girl scouts of the chesapeake bay

H2O Bay

Resource Book

Chesapeake Bay Ecosystem

The physical processes that drive the Bay ecosystem sustain the many habitats and organisms found there. Complex relationships exist among the living resources of the Chesapeake Bay watershed. Even the smallest of creatures plays a vital role in the overall health and production of the Bay. Forests and wetlands around the Bay and the entire watershed filter sediments and pollutants while supporting birds, mammals and fish. Small fish and crabs find shelter and food among lush beds of submerged aquatic vegetation. Unnoticed by the naked eye, phytoplankton and microzooplankton drift with the currents, food for copepods and small fish. Clams and oysters pump Bay water through their gills, filtering out both plankton and sediment. During the fall and winter, waterfowl by the thousands descend upon the Bay, feeding in wetland and shallow waters. Bald eagles and ospreys, perched high above the water, feed on perch, menhaden and other small fish to their young. The spectrum of aquatic environments, from freshwater to seawater, creates a unique ecosystem abundant with life.

The relentless encroachment of people threatens the ecological balance of the Chesapeake Bay. Fifteen million people live, work and play in the water shed. Each individual directly affect the Bay by adding waste, consuming resources and by changing the character of the land, water and air that surrounds it. However, through the choices we made in our everyday lives, we can lessen our impact on the Bay's health. We must nurture what Aldo Leopold once termed as our "wild rootage"- a recognition of the fundamental connection and dependency between society and the environment. As advocates for the Bay and its many living resources, we can preserve the Chesapeake for years' to come.

The Watershed

The Chesapeake Bay receives about half its water volume from the Atlantic Ocean. The rest drains into the Bay from an enormous 64,000 square-mile drainage basin or watershed. The watershed includes parts of New York, Pennsylvania, West Virginia, Delaware, Maryland and Virginia and the entire District of Columbia. Freshwater from springs, streams. Small creeks and rivers flow downhill mixing with ocean water to form this estuarine system. Soil, air, water, plants and animals, including humans, form complex web of interdependencies that together make up this Chesapeake ecosystem. The 15 million people living in the Chesapeake watershed play an important role in this ecosystem. The activities and problems occurring throughout the entire watershed significantly impact the functions and relationships of the Bay proper. We must choose whether our role will be destructive or productive.

Bay Fact

Everyone in the watershed lives just a few minutes from one of more than 100,000 streams and rives draining into the Chesapeake Bay

Chesapeake Bay- An Important Resource

Through the years, residents and visitors alike have found the Chesapeake imposing yet hospitable. The Algonquin Indians called it "Chesepiooc," meaning great shellfish bay. Spanish explorers described Chesapeake Bay as "...the best and largest port in the world." Captain John Smith, an English explorer, extolled, "the country is not mountainous nor yet low but such pleasant plain hills and fertile valleys...rivers and brooks, all running most pleasantly into a fair Bay." All were impressed with its size, navigability and abundance of wildlife and food.

Today, the Chesapeake is still on of this country's most valuable natural treasures. Even after centuries of intensive use, the Bay remains a highly productive natural resource. It supplies millions of pounds of seafood, functions as a major hub for shipping and commerce, provides natural habitat for wildlife and offers a variety of recreational opportunities for residents and visitors.

Oysters and blue crabs are famous Chesapeake Bay delicacies. From the 1920s to the 1970s, the average annual oyster catch was about 27 million pounds of meat per year. In the last 10 years, the catch has declined dramatically due to overharvesting, disease and loss or degradation of habitat. Chesapeake Bay blue crab production averaged 86 million pounds annually from 1983 to 1992, contributing more than half the nation's

catch. Although this figure is consistent with past harvests, fishing pressure, both commercial and recreational, continues to grow. The states of Maryland and Virginia have pledged to jointly manage the Bay's blue crab harvests through pot limits, gear restrictions and license restrictions. More than half the nation's soft-shelled clams also come from the Chesapeake. An extensive finfish industry, primarily based on menhaden and striped bass, rounds out the Chesapeake's commercial seafood production. In 1992, the dockside value of commercial shellfish and finfish harvest was close to $80 million.

Bay Fact

Prior to the late 1800s, oysters were so abundant that some oyster reefs posed navigational hazards to boats.

The hospitable climate, lush vegetation and natural beauty of the Chesapeake has made it an increasingly popular recreational area. Boating, crabbing, swimming, hunting and camping are major attractions. Both power and sail boating have grown dramatically. In 1993, more than 175,000 pleasure craft were registered.

Sportfishing is another major recreational activity in the Chesapeake. The National Marine Fisheries Service reported that close to 1 million anglers from Maryland and Virginia took almost 600,000 fishing trips in 1991. recreational fishing in the states of Maryland and Virginia is estimated at more than $1 billion per year.

H.L. Mencken once called the Bay. "...a great outdoor protein factory." A study by the National Marine Fisheries Service ranked the Chesapeake as third in the nation in fishery catch. Only the Atlantic and Pacific oceans exceed the Bay in production. That is an impressive ranking, since the Bay is small compared to these other bodies of water.

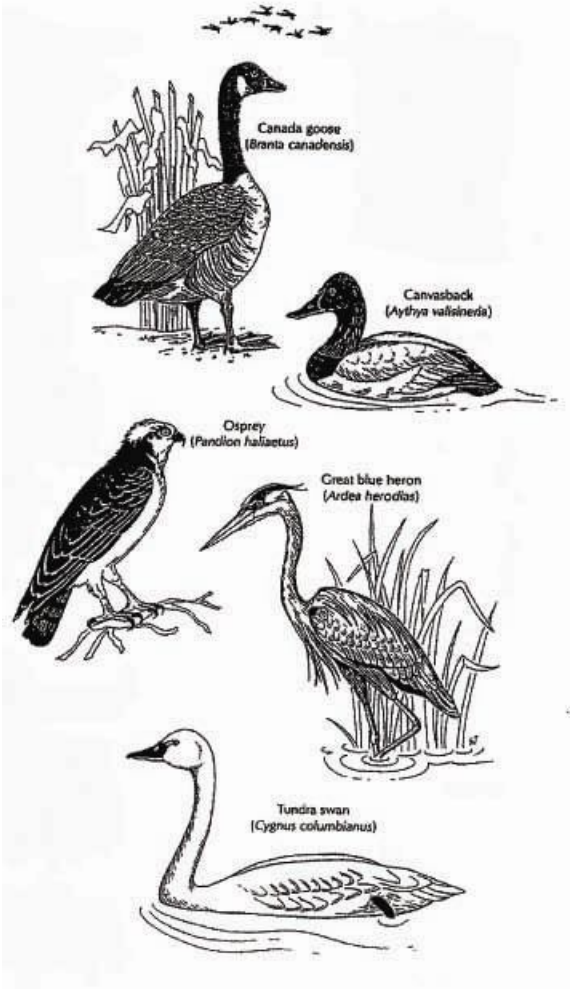
The Chesapeake is also a key commercial water way, with two of the nation's five major North Atlantic ports located here. The Hampton Roads Complex, which includes Portsmouth, Norfolk, Hampton and Newport News, dominates the mouth of the Bay. Hampton Roads ranks third in tonnage of foreign water-borne commerce. At the northern end, the Port of Baltimore is ranked ninth in the nation. Baltimore is the leading exporter of trucks and cars in the nation. More than 90 million tons of cargo were shipped via the Chesapeake during 1992. Both Baltimore and Hampton Roads are near the coal-producing regions of Appalachia, making them essential to exporting U.S. coal abroad. The Hampton Roads Complex already leads the nation in exporting coal and lignite.

Shipbuilding and other related industries also depend on the Bay. Industries and power companies use large volumes of water from the Bay for industrial processes and cooling.

Perhaps the Chesapeake's most valuable function, yet most difficult to put a price tag on, is its role as habitat for living resources. The Chesapeake Bay and its surrounding watershed provide homes for a multitude of plants and animals.

Waterfowl and other birds migrating along the Atlantic Flyway stop here, finding food and shelter in the many covers and marshes. The Chesapeake is the winter home for tundra swans, Canada geese and variety of ducks, including canvasbacks, pintails, scoters, eiders and ruddy ducks. Between 1992 and 1994, an average of 28,000 swans, 300,000 geese and 650,000 ducks wintered on the Bay. It is also a major nesting area for the threatened bald eagle. The nation's largest population of another raptor, the osprey, is in the Bay region.

The Chesapeake's tidal freshwater tributaries provide spawning and nursery sites for several important species of fish, such as white and yellow perch, striped bass, herring and shad. During the warmer months, numerous marine species, including bluefish, weakfish, croaker, menhaden, flounder and spot, enter the Bay to feed on its rich food supply.



A Threatened Resource

Chesapeake Bay, the largest estuary in the United States, is part of an extremely productive and complex ecosystem. This ecosystem consists of the Bay, its tributaries and the living resources it supports. Humans, too, are a part of this ecosystem. We are beginning to understand how our activities affect the

Bay's ecology. Growing commercial, industrial, recreational and urban activities continue to threaten the Bay and its living resources.

Bay Fact

The Bay is fairly shallow. A person 6 feet tall could wade over 700,000 acres of the Bay without becoming completely submerged.

Overharvesting and loss of habitat threatens fish and shellfish species. These two factors, plus disease, have decimated the oyster population. Excess sediment and nutrients endanger the Bay's water quality. Hypoxia (low dissolved oxygen) and anoxia (absence of dissolve oxygen) are particularly harmful to bottom-dwelling (benthic) species. Toxic substances, particularly high in industrialized urban areas, accumulate in the tissues of birds, fish and shellfish.

To find the causes of and potential remedies for these problems, it is necessary to see the Bay from an ecological perspective. All too often we think of ourselves as external to our environment and ignore the many relationships that link people, other living creatures and the surrounding habitat. If we ignore these connections when seeking solutions to problems, more and greater problems may result.

For example, agricultural activities and residential development increase the amount of sediment and nutrient-rich fertilizers entering the Bay through runoff. Water clarity is reduced and rivers are silted in. excess nutrients cause algae blooms that block sunlight from reaching critical bay grasses known as submerged aquatic vegetation or SAV. As SAV declines, so does the food, shelter and nursery grounds for many aquatic species. Solutions to these environmental problems can only be effective if complex relationships among all components of the ecosystem are also considered.

Bay Fact

Nearly half of the nations' catch of the blue crab comes from the Chesapeake Bay.

When environmental problems are approached from an ecosystem perspective, both living and non-living components are considered when recommending solutions. A truly effective solution not only corrects the problem, but avoids damaging other relationships within the ecosystem. This approach makes problem-solving a great deal more challenging, but leads to more effective environmental management.

Habitats

The Bay provides food, water, cover and nesting or nursery areas, collectively known as habitat, to more than 2,700 migratory and resident wildlife species. All plants and animals have specific habitat requirements that must be satisfied in order to live and thrive. Food, temperature, water, salinity, nutrients, substrate, light, oxygen and shelter requirements vary with each species. These physical and chemical variables largely determine which species can be supported by a particular habitat.

As a highly productive estuary, the Chesapeake Bay and its surrounding watershed provide and array of habitats. Habitat types range from hardwood forests of the Appalachian mountains to saltwater marshes in the Bay. These physical and chemical variables largely determine which species can be supported by a particular habitat.

Islands and Inlands

Lands that lie near water sources support a multitude of species, from insects, amphibians and reptiles to birds and mammals. Steam banks, floodplains and wetlands form the transition from upland to water. These areas act as buffers by removing sediments, nutrients, organic matter and pollutants from runoff before these substances can enter the water. Forests and forested wetland and particularly important to waterfowl, other migratory birds and colonial waterbirds.

Forested uplands and wetlands are nesting and resting habitat for neotropical migratory birds. These birds breed in the United States but winter in Central and South America. Some neotropical birds breed in the forests found in the Bay watershed. The Chesapeake Bay lies within the Atlantic Flyway, a major migrating waterfowl, and is a significant resting area for birds.

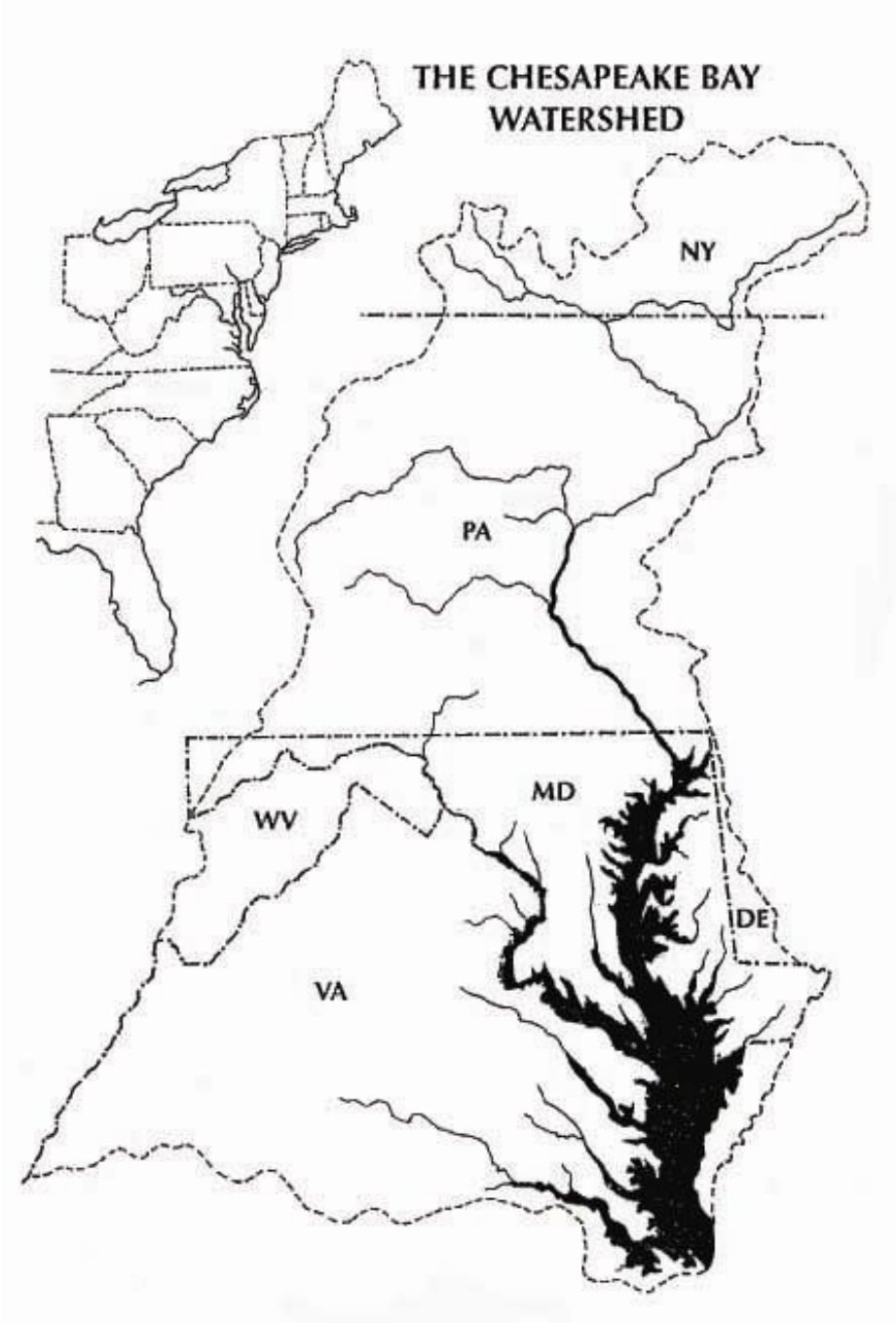
Surrounded by water and cut off from most large predators, Chesapeake Bay islands are haven for colonial waterbirds (terms and herons), waterfowl (ducks) and raptors (osprey and bald eagles). Island can also protect submerged aquatic vegetation and shallow water areas from erosion and sedimentation. However, islands themselves are eroding at alarming rates, mostly due to sea level rise and the erosive force of wind and waves.

Freshwater Tributaries

Within the Chesapeake Bay watershed, five major rivers, the Susquehanna, Potomac, Rappahannock, York and James, provide almost 90 percent of the freshwater to the Bay. These rivers and other smaller rivers along with the hundreds of smaller creeks and streams that feed them, provide habitat necessary for the production of many fish species. Anadromous fish spend their adult lives in the ocean but must spawn in freshwater. Anadromous fish species in the Chesapeake Bay include striped bass, blueback herring, alewife, American and

hickory shad, short nose sturgeon and Atlantic sturgeon. Semi-anadromomous fish, such as white and yellow perch, inhabit tidal tributaries but also require freshwater to spawn.

