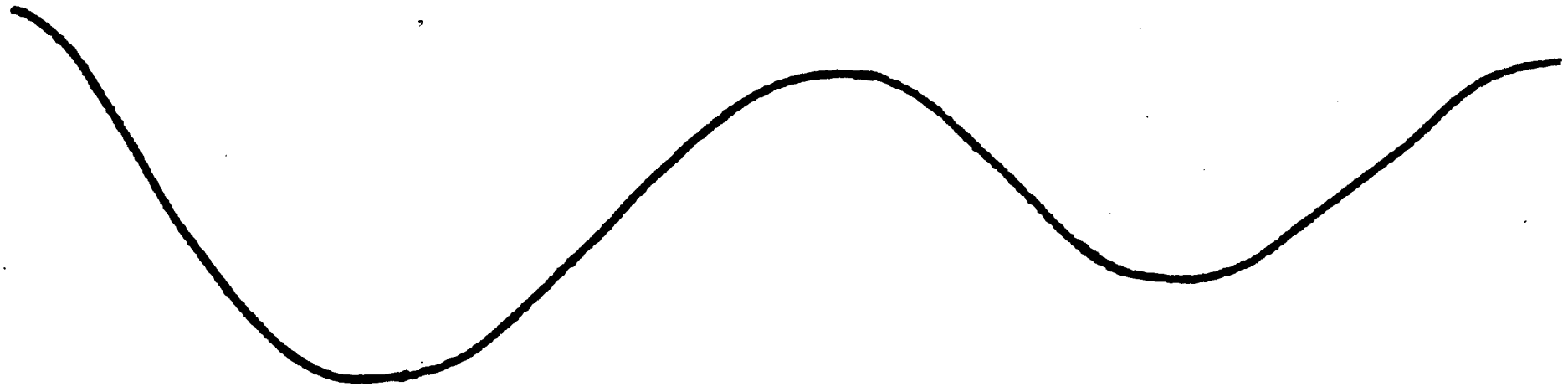
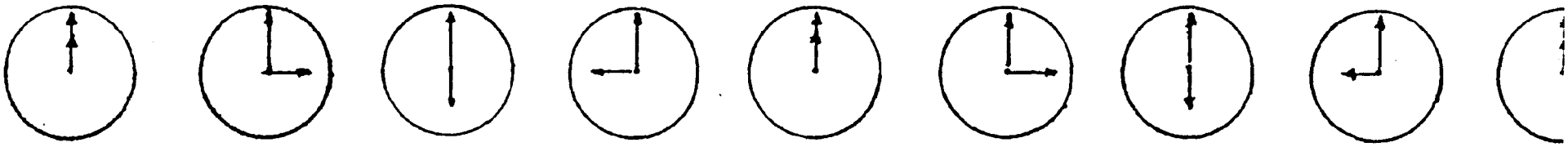


THURSDAY



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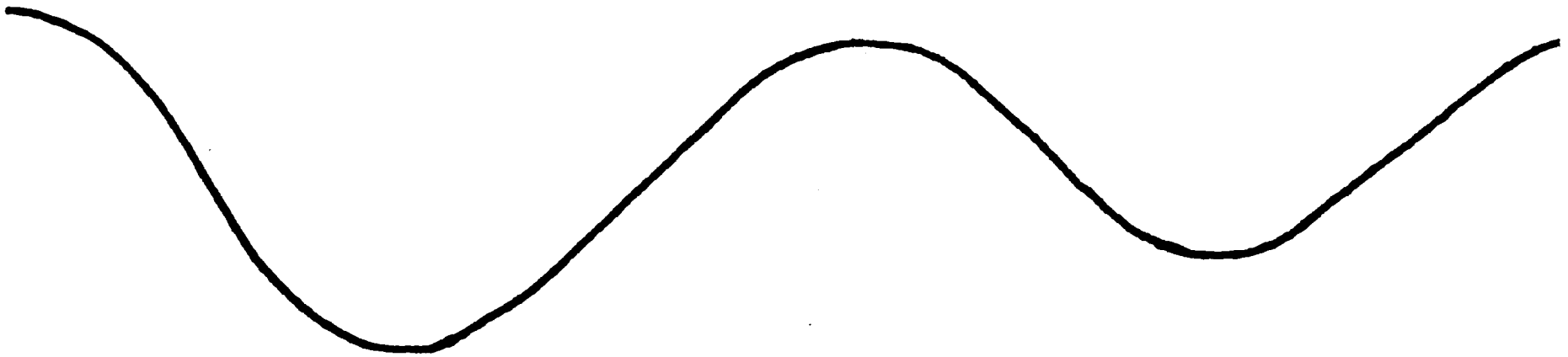
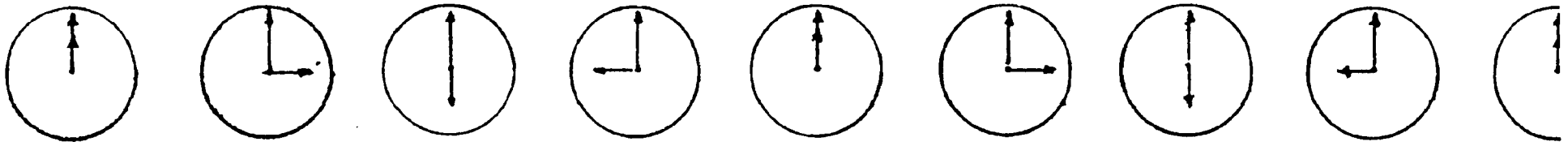


FRIDAY



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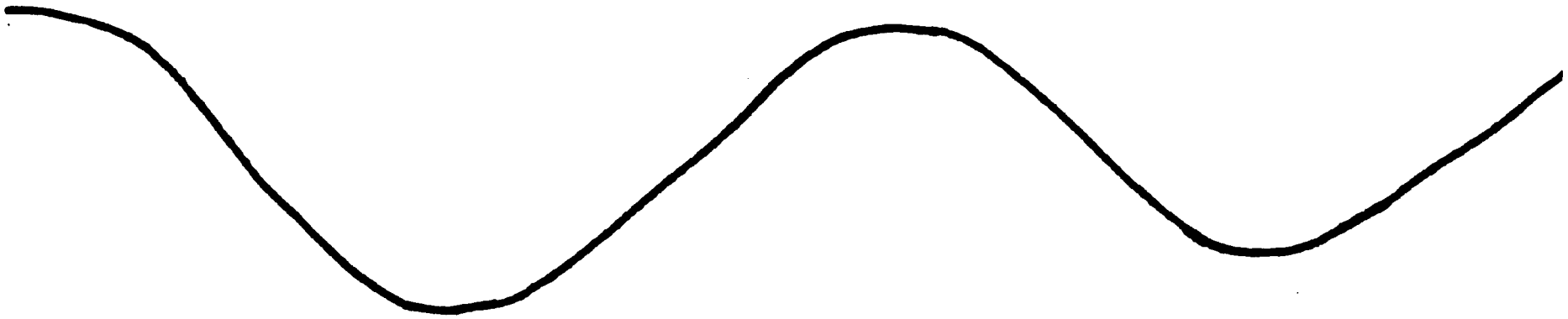


ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

GARBAGE IN YOUR CLASSROOM

SUMMARY: Students analyze the contents of the wastebasket to identify the quality and quantity of garbage generated by their class. Students then take simple steps to reduce the amount of garbage produced in their classroom.

FOCAL CONCEPT: Our garbage is filled with many different types of valuable materials which we unwisely throw away every day. Students can learn to identify valuable materials and take simple steps to reduce waste, conserve valuable resources, and extend the life of our landfills.

TRANSITIONS: In the "Tidal Waves" activity, students learned that tides and currents can transport garbage great distances before depositing it on the shore. In the activity "**Garbage in Your Classroom**", students learn to recognize and classify different types of garbage often found on the beach.

BACKGROUND: Our garbage is disposed of in landfills, which are limited in number and capacity. The landfills in the U.S. are filling up so rapidly that we face a serious landfill shortage in the next decade. Each man, woman and child in this country now produces 4-6 pounds of garbage per day. In San Francisco alone we produce nearly 700,000 tons of waste per year. The city's garbage is collected by the garbage companies and taken to the nearby transfer station where it is sorted, compacted and loaded into large double rig trucks. From there it is driven over 60 miles to the Alameda county landfill site at Altamonte pass. San Francisco sends an average of 5 million pounds of garbage each day to the landfill site and pays about $52,000.00 a day to dispose of it there.

What makes up our garbage and why is there so much of it? Garbage is anything that is thrown away. Every day we throw out great quantities of valuable materials. Paper, which is often tossed out after only one use, makes up 50% of our garbage by volume. Yet paper can be re-used in different ways and then recycled. Cans, bottles and some plastics can all be recycled and in some cases reused before recycling. Yet these items abound in our landfills. In addition, one-third of our nation's garbage by volume is packaging. Packaging is most often composed of non-reusable or non-recyclable materials, making it little more than manufactured garbage. Often packaging for consumer goods is much larger than the product it holds in order to attract attention and increase sales. The production of this vast amount of packaging consumes 50% of our paper, 75% of our glass, 40% of our aluminum, and 30% of our plastic produced each year and its disposal is filling our landfills at a staggering rate.

By becoming more aware of what we throw away, we can find ways to both reduce the amount of waste we produce and decrease our consumption of natural resources. Items that are reusable and recyclable can be identified and removed from the waste stream. There are many recycling centers here in San Francisco equipped to accept cans, bottles, aluminum, paper and some plastics. With an awareness of recyclable materials, students can easily reduce their contribution to the garbage crisis by reusing or giving items away whenever possible, by selecting products which have the least amount of packaging, by buying recyclable items in place of non-recyclable items and by recycling. Through the reuse and recycling of goods, our nation saves valuable energy, resources, money and land.

This activity will give students practice identifying recyclable "garbage" before the beach clean-up and will demonstrate to your students how easily they can reduce the amount of garbage they produce every day.

SCIENCE PROCESS SKILLS: Observing, communicating, comparing, organizing, applying.

KEYWORDS:

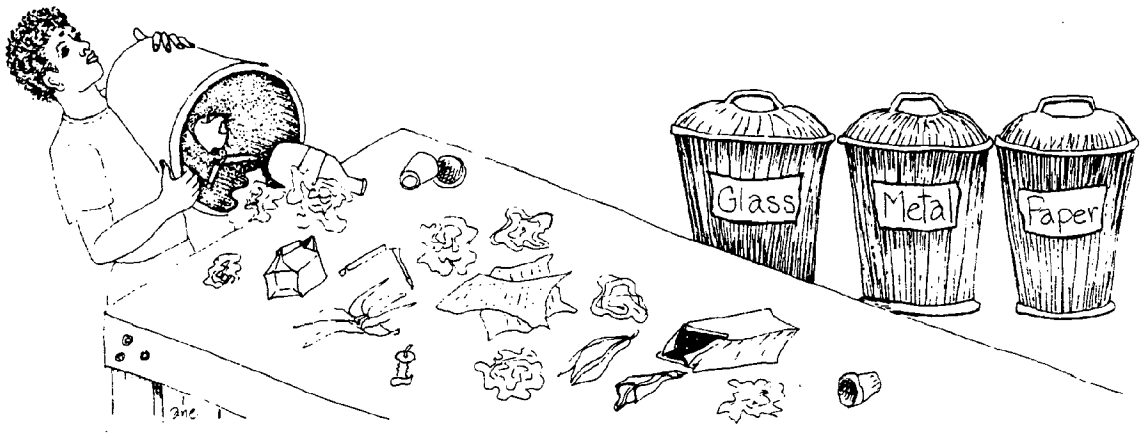
biodegradable	natural resources	consumer
waste	disposable	garbage
landfill	organic	packaging
compost	recycle	CA Redemption

TIME:

Part 1	**Demonstration**	20 minutes
Part 2	**Garbage Census**	15 minutes at the end of each day (or during recess)
Part 3	**Summing it up**	20 minutes the end of the week

MATERIALS:

Table in front of class
A prepared waste-paper basket "from the teachers' room" full of garbage including: lots of paper — -white, color, glossy, newspaper
a paperboard box or two
a plastic CA Redemption 1-2 liter soda pop bottle
a glass pop bottle
a small glass jar (smaller the better to minimize chances of breakage)
a food product (apple cores, orange peels and banana peels are easy to work with)
styrofoam cup
a paper cup
an aluminum can
aluminum foil
plastic grocery bag
paper grocery bag
a throw-away plastic toy
List of Recycling Centers in the area served by your school.
See complete list of Recycling Centers in San Francisco (call 661-6479)
Garbage Tally Sheet - 1 per group



ACTION:

PART 1 • Demonstration

1. Bring in the prepared "teacher's room" wastepaper basket. Pull some newspapers out of it and cover the demonstration table with them. Tell the students that today we are going to investigate the garbage from the teacher's room. Then, dramatically dump the contents of the wastepaper basket on the table.