While all these species have different habitat requirements, all must have access to freshwater spawning grounds. However, due to dams and other obstacles, many historical spawning grounds are no longer available to fish. The fish not only need access to spawning grounds but require good stream and water quality conditions for the development and survival of eggs and juvenile fish. Nutrients, chemical contaminants, excessive, sediment and low dissolved oxygen degrades spawning and nursery habitat.



Shallow Water

The shallow water, or littoral zone, provides key habitats for many life states of invertebrates, fish and waterfowl. Shrimp, killifish and juveniles of larger fish species use submerged aquatic vegetation, tidal marshes and shallow shoreline margins as nursery areas and for refuge. Vulnerable, shedding blue crabs find protection in the SAV beds. Predators, including blue crabs spot, striped bass, waterfowl, colonial waterbirds and raptors forage for food here. Along shorelines, fallen trees and limbs also give cover to small aquatic animals. Even unvegetated areas, exposed at low tide, are productive feeding areas. Microscopic plants cycle nutrients and are fed upon by crabs and fish.

Open Water

Striped bass, bluefish, weakfish, American shad, blueback herring, alewife, bay anchovy and Atlantic menhaden live in the open, or pelagic, waters of the Chesapeake Bay. Although unseen by the naked eye, microscopic plant and animal life, called plankton, float in the open waters. These tiny organisms form the food base for many other animals. More than 500,000 wintering ducks, particularly sea ducks, like scoters, oldsquaw, and mergansers, depend on open water for the shellfish, invertebrates and fish they eat during the winter months. Open water also supports oysters and other bottom-dwellers. Oysters and other filter feeders help maintain water quality by filtering suspended organic particles out of the water. The oyster reef itself is a solid structure that supports other shellfish, finfish and crabs.

Delaware Sea Facts

From bustling bays to emerald marshes, Delaware has a wealth of marine resources. Delaware beaches are haven for hundreds of thousands of migrating shorebirds, as well as millions of tourists each year. Delaware Bay is the chief spawning grounds for the horseshoe crab and a nursery ground for many coastal fisheries. The estuary is also home to the busiest oil-shipping corridor on the East Coast. Yet increasing pressures threaten Delaware coastal areas. Population growth, pollution, overfishing, other human impacts are contributing to marine resource decline on a global scale. Natural forces such as wind, waves, and tides also make substantial demands on the coast.

Delaware and Maryland are blessed with variety of bays and rivers. In Lewes, the Delaware Bay is the center of much fishing, boating, and water sports activities. The Rehoboth Bay does the same for the communities of Rehoboth beach and Dewey Beach, Delaware. The Indian River Bay affords outstanding recreational opportunities for Bethany Beach and the Assawoman Bay serves boaters and other water sports enthusiasts in Fenwick Island, Delaware and Ocean City, Maryland. Further south in ocean city are the Sinepuxent Bay and Chincoteague Bay. Residents of ocean pines (MD) enjoy the St. Martin's river and isle of Wright Bay.

- Delaware has 90,000 acres of tidal marsh, which comprise about eight percent of the state. Delaware lost an average of 440 acres of tidal marsh every year from 1954 to 1971 due primarily to development activity. New regulations were enacted in 1973, resulting in a loss of less than 20 acres of tidal marsh every year.
- Delaware's population is approaching 700,000. From 1970 to 1990, New Castle County's population increased 14.5%, Kent County's by 25.5% and Sussex County's by 40.9%.
- About 95 industries hold permits to withdraw from/discharge into Delaware waters. The state's 2,900 farms and 300,000 housing units also impact our waterways. High loads of nutrients and sediments in runoff, wastewater and sewage can kill aquatic life.
- The Chesapeake & Delaware Canal is the busiest canal in the US. As average of 100 ships and 350 tugboats travel it each month. The 19-mile canal shortens the voyage between Baltimore and Philadelphia by 294 miles.
- Delaware Bay is the world's horseshoe crab capital. The crab's blood contains a unique compound that is used to test prescription drugs for dangerous bacterial toxins.
- Crab eggs fee migrating shorebirds that rely on Delaware's shores for rest and food. Some species travel 5,000 miles non-stop before landing to refuel.
- The Delaware Estuary supports the second largest port in the nation and the largest oil port on the East Coast – the Philadelphia port complex.
- In 1991, more than 2.5 million tourists came to Delaware to visit the state's beaches.

Sixteen Simple Steps

Here is a list of sixteen simple steps you can take to help heal the environment. Put a check mark in the box besides each step you take during a two-week period. Make these steps part of you routine.

Packaging

- ☐ Select products that come in biodegradable packages whenever possible.
- ☐ Buy products in returnable bottles, and return them.
- ☐ Wash and reuse glass jars.
- ☐ Rinse and reuse aluminum foil.
- ☐ Recycle aluminum cans.

Paper Products

- ☐ Use cloth napkins instead of paper ones.
- ☐ Buy greeting cards that have been printed on recycled paper.
- ☐ Reuse gift wrap.
- ☐ Recycle newspapers.
- ☐ Write on the back of a sheet of notebook paper, not just on the front.
- ☐ Reuse paper lunch bags or carry your meal in a fabric bag or lunch box.
- ☐ Save and reuse cardboard gift and shipping boxes.

Plastic Products

- ☐ Select nonplastic products whenever possible.
- ☐ When you shop in grocery stores or supermarkets, avoid putting fruits and vegetables in plastic bags.
- ☐ Rinse out and reuse plastic produce and grocery bags.
- ☐ Encourage your local recycling center to begin accepting plastic.

Water Plant Art

Objective

Students will be able to identify a variety of aquatic plants.

Method

Students create artwork from pressed aquatic plants.

Background

Aquatic plants grow in a variety of sizes, shapes, and colors. They are essential to the web of life in any aquatic ecosystem. The major purpose of this activity is to heighten students' awareness and appreciation of aquatic plant life.

Materials

Seaweed, grasses, or samples of other aquatic plants: shallow pan filled with fresh water; heavy, porous white paper: wax paper; newspapers: several large heavy books or plants press if available: waterproof marking pen. Note: A guide to common aquatic plants would be helpful. The Golden Press guides to pond life and seashores are examples of helpful resources that tend to be readily available.

Procedure

Talk with the students about the importance of there being a variety of plant life in aquatic habitats. Plants are important parts of aquatic ecosystems. They may provide food or shelter for aquatic animals.

Show the students pictures of some different kinds of aquatic plants, aquatic animals, and aquatic habitats. Freshwater habitats like streams and lakes, and marine habitats like saltwater bays and ocean environments, are examples.

Show the students a small variety of a sample of local aquatic plants. Seaweed from saltwater areas or grasses and algae from freshwater areas work well. If you collect these yourself, do not take a large amount from any one area, or, if possible, from any single plant. Make sure the plants are abundant and that you will do no permanent damage to the aquatic habitat by bringing your sample of plants to class. While gathering these plants, look carefully for aquatic animals. Gently remove any you find on your plant samples and put them in the water or on another plant in the environment, rather than accidentally taking them with you on your sample of plants. Put any samples of plants in plastic bags to keep moist. OPTIONAL; if possible, take your students to a place where they can gather their own samples, using the same rules for not damaging animals, plants, or the habitat.

Ask the students to identify the different types of seaweed, grasses or algae collected. You may need to call on community experts for help or use reference materials.

Place the seaweed, grasses and/or algae in a pan filled with water. Clean the seaweed or other water plants. If you want, the plants may be torn into small sizes for mounting and designing artwork

Gently lift the plants and place on heavy, white, porous paper. Arrange the plant or parts of plants into the desired design. NOTE: Each student may do this on his or her own: may work in small groups: or the group may make one design for the whole class.

Cover the arrangement of plants with wax paper.

Write on the wax paper with waterproof pen the kind of plant, and where and when it was found.

Lift the artwork—white paper and wax paper, too—and place it between several sheets of newspaper. (The wax paper protects the plant, while the water will seep through the white paper. As the plant dries, it will adhere to the white paper.)

Place the stack of newspapers containing the plant on a flat surface. Stack several heavy books on top to serve as a plant press. An actual plant press is ideal, if available.

Drying may take from a few days to several weeks, depending on humidity. NOTE: These plant prints can serve many purposes, including as plant identification keys for classroom use and for bulletin board artistic displays. The wax paper can be retained as protection or it can be removed gently, leaving the plant dried flat to the paper.

Display the aquatic art and ask the students to talk about what they learned! Again talk with the students about the importance of there being a variety of plant life in aquatic habitats. Ask the students to give examples of ways these plants are important.

Extensions

Name local plants that are found in water.

Tell how plants that grow in water can provide food and protection for animals that live in water.

Give reasons why it is important to have a variety of kinds of aquatic plants in aquatic ecosystems.

When discussing aquatic life, use a brainstorming technique to discover how plants are similar to animals. Whit down common characteristics of plants and animals, or make posters.

Find out more about the habitat in which an aquatic plant grows. What is it like? What animals live there? What plant and animal adaptations are evident?

Evaluation

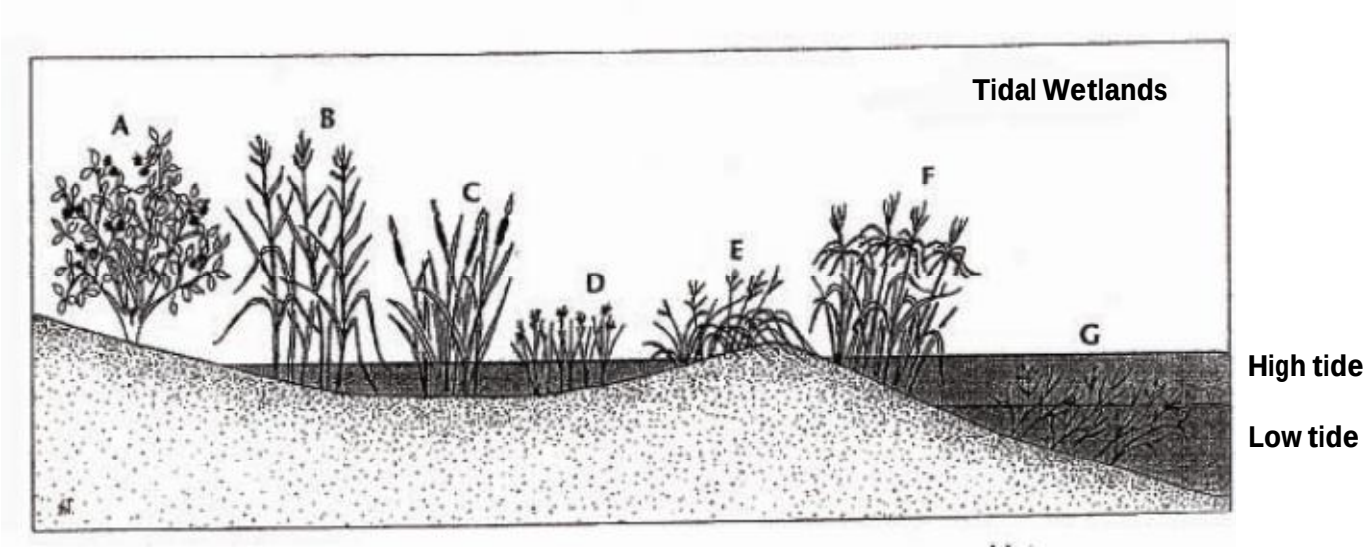
For Younger Students

Name or draw two plants that grow in bodies of water near your home. Add animals to your pictures to show how these plants can help animals that live in water.

For Older Students

Create an identification key for variety of aquatic plants that are found in your area.

These are some wetland plants native to the Chesapeake Bay Region



A. Button bush (Cephalanthus occidentalis
B. Big cordgrass (Spartina cynosuroides)
C. Narrow-leaved cattail (Typha angustifolia)
D. Black needlerush (Juncus roemerianus0
E. Saltmeadow cordgraa (Spartina patens)
F. Wild rice (Zizania aquatic)
G. Widgeon grass (Ruppia martima)

Are You Me?

Objective

Students will be able to recognize various young stages of aquatic animals and match them with corresponding adult stages.

Method

Using picture cards, students match pairs of juvenile and adult aquatic animals.

Background

Many animals look significantly different in their earliest stages of development, compared to adulthood. This is obviously true for some aquatic insects. Many aquatic insects undergo metamorphosis. Metamorphosis means change during growth. Some insects experience simple metamorphosis while others undergo complete metamorphosis. In simple metamorphosis, the insect egg hatches to produce a **nymph**. Insect nymphs have essentially all the features of adults. As they grow, they are visibly similar at each stage.

Insects that experience complete metamorphosis are characterized by eggs that hatch into **larvae**. The larva grows through several stages and then changes into a **pupa**. Pupae are usually encased in a protective cover for their next stage of growth. From the pupae emerge the softbodied, often pale-colored, insects. They differ remarkably in appearance from their earlier forms, but are not yet completely formed. Gradually the soft pale body develops firmness and color. In complete metamorphosis, there is little resemblance between the adult and earlier forms.

There are also remarkable similarities and differences between other aquatic animals in different life stages. The eggs of many animals hide their eventual from (alligators, turtles, birds). Pelican hatchling, for example, may be the closest image of miniature dinosaurs to be found on the planet. Aquatic mammals often are easy to recognize. They frequently do not change as dramatically as some other animals in overall appearance as they grow from young to adult stages.

The major purpose of this activity is for students to recognize that there are differences in the life stages of aquatic animals as they grow. The students will increase their appreciation of the diversity of wildlife as well as their understanding of growth and change in animals.

Materials

Cardboard for making picture cards, marking pens or crayons

Procedure

Make pairs of aquatic animal cards. The animals in the pair should be the same kind. For example, one might be a pair of beavers: another might be a pair of pelicans. One animal in the pair should be an adult, the other should be at a younger stage of development. The pairs might include adult, larval, nymph, hatchling, juvenile, infant and/or egg forms of aquatic animals. You may use the masters provided.

Ask the children to bring two pictures from home. One should be of an adult, the other should be a picture of a child. The pictures should be pictures of the same person as an adult and as a child. For example, the pair may be of the student's parent as an adult and in a childhood picture, or it may be a school picture of the student and a picture of the student as an infant.

Divide the class into small groups of three or four students each. Have them hold their own set of paired pictures in their hands. Assign each group a single table or station. Ask them to stand in a circle around that station.

Have the students at each station place their pairs of pictures on the table and mix them randomly. Once the adult-child pictures are mixed at each table, have the entire group shift to another table, so there will not be anyone at the table, so there will not be anyone at the tables where their own pictures are placed.

At the new table, have the group attempt to match pairs of adult/child or student and infant photos.

When the students at each table have completed their efforts to match the pairs, ask all of the groups to return to their original tables—the place they left their own pairs of pictures. Are the matches correct? Ask the students to change any pairs that are not correctly matched. Talk about how difficult or easy it was to correctly match pairs. Introduce the idea that many animals look remarkably different as adults than they appeared in younger forms. Tell the students that they are about to learn how to match young and adult forms of many different kinds of aquatic animals.

Introduce the aquatic animal cards and divide the class in two. Designate one half of the students "adults" and the other half "young animals." Give each student in the "adult group" an "adult" animal image. Give each student in the "young animal" group a "young animal" image. Make sure there is a corresponding match, adult or juvenile, for each card given. Instruct the students to look for their "match"—pairing the appropriate adult and juvenile forms. NOTE: You can attach each animal card to a string loop so the pictures can be hung around the students' necks as they try to match the pictures.

When all the students have been made their choices and think they have a match, let everyone help to see if the matches are correct. Some are more difficult than others and may be confusing. You may show the students the matched images on the master.

Have all of the students look at all of the correctly matched pairs. Look at similarities and differences in how different kinds of aquatic animals grow and change.

NOTE: This activity can be repeated several times by shuffling the adult and young images and passing them to new "animals" so that each student becomes familiar with wider array of animals.

Extensions

Find out as much as possible about some of the habitats in which these animals live.

If possible, visit some of the habitats where the animals are actually found.

Pick a pair of images and find out more about the life cycles of the animals shown.

Discuss and/or pantomime the concept of metamorphosis.

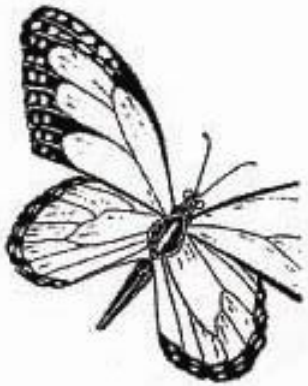
Evaluation

Pick two aquatic animals. Draw a picture of each animal as an adult, and another picture of each animal as it looks when it is young.

Frog

Duck

Butterfly

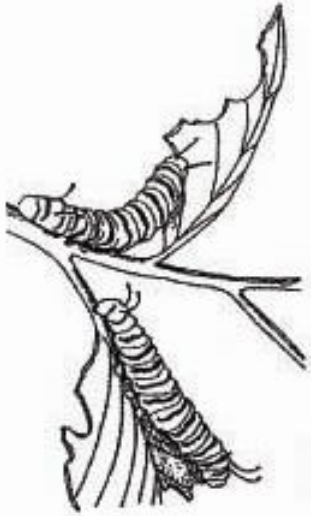


Pelican

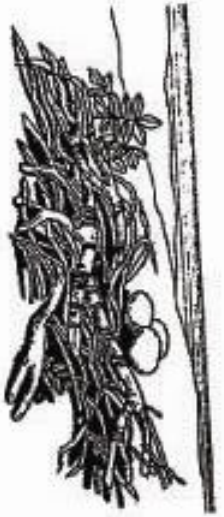
Mayfly

Tadpoles

Ducklings



Butterfly Larvae



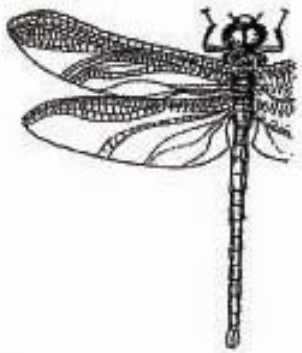
Pelican Nest and Eggs

Mayfly Nymph

Osprey

Stonefly

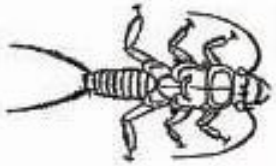
Dragonfly



Caddisfly

Whirligig Beetle

Osprey Hatchlings



Stonefly Nymph

Dragonfly Nymph

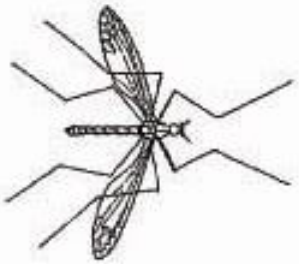
Caddisfly Larvae

Whirligig Larva

Skate

Manatee

Cranefly

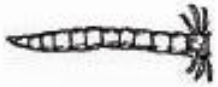


Sea Otter

Sea Turtle

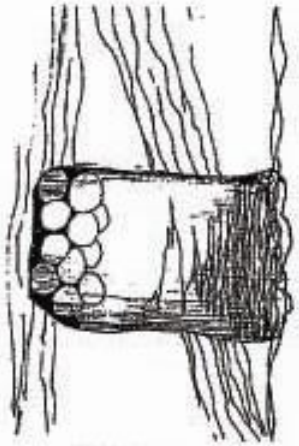
Skate Egg Cases

Young Manatee



Cranefly Larva

Young Sea Otters



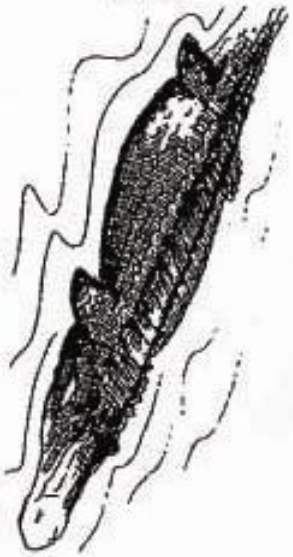
Sea Turtle Eggs

Adult Beaver

Mosquito

Porpoise

Black Fly

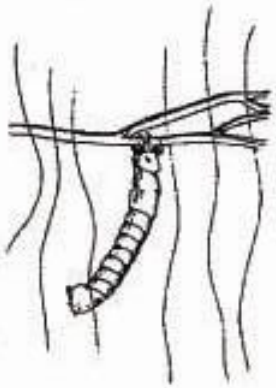


Alligator

Young Beavers

Mosquito Larva

Young Porpoise



Black Fly Larva

Alligator Hatchlings

Plastic Jellyfish

Objectives

Students will be able to: 1) describe the potential effects of plastic waste on aquatic wildlife; and 2) identify specific actions they can take to help remedy the problem.

Method

Students monitor the plastic waste production in their own households, research its effect on freshwater and marine life, and propose various ways to lessen the problem.

Background

In both marine and freshwater environments, plastic waste materials have potential negative impacts on wildlife. For example, aquatic animals mistake some plastics for food. In other cases, they become entangled in plastic debris and subsequently die.

The Cousteau Society estimates that six million tons of litter enter the sea each year. Most of this is the product of merchant ships and the practice of dumping garbage in the sea. Among the most damaging kinds of solid waste from litter are non-biodegradable plastics. Plastics simply do not decay. Commercial fishing fleets are estimated to have lost nearly 300 million pounds of plastic fishing gear in 1975 alone. It is this plastic netting material that may be the greatest hazard to marine life. Few fish or marine mammals can swim backward. Once entangles, nearly all animals perish.

Scientists estimate that plastics are killing up to a million seabirds and over 100,000 sea mammals a year. Recently plastic have been found in the stomachs of whales, dolphins, fish, birds, and manatees. Leatherback turtles often mistake plastic bags floating in the sea for jellyfish, one of their favorite foods. As plastic accumulate in the intestines of such animals, starvation occurs slowly.

It is not just in marine environments that plastic litter can be found which has potential to harm aquatic life. Plastic holders for beverage cans, plastic bags, and lost or discarded fishing line on land can all be damaging to wildlife.

Some creative actions are also being explored to use plastic and other materials to enhance, rather than damage, habitat for wildlife. For example, wildlife specialists are experimenting with ways to use plastics intentionally to provide anchoring sites for aquatic organisms in lakes where grasses no longer grow. Some are using plastic bottles and jugs to provide a microhabitat for certain fish. These actions are beginning to have what appear to be beneficial effects. These positive examples, however, are presently overshadowed by the considerable damage being done to wildlife and its habitat as a result of plastic litter.

There are a variety of sources of useful information about the subject of plastic litter and its impacts. One helpful reference is the publication Plastics in the Ocean: More Than a Litter Problem, prepared by and available from The Center for Environmental Education, 1725 DeSales Street N.W., Suite 500, Washington, D.C. 20036. Actions can be taken to help reduce plastic litter and its negative consequences.

The major purpose of this activity is to enhance students' awareness of the hazards of plastic waste for wildlife in aquatic environments, having them explore ways they can take action to reduce its effects.

Materials

Plastic waste from home

Procedure

Ask the students to collect and save every piece of plastic waste produced in their homes for a two-day period. Have them bring these materials to school. Or, have them bring a sample if the quantity is too great! Caution students to clean the plastics before bringing them to school so that they are free of food or drink remains. Also caution them about toxins such as ammonia, chlorine bleach, etc, which may be in the containers. These should be emptied and rinsed completely.

Ask the students to separate these plastic waste materials into categories. Have them classify them in terms of how they might be perceived by aquatic wildlife as food, e.g. very likely to be perceived as food, somewhat likely, or unlikely. Identify the species that might attempt to eat the plastic. Also classify the materials according to the likelihood of aquatic animals becoming entangled with them and subsequently dying.

Ask the students to hypothesize about how these materials might affect aquatic animals. Have them check their hypotheses against current finding reported in the literature, or provide them with sufficient information to do so. Ask the students to summarize what they have learned about the potential hazards to aquatic wildlife from

plastic waste materials.

Invite the students to survey their school grounds or community for plastic litter. Look to see if and where it exists. Investigate its potential negative impact on animals in the community. If there is damaging plastic litter in the community, ask the students to create an action plan that will increase awareness of the problem and help take care of it, e.g. setting up a plastic recycling depot.

Help the students put the plan into effect!

Extensions

Contact local environmental, conservation, animal welfare, and wildlife groups to see what is being done about the impact of litter on local wildlife and if specific help is needed.

Establish a litter patrol. Designate specific targets such as nearby beaches, lakes, and stream beds. Establish scheduled tours of these areas to pick up plastic and other forms of litter.

Write a plastic consumption conservation plan! Is plastic recycled in your home or community? If so, how? If it seems appropriate, see if you can break some of your own plastic habits. Consider whether your own uses of plastics could be potentially damaging to wildlife as well as wasteful of natural resources. What courses of action might you personally take?

Take various types of plastic and put them some place outdoors where they will not be disturbed for one month. Set up an observation schedule and a means of recording the date and the changes you observe in the plastic samples. What conclusions can you draw from your observations?

Investigate the processes for making plastic biodegradable. What progress is being made in this technology? (You will need to do some research in the library for this activity. Perhaps you can ask an “expert.”)

find out if there are any laws in place in your city, county, or state which attempt to address the problem of plastic pollution. What about national and international law? Are there any bills before the legislature? Before Congress?

Evaluation

For Younger Students

Which of these things might be most likely to harm animals that live in water: Styrofoam pieces, comb, six-pack holder, rope, toothbrush, fishing net, fishing line, candy wrapper, toy airplane?

Tell how animals might be harmed by each of these plastic: fishing net, toy car, clear plastic bags. Which might be most harmful, and why? Write two things you can do to prevent harm to wildlife form plastic litter.

For Older Students

Give three examples of ways that plastic waste could enter an aquatic food chain. For each, discuss two possible consequences of plastic waste entering the food chain.

Describe some actions you and others can take to help remedy the problems associated with plastic wastes.

Horseshoe crab

Living fossil

It's late May, and you have just arrived with your family to spend a weekend at the shore before the summer vacation crowd invades the resorts. After settling in at your cottage on Delaware Bay, you head down to the beach to watch the sun set and see the strangest sight you've ever laid eyes on!

All along the beach, for as far as you can see in either direction, hundreds upon hundreds of bizarre marine creatures are emerging from the depth of the Bay. Looking like miniature army tanks, they clamber up onto the wet sand with slow jerks of their glistening shells, or patrol the shallow water waves are breaking gently. There are so many of them that they climb over one another or collect in small clusters. Some cling to the shells of others and are carried along by the lead animal. It's a fascinating, but almost frightening sight to you. What are these strange animals? What are they doing? How can anyone hope to wade or swim with all this incredible activity going on? To local residents, the event you witnessed is just as fascinating, but is also a familiar and expected occurrence. They would have no problem identifying the animals for you as the harmless horseshoe crab.

The horseshoe crab belongs in the large group of animals called Arthropoda, which includes lobsters, crabs, insects, spiders and scorpions. Even though it looks crab-like, the horseshoe crab is more closely related to scorpions and spiders.

Over 300 million years ago, long before the dinosaurs appeared on earth, there were hundreds of kinds, or species, of horseshoe crabs and their relatives, the sea scorpions. Today sea scorpions are extinct, and only four species of horseshoe crabs remain. Three of these are in Far East, from Japan through Vietnam; the fourth is found along the Atlantic Coast, from Nova Scotia south to Mexico's Yucatan peninsula. The scientific name for the Atlantic Coast horseshoe crab is Limulus polyhemus.

A "Living Fossil"

Because its basic body design has remained almost unchanged for millions of years, the horseshoe crab is often called a "living fossil". The horseshoe crab gets its common name from the "U" or horseshoe shaped of its shell, which is called a carapace. The carapace is the color of sand or mud. This helps the animal blend in with the muddy and sandy bottoms on which it lives.

Two pairs of eyes are on the rounded front part of the carapace. The largest pair is located near the top, one on each side. These eyes are compound, like those of insects. They allow the animals to see in all directions and are good at detecting movement. Two very small eyes are located on each side of a small spine found on the front of the shell.

Beneath the shell are seven pairs of appendages, four of which bear claws. The first pair, called chelicerae, are small, and are used to push food into the mouth. The mouth is located at the base of the legs. Then come five pairs of long walking legs. The last set of appendages, the chelaria, are also small, and are used to help the first pair move food toward the mouth

Horseshoe Crabs are for the Birds!

The scene described at the beginning of this article is really only part of the fascinating spectacle seen every year on the Bay, for when the crabs arrive, so do the shorebirds. Hungry birds which are flying northward from their southern wintering habitats in Central and South America stop along the Bay shores to feast on the horseshoe crab eggs. Red knots, sanderlings, ruddy turnstones, sandpipers, as well as gulls, song sparrows, grackles, mourning doves, and even pigeons are just a few of the kinds of birds that find a feast. Raccoons, foxes, diamondback terrapins, moles, and even small fish and mollusks join in. during the last two weeks of May the bay beaches may host between 500,000 and 1,500,000 shorebirds alone! The birds gorge on the eggs and may double or triple their weight before moving on.

Good for People, Too

Though the eggs and flesh of Limulus Polyphemus are not toxic to people (that of the other three species are),

they are not eaten by people today. Years ago, however, Indians did eat the lump of meat in the abdomen that moves to tail. They also used the shells to bail water out their canoes, and the tails as spear tips.

More recently, horseshoe crabs have been used as fertilizer and as feed for chicken and hogs. Though a few farmers still till horseshoe crabs into their fields today, their use as fertilizer has largely been replaced by chemicals. Chicken and hogs fed on horseshoe crabs developed a bad taste, so this was discontinued.

Today horseshoe crabs are important to people for their use in medicine. For over 50 years they have been used in eyes research. They are easy to study because they have large eyes and a large optic nerve (the nerve that sends signals from the eye to the brain). Scientists have learned a great deal about how human eyes function from research on horseshoe crab eyes.

Chitin is Excitin'

Chitin is a substance found in the shell, or exoskeletons, of horseshoe crabs as well as other arthropods, such as lobsters, crabs, shrimps, spiders, beetles, and mosquitoes. It has received the attention of scientists because is non-toxic, biodegradable, and when processed to produce another substance called chitosan, can be used to produce a variety of important products.

Contact lenses, skin creams, and hair sprays can be made from chitin. It can be used to remove lead and other harmful metals that may be dissolved in drinking water, and clean certain harmful chemicals from wastewater. Chitin joins the fight against fat when it is added to foods. It has the ability to bind with fats and then passes them through and out of the body without being digested.

Chitin can also be made into string used to sew up wounds and used in wound dressings. People do not have an allergic reaction to the stitches, which dissolve, and the dressings actually promote healing. Many of these products are now available in Japan and are under development in the Unites States.

To find a meal of its favorite foods – worms, mollusks and dead fish, the horseshoe crab crawls along the bay bottom, using its small first pair of legs as feelers to detect the presence of prey. When it comes upon a worm or clam the small claws pick it up and move it to the bristly area near the base of the walking legs. The horseshoe crab has no jaws and uses these bristles to crush the food as it moves its legs. This means that a horseshoe crab can only eat while it walks along the bottom!

Behind the mouth and the walking legs is a body segment called the abdomen. The abdomen is connected to the rest of the carapace by a flexible joint, allowing it to move up and down. Located on the underside of the abdomen are the horseshoe crab's gills, called book gills. There are broad and flat and look like the pages of a book. The horseshoe crab gets oxygen from the water using these gills. Also, as long as the gills are moist, the horseshoe crab can get oxygen from the air while it is on the beach. Young horseshoe crabs can swim upside down! They flap their book gills and flip their abdomens up and down to propel themselves along.

The horseshoe crabs ends with a long tail, or telson. The telson is used to help the animal flip over when lying upside down on its carapace. The tail is not poisonous and does not have a stringer as some people believe. A horseshoe crab, though it look mean and fierce, is a very gentle, harmless creature.

Like many animals with shells, eventually a horseshoe crab outgrows its own, and must molt. This means it grows a new shell and leaves its old one. To do this, the old shell splits around the front edge, and the crab crawls out. As first the new shell is very soft, but it soon hardens, and the horseshoe crab is about one-quarter larger than it was before. Females are larger than males, and can grow to a length of 60 cm (24 inches).

Reproduction

During the cold month of the year, the crabs lie half-buried in the bottom of the Delaware Bay and Atlantic Ocean. As spring returns, an unknown signal triggers the crabs to stir and begin an annual migration to the shore. By late May, over one million horseshoe crabs are crawling in the shallow water along the Delaware Bay, the center of the Atlantic Coast population.

First the males arrive, them the larger females. To attract a mate, the females release a chemical called a pheromone into the water. A male attracted to female attempts to hook onto her abdomen using special claspers located on the end of his first pair of walking legs. Sometimes a chain of several crabs is formed as one male clasps onto another behind a female! Once the female has a male in tow, she slowly leads him to the edge of the water, where she scoops out a nest in the sand and deposits up to 20,000 BB-sized eggs. As she drags the male over the nest, he in turn fertilizes them. Two weeks later the eggs hatch, and out emerge tiny horseshoe crabs about 3.mm in size. Minus a tail and called trilobite larvae, because of their similar appearance to the ancient, extinct trilobites, they swim feebly about in the water as plankton, feeding off a yolk sac while their digestive system matures. Finally, after several molts and the development of a tail, they come to rest and live

on the bottom.