2. Hold a brief discussion about how the garbage is disposed of and where it goes. Diagram it on the board using simple sketches and arrows. For example: From teacher —— to wastepaper basket —— to school dumpster —— to garbage truck —— to the San Francisco transfer station —— to semi-truck and trailer —— to the landfill site at Altamonte.

3. Separate the paper out on to one side of the pile. Note how much there is and that it can be recycled to make new paper. Inform the students that it makes up half of the garbage sent to the landfill. Hold up samples of the paper pointing out sheets that have only been used on one side, pieces that are only used in part, newspapers that were used to cover the demonstration table. Ask the students if there is any way in which some of the paper could have been used over before it was thrown out. Consider note paper, scratch paper, art projects, homework, letters.

4. Pull out all the cans and bottles and stand them up to one side. Note that they are all recyclable. California has established a CA Redemption law to promote recycling. Point out the CA Redemption mark on the plastic bottle and pass it around for all to see. Separate the CA Redemption containers from the others. Explain that all the recycling centers will accept containers with this mark. Most centers will either pay you at least 1 penny for each or accept your recyclables (aluminum foil, pieces of metal, etc.) with the non CA Redemption containers. Specify which centers in your area accept these other recyclables. Ask if any of your students have already been to one of these centers.

5. Now point out what is left — plastic bags, plastic toy, plastic wrap, the food item . . . Hold up the plastic toy, announce that you do not have use for the toy and ask if anyone else has an idea for it. You can then give it to a student for a younger brother or sister. Focus on the non-recyclables. Ask how the users of those items could have selected reusable or recyclable products in place of this garbage (e.g., paper bags used in place of plastic, aluminum foil in place of plastic wrap, a thermos in place of juice box, etc.) Brainstorm with your students.

6. Now draw attention to the food item. Explain that it is possible to compost many organic items to make new soil. Compost piles are made to encourage plant materials to biodegrade. Your classroom is probably not set up for that so you'll have to throw it out. Ask your students if their grandparents or other family members have compost piles in their yards.

7. Clearly identify the items that will be recycled on the beach clean-up: glass, aluminum cans, and plastic CA Redemption bottles. It is best if you keep the recyclables separate and plan to take them to your neighborhood center. Return the "Trash" to the wastepaper basket.

PART 2 - Daily Garbage Census

Students will record the type and quantity of garbage generated by their class during one week. They identify reusable/recyclable items and take steps to reduce waste in their classroom. If for some reason food items or other very messy types of garbage are normally thrown away in your classroom, it will be necessary to designate a separate garbage can for those items and then not use that can for this activity. Make sure that students understand that they are to identify areas of waste and figure out how to reduce it. (It will not help to throw the garbage outside of the classroom . . . it is still garbage.) The trick is to make less garbage!

1. Divide the class into groups of 3-5 students. Give each group a tally sheet and assign them a day to be responsible for recording the garbage output of the class. Allow time at the end of the day (before the janitors empty the trash) for one of the groups to survey the class garbage. You may prefer to have them conduct the survey during the last recess of the day so as not to disturb the rest of the class.

2. Measure total quantity of garbage in the waste basket that day. This can be done by weight using a postal scale or a bathroom scale or by extent of fullness using a ruler to measure the height of garbage in the wastepaper basket.

3. Have students separate the garbage into reusable, recyclable, and throw-away and itemize in each category on the tally sheet. Reusable items represent the highest savings. For every item listed as reusable, have the students write suggestions as to how it will be reused. Have them separate the reusables out and prepare them for the new use. Be responsive to students' suggestions. If students suggest using old paper for scratch paper, have them designate a container in the classroom for scratch paper. Encourage the whole class to use scratch paper and to place reusable paper there instead of in the trash. If they suggest notepads or phone pads, have them cut the paper and staple it into a pad.

4. Make sure that the items listed as recyclable are not still reusable. If they are, remove them from the recycling category and list them as reusable. Designate a box for recyclables. Encourage students to place recyclables in the box instead of the wastepaper basket. You'll need to keep them until the end of the week so they can be totaled up.

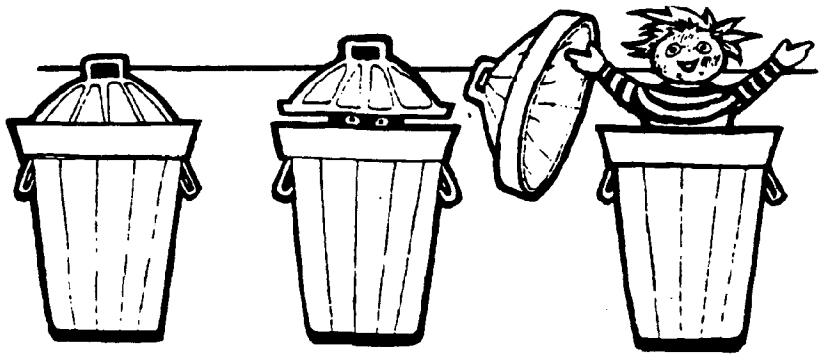
5. The items listed under Trash are those things that are no longer reusable and which are not recyclable. Consider each item listed as trash. Are there reusable or recyclable items that could have been selected in place of it? (Could a refillable pen have been used in place of a disposable pen? Or how about using a pencil in place of a pen? Bring a cup from home instead of using a disposable styrofoam cup?) Write the suggestions next to each item in the list.

6. Post the tally sheets on the board at the end of each day. Discuss the suggestions that were made that day. Are there any other ideas?

PART 3 - Summing It Up

1. At the end of the week compare the daily totals. Graph the results on a large bar graph. Older students can use graph paper to make their own graph. Was there a decrease in the amount of trash each day? Was there a decrease in the amount of reusables thrown out as the week progressed? Did the amount of recyclables found in the wastepaper basket decrease from day to day? Explain.

2. Now add up the total amount of garbage produced in the class. Measure the total quantities of recyclables collected in the box. Use the same method that was used to measure the garbage (either weigh it or pile it into an empty can and measure it with a ruler). What was the volume of recyclables saved by your class in one week? How much could your class save in a school year?



DISCUSSION:

1. Ask the students how they would feel about having a landfill site near their house. Consider truck traffic, smells, sea gulls, and wind-carried debris.

2. Brainstorm as to how they could reduce the amount of garbage produced at home. How could they produce less garbage? Are there ways to reuse the paper before throwing it out? Can they reuse other items at home? What recyclable items have they thrown out in the past? What disposable products could be replaced with non-disposable products? Record suggestions on a large sheet of paper and post them. Which suggestions could they follow at home? Which ones are they going to try?

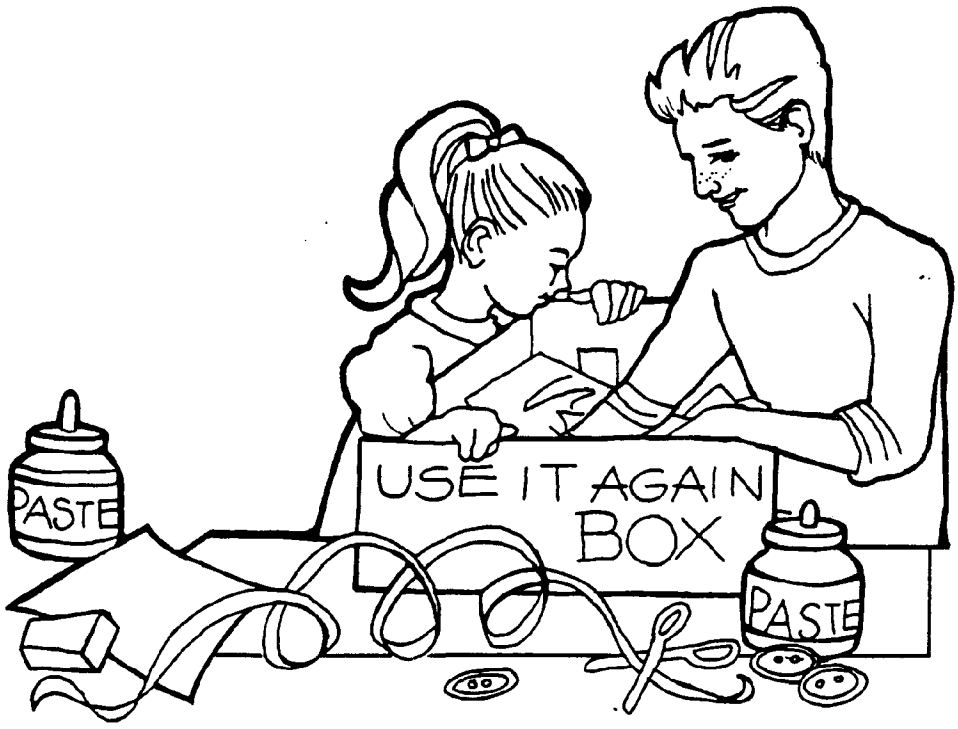
3. Did students find themselves removing things from the garbage or saving them for some future use? What does it mean to be wasteful? Do you waste things every day? How can you reduce waste? What will happen to our natural resources if we do not stop wasting them? How does this affect us every day? (higher cost to dispose of garbage, higher cost for nonrenewable resources, more oil exploration as demand increases, polluted air, polluted water).

4. Can your family get to the recycling centers in your neighborhood? When would be the best time? Can you and your friends take recyclables to the centers?

5. Do you think that the city should require people to recycle? Should the garbage companies be required to pick up your recyclables the same way they pick up your garbage? Should companies producing products and packaging that can not be recycled be taxed to pay for the waste they are producing?

6. Discuss the concept of recycling, where items are reused or reprocessed into more usable items. Is this a good idea? Currently, we recycle primarily aluminum cans, glass, and newspaper. Discuss how recycling will reduce the overcrowding in the landfills. Can you think of other things to recycle?

7. Did they realize their class produced this much garbage? Has this experiment made them more aware of what they throw away? Do they want to change their habits by reducing the amount of waste their family produces or by recycling cans, bottles, and newspapers? What other actions can they take to reduce the waste that they produce?



TEACHING STRATEGIES:

1. Use smaller groups with older students and conduct the census for a longer period of time. Have them list the paper products separately (white, construction, color, newspaper, computer, magazines). Different types of paper are handled differently.

2. Provide younger children with assistance classifying the garbage. Allow more time to measure and sort out the garbage. Compare the results.

EXTENSIONS:

1. Conduct a second survey of classroom garbage after the beach clean-up, at the end of the year or do spot checks every month. Compare the results.

2. Have students survey their household garbage cans (you can request a copy of the Home Garbage Survey from the San Francisco Recycling Program # 661-6479). Have the students record garbage thrown out normally and identify ways to reduce waste in their own homes. Compare results with other students. Encourage students to try some of their suggestions at home. Follow up by asking what worked for them. Was it easy? Did they find it difficult to change their habits? Did other members of their families cooperate? What was the most unusual thing you found in your garbage?

4. Conduct a litter walk on the school ground or in the school neighborhood (a copy of this activity is also available through the SFRP - # 661-6279).

5. Set up a demonstration compost pile in your classroom or school.

6. Have your class visit the local landfill or transfer station to see where our garbage goes. Combine this field trip with a tour of a recycling center near your school.

Developed for the Adopt-A-Beach School Education Program by Pamela Byrnes, San Francisco Recycling Program.

GARBAGE TALLY SHEET

Day and Date _____

Students names _____ _____ _____

_____ _____ _____

_____ _____ _____

REUSABLES

List of items found in the waste basket that can be reused.

DESCRIBE HOW YOUR CLASS WILL USE EACH

RECYCLABLES

List of items found in the waste basket that can be recycled.

TRASH

List of items found in the wastepaper basket that cannot be recycled or reused.

SUGGEST REUSABLE AND RECYCLABLE ITEMS
THAT COULD HAVE BEEN USED IN PLACE OF THIS TRASH

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

SCAVENGER HUNT

SUMMARY: Students learn about the marine environment by examining "evidence of life" found on a sandy beach.

FOCAL CONCEPT: An ocean beach is often covered with evidence of plant and animal life and human debris that has been transported from other areas by currents and wave action.

TRANSITIONS: In the activity "**Garbage in Your Classroom**" students learned to recognize and classify different categories of garbage into recyclable or nonrecyclable. In "**Scavenger Hunt**," students identify the difference between "evidence" of animal and plant life and the human debris left on a sandy beach. In the following "**Beach Clean-up**" activity, students remove and/or recycle human debris from this special habitat.