Young horseshoe crabs continue to molt and grow for the next ten years until they reach maturity. How long can horseshow crabs live? No one really knows. A few horseshoe crabs have been kept in aquariums for 15 years.

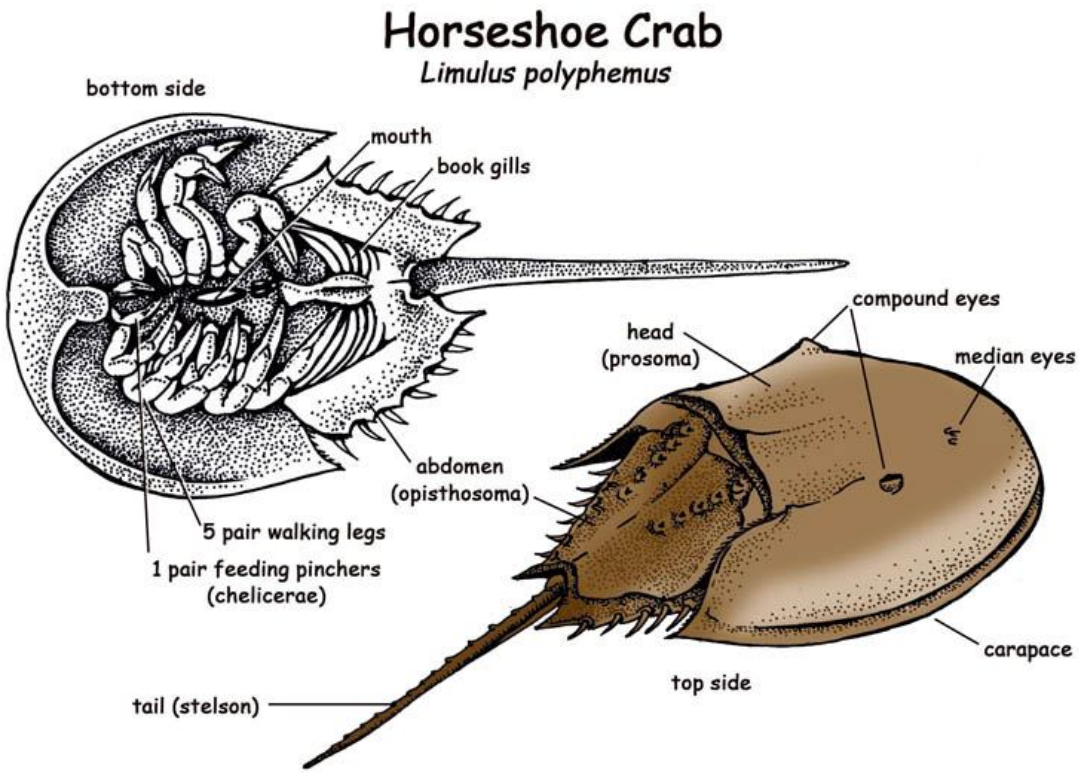
True Bluebloods!

Perhaps the greatest use of horseshoe crabs is found not in their shells, but in their blood. In the early 1950's, scientist Frederick Bang discovered that the blue-colored blood of the horseshoe crab contains special cells that kill certain kinds of bacteria. When a crab receives a wound, the cells swarm to the area, form a clot, and kill the invading bacteria. Bang was able to separate the chemical in the blood cells that formed clots in the presence of bacteria, which can be harmful to people as well as horseshoe crabs. He called the substance LAL- limulus amoebocyte lysate. LAL is now used as a fast, effective way of testing drugs to make sure they are free of harmful bacteria before they are given to people. Blood is collected from horseshoe crabs during the summer months, where they are easily caught in the shallow waters off the Atlantic coast from Cape Cop through North Carolina. After collecting some of the blood, the crab is returned to the water. In one bay off of Cape Cod, over 80,000 crabs are bled over the course of a season. Even so, the product is rare enough to be very expensive, up to $15,000 a quart!

What's in Store for Horseshoe Crabs?

If you were to actually see the springtime arrival of horseshoe crabs to the Delaware Bay, you might think that there will always be plenty of Limulus in the waters of the Atlantic. But because they have become important sources of products for people, there is some concern that we may use them to the point where population numbers go down. This has happened already with the species that live off of Japan. In that country horseshoe crabs were declared endangered and are now a protected animal. In the Untied States the importance of the horseshoe crab was recognized in 1986 when the governors of the New Jersey and Delaware declared a strip of beach where the horseshoe crab mate as a sanctuary to protect the crab eggs. The food and Drug Administration is also setting stricter rules for the bleeding of horseshoe crabs, so that they may be returned to the water in a shorter time, and subjected to less stress.

Horseshoe crabs have successfully survived for millions of years. Their future depends on how much people understand and appreciate the importance of horseshoe crabs to wildlife and humans, and on the conservation practices undertaken to preserve them.



A Horseshoe Crab Tale

One morning in early June, a brother and sister went on a trip to the Delaware shore with their mother. The day was warm, the sun was bright and the water was sapphire blue—a perfect day for the beach!

As soon as they had laid out the beach blanket, weighting down the corners with a few small stones, Jessie and Jamal peeled off their socks and shoes, wiggled their toes in the sand and scampered off to explore.

"I'll be along in awhile," Mother called out as she settled down in her beach chair. Jessie was the oldest and was bigger and faster then Jamal. She ran down the beach, stopping now and again to do a cartwheel or backflip while her younger brother hurried to catch up. So it was Jessie who saw the strange animals first. It looked like a large brown helmet lying upside down in the sand. Lots of legs thrashed about, and a long tail stabled at the air. "Don't touch it!" Jessie warned as Jamal finally caught up to her. "It might sting you with its tail."

"What is it?" asked Jamal between breaths. "It's scary looking!"

"It looks like some sort of a crab," Jessie answered. "I don't think it can turn itself over."

The children were still looking at the animal when their mother strolled over to them. "Oh, you found a horseshoe crab!" she exclaimed, bending close to see.

"Don't touch it, Mom. Won't it hurt you?" Jamal asked anxiously.

"Oh no," Mom said. Horseshoe crabs are harmless animals. Many peoples think their tails are weapons and can sting, but that's not true. They use their tails to help right themselves when they are overturned in the water. If they lose their tail or get stranded when the tide goes out, like this horseshoe crab did, then they are as helpless as turtles are when they are turned on their backs!"

Jamal's curiosity overcame his fear of this strange animal. "I want to hold it," he said. "How do you pick it up?"

"Never pick up a horseshoe crab by the tail," Mom explained. "You might hurt the joint where the tail attaches to it body."

"You might even pull it off!" Jessie chimed in. "And then it wouldn't have any way of turning over.

"Instead," Mom continued, "hold it on each side of the shell. If you want to look at it undersides, support the top of the shell in the palms of your hands."

After they had held and inspected the horseshoe crab, Jamal said, "Let's bring it down to the water and watch it crawl back to the ocean where it belongs!"

The children carried the horseshoe crab down to the water's edge and put it on the sand. Slowly it crawled into the water, pushing against the incoming waves, gradually moving deeper and deeper until they couldn't see it anymore.

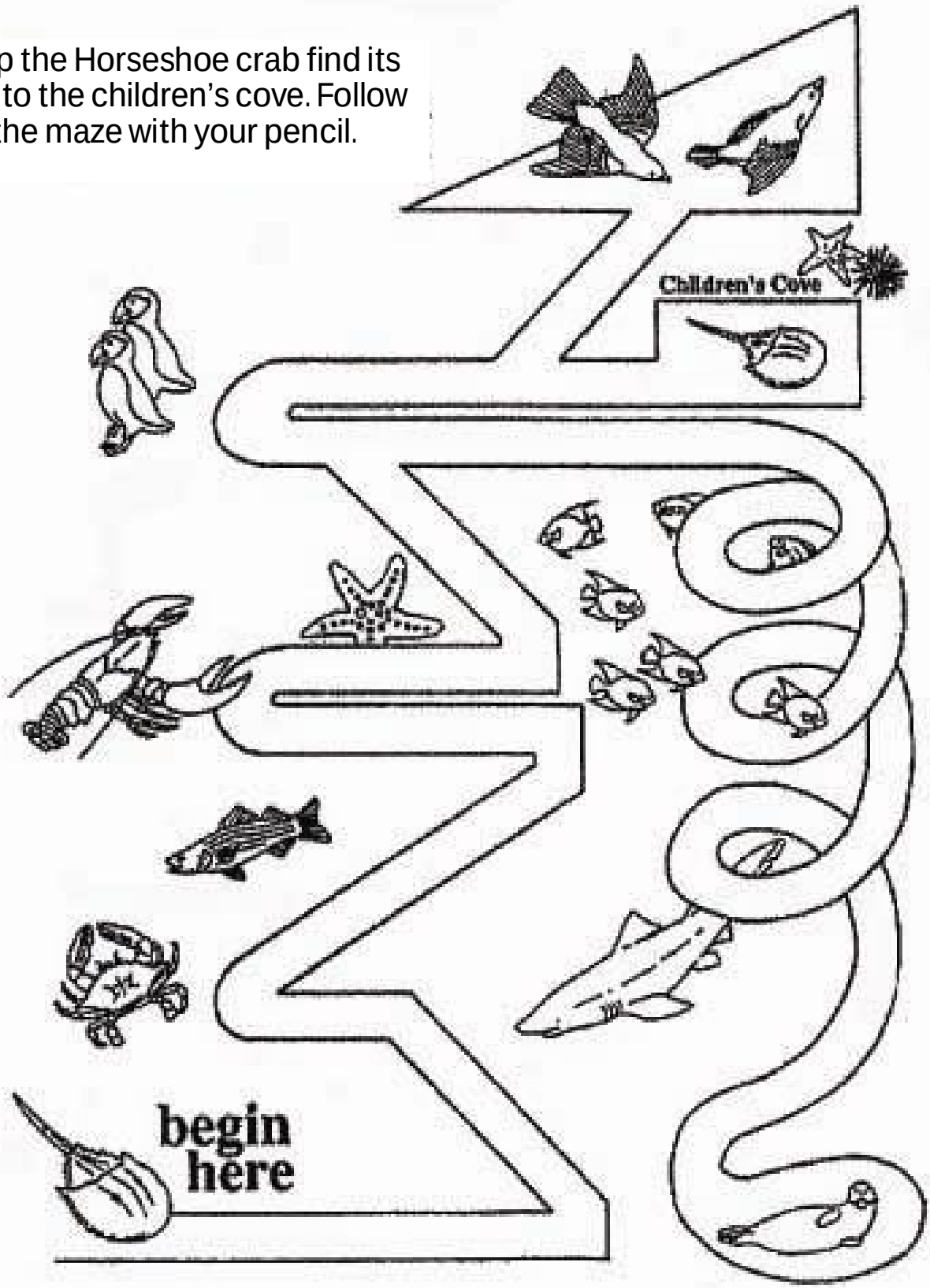
As Jamal watched the horseshoe crabs tail disappear he said thoughtfully, "Horseshoe crabs aren't so scary looking now. I think they're neat."

Jessie agreed, saying, "I think they're kind of cute."

All morning as the two children played on the beach, they gently helped stranded horseshoe crabs slip back into the cool waters of the Delaware Bay.

Horseshoe Crab Maze

Help the Horseshoe crab find its way to the children's cove. Follow the maze with your pencil.



National Aquarium In Baltimore

Horseshoe Crab Puppet

Materials

Construction paper

Glue

Stapler

Brass fasteners

Directions

Cut out the patterns for the top shell, bottom shell and horseshoe puppet parts. Use these for cutting your construction paper shapes.

Place bottom shell in the place on top shell.

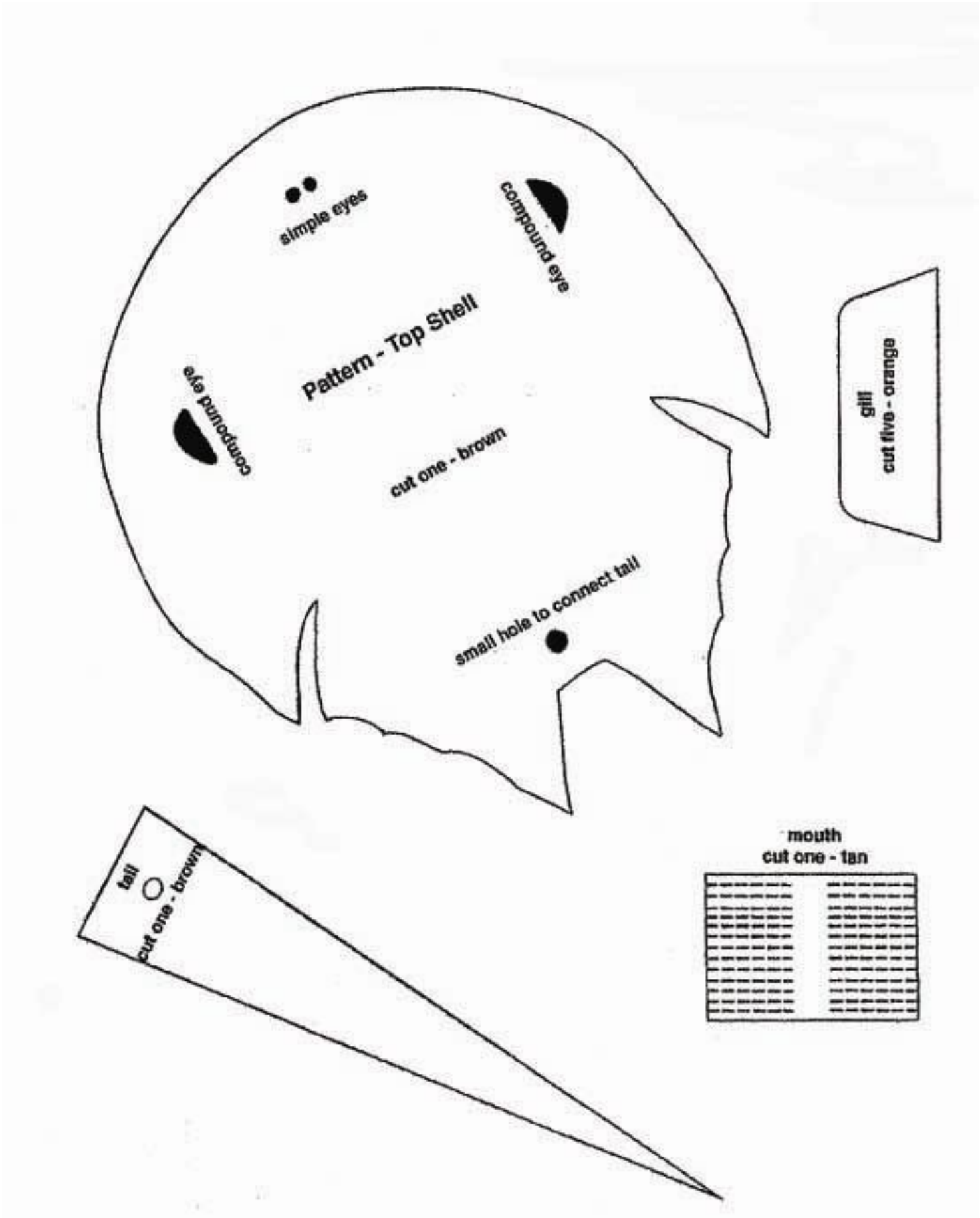
Staple around the edges

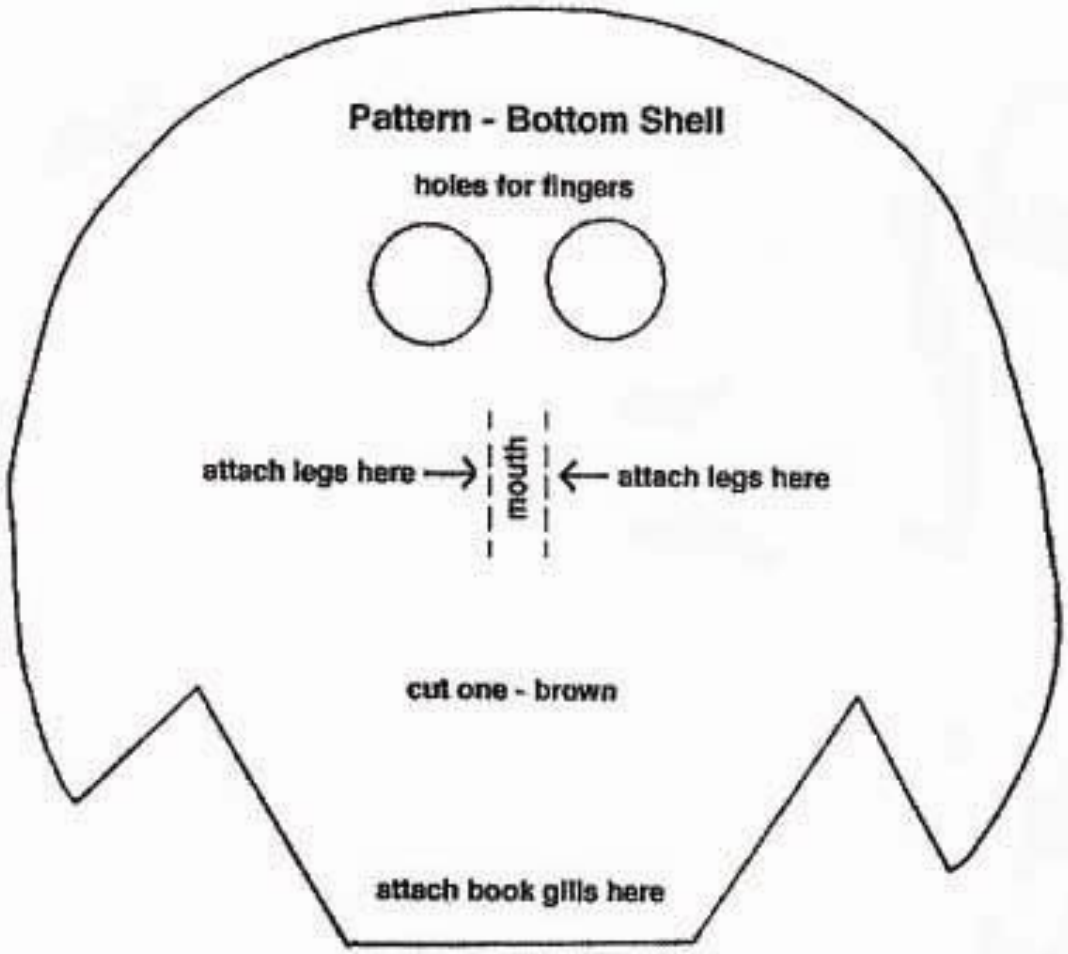
Glue book gills in place on bottom shell as shown in diagram

Glue legs in place above book gills

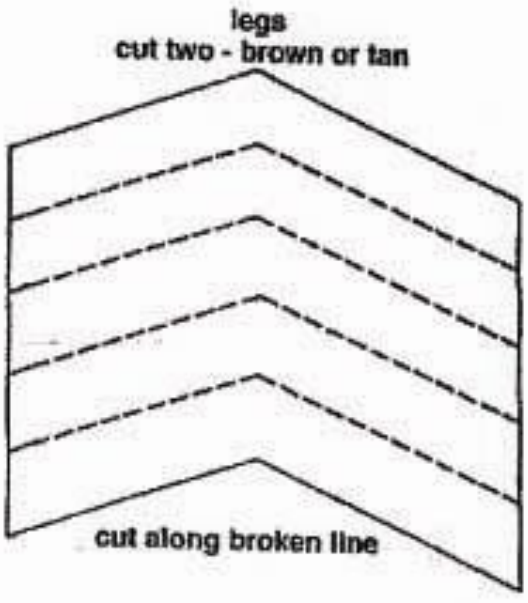
Place mount on legs

Attach tail with brass fasteners. Glue on eyes or draw on with felt pen. You can give the puppet more shape by folding the sides of the upper shell along the edges. Girls can insert their hands between the two shells so that their fingers become the horseshoes crabs' front legs.


simple eyes
compound eye
Pattern - Top Shell
compound eye
cut one - brown
gill
cut five - orange
small hole to connect tail
tail
cut one - brown
mouth
cut one - tan


Pattern - Bottom Shell
holes for fingers
attach legs here
mouth
attach legs here
cut one - brown
attach book gills here


compound eye
cut two - grey


legs
cut two - brown or tan
cut along broken line

Hi, my name is Ollie the Osprey. I soar high above the water and beaches. Sometimes when I walk on the beaches and search for food, I become tangled in fishing line that someone has left behind. Freeing myself from the tangled line is a tough job, because I do not have hands to help me. Everyone should remember to take all of their fishing line home with them.

Soil Erosion

After the rain, have you noticed how water has carried away, or *eroded* soil? Splashing raindrops and running water are responsible for much soil erosion. But not all places with soil erode, and some places erode much more than others.

Exploratory Problem

How can you test to see what affects soil erosion?

Materials

Two disposable pie pans

Two matched, plastic sauce dishes

Two small matched juice cans

A small and a medium sized nail

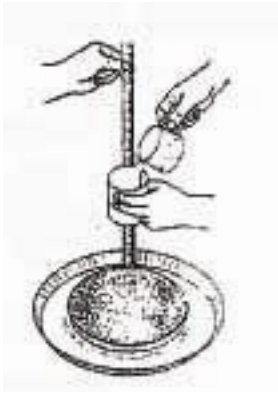
Soil

Measuring cups

Meter stick or yardstick

Hammer

Try This



Punch 10 holes in the bottom of 1 juice can with a small nail. Use a medium size nail to punch 10 holes in the second can. Both cans should be open at the top.

Fill a sauce dish level and to the brim with soil. Put the dish into a pie pan to catch any spilled material.

Place a meter stick or yardstick upright behind the dish. Hold the small-hole can 60 centimeters (24 inches) above the dish.

Have someone pour a half-cup of water into the juice can. When the can stops 'raining', observe the soil and pie pan.

Observation Questions

What, if any, signs of erosion can you observe?

How will a heavier 'rain' affect erosion? Fill a second saucer with soil. Use the medium-hole can for rain. Compare the results with the first trial.

How will loose soil erode compared to tightly packed soil? Prepare two saucers and find out. (Use only one can for the 'rain' in problems C through E.)

How will tilted soil erode compared to level soil?

How will covered soil erode compared to bare soil? Cover the soil in one dish with several leaves.

What are some conditions that seem to reduce soil erosion? That seem to increase soil erosion? What examples can you find outdoors that show some or all of these conditions?

All of the preceding conditions are important in affecting soil erosion. But all are not easy to product reliably with small-scale soil testing. The sizes of material suggested (5 inch sauce dish, ½ cup of water, small juice can, etc.) are likely to bring satisfactory results. Finding actual samples of erosion, as in Observation Question F, is important to achieving full understanding.

Generalization

Rainfall, soil cover, incline and compactness affect soil erosion.

Sample Performance Objectives

The girls can locate several outdoor examples of soil erosion and infer the conditions that influenced the examples.

The girls can state several conditions that effect soil erosion.

Shell Game

How much do you know about the turtle of the Chesapeake Bay and its watershed? Match up the turtles below with their descriptions.

Bog turtle

Common snapping turtle

Eastern box turtle

Eastern mud turtle

Easter painted turtle

Northern diamondback terrapin

Red-bellied turtle

Spotted turtle

Stinkpot

Wood turtle

A. This large, aggressive turtle eats aquatic plants, carrion, invertebrates, fish, birds and small mammals.

B. The jaws of this long-necked turtle can reach back to its hind legs. It gets its name from the foul smelling liquid it secretes when bothered.

C. This is the most widespread turtle in North America. It begins life carnivorous, but becomes an herbivore as it matures.

D. This shy turtle loves to bask in the sun, often alongside its smaller cousin, the painted turtle.

E. This turtle east slugs, worms, wild fruits and berries and poisonous mushrooms. There have been cases where humans have died after they ate the flesh of this turtle after it had eaten these mushrooms.

F. This turtle is able to climb over six foot chain-link fences.

G. This endangered turtle beats the heat by burying itself in mud or vegetation. This is also the smallest turtle in North America.

H. Hunting greatly reduces this turtle's numbers once humans discovered how tasty it was. Now its coastal marsh habitat is threatened by development. It is a particular favorite at the University of Maryland.

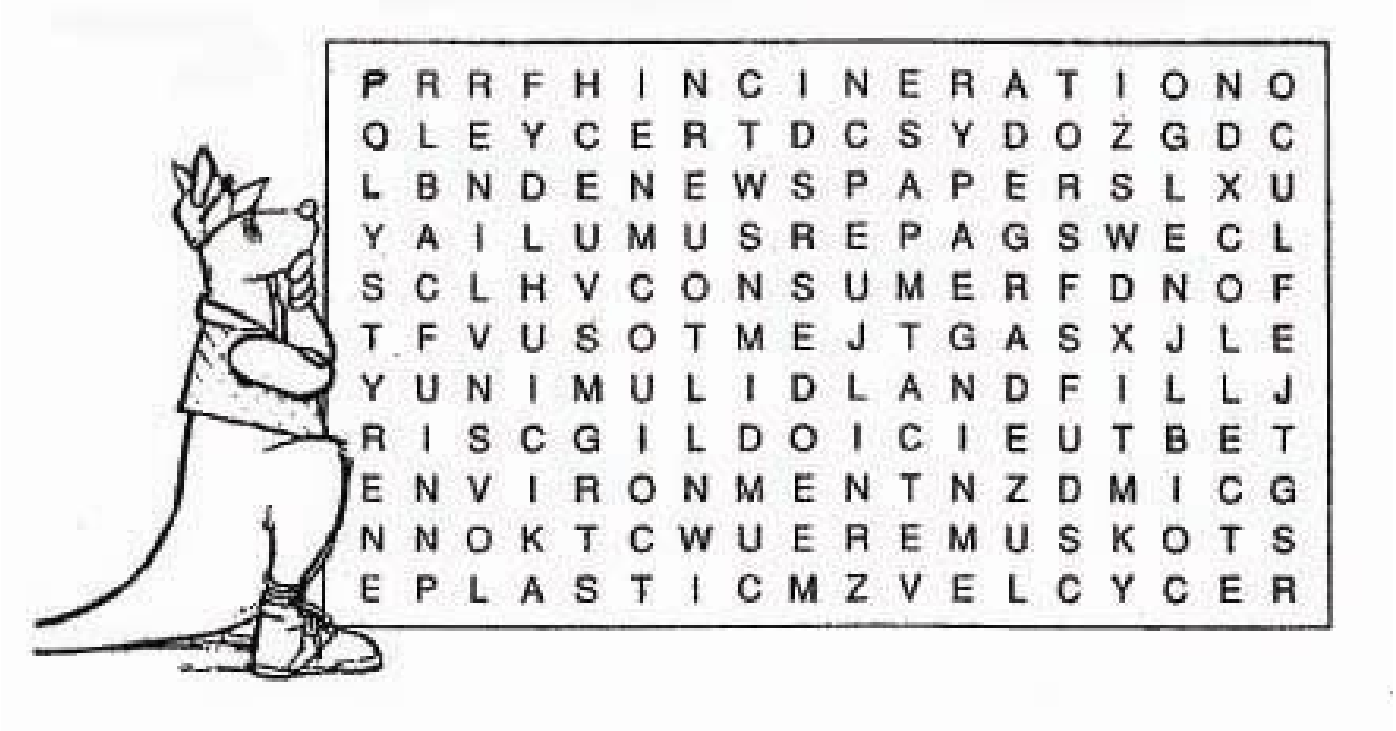
I. Unlike its cousin, the bog turtle, this creature is fairly numerous. It is most likely to be seen in the cooler spring months.

J. The length of this turtle's upper shell, or carapace, is only 3 – 4 inches. It frequently travels on land and is often seen and killed, while crossing roads.

Answers

1-G; 2-A; 3-E; 4-J; 5-C; 6-H; 7-D; 8-I; 9-B; 10-F

Word Search



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L	B	N	D	E	N	E	W	S	P	A	P	E	R	S	L	X	U
Y	A	I	L	U	M	U	S	R	E	P	A	G	S	W	E	C	L
S	C	L	H	V	C	O	N	S	U	M	E	R	F	D	N	O	F
T	F	V	U	S	O	T	M	E	J	T	G	A	S	X	J	L	E
Y	U	N	I	M	U	L	I	D	L	A	N	D	F	I	L	L	J
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N	N	O	K	T	C	W	U	E	R	E	M	U	S	K	O	T	S
E	P	L	A	S	T	I	C	M	Z	V	E	L	C	Y	C	E	R

Aluminum
Collect
Consumer
Degrade
Environment
Incineration
Landfill
Newspapers
Plastic
Polystyrene
Recycle
Reduction

Making a Soft Drink Bottle Terrarium

Materials

A two-liter clear plastic soda bottle with black base

Marking pens

Potting soil

Pointed knife

Scissors

Appropriate plants such as – prayer plant, Coleus, Philodendron or Baby Tears

Directions

Take off the bottle label. Pull off the black plastic bottom of the bottle. Rinse the inside of the bottle very carefully with hot water.

You will have to get a grown up to help with the next step. Cut the bottle at the tip where it begins to curve in. use a marking pen to draw a line around the bottle on the place to be cut. Poke a hole with a sharp knife on this line and cut along the line with your scissors.

Spread one inch of gravel on the bottom of the bottle. Fill with potting soil. Remove plants from containers one at a time. Dig a little space for each. Press lightly. Water your plants with one-quarter cup of water.

Place the clear plastic over the bottom and put on a window sill where it will get plenty of light, but no direct sunlight.

Watch the terrarium to see if you have given it the correct amount of water. Droplets of water should form on the inside of the terrarium and will 'rain down' on the plants. If it is too dry, open the cover and add a little more water. If it is too wet and it becomes 'foggy' inside, take the cover off and leave it open overnight. If it gets too hot inside, poke additional holes at the top.

Puppet Show

Hot on the Trail of Tricia Trash and Wally Waste

Characters

Erin eagle

Fanny Fish

Danielle Deer

Olivia Owl

Tricia Trash

Wendy Waste

Recyclaroo

Danielle: Hey, Erin Eagle. Wait up. What are you doing?

Fanny: Where are you going?

Danielle: Why are you wearing that funny hat?

Erin : Good morning, Danielle Deer and Fanny Fish! I just heard a story on the news and I don't understand it.

Danielle: What was the news story about?

Erin : It was about two characters named Tricia Trash and Wendy Waste and something called solid waste.

Fanny: What's sold waste, Erin ?

Erin : That's what I don't know.

Danielle: Then let's find out. We'll go with you, Erin .

Fanny: Right! We're hot on their trail! But you must have heard more than that on the news.

Erin : well, they said that every year Americans throw away more than 180 million tons of solid waste. That's about 1,500 pounds of garbage per person. And they said that it takes 500,000 trees to make the newspapers Americans read on Sunday. And did you know that every 20 minutes Americans dump enough cars into junkyards to form a stack as high as the Empire State Building? They even said that if the Pilgrims had used aluminum cans at the first Thanksgiving meal, the cans would still be around today.

Fanny: This sounds serious!

Danielle: Let's go ask Olivia Owl about this. She's so wise. She knows everything!

Erin : I heard other things that are very disturbing too. Every day we dispose of things – plastic packaging materials, bottles, cans, food waste, office paper and newspaper. Out 'use-it-once-and-throw-it-away' way of life is causing big problems.

(Enter Olivia Owl)

Fanny: Good morning Olivia. We've got a question for you!

Erin : Yes, Olivia. What's solid waste?

Olivia: Solid waste is really all the things that we throw out; all the items that we don't want anymore.

Erin : So when people are done using something and don't want it anymore, it has to go somewhere.

Olivia: Yes.

Danielle: And it takes up space wherever it goes?

Olivia: That's right.

Fanny: I'm beginning to get the picture of what these trash and solid waste creeps look like.

Danielle: Me, too.

Erin : they are made up of things people throw away. They are rubber and paper and cardboard and metals.

Fanny: Yes, and also glass and wood and plastic.

Danielle: And organic things like leftover foods and lawn clippings and the leaves we rake up in the fall.

Erin : So then we have to find out more about where waste comes from and where it goes. Come with us, Olivia. Let's see where Tricia Trash and Wendy Waste go after people throw them out.

(You can use a neighborhood backdrop for your set or rely on children's imaginations.)

Danielle: Look over there! There's the Smith family putting out their trash now!

Erin : Oh, my goodness, there's three trash cans full!

(Enter the puppet Wendy Waste)

Olivia: And, look! They're not done yet!

Fanny: Here come the children with two bags of leaves and a trash can of grass clippings!

(Enter the puppet Tricia Trash)

Erin : All that trash for one family? Every week?

Olivia: That's right, Erin. The Smith family is not unusual. It happens like this all over America on every trash pick-up day.

Fanny: So that's Tricia Trash and Wendy Waste!

Danielle: They must feel terrible. People don't want them anymore, so they just throw them out.

Fanny: Wait! Look over there. What's Mrs. Green doing?

Erin : Why she has four big trash cans in her garage. One marked glass, one marked paper, one marked aluminum and one part PET plastics. What do you think she's doing?

Olivia: She's recycling.

Danielle: Recycling? What's that?