BACKGROUND: An ocean beach, with its constantly shifting sand and unrelenting surf, is home for organisms most often hidden from sight. Most beaches however, are often covered with "evidence of life" that has been left by residents or transported from other areas by currents and wave action. The erosive properties of water affects these treasures, often disguising them from casual passers-by. The curious beachcomber may discover the remains of both familiar and unfamiliar life forms and evidence of human activities. These findings can be very interesting. A molted feather, an empty sea shell, or an old tennis shoe are all evidence that can lead to creative speculation as to their origins.

SCIENCE PROCESS SKILLS:

observing
communicating
comparing
organizing

KEY WORDS:

organism
evidence
currents
beachcombing
debris

TIME: 40 - 60 minutes

MATERIALS: For each buddy team;
one collecting bag, dishpan, or cut-off milk carton
one bug box or magnifying lens (can be ordered from Delta Education)

ACTION:

1. Tell the students they will comb the beach for "evidence of life". Discuss with students what this means. Shells, feathers, a plastic bottle, or a piece of driftwood are all evidence of life because they were all part of or created by organisms.

2. Discuss safety precautions and all instructions on collecting. (Refer to *Conservation and Safety Information* in the **At the Beach** section of your guide.)

3. Divide the group into their buddy teams and distribute the hand lenses, bug boxes, and containers (bucket, plastic bag, dishpans, or milk cartons).

4. Give students the boundaries and 10-15 minutes time for their beachcombing. Challenge each team to locate at least one item that fits into an animal, plant, or human-made category.

5. When your class has regrouped have each team examine their finds and put them into groups of animal, plant, or human-made items. Ask each team to choose an interesting find and have them share it with the group. Have them speculate as to how this item reached the beach and where it came from.

6. Discuss the difference between the natural and human-made evidence they have found. Which of the items would be considered garbage? Where did the "garbage" come from? What happens to the garbage that stays on the beach? How might these items adversely affect the animals living in this habitat (entanglement, strangulation, etc.)? Can this debris ever be considered useful? What about old tires that serve as a home to anchoring barnacles and mussels?

7. Look at the natural evidence that was found. How are natural materials recycled on a sandy beach?

8. Return the natural evidence to where it was found. Save the human-made debris for your beach clean-up.

DISCUSSION:

1. How did all of these discoveries arrive on this beach? Discuss wave action and currents. Did you find any items that might have originated in a foreign country? How might they have traveled such a distance?

2. Do seasonal changes affect a sandy beach? Would you expect to find more or less debris after a winter storm? Would the type of items you might find differ with the seasons?

TEACHING STRATEGIES:

1. Taking students to the beach can be difficult if they are not given an opportunity to explore the area on their own. This activity will allow students to explore the beach in an informal setting so they are ready to settle into a more structured activity when you are ready to start the beach clean-up.

2. The cooperative game below **(Extension #2)** is good way to promote group team building. If you are having difficulty with a buddy team you might take this opportunity to divide the group differently. The "memory game" is an old technique that can be used back in the classroom with any assortment of objects.

EXTENSIONS:

1. Select a few of the discoveries and place them in a sequence which reflects how they might be part of a food web on a sandy beach.

2. Using several pieces of string or rope, create a grid with at least 9 squares (you can draw this grid in the sand if the materials are unavailable). Place a different item from the evidence pile in each of the squares. Cover the grid until you are ready to play the "memory game". Break the class into groups of 6 or 8 (you can have several buddy teams join forces). Give your students 15 seconds to study the grid and try to reproduce items on the grid from memory on their own grid (have them draw one in the sand). Students may either use items from their own evidence piles or locate new items on the beach.

Remind the groups that they will need to work together cooperatively to accomplish this task most efficiently. You might suggest that each buddy team within a group be responsible for remembering and locating one section on the grid.

3. Have each student choose a natural item from the list of discoveries to research back in the classroom. Encourage them to draw a picture of it to help them identify it back in class.

Remember - all evidence needs to be returned to its original location and nothing should be removed from the beach.

4. Follow up in the classroom by asking your students to locate a picture of what the original plant or animal looked like and make up a story explaining:

What it is
Where it came from
How it got there
Where it lived
What it was used for
Where it was going

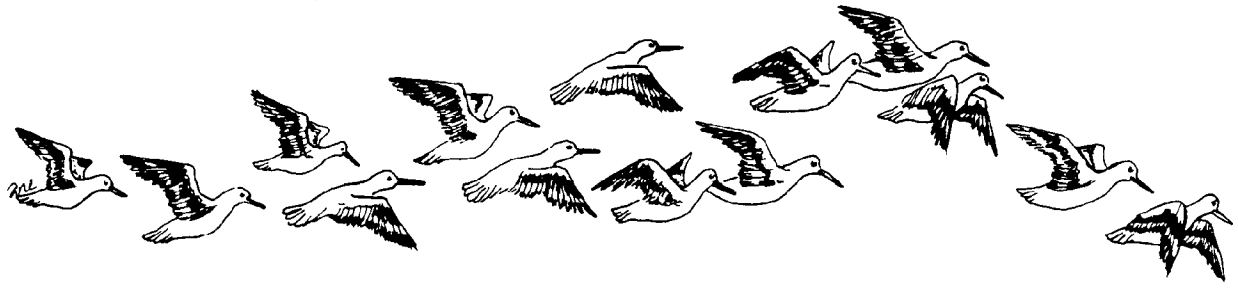
Students might want to present their creative composition in a variety of ways. Poetry, drawing a picture, or creating a travel journal might all be ways to share this story.

5. Compare a sandy beach and a tidepool area for similarities and differences. Try to visit a tidepool area or the touch tank at Steinhart Aquarium to see some of the critters that once lived near the sandy beach. Try to match the discoveries on the sandy beach with the animals in a tidepool.

Adapted from: "Beachcombing", *OBIS*, Lawrence Hall of Science and *Project Ocean Sandy Beach Habitat Guide*, San Francisco Bay Chapter, Oceanic Society.

ADOPT-A-BEACH

SHOREBIRD FLOCKING



SUMMARY: Students role-play a flock of shorebirds to understand strategies and advantages of shorebird behavior.

FOCAL CONCEPT: Shorebirds fly in flocks to protect themselves from predation.

TRANSITIONS: In the field trip activities "**Scavenger Hunt**" and "**Beach Clean-up**", students found and classified "evidence" of life. "**Shorebird Flocking**" gives students the opportunity to observe and imitate the behavior of the many shorebirds they see on a sandy beach.

BACKGROUND: Many shorebirds migrate from their breeding grounds in the northern Arctic to feeding areas south along the beaches and wetlands of the Pacific Flyway. They pass through California in August and September in great numbers and return again in April and May on their way north. They stop here to feed on the tiny burrowing crustaceans and worms that live in the sand and mud. These invertebrates are important sources of food for these small birds, which travel up to 4000 miles in their annual migration. Some species overwinter in central and southern California because the climate is relatively mild and the food sources abundant.

Shorebirds, especially tiny "peeps" such as sanderlings and turnstones, fly in tight, mobile flocks to avoid predation by hawks, falcons, and owls. The inside of the flock is more protected than the outside. Juvenile shorebirds of some species tend to occur more often around the outer edges of the flock, while the more skillful and experienced adults fly in the center of the flock.

Shorebird flocks fly in beautiful patterns that demonstrate a high degree of cohesion and synchrony. The flock changes directions and shape both during normal travel to feeding areas and also as a response to predator attacks. Individual birds may coordinate their movements by watching their neighbors in the flock. As individuals change directions, a turn signal travels like a flash of light from one side of the flock to the other. This coordinated communication benefits all members of the flock; the flock behaves as one organism as it moves. The flock is most vulnerable to a predator during the stretching-out phase of a turn or response. As the flock splits, some individuals spend too much time deciding which way to go and get left behind by both sides of the flock. Falcons have a better success rate with large flying flocks because they are easier to split. A small flock can sometimes dodge out of the way of an attacking falcon.

SCIENCE PROCESS SKILLS:

observing
communicating (non-verbal)
relating (space-time relationships)

KEY WORDS:

flocking	Pacific Flyway
migration	shorebird
predation	prey

TIME: 20 minutes

MATERIALS: optional — colored rope to set off food patch areas

ACTION:

PART 1 Communicating in a Flash

1. Have students stand in a line or circle and practice passing a non-verbal signal down the line. The signal could be a squeeze of the hand or a movement of their arm. The first student lifts his right arm up quickly, and the next student raises her arm as soon as she sees her neighbor's arm go up. See how long it takes for the signal to pass from one end of the line to the other. Does the communication proceed faster with practice? Time each communication episode. Now have students pass a message, "turn to the right" down the line by talking. How long did it take to get the message to the end of the line? Which method was the most effective form of communication?

PART 2

1. Optional preparation: place two colored ropes in circles (or use some other marks) at the far end of the running area, about 10-15 feet apart.

2. Have students stand together in a tight "flock" without touching shoulders. Walk around the circle making mean predator faces while the students try to maneuver into the center without touching. This is nearly impossible, but fun. A circle of colored rope on the ground can help control flock boundaries.

3. Ask everyone to "fly" as a flock to a "food patch" across the playground or beach (the colored rope circles). If anyone strays from the flock, catch 'em! Repeat these flight runs until the group can fly quickly in a tight flock. This usually takes 3-4 flights.

PART 3

1. Back at the starting area, instruct the group to "fly" toward a point halfway between the two food patches. When they reach this point they must make a right or left turn to one of the circles **without talking** and without splitting the flock.

2. Repeat these flight runs, giving different students a chance to be in the middle of the flock.

PART 4

1. This time the teacher kneels down at the point halfway between the two food patches. The flock will again fly toward the colored rope circles, but they should split into two flocks when they see the teacher (falcon) stand up. As the flock splits, confused individuals get split off from the main group and can be caught by the falcon.

2. Repeat several times to allow all students to experience the split-second decisions of birds in the center of flocks.

DISCUSSION:

1. How do birds avoid running into other birds in the flock as they fly? Which of their senses do they need to use? (sight, hearing, or touch)

2. What if shorebirds could talk? Do you think that would help them keep their flocking patterns and avoid predators? Why or why not?

3. Is litter a threat to shorebirds? In what ways? (Note: birds may confuse plastic particles with invertebrates-see Plastic Fact Sheets)

TEACHING STRATEGIES:

1. Make sure students do not rely on talking to communicate while flying. This is a great way to give students a lot of exercise, but with very little attendant noise in the process.

2. Make this activity more challenging by adding a roving predator around the food patches. Have the flock split when they arrive at the point halfway between food patches, but the predator may also swoop and attack, causing the flock to split again and add to the confusion.

3. What if a shorebird had an injured wing? Would the other birds protect it or leave it to survive on its own? Try acting out flying in a flock with an injured individual. What happens?

EXTENSIONS:

1. Study patterns on shorebird wings and discuss how the sharp markings may make it easier for birds to see a quick shift in direction. Provide students with blank outlines of birds from bird coloring books and have them color in the markings according to pictures in bird field guides.

2. Compare shorebird flocking patterns to the movements of schools of fish. How is the cohesion and synchrony of movement similar? Do schooling fish have markings for fast communication?

3. Collect feathers of shorebirds, raptors, and any other landbirds. Compare the sizes, shapes, color, and marking patterns of the different types of birds.

Adapted from an activity by John Kelly, Point Reyes Bird Observatory, and *Project OCEAN Sandy Beach Habitat Curriculum Guide*, San Francisco Bay Chapter Oceanic Society.

A D O P T - A - B E A C H
SCHOOL EDUCATION PROGRAM

PAPER TO PULP TO PAPER

SUMMARY: Students make new paper or paper products from old paper to understand how paper can be easily recycled into new paper products.

FOCAL CONCEPT: Paper is made of durable cellulose fibers that can be used over and over again.

TRANSITIONS: At the beach students learned that litter is harmful to the beach organisms and that much of the litter is plastic, glass or metal, and very little of it is paper. In the "**Paper to Pulp to Paper**" activity students discover why paper is less persistent in the environment.

BACKGROUND: Trees provide us with cellulose wood fibers to make paper and many other products. They are considered a renewable natural resource since certain species of new trees can be grown (however slowly) to replace cut ones. In order to assure a continuous supply of this important resource, logging and reforestation requires careful planning and management and the resulting products must not be wasted. Cellulose is an insoluble, inert and stable organic compound. The cellulose fibers can be broken apart and mixed with water to make pulp. When the pulp dries, the fibers bind together as if glued. If the dry fibers are then agitated in water, their bonds release and they return to pulp. They are so resilient that they can be re-pulped many times without disintegrating.