Olivia: I have a friend who's an expert on recycling! Would you like to meet her?

Erin : Sure!

Fanny: We'd love to!

Olivia: Oh, good! Here she comes now! (Enter Recyclaroo) Friends, I'd like you to meet Recyclaroo!

All: Hello, Recyclaroo!

Danielle: Can you tell us about recycling?

Roo: Recycling means using things again. You can recycle paper. Save your newspaper and also white paper and take them to a recycling center. The people there will take them to a paper mill where they will be made into recycled paper that can be used again. Aluminum cans can be recycled too. So can glass bottles and jars and some kinds of plastics.

Fanny: Ok, I believe you when you talk about recycled paper and recycled aluminum. And it makes sense that you can melt down glass to use it over again! But recycled plastics? What can be made out of recycled plastics?

Roo: Oh, recycled plastics, such as soft drink bottles and milk jugs can be made into plush carpets, insulating fiberfill for jackets and even park benches.

Erin : Recycling must be hard to do.

Olivia: For recycling to work well, four things must happen. The material must be sorted and collected.

Fanny: What do you do with it then?

Roo: Then it must be reclaimed – that means turned into a usable form. And finally, the material must be made into something else – something people need and will use. The hard part about recycling is that someone must separate (or sort) the trash. Glass, aluminum, plastic soft drink and milk containers, and newspapers can all be recycled. I can explain it better. Listen to this:

(Roo sings Recyclaroo song)

Danielle: Now I understand!

Erin : Come with us, Recyclaroo. We're on the trail of Tricia Trash and Wally Waste!

Roo: Okay. I'd like to come, too.

Danielle: Look at Mrs. Jones. What is he doing?

Fanny: He just finished mowing his lawn and now he's dumping the grass inside that big bin in his backyard.

Olivia: That's a compost pile. Mrs. Jones puts all her yard cuttings and leave on that pile and when they break down she will add that material to her garden. It makes the gardens rich and helps to grown healthy plants. Composting is really a way of recycling grass, leaves, shrubs and tree clippings.

Roo: Look over there!

Erin : Oh, no! Look at Sandy Smith! She just finished a popsicle and she threw the wrapper and stick in the street.

Olivia: Some people drop their trash all over the place. They leave their trash on the streets, in the parks, on beaches and along highways. This is called littering. Many people throw trash into oceans and lakes. Some of the trash is plastic. It floats on water. Sometimes water animals eat the plastic trash. It makes the animals sick. Sometimes water animals are caught in the floating plastic and sometimes the animals die.

Fanny: That makes me mad! That's where I live.

Danielle: What happens to the waste that does go into the trash truck?

Erin : Here comes the trash truck now. Let's follow it to find out where it goes from here.

(Interlude. Puppets disappear. Some music. Puppets reappear.)

Erin : The trash truck is stopping here, Olivia. Where are we now?

Olivia: This is a reclamation center. The trucks take the trash inside and it is sorted.

Roo: The things that can be recycled will go to recycling centers to be remade into usable items.

Olivia: Some items can be incinerated and other things can be taken to landfills.

Erin : Well, I understand about recycling, but tell me about incineration and landfills.

Olivia: Incineration is when solid waste is burned and the seam from burning the waste is used to generate energy for electricity. Some very modern reclamation centers can do this. Some items, like old appliances, cannot be burned, so these are taken to landfills. At a landfill, waste is packed together by tractors and covered with a shallow layer of dirt. The problem is that in some parts of our country, people skip the part about recycling or incineration and just take all the solid waste to the landfills – but we're running out of space. Within the next five years, most of the available landfills will be filled. No one wants to open new landfills. There are more fun things to do with the land we have.

Fanny: Oh, look. There's Tricia Trash and Wally Waste over there at the landfill. Let's go talk to them.

Erin : Hello, you two. You certainly led us on a chase. We wanted to find out what happens to the things people throw away.

Tricia: If I had my choice, they would be recycled into something useful.

Erin : Then the big question is, What can we do about it?

Danielle: I think there are lots of things we can do. Let's make a list:

Roo: Don't throw away anything you can use again.

Fanny: Reduce the amount of trash (or waste) at your house.

Danielle: Use glass jars, cardboard boxes, paper and plastic bags over and over again.

Tricia: Write to companies that send unwanted junk mail. Ask them to take you off their mailing list.

Wendy : Purchase the least packaged items. Tell the company, by letter or telephone, why they must use less packaging.

Tricia: Be creative with leftover food. Store it safely and then eat it instead of throwing it away.

Wendy : Use the back of paper.

Erin : Keep your car in good condition so it will last longer.

Wendy : Experts say it takes only three minutes a day to separate the glass, household paper, aluminum and plastic bottles in the household trash for recycling.

Tricia: Separate your trash and take it to your local drop-off or buy back center.

Danielle: See what you can find out about recycling your plastics.

Fanny: Investigate local recycling centers.

Erin : take newspapers, white paper, bottles, aluminum cans and plastic soft drink bottles and milk jugs to a recycling center.

Roo: Return hangers to your dry cleaner.

Tricia: Buy recycled paper products.

Wendy : Buy recycled plastic products.

Olivia: Look for the recycling symbol on the products you buy. (Have Olivia hold up a poster of the symbols and say: This is the sign on recycled or recyclable products).

Roo: we need to help save trees by recycling paper.

Tricia: in your yard start a compost pile for yard cuttings and leaves.

Wendy : Save your kitchen scraps for the compost pile.

Danielle: Don't litter.

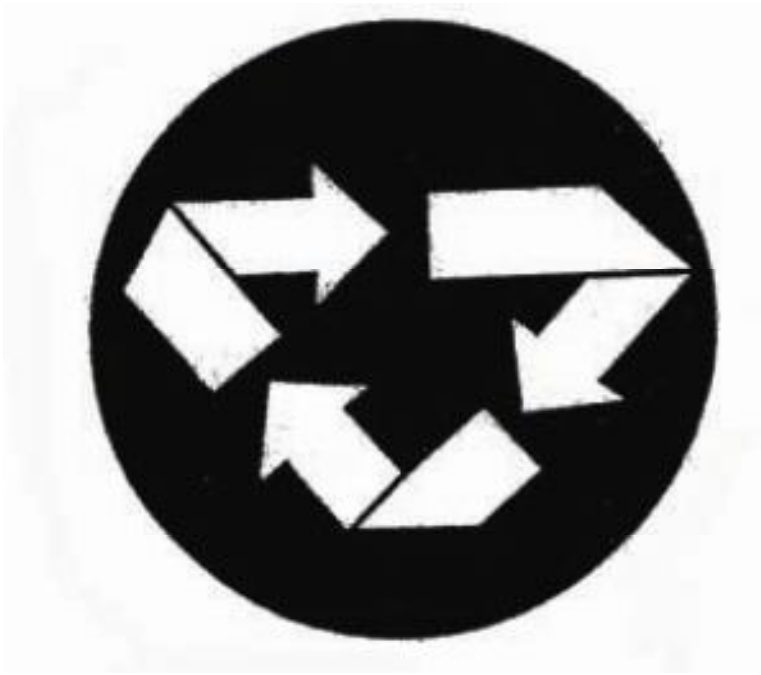
Fanny: Help keep water animals safe. Don't throw trash in the water.

Tricia: You can help by disposing of your trash properly and encouraging your family and friends to do the same!

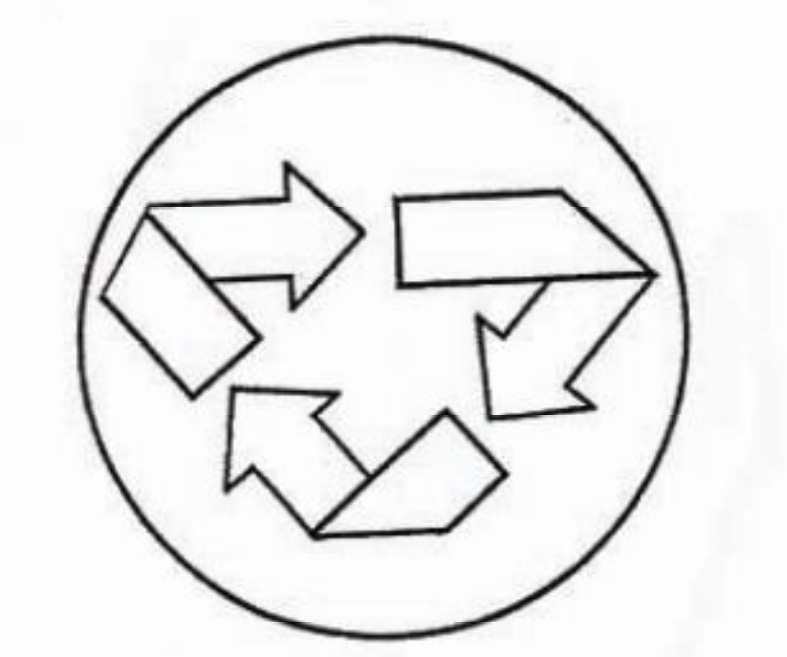
Olivia: Then let me see if I can summarize. You think it would help if we all reduce the waste we make, recycle glass, paper, metals and plastics, reuse things made from paper, cardboard, clothing and plastics, and reject products with too much packaging.

Erin : That's right. Thank you, Olivia, for coming with us so that we could find out more about Tricia Trash and Wendy Waste. We'll dispose of them properly from now on!

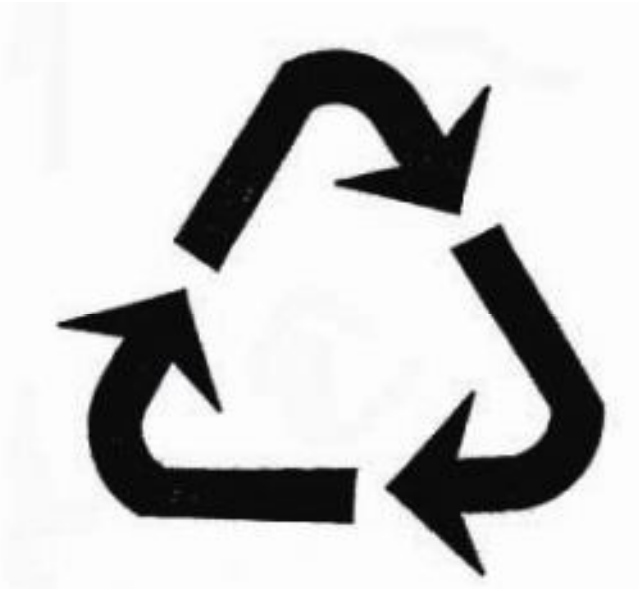
Olivia: Remember Recyclaroo's song! (All sing the Recyclaroo song)



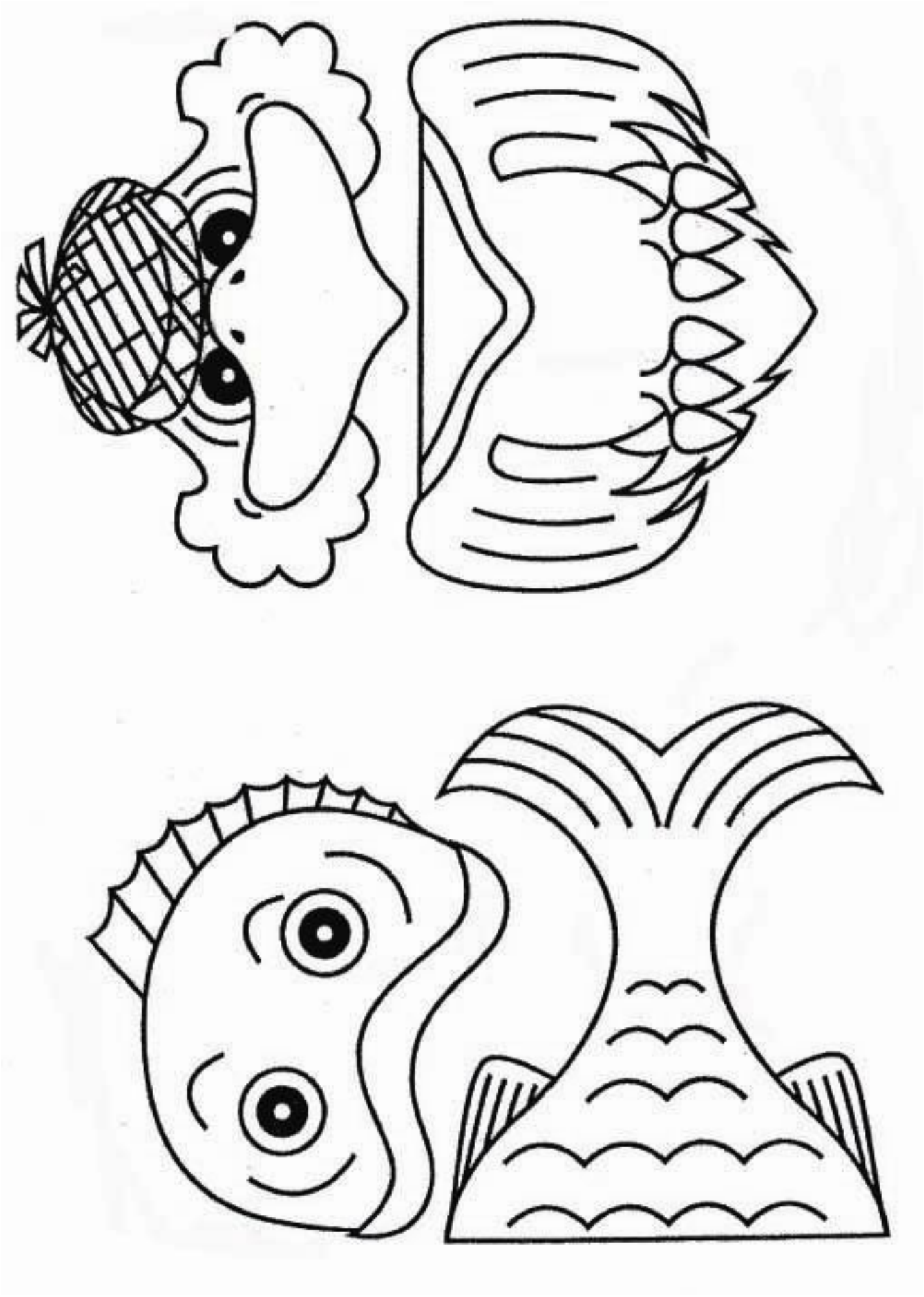
Recycled



Recyclable



Recyclable Plastic

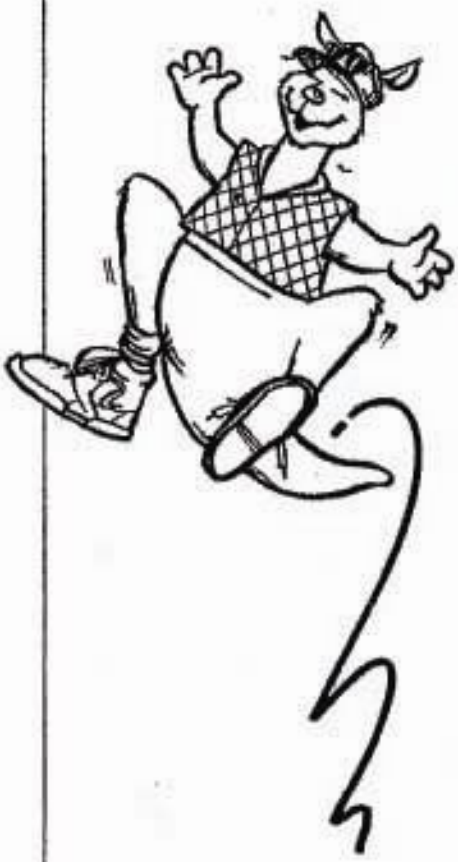



HOP TO IT!
RECYCLE PLASTICS


SODA

HOP TO IT AND HELP!

"THE RECYCLAROO SONG"



Bright swing tempo

1. There's a kan ga roo named Re – cy– cla– roo who's
2. Re cy – cla – roo searches day and night collecting
3. Recycle – roo needs help from everyone. Re – cycling

1. hoping to get a little help from you in
2. eve ry piece of plastic in sight then
3. plastic is a job that you can help get done. So tell your

1. giant floppy sneakers hopping all a round
2. dropping it in to the re – cy cla ble as we can
3. brothers your sis ters – your mom and dad too. It's

1. picking up plastic all a – ver your town. Re
2. use that plastic a – gain and a – gain.
3. save that plastic and give it to you.

cy cla roo is on the way picking up plastic to

use a – nother day. Now when you're done with plastic don't throw it away. Hop

D.S.

to it and help re cy cle to day.