Paper is made of cellulose fibers which have been pulped, shaped, pressed and dried. Recycled paper is made by re-pulping old paper and forming it into new paper. It is cheaper to obtain the cellulose fibers from old paper than to cut down new trees. In addition, recycling old paper to make new paper requires less energy (uses up less of our nonrenewable resources like oil and natural gas), produces less water and air pollution, and requires fewer trees. Until recently, our society has unwisely overlooked this extra cost to our pockets and our environment and has thrown away re-usable paper everywhere.

Some paper is already being recycled. Perhaps you use recycled paper and don't even know it! Many grocery bags are made from recycled paper, as well as cereal boxes and shoe boxes. Recycled paperboard can be recognized by its gray color. Look for the sign that indicates recycled products - three arrows that form a circle.

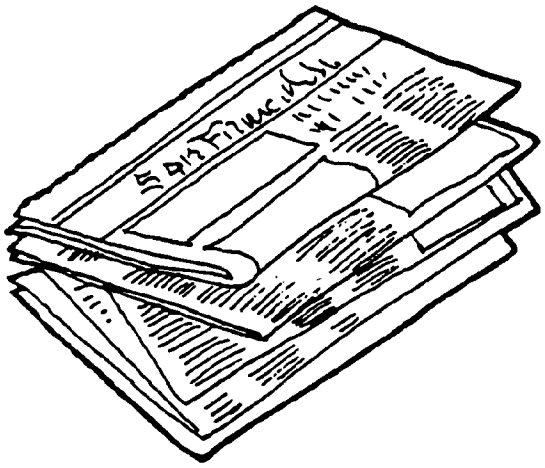
Many San Francisco businesses as well as our city government are now recycling their white office paper. Recycled computer paper, stationery, envelopes, wrapping paper, cardboard, and paperboard are being used by some energy-conscious people and companies. By recycling paper, we can reduce our consumption of energy and lessen the need for coastal oil development. We can also reduce the amount of air and water pollution stemming from paper making.

Hand-made paper is a recognized art form. With some creativity and practice, students can make beautiful hand-made paper too. The procedure below gives the basic recipe for recycled hand-made paper.

SCIENCE PROCESS SKILLS: Observing, communicating, and comparing.

KEY WORDS:

pulp	organic
biodegrade	disintegrate
recycle	cellulose
insoluble	fibers
renewable resource	



TIME:

PART 1	Introduction	15 minutes
PART 2	Demonstration	10 minutes
PART 3	Student Projects	30 minutes
PART 4	Completion	10-30 minutes follow-up later in the week (depending on what you choose to do with the home-made paper).

MATERIALS:

Old newspapers or paper towels
Magnifying glass or microscope to look at paper fibers
Samples of home-made paper (Make them when you practice steps 7-11!)

You can check out a kit with all the needed materials from the San Francisco Recycling Program. Call 661-6479 and reserve a paper making kit for the days needed. OR, make your own paper kit:

— Several sheets of one type of used paper (select white paper, color paper, paperbags or newspaper).
— Container for soaking the paper
— A window screen as a paper mold OR make your own from:
  - screen from a hardware store,
  - a stapler, &
  - an old picture frame or a home-made wood frame
— Wide flat tray (or access to a sink) to catch the water poured through the screen
— Blender

For SEED CUPS:	For MASKS:	For ART PROJECT & PAPER MOUNT:
a few paper egg cartons	newspaper	glue
muffin tins	small hairdryer	

ACTION: Practice the **Demonstration** below ahead of time and save the paper you made (the good pieces and the mistakes!). You will need these samples to show your students during the demonstration. You should decide which paper product you are going to have your students create and how it will be used (e.g. book markers, poem, backing for short essay, seed cups, masks, etc.) before you start the demonstration. Review **Part 3** of the **Action** below and select the paper project best suited for your students and classroom. Familiarize yourself with the instructions specific to that project.

PART 1 - Preparation and Introduction

1. Set up a paper station a day or two before you plan to do the paper making activity. Supply the station with magnifying lenses or microscopes and samples of several different types of paper — newspaper, paper towel, color paper, paper board, egg carton. Have each student use the microscopes(s) or magnifying lenses to see the fibers and compare the different types of paper. Have students record their observations with sketches or written descriptions.

2. Choose one type of used paper and tear it into 1" strips or into pieces about 1" x 2". Place them in water to soak for an hour. You'll need about 3 sheets of used paper for every new sheet of paper made. This is a good time to have students tear up paper and start it soaking for the project they will be doing later.

3. Describe how paper is made from the cellulose fibers in trees. Discuss the strength and durability of the fibers and that they can be used over and over. Stress that the fibers are more easily obtained from used paper than from trees. Used paper can be recycled to make many paper products including newspaper, paper board, cardboard, paper for copy machines, and grocery bags! Consult the "**Paper Facts**" sheet in this guide.

4. Ask the class what categories of materials are recyclable and list them on the board. Then have your students name some of the items found during the beach clean-up and list them under each category of materials. List non-recyclables separately. Select two students to write the items in the appropriate categories on the board as they are stated. The list might look like this:

MATERIALS WE FOUND THAT CAN BE RECYCLED

Aluminum	Paper	Plastic bottles	Metals	Glass
foil	wrappers	soda pop	can	bottles
cans		bleach	nail	
		water		

MATERIALS WE FOUND THAT ARE NOT RECYCLABLE

plastic bags	plastic pens
fishing line	fishing nets
cigarette butts	styrofoam

5. Briefly discuss how human garbage finds its way to the beach through the action of waves, currents, boats, wind, and picnickers. Describe the effects of waves, sand, and water on the garbage. Identify items which would break down or biodegrade quickly under these conditions (sandwiches, newspaper, apples). Note that paper breaks back down into cellulose easily and is less prevalent than the plastic, metal, and styrofoam litter.

6. Show the students how easily paper breaks down in turbulent water by taking one small piece of paper that has been soaked and putting it in the blender. Turn it on briefly, then off. Where did the paper go? The paper has broken apart into tiny wood fibers. Ask your students to tell you why they think there was not much paper on the beach.

PART 2 - Demonstration

1. Show the students how pulp can be made by having one student add more of the pre-soaked paper (about ½ cup) to a nearly full blender of water. Turn it on and let it blend for 2 minutes. The pulp should be the consistency of very thin soup. If it is thick, you'll end up with something more like a smashed egg carton than paper. Hold the blender with the pulp up for all to see. (**Note:** It's great to use a single bright color of paper because it looks wonderful . . . much like a milkshake . . . and the kids will react more strongly to it.) Have the students touch the pulpy water and look at the cellulose fibers with a magnifying glass.

2. Have a student hold the screen over the pan or sink as you pour the pulp quickly and evenly onto the screen. Let the mixture drain. Set the screen on some newspapers on the table (pulp side up). Then place a few dry sheets of newspaper gently over the screen of pulp and hold it firmly in place. Have the student gently rub the newspaper (as if petting a cat) to draw the excess water out of the pulp. Be careful not to move the newspaper or lift it off the screen!

3. Carefully turn the frame and newspaper over onto the table. Now have your helper gently tap the screen to loosen the pulp. When you or a second student slowly lifts the screen off the pulp, it should drop off the screen and remain on the paper. Hold up the newspaper for the class to have a quick glimpse of the pulp, then lay it on the table – pulp side up.

4. Next, place a layer of dry newspaper directly onto the layer of pulp (you now have a sandwich with newspaper for bread and pulp for filling). Rub it gently (as if petting a cat) to draw out more of the water. Turn the "sandwich" over. Gently peel off the top layer of newspaper. Repeat this step a few times.

5. Hold the damp home-made paper up for all to see. Bring out the samples of paper you made earlier and pass them around to verify that the pulp becomes real paper when it dries! Place your new paper on dry newspaper to finish drying over-night.

6. Finish the paper making demonstration with a summary of paper's resiliency and recyclability.

PART 3 · Student Paper Making Project

Students will have the opportunity to make their own recycled paper products in small groups. Select one or more of the following projects:

A. Paper Mount. The recycled paper will make a very nice backing for a writing project or a drawing done previously – or have them do a new one. With older students you can have them write an essay outlining ways to reduce paper consumption or a poem about the trees that were made into paper or an imaginative story about how the paper litter got to the beach. Have younger students create a picture of their day at the beach, or a simple diagram showing how recycled paper is made. Make sure to check their work. Have students make corrections and then copy it over as neatly as possible. Glue or staple the finished product to their home-made paper.

B. Art Project. The recycled paper can be the art project itself. It can be made into book marks, place mats, or wall hangings. Students can mix paper colors or add decorations of leaves, threads, magazine pictures or glitter to the pulp. They can make the pulp different thicknesses for different effects. They can also shape bits of thick pulp and attach it to their projects. Or they can use the home-made paper after it is dry by cutting it up and gluing it to a picture made earlier of their day at the beach. Encourage creativity and experimentation.

C. Masks. This project is recommended for older students because of the use of the hair dryer and the additional patience required. To make masks, start with enough newspaper to make a thicker pulp and follow the procedures described in the first three steps of **Part II** above. Then, instead of laying the moist paper flat to dry, gently press the sheet of wet pulp on a student's face. Make small breathing holes in the mask. The student model will need to hold still for about fifteen minutes or so until the mask hardens. Unless it is a warm day, you will need to assist the drying process with a hair dryer set on the LOW setting (avoid steam burning anyone!). After the damp mask has taken shape, remove it from the student's face and place it in the drying area supported on a bit of crumpled newspaper to retain its shape until it dries. Later, when the masks have dried, allow time to paint and decorate them.

D. Seed pots. Seed pots are used by gardeners as growing pots for plants than cannot survive the root disturbance associated with transplanting. After sprouting, the seedling with its seed pot is planted in the ground. The paper pot (cellulose) decomposes in the ground as the seedling grows to an adult plant. To make seed pots, use plain brown paper or egg cartons soaked in water (any paper works but the less dye the better). Fill the blender with ⅓ paper and ⅔ water. Blend well. Have each group pour one or two blenders full of pulp onto the screen, let it drain, then dump the wet pulp into a bowl for easy access to all students in the group. Have the group return to their work station with the bowl of pulp. Supply each group with a muffin tin and newspaper to absorb the water that will drip from the wet pulp. Students mold the pulp into the muffin tin, then let it dry for a few days. Remove the seed pots and use them to start a classroom garden!

1. Introduce the assigned project and provide each group with a copy of "**Paper-Making Instructions**". Quickly demonstrate the steps they are to follow (see **Steps 1-6** of **Part II** and the above descriptions of each project). Have the students write the additional instructions needed to create their assigned project.

2. Divide the class into four groups and prepare a work station for each. Assign one of the students that assisted you during the demonstration to each group. Designate a drying area for the home-made paper project.

3. Have groups take turn with the blender. Supervise the use of the blender. Students can work on other assignments or design their paper project while they wait.

4. Students need a way to identify their own projects. They cannot write on the wet paper. Instruct them to place a name tag next to their recycled paper when they take it to the drying area. It will take at least one to three days for the paper to dry depending on the thickness of the paper and the temperature of the classroom.

PART 4 · Completing The Project

1. Part IV takes place at a later date after the paper projects have dried. It is very important to complete the second half of this activity. If you end with **Part I** then the paper made may be seen as nothing more than garbage. Schedule time a few days later for the students to complete their paper-making project. These projects will reinforce the concepts presented and allow students to place a higher value on the Recycled Paper! Hang the finished projects in the classroom and refer to them during later discussions.

TEACHING STRATEGIES:

1. Use cooperative groups. Have groups of younger children produce one project per group instead of one per student.

2. With older children you can set up one work station for each project listed and assign different projects to each group.

3. You can reduce the amount of class time devoted to this project by combining the Paper Mount project with a class writing assignment. Allow two or three students to use the blender and screen at the designated work station while the rest of the class is writing. Later, have them finish their paper project by mounting the assignment on their home-made paper.

DISCUSSION:

1. Does your family throw away paper? Did you know that it could be recycled? Do your parents know? Would you like your school to recycle paper? Why?

2. Have you ever used recycled paper products in your home? Don't forget newspapers, paperboard, cardboard. Paper cups break down in the environment and plastic cups do not. Are you willing to pay more money to buy paper cups in place of plastic ones knowing that it will cause less damage to the environment?

3. San Francisco's city offices and some private businesses have started recycling their paper. Do you think businesses should be required to recycle? Why or why not?

EXTENSIONS:

1. Homework assignment: Students look in their homes and at the grocery store for products packaged in recycled paper board. Recycled paper board packages can be identified by the gray rather than white or brown interior. In addition, there may be a recycling emblem on the package. Keep a running list of products in the classroom. Be specific, include the brand name and the item, e.g. NutriGrain Wheat Biscuits cereal box.