Hop to it and help re cy cle to day. Hop

to it and help re cy cle to day. Hop

to it and help re cy cle to day.

Fine

Waste Watchers

Exercise Objective

Girls will identify ways to save energy in their daily lives and explain how saving energy can reduce air pollution.

Materials

Copies of pages 49 & 50

Thermometers

Art supplies

Calculators (opt.)

Time Considerations

Preparation time : 15 minutes

Activity time: several 50 minute periods

Overview

Every year some 41% of all the energy we use in the US is wasted needlessly. By cutting energy waste, we can reduce our demand for sources of new energy and reduce the amount of pollution we create. In this activity, your troop can take a look at how they can use energy in their own home and how they can reduce the amount of energy they waste.

Background

When you drive to the store, take a shower, turn on the air conditioner or a lamp, you're using energy. Much of the energy we use comes from burning fossil fuels such as coal, natural gas, oil and gasoline. When fossil fuels are burned, large amounts of carbon dioxide (CO_2) are emitted into the atmosphere.

Carbon dioxide, water vapor and methane are sometimes referred to as greenhouse gases. They are a natural part of Earth's atmosphere. Like the walls of a greenhouse, they let sunlight in, but trap the heat that radiates from Earth (see diagram on opposite page). This heat-trapping mechanism is called the greenhouse effect and is critical to life on Earth. Without it, the planet would be much colder – too cold to support life as we know it. however, concentrations of many greenhouse gases in the atmosphere have been increasing for the past 130 years or so, and this increase could lead to changes in the Earth's climate.

Since 1860, average CO_2 levels have increased more than 25 percent. A lot of this excess CO_2 has come from burning fossil fuels (in automobiles, power plants, factories, and so on). Although most of these fuels are being burned in more developed countries, less-developed countries are expected to put greater levels of CO_2 into the atmosphere as they acquire more automobiles and other fossil-fuel burning technologies. Levels of cholroflourocarbons or CFCs (used in air conditioners, solvents, the manufacture of plastic foams and other products); methane (from sources as diverse as rice paddies, landfills, cows and termites); and nitrous oxide (from fertilizers, livestock wastes and other sources) in the atmosphere have also increased. Concentrations of all these gases in Earth's atmosphere continue to rise: Co_2 at about 0.4 percent per year, methane at about 1 percent per year, CFCs at about 5 percent per year and nitrous oxide at 0.2 percent per year.

The US is an urban industrial society, and most of our machines run on carbon-based fuels. Each person in the US is responsible for producing 2.3 tons of atmospheric carbon a year. About half of that comes from our cars. Close behind us are citizens of other industrialized countries: Canada (1.8 tons per capita); Western Europe (0.9 tons); Japan (0.9 tons); China (0.2 tons); and India (0.1 tons). At current rates of growth, atmospheric concentrations of CO_2 will have doubled from pre-industrial levels by approximately 3036. Some scientists agree that this doubling of atmospheric CO_2 levels will raise average temperatures on Earth by a few degrees Celsius.

While these scientists agree that the increase in atmospheric CO_2 concentration will raise average world temperatures, they do not agree on the effects of such global warming. Some scientists believe global warming could disrupt weather patterns worldwide; could flood coasts; could extend ranges of some disease causing organisms; and could alter natural habitats, causing some plants and animals to become extinct. Others believe that the changes could be beneficial – increasing food production by lengthening growing seasons for crops and decreasing the need for heating in many areas. Some scientists don't believe global warming will happen at all. Because no one can predict with any certainty what effects increased levels of CO_2 will have on the planet, people disagree about what should be done. For instance, the many people who believe that global warming will occur with severe negative effects on the planet argue for immediately reducing CO_2 emissions, more

stringently banning CFCs, planting trees, slowing population growth, raising the cost of fossil fuels, and other actions. Many others believe that we don't know enough yet; they advocate a more cautious approach. They believe that greatly curtailing CO2 emissions, for example, could have devastating economic consequences and that we should be more sure of the problem before designing solutions.

Many countries, organizations and individuals around the world are concerned enough about the threat of global warming that they've already taken steps to reduce their CO2 emissions.

At the United Nations Conference on Environment and Development (UNCED, or the Earth Summit) in Re de Janeiro, Brazil in 1992, all participating countries signed and agreement to stabilize or reduce their CO2 emissions (no target dates or reductions were set).

Getting Ready

Make a copy of student pages 49 & 59 for each student. You might also call your local electric company and find out how your electricity is generated.

Doing the Activity

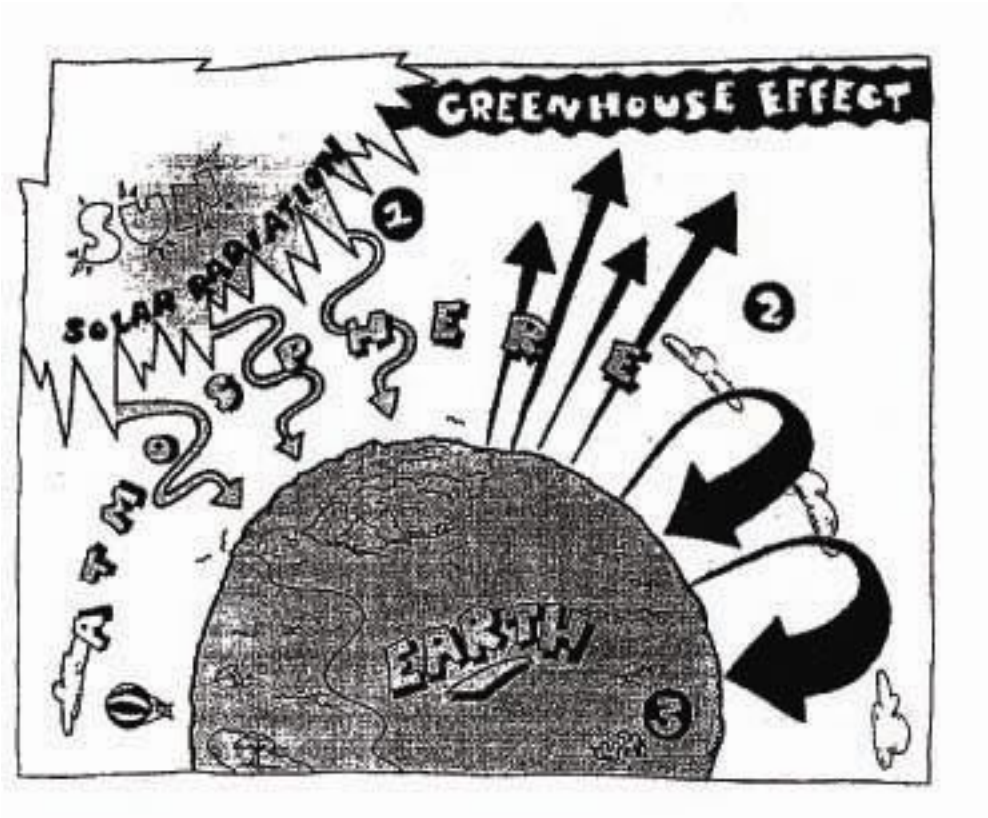
Ask the students to brainstorm a list of ways they use energy in a day.

Create a master list of all these activities and put it where everyone can see it.

Using the background information, discuss with your students the connection between energy use and pollution. Be sure to point out that burning fossil fuels is a major source of air pollution, including CO2 emissions that contribute to the greenhouse effect.

Have students identify which of the energy-using activities that are listed in Step 2 rely on fossil fuels. Have them name some ways they could cut down on this energy use. List their ideas where everyone can see them.

Pass out copies of 'home audit' on page 50 to the students and explain that they're going to do an energy audit of their homes or apartments. Explain that the first thing they need to do is read their electric meter. Use the diagram on page 47 to explain how students can read their electric meter. You may also need to create other examples to be sure that everyone understands how to read a meter

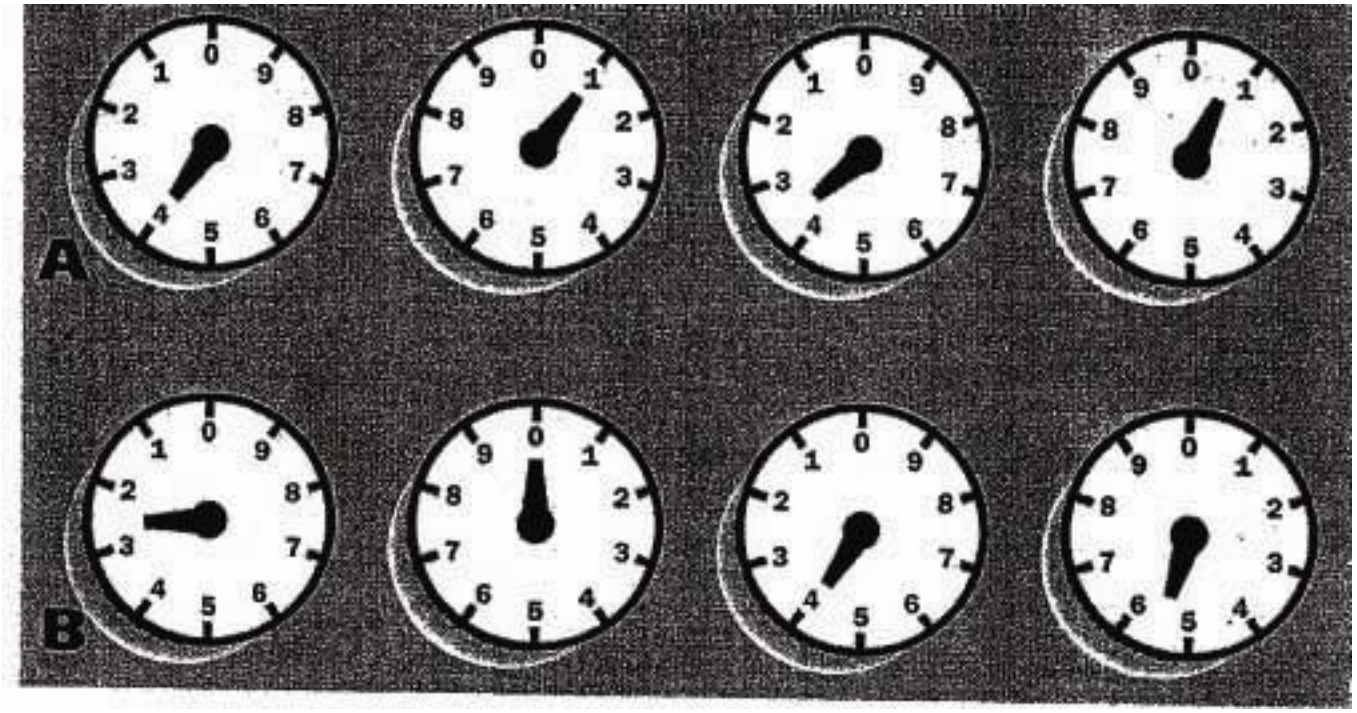


1. The sun's energy warms the earth's surface.
2. Some of the sun's energy is radiated from the Earth's surface, through the atmosphere, and back into space.
3. When green house gases and water vapor accumulate in the atmosphere, they tend to absorb heat radiated from the Earth's surface and direct it back to ward the Earth. As a result, the temperature of the Earth's surface may in crease

Reading an Electric Meter

An electric meter consists of four round dials. Read the dials from left to right. If the dial points directly to a number, record that number. If it lies between two numbers, record the smaller number. For example, the number of kilowatts shown below are 4,130 (in 'a') and 2,045 (in 'b').

For students who live in apartment buildings, suggest that they talk to the building superintendent to see if they can have access to the meters.



Exactly one week after their first reading, students will read the meter again to determine the number of kilowatt hours of electricity their family used during the week (a kilowatt hour is the amount of energy expended by 1 kilowatt in 1 hour). During the time between their two readings, they should go all around their home, filling in the other items on the sheet.

Note: depending on the level of your students, you might want to recommend that they do their energy audits with help from their parents.

When the students have filled out their sheets, have them share the information they collected. Keep a running total on the chalkboard of everyone's kilowatt usage, and post the class total where everyone can see it.

Have students calculate the amount of Co2 their family generates each week and the amount the class generates each week using the fact that, on average power plants (of all types) in the US generate 1.5 pounds (.68 kg) of CO2 per kilowatt hour. Then have students calculate how much CO2 they generate in a year.

Note: utilities usually get their electricity from a variety of sources, including coal-burning, natural gas, hydro-electric or nuclear power plants. These different types of plants generate different amounts of CO2 per kilowatt hour. For example, hydropower and nuclear power plants generate little CO2 per kilowatt hour. High-sulfur, coal-fired steam plants, however, generate 2 pounds (.90 kg) per kilowatt hour. Just how much CO2 your students generate per kilowatt hour at any given time depends on the types of plants your local utility uses to generate electricity at that time. The simplest way to estimate the amount of CO2 you generate per kilowatt hour is to use the national average for all power plants which is: 1.5 pounds (.68 kg).

Assessment Opportunity

Have students write a brochure that outlines energy-saving actions people can take and explain why saving energy is important. Their brochure should include an explanation of the link between energy use and air pollution.

Have students look back at the list of energy-using activities they generated earlier. Which ones do they think

use the most energy? Can they think of anything they could do to reduce the energy they use? For example, they could turn off lights when they leave a room ,carpool, ride their bike, or take public transportation, think about what they want before they open the refrigerator door, encourage their parents to buy energy-efficient appliances when the y need new ones, and so on.

Now pass out copies of 'saving a ton of CO2' on page 49 and go over it with students. You might, for instance, ask them which action on the page will result in the single greatest savings of CO2 production. (For example, turning down the thermostat 10 degrees at night on an electric heating system saves 2,070 pounds (937.7 kg) a year.) or how many pounds of CO2 could you save in a year by replacing a single 100-watt light bulb with a lower-energy fluorescent bulb. (160 pounds or 72.5 kg a year.) what actions on the page look like things they could do in their own homes?

Have the students take the pages home to go over with their families. They should identify things they will do to reduce the amount of CO2 they produce. Have students record those things in the blanks on the right side of the page and then add the total CO2 they would save in a year.

Enrichment

Have students read their electric meter or look at their electric bill so they can keep track of the number of kilowatt hours of electricity they use over a longer period. (Electric bills specify the number of kilowatt hours used each month.) Is the monthly usage fairly constant through the year or does it rise and fall? (Students can analyze their by making a graph.) What might account for increases or decreases in energy use during the year?

Do an energy audit at your school, or contact your local electric utility company, and ask if they will do a professional energy audit (with students watching). Then design and carry out an energy-savings plan. As part of the plan, for example, students could educate other people or younger students about running off lights when they leave a classroom. Or they could caulk windows in their classroom or throughout the school.

Ask a landscape architect to visit and recommend ways to save energy by planting trees, shrubs and ground cover on the school grounds. For example, the landscaper might recommend planting trees or shrubs to block winter winds, provide shade or channel cooling breezes to the building. Then develop and carry out a plan to implement some of the recommendations. Besides saving energy, trees and other plants will absorb CO2 out of the atmosphere.

Have students take copies of the brochures made in the Assessment Opportunity and distribute them in their neighborhoods. They could also make copies of the 'saving a ton of CO2' page and distribute them along with their brochures. If people decide to reduce their CO2 production, they can let your group know and they can keep a tally in your room of how many tons of CO2 people have saved because of their campaign.

Have students research energy efficient home designs such as active or passive solar and earth-sheltered homes, or examine other energy-saving technologies and report on them to the rest of the group.

Saving a Ton of CO2

Keeping a ton of CO2 from getting into the atmosphere each year will also mean saving at least $100 on your utility bill! Decide which of the following energy-saving measures you can take. (To convert pounds to kilograms, multiply by .453.)

Electricity Simplicity

Replace a 100-watt incandescent bulb with a 27-watt compact fluorescent bulb. We save 160 pounds per year for each bulb.

_____

Replace a 75-watt incandescent bulb with a 18-watt compact fluorescent bulb. We save 120 pounds per year for each bulb.

_____

Turn lights out when we leave the room. We save 120 pounds every year for each room.