2. Make a class collage of commercial recycled paper products.

3. Have students write letters to a few companies congratulating them for using recycled paperboard packaging and encouraging them to include the recycling emblem on their packages if they have not already.

4. Start a paper recycling project in your school (See "**How to Recycle in your School**" in this guide).

Adapted from *The 4th R - Recycling Curriculum*, San Francisco Recycling Program, Office of the Chief Administrator.

STUDENT INSTRUCTIONS
PAPER MAKING PROJECTS

1. Tear up some used paper and put it in water to soak one hour before you plan to make the paper.

2. Plan your project design until it is your group's turn at the blender.

3. When it is your group's turn at the blender, help each other make the pulp. Add water to the blender until it is 4 inches from the top. Add enough paper to bring the water level up to about two inches from the top.

4. Put on the lid and blend the paper with the water for 1 minute. Check the pulp. It should be like a soup.

5. Ask someone to hold the screen over the sink or a container to catch the water.

6. Pour the pulp through the screen. Try to cover the whole screen.

7. Write the rest of the instructions as explained by your teacher.

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

SAND LAB

SUMMARY: Students compare sand from a variety of locations and determine the probable origin of the sand samples.

FOCAL CONCEPT: The origins of a sand sample can be determined by looking at the grain size, color, and chemical make-up.

TRANSITION: In the previous section (At The Beach) students had the opportunity to visit a sandy beach and discover both natural and man-made "evidence of life". "Sand Lab" allows students to take a closer look at the sand on a beach in order to better understand the physical substance that makes up this habitat.

BACKGROUND: Children share a common love for sand. We give children sand boxes to play in and spend hours building sand castles on the beach. Sand conjures up feelings of timelessness, drifting, shifting, and eternity. Much of our literature reflects our awe and fascination with the beaches of the world.

Sand is sometimes called "the earth in miniature". It is made up of rocks, shells, or corals that have been ground down by the action of water. Every beach has its own kind of sand. The sand found at the base of a coastal bluff will be made up primarily of the "mother" rock. The rock can be Igneous (rocks that were once melted); Metamorphic (rocks that used to be other rocks, but have been changed by extreme heat, pressure, or friction); or Sedimentary (sand and silt that has been compressed together over time) . . . or a combination of all three.

There is quite a color variation in sandy beaches. Most of our light colored beaches in the United States are made up of quartz and other minerals. Quartz is abundant in most rocks, is a very hard mineral and is nearly insoluble in water. Dark sand beaches may contain minerals from igneous or volcanic rocks. Coralline algaes are made of calcium carbonate and are the primary source of pink sandy beaches. Each of these sand types has unique characteristics that make it an ideal habitat for the organisms that live there.

Sand is generally considered to be any loose rock fragments, mineral grains, or other organic matter between .06 - 2 mm. Sand is created in a variety of ways. The two most common ways for abiogenic (from a non-living source) sands to occur are through physical and chemical breakdown. Physical breakdown can occur through weathering and wave action. Freezing and thawing causes rock matter to break apart and eventually disintegrate. Water erosion from rain, rivers, streams, and waves break down rock matter. Chemical changes in minerals, much like dissolving or rusting, help break down the rocks and minerals into smaller pieces. Biogenic sands can originate from animals or plants. Shells of animals, skeletal debris, and coral fragments can make up the majority of some sandy beaches. The parrot fish which grinds up pieces of coral in order to eat the tender polyps within, can excrete 100 pounds of coral sand a year. Pellets excreted from the guts of little organisms can also create sand size particles. Many benthic (bottom) dwelling animals are debris feeders that make a living scooping up mud, digesting it and excreting unusable material in pellet form.

SCIENCE PROCESS SKILLS: observing, communicating, comparing, organizing

KEY WORDS:

Igneous	abiogenic
Metamorphic	biogenic
Sedimentary	weathering
quartz	erosion
minerals	pellets
volcanic	benthic
organic	inorganic

TIME: 1 - 2 30 minute periods

MATERIALS: Collecting sand

Initially you will want a large container of sand to fill your sand table. Hopefully you are situated near a beach that does not have a protected status which would prohibit you from collecting anything, including the sand. Bags of sand can be purchased from a building supply company if you are unable to obtain it from a natural source.

For all students:

- sand table or large plastic or metal tub
- a variety of sand samples

(sand kits can be ordered from *Math/Science Nucleus* – see **Resource List** in **Background Information section.**)

- hand lenses or magnifying glass
- bar magnets wrapped in light (both color and weight) smooth paper
- sieves, funnels, spoons, and cups
- simple balance scale
- white paper and black paper
- 5 quart jar and lid
- a little oil (crankcase oil is great)
- small bowls

For older students:

- 10% hydrochloric acid (muriatic acid for swimming pools)
- eye dropper
- well slides
- microscope
- rock and mineral sample kit

(rock and mineral sample kits can be ordered from *Math/Science Nucleus*)

- copy of "**Describing Sand Grains**"

ACTION:

ACTIVITIES FOR ALL STUDENTS

1. A variety of sands from different locations will greatly increase the possibilities for observation and comparison. By asking your students and their friends and families (and their distant relatives) to collect sand samples when visiting a beach or coastal area, you will soon find that you have a growing collection of interesting sand samples. Ask people to collect a small baggy or baby food jar full of sand. Each sample should be labeled with the name and location of the beach. This main source of sand will be your classroom "beach". It will be this source of sand that others sands will be compared to.

2. Initially, it is important to let students have a chance to explore the sand. If you first set the sand station up with sieves, funnels, spoons, and cups you can allow your students to 'play' with or explore the sand on their own. This way they will be ready to follow your instructions when it comes time for the actual sand lab.

3. Discuss with your students what sand is, how it it is made, and how it arrives on a beach.

4. Give students samples of sand. Have them identify the color of their sand and share their ideas on why the sands have different colors. Compare their sand samples to the classroom sand.

5. Do the sand samples have any different material in them other than the tiny rocks that make up most of the sand? Shell, wood pieces, glass, bones, or plant material might all be part of the samples. How did these items become part of the beach sand?

6. Put a magnet covered in paper in contact with the sand samples. Are the grains attracted to it? What color are the grains that are attracted to the magnet? Some heavy metals, especially those with iron in them, will be attracted by a magnet.

7. If you have a dark sample of sand, put a small amount of it on a piece of white paper. If your sample is light, put a small amount on a black piece of paper. Look at the sand grains with a hand lens or magnifying glass. Do all the sand grains look the same? Shell fragments tend to be more rounded and less jagged looking. If you can find one draw a picture of it. Now draw a picture of a sand grain.

8. Pour **a little** sand into your hand. What are some words that would describe what it feels like? One of the ways that scientists classify sand is to note how round the sand grains are. The rounder the grain, the longer its been moving in the water. If your sand has jagged edges, chances are good that it hasn't been traveling for very long.

9. Put an inch of sand in a jar, then fill it almost full with water. Put the lid on. Tip the jar and watch the sand. What does it do? Shake the jar. Does the sand settle back to the bottom immediately? The water is in constant motion. Waves hit the beach endlessly, one after the other. What do you suppose this does to the sand?

10. Put some dry sand in a bowl. Gently, blow on it. A breeze blows almost constantly on a sandy beach. What effect do you think this might have on the sand of the beach? Sand dunes build behind some beaches. How do you suppose this happens?

11. Gently drain as much water as you can out of the jar. Pour in just enough oil to cover the sand. Next try to wash the oil out of the sand. Can you do it? Sometimes ships carrying oil or oil rigs will spill oil out to sea. The oil they spill is much thicker and heavier than the oil you have just used. When it floats to the beach, it covers everything with a sticky black goo. Do you think such an oil spill might be hard to clean up? What effect do you think the oil spill would have on the animals that live on a sandy beach?

FOR OLDER STUDENTS

1. Older students will be intrigued with acting as amateur arenologists (one who studies sand). Sand grains can tell us a great deal about the local geology, biology and wave action within a particular area. Give students a variety of sand samples to work with for these next few activities.

2. Try to identify as many types of minerals within your sand sample as possible. Magnetite is a common magnetic material found in igneous rocks. A basic rock sample kit will be very useful in identifying other types of rocks and minerals found in the sand samples.

3. Place a small amount of sand into one of the well slides. Add a drop of the dilute hydrochloric acid (HCL). A fizzing reaction will indicate the presence of calcium carbonate (the major component of shells and corals).

4. Sometimes scientists use color to group sands. Divide your sands into light and dark groups. Are some samples difficult to place? Why? Try dividing the sands into three groups based on color. Did that make your job easier or harder? Is there a characteristic of sand that might make a better classification system than does color? Suggest a few.

5. Distribute copies of the sheet called "**Describing Sand Grains**". Have students first look at the size of their sand grains. If they are working with dark grains they should use the light wheel. If they have a dark sample they should use the second and lighter wheel. Have them sprinkle a little on the paper and match the particle size to the diagram. In most cases there will be a range of sizes. Have students hypothesize as to why there is a range of particle size. Size just tells how long a particle has been eroding . . . the longer it has been moving around, the smaller it will be in general.

6. The next part of the scale has students comparing the particles in their sand with the pictures of roundness. A magnifying glass or microscope will be most useful with this examination. Why are some particles more round than others? The rounder the particle...the longer it has been moving.

7. Next have students sort their sand samples. Sorting refers to the range in size particles. If a sample has big and little pieces it is not well sorted, but if all the particles are of the same size it would be very well sorted. What do you think causes sorting? This has most to do with how the sand particles settle down. Also, wind can carry small particles to areas high up on a beach. Dunes are the result of wind carried particles and tend to be very well sorted.

8. You might want to make your own sand slides for future use. Take a regular microscope slide and place a small dot of white glue in the middle. Sprinkle a small amount of sand on the glue and allow this to dry. Label the slide with the origin of the sand sample using a permanent marker. These slides can be used under a microscope or with a hand lens.

DISCUSSION:

1. What are some similarities between the sand on a beach and the sand you might find in a desert? Its funny to think that sand can be associated with two very opposite climatic conditions. Water at the edge of the sandy beach, rivers, or lakes erode the sand. Wind is constantly shifting sand in desert areas. If you can understand the process that creates sand, you can see that in both situations some kind of erosion of the surrounding rock is creating the sand. Can you think of any other similarities between a desert and an ocean environment? What about the plants and animals?

2. Why is sand important to us? Other than the aesthetic qualities associated with walking on a sandy beach with your shoes off, are there any other ways that we use sand in our daily lives? Sand is very important to the manufacturing and oil business. Glass is made from silica sand which has been melted and reformed. Pure quartz sand is used in sandblasting and sandpaper industries. Sand is very important to the cement industry. If it weren't for sand, we wouldn't have concrete sidewalks to skateboard on, or tall buildings, or glass windows to look out of, or highways to drive on, or lots of other things. Can you name a few more?

TEACHING STRATEGIES:

1. Set the sand lab up initially as a free-time work station. Used as a reinforcer for completed work, it will allow students to explore the properties of sand in the form of play before they actually participate in a structured lab. Make sure your lab is equipped with sieves, funnels, spoons, and cups for this initial exploration.

2. The lab can be done with individuals, pairs, or cooperative learning groups, depending on the amount of sand you have available. If you have students working independently, allow time for them to compare their results with other students.

EXTENSIONS:

1. The acquisition of different sand samples can become a class project in itself. When collecting sand, have students write letters to a class along a coastal area asking for sand samples. Examine sand for plastic particles and other human debris. Make a record of the origin of samples with the most and the least human debris. Can you make any deductions as to why this is so?

2. Sand activities can be incorporated easily into a math program. Comparing, sizing grains, sorting, weighing, measuring, counting the number of grains in an area and graphing the results can all be good math activities.

3. As an art activity color white sand with a variety of food coloring and try your hand at Navajo Sand Painting. Beautiful sand candles can be made in the classroom using buckets of wet sand, paraffin, and crayons to give them color. String dipped in wax can be used as a wick.

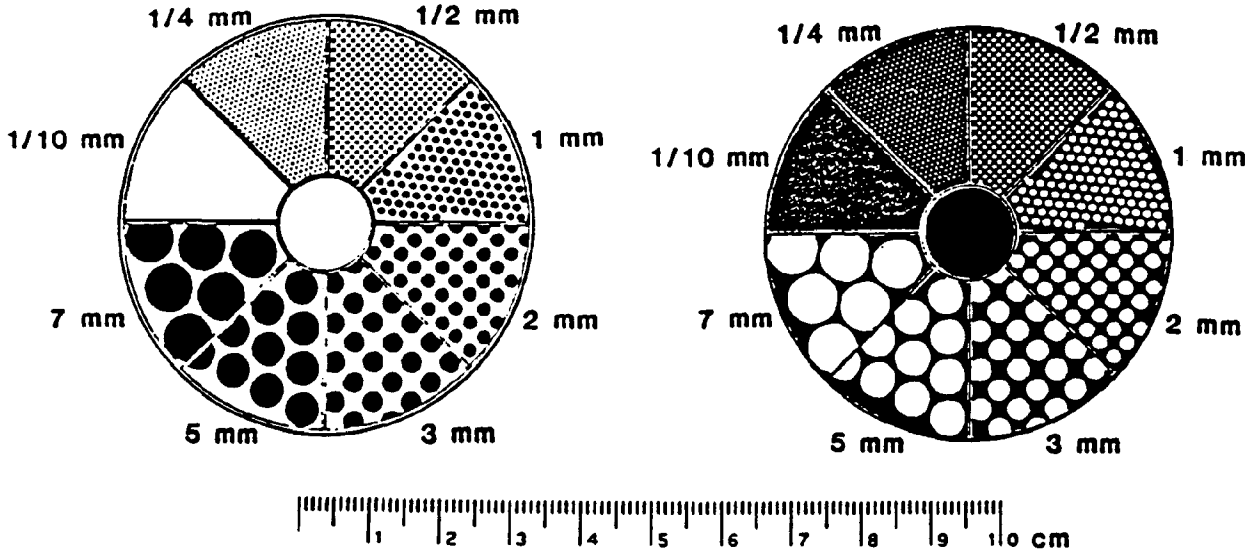
4. Create a geography lesson by mapping the locations of the sand samples used in your lab. Make some hypothesis about the sand types based on the surrounding water and land masses.

5. Language arts activities abound using sand as your central theme. One idea might be to have students write stories about their travels through time as a sand grain.

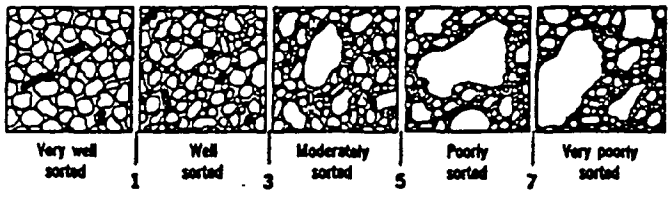
Adapted from: *Sand Kit,* Math/Science Nucleus
Project Ocean Sandy Beach Curriculum Guide, San Francisco Bay Chapter, Oceanic Society

Describing Sand Grains

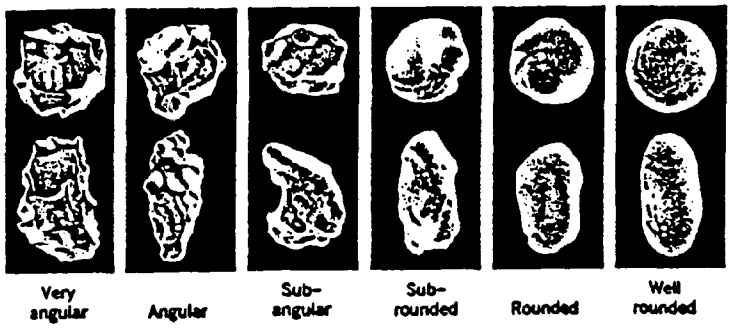
size



sorting



roundness



A D O P T - A - B E A C H
SCHOOL EDUCATION PROGRAM

OIL ON THE OCEAN

SUMMARY: After creating an artificial oil spill, students attempt to clean it up using a variety of materials.

FOCAL CONCEPT: The environmental impact of an oil spill depends on the size and location of the spill, the wind and water conditions during the spill, and the seasonal abundance of wildlife in the area at the time.

TRANSITIONS: In "Sand Lab", students took a close look at the sand on a beach to better understand the physical substance that makes up this habitat. In "Oil on the Ocean", students investigate the environmental impact of an oil spill on a sandy beach.

BACKGROUND:

> **PAN PAN, PAN PAN, PAN PAN. Hello all stations, hello all stations, hello all stations. This is the United States Coast Guard San Francisco Group, United States Coast Guard San Francisco Group. The Tanker PUERTO RICAN with 26 people onboard has exploded and is burning at the pilot station. There are Coast Guard small boats, Coast Guard aircraft and commercial vessels on scene. There are possibly still people in the water. All vessels are urged to use caution when navigating this area and report all sightings to the U.S. Coast Guard. Break. This is the United States Coast Guard Group. Out. ***

It was only a few years ago that the tanker PUERTO RICAN exploded just a few miles outside the Golden Gate. After disregarding orders not to move the damaged vessel through the protected waters of the Gulf of the Farallones National Marine Sanctuary, the PUERTO RICAN broke in half while under tow. The stern section sank in 12,246 feet of water, spilling an estimated 1,450,000 gallons of oil into one of the world's most fragile ecosystems.

For three days the oil spill followed its predicted path, moving south away from the mainland. On the third night the wind suddenly shifted. The oil spill reversed its direction and moved north, first encircling the Farallon Islands and then coming ashore in Bodega Bay. Clean-up attempts managed to skim less than 5% of the total estimated spill from our coastal waters. Bird mortalities were placed as high as 5,000. Damage to the plankton, fish and invertebrate populations has still not been assessed.

This is the story of only one oil spill. In this age of supertankers, offshore oil rigs, and the political climate that so often surrounds the oil industry, there are many possibilities for major spills just like the one that befell the PUERTO RICAN. What happens to the wildlife when such a disaster occurs? Who is responsible? How can the damage be repaired? How can we learn from this to help us with future incidents? These are just a few of the many questions that we need to consider when planning for our planet's future.

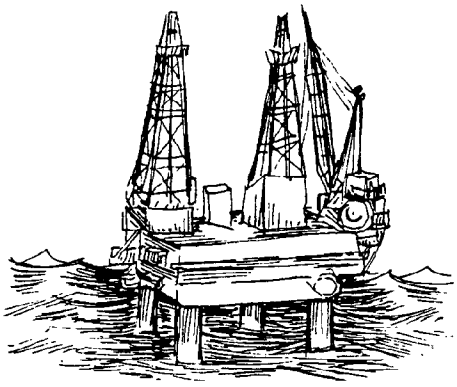
Standard operating procedure for dealing with oil spills involves containment by floating booms (a barrier of floating logs, foam or rubber tubes) followed by removal of oil from the contained area. Several methods have been developed to clean up the oil spills. Some of the methods include: absorption of the oil on other substances such as straw, sawdust, etc.; skimming; coagulating; sinking of the oil with sand or dirt; or adding dispersants like detergent to break up the spill. The method used depends on the type of oil spilled and where the spill occurred. Sometimes several of these methods are used on one spill. This activity compares various methods used in cleaning up an oil spill.

*From the Coast Guard transcript of marine radio transmissions, October 31, 1984, 4:24 AM

SCIENCE PROCESS SKILLS: observing, communicating, comparing, organizing, relating, inferring

KEY WORDS:

absorption
booms
benthic
containment
data
detergent
dispersants
endangered species
hypothermia
knot
lubricating oil/crude oil
oil slick
oil spill
sanctuary
simulation
trajectory



TIME: 1-2 40 minute periods

MATERIALS:

aluminum pie plates or similar containers
water
used motor oil (ask for in filling station)
salad oil (simulating highly refined oil)
detergent
eye droppers (separate ones for light and heavy oil and detergent)
drinking straws

List 1
cotton balls
styrofoam pieces
nylon stockings, cut into 2" squares
cardboard, cut into 2" squares
string, cut into 5" lengths
straw (not hay)
spoons
paper towels
aquarium net

List 2
leaves or algae
feathers
sand

ACTION:

1. Divide the class into groups and tell them that they are faced with cleaning up the oil spill which resulted from the PUERTO RICAN Tanker Accident. They will attempt to clean up the spill using techniques simulating those actually employed by the agencies responsible for cleaning up oil in the San Francisco Bay Area. Read the **boldface** scenarios and then have the students attempt to simulate the clean-up techniques described in the narrative.

2. Creating the Oil Spill.

On October 31st, 1984 the Tank Vessel PUERTO RICAN exploded and caught fire just beyond the Golden Gate. The fire was put out before the tanker sank, but oil immediately began to leak into the water.

a. Have each group fill the pie plate with about 1 inch of water. Then use the eye dropper to place 15 to 20 drops of salad oil on the surface of the water in the dish.

3. Offshore Oil Clean-up.

In the SF Bay area, the oil production and shipping companies have formed their own clean-up cooperative, Clean Bay. Clean Bay was notified of the PUERTO RICAN incident only minutes after the initial explosion, and immediately began to mobilize its resources, including requesting the offshore oil recovery vessel, MR. CLEAN II from Southern California. During the first two days of the incident, Clean Bay's SPILL SPOILER II collected a small quantity of oil at the scene of the explosion. Up to this point, no oil had come ashore.

a. How can you clean up the oil with the equipment you have at hand? Select any of the materials from List 1 and use it to clean up the oil slick. Try at least three different techniques and materials and record the results in a Data Chart on the board similar to the following:

METHOD	WHAT HAPPENED	RATING AS TO EFFECTIVENESS (1-5)

What actual clean-up procedure was simulated by each of the methods you tried?

4. **Fortunately, the PUERTO RICAN was only carrying a variety of light, highly refined lubricating oils, unlike the majority of tankers entering San Francisco Bay, which carry crude oils.**

a. Now perform the same procedures using the heavier motor oil. Again record the results in the Data Chart on the board.

5. Three days later, while under tow in the waters of the Pt. Reyes-Farallon Islands Marine Sanctuary, the PUERTO RICAN broke in two and the stern sank, releasing 25,000-35,000 barrels (1,050,000-1,470,000 gallons) of oil into the ocean and creating a major pollution incident. MR. CLEAN II was sent for from Half Moon Bay, but as she was departing, "....a large wave broke through the pilot house window of the Mr. Clean II, causing flying glass to injure two of the vessel's operators and rendering the vessel's radio and radar inoperative."

With this first line of defense rendered inoperative by weather conditions, Clean Bay recommended that they obtain the necessary approvals for what they considered the only remaining response-aerial dispersant application.

a. Now add 5-10 drops of detergent and again try to remove the oil using materials from List 1. Record the results in the Data Chart.

6. Onshore Oil Spill Clean-up.

The spill trajectory observations and predictions for the next two days were for continued southward movement without any landfall. However, on the morning of November 6, the biologists on S.E. Farallon Island awoke to "the smell of oil". Overnight the spill had stopped its southward progress and had moved 24 miles north and surrounded S.E. Farallon Island. The oil had now come ashore and was threatening the harbors, bays and beaches of northern California.

Beach clean-up crews were sent to Bolinas Bay and Stinson Beach and clean-up started at first light on the 10th with absorbents and vacuum trucks. An absorbent boom and zodiac boats were staged at the entrance to Tomales Bay but were never actually rigged because the current was such that the boom could not successfully have prevented oil from entering the Bay. By November 10th, as much of the oil as could be skimmed had been vacuumed up, and absorbent pads were being used to collect the remainder. Booms were also deployed on either side of Bodega Bay Harbor entrance, but a significant amount of oil entered the harbor. Some oil also entered Tomales Bay and Drakes Estero, coating the vegetation at the high tide line.

a. Use the materials from List 1 and List 2 and again try to clean up the oil, this time from the sides of the pie pan. Look at the dry feather, then when wet and finally when coated with oil. Record the results in the Data Chart. Were you surprised at the materials which were most efficient at cleaning up the oil? What happened when you added the sand? Now how are you going to clean the oiled sand?

7. Weather conditions were the most important factor determining success of skimming operations. On almost half of the days following the breakup and spill, wind and sea conditions were in excess of those which would permit operations (over 6-foot seas and when white caps start to form in greater than 12-knot winds).

a. To simulate rough weather, carefully make waves in your model ocean. You can make waves by gently blowing over the surface or using the straw or by moving a card through the water. Repeat two of the methods you used above, this time with heavy oil and rough water. Record your data in the Data Chart.

The oil slick continued to move northward along the coast and was observed off Point Arena. Although traces of oil continued to be sighted in the surf line along the Mendocino coast, there were few additional reports of beached oil after November 12.

DISCUSSION:

1. With which method were you able to most rapidly clean up the oil spill? Did this differ between the light and the heavy oil?

2. The first activities following an oil spill involve attempts to contain the spill to keep it from spreading. Which of the materials provided would help to contain an oil spill? In the PUERTO RICAN Accident, what materials were used to try to contain the spill? Under what weather conditions would booms work best?

3. Most of the oil removal techniques use materials that absorb oil. Which of the methods you tried used absorption to remove oil? Some people say that these techniques simply move the oil spill from the water to the land. What happens to the oil-soaked material once it is brought ashore?

4. What effect did the detergent have on your oil spill? Did the detergent make the clean-up technique more or less effective? How might living organisms be affected by the addition of detergents or other dispersants to the environment? (ANSWER: Sometimes the detergent or other dispersant is actually more harmful to the environment than the oil spill itself.)

5. Fire is another technique often used to remove oil spills. Where does the oil from the water go when it is burned? What effect might this have on our air quality? (ANSWER: The problems that burning oil might cause are the same as those caused by air pollution, such as respiratory problems, photo-chemical smog, etc.)

6. Wind and currents carried the spill northward after it was predicted to be on a southerly course. How do the major current systems off California and their alternation affect circulation in central and northern California during different seasons? (ANSWER: During most of the year, the surface waters along the coast are moved southward by the California Current, part of the great clockwise rotation of waters of the north Pacific. In the fall and winter (November-February), the California Current weakens and is replaced by the Davidson Current which moves northward at about the same rate. At the time of the PUERTO RICAN incident the system of currents off the coast was in the process of reversing from the southward-moving California to the northward-moving Davidson.)

7. What is one of the most important factors affecting the cleaning up of oil spills in the ocean? (ANSWER: Weather.)

8. Why was the location of the oil spill from the PUERTO RICAN of particular concern to biologists? (ANSWER: It occurred in the Gulf of the Farallones National Marine Sanctuary, an area of extremely high resource value in terms of seabirds and marine mammals, some of which are endangered species and many of which migrate and reproduce on the islands or in the surrounding waters.)

9. Why was the time of year that the accident occurred of particular importance? (ANSWER: Populations of marine mammals and seabirds were at their low points for the year. Had the spill occurred a month or two later, ten times more birds would have been on S.E. Farallon Island and more than 16,000 California gray whales would have been passing through the area of the spill on their southward migration. In addition, a spill occurring during the winter months could pose a major threat to hundreds of fur seals and thousands of elephant seals. Also, the principal commercial and sport fishing seasons (salmon, rockfish, flatfish, crab and striped bass) were either past or had not yet begun.

10. Why are oil spills especially harmful for seabirds and sea otters? (ANSWER: Seabirds and otters coated with oil are no longer able to keep themselves waterproof and are then at risk of hypothermia and freezing in the very cold Pacific waters.)

11. Once the oil spill sinks to the bottom, (out of sight of humans and beyond the range of harming the birds) is the oil a problem for the environment? How? (ANSWER: It may suffocate the benthic organisms or contaminate invertebrates living on the ocean floor which are used as prey items for animals such as the sea otter.)

12. Who should be responsible for cleaning up and paying for oil spills?

TEACHING STRATEGIES:

1. This activity works well in small cooperative groups. Suggested roles may include 1 student to get supplies, 1 to read/interpret/reiterate directions, 1 to try the different techniques agreed upon by the group, 1 to record data.

2. For younger students, read the narrative aloud and have the groups perform the different steps as you describe them.

3. For older students, you might have them read the accident scenario aloud or duplicate the activity for each group and have them do it at their own speed.

4. Plan to spend some time discussing what should be done with the oily materials once the activity is completed. There are recycling centers which will take the used oil and contaminated water and materials.

EXTENSIONS:

1. Research the animals living on or around the Farallon Islands.

2. The Department of Interior's Minerals Management Service (MMS) intends to lease portions of central and northern California's Outer Continental Shelf for exploration and development of oil and gas in the near future. MMS environmental impact statements on proposed lease sales for this area predict a variety of major and minor oil spills associated with exploration and development. President Bush has recently put Tract 95 (in southern California) and 91 (in northern California) on indefinite hold for drilling. However Lease Sale 119, the central California tract, has not been mentioned. Contact your representatives in Congress and let them know how you feel about drilling off the central California coast.

3. Research the environmental effects of other oil spills and explorations, such as the 1969 Santa Barbara oil well blowout, the 1971 tanker collision and spill at the entrance to San Francisco Bay, and the oil pipelines in Alaska.

Adapted from: *Marine Science Center, Project For Sea gr.7-8* and
Analysis of the Puerto Rican Tanker Incident by Michael Herz & Dianne Kopec.
Paul F. Romberg Tiburon Center for Environmental Studies

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

PACKAGING YOUR PRODUCT

SUMMARY: Students examine product packaging and identify the various purposes served by the packaging. Students then design alternative packages which are less wasteful of resources and minimize waste disposal problems.

FOCAL CONCEPT:

Packaging contributes vast amounts of garbage to our landfills and is highly wasteful of our natural resources. Such packaging can often be avoided or redesigned to alleviate these concerns.

TRANSITIONS:

In the "Oil on Water" activity students learned that oil is released during drilling and transport and that it is exceedingly difficult to clean up. In the "**Packaging your Product**" activity students investigate the wasteful use of petroleum-based plastic packaging and design alternative packages which would reduce consumption of this limited resource.

BACKGROUND:

Manufacturers consider a number of factors when designing a package for their products. They prefer a package that most economically meets a number of requirements such as preservation of product quality and compliance with governmental regulations (FDA laws require that the packaging for many products be designed to prevent spoiling and harmful tampering). Above all, they design their packages to appeal to the consumer, provide function and promote their product.

Manufacturers know that the consumer can be persuaded to buy a product if they are attracted to the package that contains it. Consumers look at the package size, shape, written messages, convenience of use, and color combinations to identify the product and select the one they want. In stores, packaging serves to advertise products and identify contents, and may be required to meet regulatory standards. During shipping, additional protective packaging is often required for ease of transport and product protection. Unfortunately, most packaging is disposable. Disposable packaging has accelerated the consumption of our natural resources by funneling them into our landfills at a staggering rate.

Discarded packaging is the largest single component of household waste. It makes up approximately one-third of the nation's trash, using up a major portion of our limited landfill space. The production of packaging alone uses up tremendous amounts of valuable natural resources. Packaging comprises 50% of the paper, 75% of the glass, 40% of the aluminum, and 30% of the plastic used in the United States!

As consumers, we play an important role in determining the types of materials used in packaging. If we buy more of a product in a certain type of box, then the box stays. If we stop buying a product, the first thing to change is the package. We can influence types of materials used in packaging by shopping environmentally. Shopping environmentally means buying products that are packaged properly but not excessively. It means considering the package when selecting products and avoiding those with excessive and disposable packaging. If we shop environmentally, manufacturers will need to respond by modifying their product's package to reflect these new concerns.

This activity will help students to recognize packaging that is highly wasteful of our natural resources, contributes unnecessarily to our landfills, and misleads the consumer. Students design packages which reflect their awareness of the waste reduction and resource conservation consequences of packaging decisions.

SCIENCE PROCESS SKILLS: Observing, comparing, organizing, relating

KEY WORDS:

natural resources	landfills
consumers	shelf life
recyclability	biodegradability
reusable	disposable
Processors	conservation

TIME:

Discussion: 20 minutes
Package design: 20-30 minutes

MATERIALS:

Bring a collection of packaged products to class such as:

pump toothpaste	lipstick
toy (unopened)	Bic Pen 5-packs
laundry soap	Cereal box

One copy per group (preferably copied onto the backs of sheets of used paper) of each of the two tables **"Packaging—Good or Bad?"** and **"Packaging Materials—Which One is Best?"** found at the end of this lesson.

Materials for design and construction of improved prototype packages:

- non-toxic markers & one regular toxic marker
- cardboard
- newspaper
- crayons
- construction paper
- white glue or paste
- tape and/or staplers
- paperboard (old cereal boxes)

ACTION:

1. Describe various examples of packaging using two or three samples brought from home. Ask the class for other examples of packaging for different products. List the examples on the board or on a large sheet of paper. Discuss the list. Could they have used less packaging? Discuss alternative packaging methods for these items. Could they have made the package from a recyclable or degradable material? Could they have chosen a material made from a renewable resource (trees) in place of a non-renewable resource (petroleum)? Then broaden discussion to other products, such as rope tied around firewood, firewood sold in plastic net bags, and presto logs wrapped in paper, newspaper or styrofoam stuffed in a shipping box, milk bottles, paper milk cartons, and plastic milk jugs, candy boxes, candy wrappers, and plastic bags of candy, butcher paper or styrofoam with plastic wrap for meats, toys in individual plastic hanging display cases and toys sold from a large container, fast food and canned food, styrofoam and paper egg cartons, etc. Identify the most wasteful and least.

2. Assign students to look at how different products in their own homes are packaged and to bring a few representative samples to class the next day. Have them write their names on the products they bring.

NEXT DAY:

3. Have students separate all the products brought from home into categories - cosmetics, food, drinks, entertainment, household, etc. (see teaching strategies below).

4. Divide students into groups and distribute one category of products to each group. Give each group a copy of **"Packaging - Good or Bad?" & "Packaging Materials - Which One is Best?"**. Discuss the functions, benefits and drawbacks of packaging including information on purposes, use of natural resources, recyclability, shelf life, biodegradability, disposability, and production of pollutants. See **Garbage, Plastic and Paper Fact Sheets.** Use products displayed in each category to illustrate your discussion. Ask someone from each group to identify one benefit and one drawback of the packaging for one of the products assigned to their group.

5. Supply each group with scratch paper (not new paper) — one to write on and several to sketch on. (When reusing paper it works well to have students draw an X across the used side of the paper and then turn it over and use the blank side).

6. Ask each group to separate recyclable and reusable packages from disposable packages and make a list of each. Next to each recyclable or reusable product have students describe how it can be recycled or reused. For instance: An oatmeal box can be reused as a household container and then recycled to make paperboard. A glass bottle can be recycled to make new glass. Plastic-coated paperboard packages cannot be reused or recycled.

7. Have students choose one of the products and answer the following questions:

- Why do they think the producer packaged it in this way?
- Is the product breakable?
- Will the product spoil?
- Do consumers need to see the inside of the package in order to decide to buy the product?
- Is the packaging necessary only during shipping (fruits and vegetables) or just until the product is purchased (plastic wrap on a cassette tape) or must it last until the product is used up (milk carton)?
- Is the packaging needed to protect the public from harm (child proof bottles, warning label on cigarette packages)?
- Is it light weight for low cost shipping?
- Is the packaging designed for consumer convenience (cup of soup, packets of hot chocolate mix, squeeze margarine)?
- Is the package bulky, making it more noticeable?
- Is the packaging material costly or inexpensive?
- What are the most important purposes of the packaging for its chosen product (to protect the product from breaking, to keep the product sanitary)?

8. Have students design a package for their chosen product which is less wasteful of our natural resources than the original package. Have them develop additional design specifications for the packaging such as whether the packaging will be reusable or recyclable. Have them describe what their package will be made of and what will be written on the outside of it. The package design should include information explaining how the consumer can reuse and/or recycle the package. And, it must serve all the important purposes of packaging for their chosen product.

9. Allow time for students to create these new packages for their products using 'the materials for design and construction of improved prototype packaging'. Encourage creativity. Students can produce a 3 dimensional model, a drawing, or a package label to illustrate their idea for improved packaging.

10. Ask students to present their prototype packaging to the class. Have them explain the reasoning behind their designs.

TEACHING STRATEGIES:

1. Separating the products. With older students you can have each group assign categories to their collection of products. With younger students it works well to designate locations around the room for each category of product and instruct students to place their product into the appropriate category (e.g., place the cereal box on the table labeled FOOD). Then assign one category to each group.

2. With younger students, keep the categories simple and familiar - food, household, toys, other. Emphasize reusable and recyclable as opposed to disposable. With older students, use a wider range of examples and distinguish between different types of paper products (glossy magazine, newspaper, white paper, paperboard . . .). See "**Paper Facts.**"

DISCUSSION:

1. Was any of the litter found on the beach clean-up packaging? Cans, bottles, and styrofoam ice chests are all packages.

2. Packaging of all materials makes up the largest single component of household solid waste. What will happen to packaging that is not reusable or recyclable? Can you think of any products that do not require packaging?

3. Can you think of any packaging that your family already reuses over and over (cigar boxes, some plastic bags)? How can we reuse or recycle other types of packaging after using the product? Can you think of ways to acquire less packaging when you shop?

4. With older students, discuss the consequences of pollutants produced during manufacturing and toxins leached out during disposal and degradation. Should the production of packaging that generates toxic wastes be outlawed or heavily taxed? Should the packaging be returned to the manufacturer after use to be reused, recycled or disposed of properly?

5. Some packages suggest that the product is bigger or more abundant (large tubes of wrapping paper, giant box with a small toy inside). Some packages mislead the consumer into thinking that the product is of higher quality than it is (product picture on the package appears to be solid and grand, but in reality is easily broken and junky). Have you ever been misled by packaging? What were the products and how were you misled?

EXTENSIONS:

1. Make a display of alternatives to poorly packaged consumer goods. Have students bring in examples of poorly packaged products and similar products in better packages (e.g., plastic detergent jug and a recycled paperboard detergent box; a tiny plastic bottle of shampoo and a large plastic bottle of shampoo). Have them write a short explanation of the benefits of the better packaging and the drawbacks of the poorer packaging on 3 by 5 cards next to each example. See ACTION 1 of this activity for more ideas.

2. Make a display of misleading packaging. Include suggestions for more accurate and ecological packages.

3. Write a letter to the manufacturer of a poorly packaged product telling them that your class does not support the practice of over-packaging. Write a second letter to the manufacturer of one of the products identified as having a better package congratulating them on their design and explaining why your class preferred their package over the competitor.

Adapted from *A-Way With Waste: Second Edition*, Washington State Department of Ecology.

A D O P T - A - B E A C H
SCHOOL EDUCATION PROGRAM

PACKAGING—GOOD OR BAD?

BENEFITS OF PACKAGING

Preservation of contents

Protects contents from damage

Sanitation

Safety

Identification of contents

Prevention of theft

Instructions for product use

Compliance with regulatory standards

Convenience

DRAWBACKS OF PACKAGING

Disposable packaging is rapidly filling our landfills (fewer places to put all this garbage!!)

Production of packaging consumes energy

Production of packaging often produces toxic wastes

Disposable packaging consumes and wastes our natural resources

Packaging can mislead consumers as to the quantity and quality of a product

Packaging increases the cost of the product to the consumer

A D O P T - A - B E A C H
SCHOOL EDUCATION PROGRAM

PACKAGING MATERIALS—WHICH ONE IS BEST?

Packaging is rated as less or more wasteful in terms of consumption of natural resources and necessity for disposal in landfills.

LESS WASTEFUL	MORE WASTEFUL
No packaging	Excessive packaging
Large quantity of product per package	Small quantity of product per package
Recycled paper products	New paper products
Recyclable paper	Non-recyclable paper or paper difficult to recycle (glossy magazine, waxed paper, plastic coated paper)
Recyclable plastic	Non-recyclable plastic
Recyclable material	Degradable material
Paper products	Plastic products
Recycled glass	New glass
Recycled aluminum	New aluminum
Recycled metals	New metals
Renewable Resource	Non-renewable resource

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

RECYCLING IN YOUR SCHOOL

SUMMARY: Students establish a recycling program in their school to demonstrate how they can play an important role in reducing waste and conserving natural resources.

FOCAL CONCEPT: Students can actively incorporate the conservation ethic by starting a school recycling program to reduce consumption, conserve natural resources, and reduce waste.

TRANSITIONS: During the Adopt-A-Beach School Education Program students explored the environmental problems associated with litter and the waste of natural resources. In the "**Recycling In Your School**" activity, students are given a chance to put what they have learned in the field to practice at school.

BACKGROUND: Recycling at school is an excellent way to culminate the Adopt-A-Beach School Education Program. It allows students to incorporate the concepts covered on marine science, conservation, and recycling into their own lives. Recycling provides students a chance to actively assert their own conservation commitment. A school-wide recycling program can accomplish the following:

1. Develop an understanding of the importance of conservation of resources through reducing consumption, reuse and recycling.

2. Provide an effective hands-on approach for environmental education and a model for life.

3. Reduce school expenses by reducing consumption of paper products and reducing waste disposal costs.

4. Develop an understanding of business operations and finance management. Students can monitor income earned through recycling, and associated expenses.

5. Generate a modest income for your school or student body.

History of Recycling in San Francisco: Recycling is not new to San Francisco. Since the turn of the century, the disposal companies in San Francisco separated garbage into three categories: paper products, wet garbage, and a combination of glass, rags and metals. The wet garbage was fed to the hogs and the others were recycled. Between 1961 and 1967 the massive influx of packaging and plastics overwhelmed this system, and recycling was terminated except for cost-effective operations dealing with newspaper, cardboard and metals. In 1970, the first community recycling center for newspaper, glass and cans opened. The number of recycling programs has grown since then, bringing the total number of centers to 34 in 1988. San Francisco is presently laying the foundation for city-wide curbside collection of residential recyclable materials. The City of San Francisco also provides grants and assistance to promote new recycling programs such as paper recycling in city businesses, promotion of school recycling and this Adopt-A-Beach School Education Program.

Schools throughout the city and across the country are starting up their own recycling programs. Organizing a school recycling program takes time and energy at the start. This lesson will help you to start your own program in your classroom or school.

SCIENCE PROCESS SKILLS: Organizing, recording, communicating

KEY WORDS:

reuse
recycle
waste
organize
cooperate
conserve
materials

TIME:

Planning and start-up 2-4 weeks
Recycling 2 hours a week

MATERIALS:

Cardboard boxes
Posters and signs
Collection containers and bins

ACTION:

1. Select A Recycling Team and Choose A Leader.

The recycling team will be needed to assist with preparations and to provide the people-power to run the program. Depending on the age or grade-level, students can be in charge of most or all aspects of the program. The recycling team may also consist entirely or in part of:

- the student council
- teachers
- one class or grade level
- a student-teacher group
- a parent group or the PTA
- athletic team or school club

The recycling team will require a leader (yourself perhaps) to organize the overall recycling program, provide guidance to the recycling team and to assure adequate day-to-day supervision of the program activities. The team leader may be any of the following:

- teacher
- administrator
- parent
- student (with supervision)

2. Identify Your Primary Objectives and Set A Goal.

Before starting, the team should identify their primary purpose in organizing school recycling and set a goal. For example: If you want to earn money, set a goal to earn $100.00 for a specified purpose. If you want to save trees, set your goal at recycling the equivalence in paper of 10 trees (one ton of paper equals 17 trees). If you want to conserve limited resources, keep track of the petroleum saved by recycling plastics or the energy saved by recycling aluminum. If you want to reduce garbage costs to the school, set a goal to reduce the volume of garbage by a set amount each month. Establish clear, attainable goals and make them known to all from the start.

3. Assess Your School Garbage.

In the activity "**Garbage In Your Classroom**" your students assessed the type and quantity of garbage generated in their class. Have them try this lesson in other classes and in other areas of the school to determine what types and how much garbage is being generated throughout the school. Follow the steps outlined in the lesson to reduce consumption of materials before recycling begins!

4. Select A Recycling Program.
Once you know what types of materials are generated at your school, your recycling team can choose a program to recycle appropriate materials. The program should be designed to fulfill the primary objectives and goals outlined by the team. You must make prior arrangements for the removal of the materials you are planning to recycle before collecting and storing them. A little research is necessary to find the best recycler for your needs. There are a number of recycling options open to your school:

A. Regular collection of recyclables at school. This option provides relative convenience with moderate financial returns.

B. Deliver your own recyclables to a dealer or recycling center. This can be less convenient but provides greater financial return.

5. Confirm Your Recycling Plans With the Administration.
It is very important that you discuss and confirm your plans with the school administration as well as with all others affected by the recycling program (the custodians, office staff, teaching staff, cafeteria people, etc.). You will need to address the following:

A. What recycler did you choose and why? You'll need to know how often recyclables will be removed from the school grounds, whether or not money will be earned, who is providing the bins and where they will be stored.

B. Transportation to the recycler. How will materials be removed from school grounds and by whom? The more convenient methods such as pick-ups at school are less profitable, but will still allow you to meet your non-monetary goals.

C. Storage of recyclables. How and where will the materials be stored? What will be done to assure cleanliness and safety?

D. Collecting recyclables. How many collection sites are needed and where will they be located? How often will materials be consolidated into larger bins? Who will do this (recycling team, class monitors, custodians, etc.)?

E. Are janitors already recycling? Will you be taking from their reserve? How can you work together?

6. Preparing Your School.
Your recycling team can do a lot to prepare your school for recycling. Advertise your goals and announce the first collection day. Identify collection containers. Have students conduct short classroom presentations explaining the recycling procedures, create decorative cardboard boxes as classroom collection containers for paper, and make posters and signs for the school grounds to remind everyone to recycle.

7. Start Recycling.
Supervise the collection and consolidation of materials closely at the start. Provide positive feedback to participants and remind teams of their responsibilities. Identify and resolve problems that arise as quickly as possible. Talk to school staff to assure smooth operations. Assist the operations until they blend in with other standard school procedures.

8. Monitor Your Results.
Have your recycling team record the accomplishments of your recycling program. Keep track of quantities recycled and the funds generated over expenses. These records can be used to document savings to the school resulting from reduced consumption, recycling sales, and reduction of garbage costs. Use the data to rally additional support, to troubleshoot and to give your students experience maintaining financial records. If you are selling the recycling materials to a dealer or a recycling center, open an account for the money generated and record how the money is spent. Celebrate and advertise your successes!

9. Meeting Your Educational Objectives.
You can further your educational objectives by teaching a unit on recycling. Units may include lessons on the marine and terrestrial environments or recycling and waste reduction, and be supplemented with field trips or guest speakers. Consult the list of resources in this guide.

DISCUSSION:

1. What reasons can you think of to recycle? What reasons can you think of not to recycle? Have the class vote on which reasons are most important and discuss the results.

2. What materials are recyclable? What impact will recycling have on global issues?

3. Were you interested in recycling before your trip to the beach? Did your trip to the beach influence your feelings about recycling? Why or why not?

TEACHING STRATEGIES:

1. Outline specific responsibilities for each grade level in your school.

2. Involve students in the planning and operations as much as possible.

EXTENSIONS:

1. Do a waste study on your school to find out what other items could be recycled — aluminum, glass, books or cardboard. Identify ways to reduce waste production. Expand your present recycling program to include other things. Try setting up a compost pile to convert clippings and cafeteria wastes to soil.

2. Start a recycling club at your school to expand the recycling program into the community.

3. Have students look in the newspapers for articles on recycling. Interview teachers and students for their views on your school recycling program.

4. Look at what you and your school purchases and identify where recyclable goods can replace disposable or non-recyclable ones.

ADOPT-A-BEACH
SCHOOL EDUCATION PROGRAM

EVALUATION/QUESTIONAIRE

It is important that volunteers get all of the information they need to do a successful cleanup. Your feedback will help us greatly in putting together a complete and useful manual. Please fill this out and return to us at your earliest convenience.

Name _____ Date of Cleanup _____

Group _____ Age of Participants _____

FORMS/RESOURCES

Which checklists did you use in your cleanup?	Did you find them helpful?
____ Students Checklist	____ Y ____ N
____ Teachers Checklist	____ Y ____ N
____ Adopt-A-Beach Checklist	____ Y ____ N

RESOURCES

____ Important Phone Numbers	____ Y ____ N
____ Resource Lists	____ Y ____ N
____ Glossary	Y N

DATA COLLECTION

Did your group complete:

____ Data Collection Activity?	____ Y ____ N
____ Data cards?	____ Y ____ N

What sections were useful?

Circle the appropriate answer:

0 = never referred to section
1 = least helpful
5 = most helpful

	NOT USED	LEAST				MOST
INTRODUCTION						
Introduction to Adopt-A-Beach Program	0	1	2	3	4	5
Ocean Pollution Fact Sheet	0	1	2	3	4	5
Who's Who/Ways to Get Involved	0	1	2	3	4	5
CLEANUP STEPS	0	1	2	3	4	5
CURRICULUM MATERIALS						
"Sandcastles and Sunburns"	0	1	2	3	4	5
"Web of Life"	0	1	2	3	4	5
"Tidal Waves"	0	1	2	3	4	5
"Garbage in Your Classroom"	0	1	2	3	4	5
"Scavenger Hunt"	0	1	2	3	4	5
"Shorebird Flocking"	0	1	2	3	4	5
"Paper to Pulp to Paper"	0	1	2	3	4	5
"Sand Lab"	0	1	2	3	4	5
"Oil on the Ocean"	0	1	2	3	4	5
"Packaging Your Product"	0	1	2	3	4	5
"Recycling in Your School"	0	1	2	3	4	5

Data Collection Activities

Were the data collection activities easy to complete and enjoyable for your group? Would you do them again? Why/Why Not?

Marine Science Activities

What activities were particularly useful and why? Was the grade level appropriate?

What activities were NOT particularly useful and why?

After the cleanup and follow-up activities, did you notice an increase in your groups' awareness and understanding of marine science/recycling?

Coastal Commission Support

Was your experience working with your beach manager positive?

Was your experience working with the Coastal Commission positive?

Where do you see a need for improvement in the Adopt-A-Beach program/manual?

What do you think are the program/manuals strengths/weaknesses?

Other Comments?

THANK YOU FOR RESPONDING. PLEASE MAIL THIS TO:

Adopt-A-Beach
California Coastal Commission
631 Howard St., Fourth Floor
San Francisco, CA 94105