_____

Total CO2 Saved here _____

Getting into Hot Water

Give our water heater a warm-up jacket of insulation to make it more efficient. If we use

Electric, we save 600 pounds _____

Oil, we save 360 pounds _____

Gas, we save 260 pounds _____

Cool the hot-water heater down by 10 degrees (but not below 120 degrees Fahrenheit). If we use

Electric, we save 660 pounds _____

Oil, we save 360 pounds _____

Gas, we save 290 pounds _____

Make our hot water go further with low-flow shower -heads. If we use

Electric, we save 920 pounds _____

Oil, we save 560 pounds _____

Gas, we save 400 pounds _____

Chill out our washing machine by doing four out of five laundry loads in cold water. If we use

Electric, we save 460 pounds

Oil, we save 280 pounds _____

Gas, we save 200 pounds _____

Total CO2 saved here _____

Turning Over a New Leaf

Plant a tree on the south or west side of our home to provide cooling shade. We save 150 pounds

_____

Home is Where the heat Is

Nudge our thermostat down one degree this winter. If we use

Electricity, we save 410 pounds _____

Oil, we save 250 pounds _____

Gas, we save 180 pounds _____

Give that overworked heating system a 10 degree rest when we're in bed at night. If we use

Electric, we save 2,070 pounds _____

Oil, we save 1,260 pounds _____

Gas, we save 900 pounds _____

Turn our air conditioners thermostat up a single degree this summer

We save 220 pounds _____

Get annual tune ups
For our air conditioner, _____
We save 220 pounds

For our furnace, if we use electric, _____
We save 1,030 pounds

For our furnace if we use oil, _____
We save 640 pounds

For our furnace, if we use gas, _____
We save 450 pounds

Plug leaks around windows and doors with weather stripping – and close the curtains and shades at night. If we use

Electric, we save 1,060 pounds _____

Oil, we save 1,000 pounds _____

Gas, we save 700 pounds _____

Total CO2 saved here _____

GRAND TOTAL of CO2 WE WILL SAVE THIS YEAR

_____

Home Audit

Kilowatcher

What is the reading on your electric meter? _____

What is the reading on your electric meter one week later? _____
How many kilowatts did you and your family use during the week:? _____

Staying Warm and Keeping Cool

What is the temperature setting of your thermostat? _____

Is your thermostat on a timer that automatically controls it at night or during the day when no one is home?

_____

Lights!

How many light fixtures are in your home? _____

How many have compact fluorescent bulbs? _____

How many lights are on even though no one is in the room? _____
How many radios or televisions are on with no one listening or watching them? _____

Out the Window

How many windows are in your home? _____

How many windows have storm windows? _____

Check for drafts around the frames of your windows. Move a piece of ribbon all around the frame and check to see if the ribbon flutters. Hold a lit candle around the frame and see if the flame flickers. How many windows have drafts? _____
Check for drafts around door frames by using the same procedure used for your windows. How many doors have drafts? _____

Down the Drain

What temperature is your hot water heater set on? _____

Note – if your hot water heater doesn't have a temperature setting, measure the temperature of the water. Just run the water until it's hot; then use a thermometer to record its temperature.

Does your shower have a low-flow shower head? _____

Do your sink faucets have low-flow aerators on them? _____

Do any faucets or pipes in your house leak? _____

Do you usually wash your clothes in hot, warm or cold water? _____

Do you run the drying cycle on your dishwasher or let the dishes air dry? _____

Do you clean the lint trap on your clothes dryer before drying a load of clothes? _____

New Life

How many of the following materials do you recycle on a regular basis:

Aluminum _____

Newspaper _____

Plastic _____

Mixed metal cans _____

Cardboard _____

Paper (other than newspaper) _____

Blue Crabs in the Chesapeake Bay

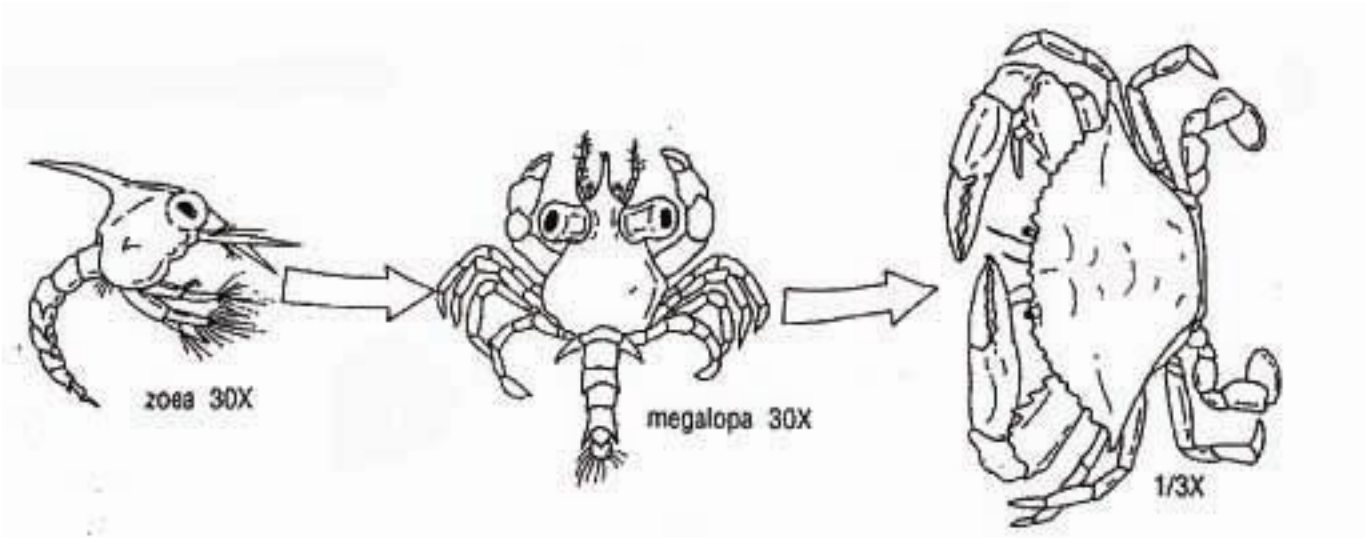
Blue crabs live in estuaries all along the Atlantic and Gulf coasts, but they are most often associated with Maryland where they are very popular cooked in hot spices. About 1 million bushels are caught for food each year. These crabs have swimming paddles on their fifth pair of legs which help them really get around. At one time or another blue crabs can be found almost everywhere in the Bay.

Like all crustaceans, blue crabs shed their old, hard hell, expand and grow a new one in order to grow larger. This is called molting. A crab that has molted is soft and helpless. These soft shell crabs hide in underwater plants to avoid being eaten by fish or other crabs until their new shell hardens. On the other hand, a hard shelled blue crab is anything but defenseless. It uses its two claws to defend itself and to eat clams, oysters, dead fish and plants.

Male blue crabs stay in water of lower saltiness in rivers and toward the top of the Bay. In winter the males migrate to deeper water, but during the rest of the year they spread out into shallow water. The females live in saltier water. From June to October, males search for females ready for their last molt and mate with them when they are soft shelled crabs.

Each female makes 1-2 million eggs! The fertilized eggs are carried under her body where they develop as she migrates toward the mouth of the Bay during the summer and late fall. There the eggs hatch, releasing tiny babies (larvae) called zoeae which become part of the zooplankton. They may even drift out into the ocean before being carried back into the Bay by currents. They feed, molt and grow into another form called megalopae which settle to the bottom. As they megalopae, they continue to feed, grow, molt and move with the bottom currents up the Bay. They gradually begin to look like adult blue crabs. Crabs take from 12-20 months to become adults and only life about 3 years.

Stages in the development of a blue crab



Crab Anatomy Glossary

External Features

Antenna (pl. antennae)

The long segmented appendages located behind the eyestalks. These allow the crab to interact with its environment by touch and chemoreception.

Antennule (pl. antennules)

Shorter segmented appendages located between and below the eyestalks, sensory organs;

these also use chemoreception to 'smell' and 'taste'.

Appendages

Ten legs (five pairs) including a claw-bearing pair with spines used for feeding and defense, followed by three pairs of sharply pointed walking legs, and a pair modified as flat swimming paddles at the rear, swimming legs.

Apron

Abdomen of a crab, which is folded under the body; male's is shaped like the Washington Monument or an inverted Y. An immature female's is triangular (pyramid shaped) and mature female's is semicircular, like the dome of the capitol building.

Carapace

The shell covering the body that provides rigidity and protective covering. It is made of chitin and is the part of the exoskeleton (hard outer covering) that covers the head and thorax (center) of the crab.

Cheliped (see appendages)

The first pair of legs, carries the large claw which is used for defense and obtaining food. Male's claws are blue tipped with red; female's are red.

Eyes

Visual organs mounted on the ends of eyestalks. The eyestalks contain cells that release hormones that inhibit molting.

Lateral Spines

Paired points on the widest outside edges of the carapace.

Mouth

Opening to the digestive system, located between the antennae. The mouth contains jaws that hold and push food into the esophagus.

Sponge

Egg masses. Numbers of eggs vary, some may contain as many as 8,000,000. They are attached to swimmerets.

Swimmerets (pleopods)

Paired abdominal appendages under the apron of the female crab on which the eggs are carried until they hatch.

Walking Legs (see appendages)

Used for movement; crabs are capable of walking forward or diagonally, but usually they walk sideways.

Internal Features

Gills

Place of respiration and filtration, consisting of many plume-like filaments arranged around a central axis. There are eight gills on each side of a blue crab's body.

Heart

The pump of the circulatory system. It is broad in size and located in the lower center part of the body.

Hepatopancreas (midgut gland)

Extremely large organ with several functions, including the secretion of digestive enzymes and absorption and storage of digested food. It fills most of the area around the stomach, depending on its contents of food reserves and water.

Intestine

Portion of the digestive system through which digested food passes.

Stomach

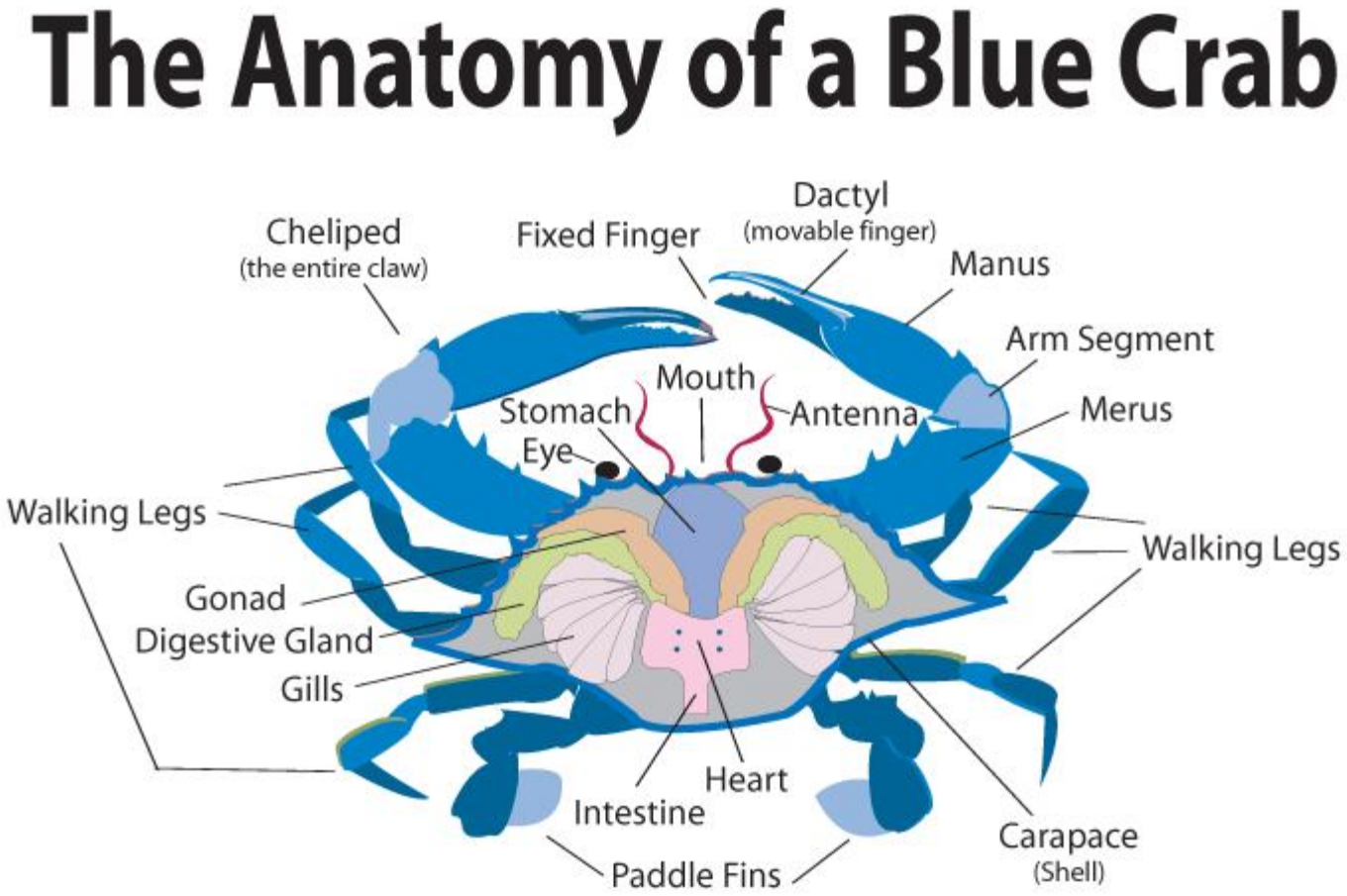
The organ of the digestive system that breaks down swallowed particles of food. It is lined with small hard plates and projections which aid digestion.

Testes

Part of the male reproductive system, located on top of the hepatopancreas on either side of the stomach.

Cartilage

External muscles that aid in the movement of the legs. The muscles are the edible portion of a blue crab.



Crab Capers

1. A crab's exoskeleton is largely made of:
A. Bone
B. Chiton
C. Cartilage
D. Crustean

2. A sexually mature female crab is called a:
A. She-crab
B. Crabbess
C. Sook
D. Clawdine

3. The carapace is the crab's:
A. Inner shell
B. Top shell
C. Bottom shell
D. Front claw

4. Which is true about the claws on the blue crab's front legs?
A. Males are blue, females are blue
B. Males are red, females are red
C. Males are red, females are blue
D. Males are blue, females are red

A. 5. The blue crab's scientific name, Callinectes Sapidus, means:
B. Beautiful swimmer
C. Athletic claw
D. Blue crawler
E. Agile legs

6. A scientist who studies crabs is called a:
A. Crabbologist
B. Crustologist
C. Callinectologist

7. Newly hatched crabs are called:
A. Swimmerets
B. Crablets
C. Larvines
D. Zoeas

8. A sponge crab is a crab:
A. That has just molted
B. With a soft shell
C. That has just scraped the mud off its shell
D. Carrying a load of eggs

9. A favored habitat of the blue crab is:
A. Eelgrass beds
B. Freshwater marshes
C. Rocky bottoms
D. Sandy shorelines

10. The period between crab's moults is called:
A. scrape
B. Punk
C. Instar
D. Megalops

Answers
1-B; 2-C; 3-B; 4-D; 5-A; 6-D; 7-D; 8-D; 9-A; 10-C

Chesapeake Bay Studies

Go Figure

The Molting of Blue Crabs

Blue crabs, like all crustaceans, shed their old, hard shell, expand and then grow a new one. Crabs need to molt because they grow so rapidly. With each new molt, the young crab can grow by as much as one-third. They take from 12-20 months to reach adult size.

Materials

One glass measuring cup

One funnel

Two balloons

Pitcher of water

Directions

Fill the glass measuring cup with ½ cup of water to represent the young crab's beginning size.

Figure out 1/3 of the beginning size of ½.

½ x 1/3 = X

Add the answer to the beginning size to demonstrate how much the young crab grew.

½ + X = New size

To demonstrate visually the rate of growth, pour ½ cup (the beginning size) into both the balloons. Tie one balloon shut.

Add 1/3 of the volume (X) of the beginning size to the second balloon and tie.

Compare the sizes of the balloons to demonstrate how rapidly a young crab grows.

Repeat this exercise to visualize how much a young crab would grow in multiple molts.

What Can Just One Girl Do?

Things to do by yourself:

Use less water. Turn the water off while you brush your teeth, take shorter showers or shallow baths.

Never litter, always throw trash in a trash can. Trash on streets and roads gets washed into streams, rivers and the Bay.

Protect the watershed. Do not use things that make a lot of trash that has to go in landfills. Pick fast food restaurants that use paper rather than plastic and Styrofoam.

Things to do with your family:

Save water. Do not run the washing machine or dishwasher unless it is full. Do not leave the water running while washing dishes. Do not overwater the lawn or leave the hose running while washing the car.

Reduce the kinds of amounts of household chemicals you use. Most people use more than needed. Read the labels. If something hurts people, it will not be good for the Bay.

Dispose of oil from the car by taking it to a recycling station at a gas station. Never dump chemicals in your home drains or storm drains.

If you have a yard, prevent erosion and encourage water to soak in by planting and letting the grass grow longer. Sidewalks and driveways made of things like brick or gravel let the rain soak in, not run off.

Recycle trash, especially things that will decay in a landfill. Ask for paper bags rather than plastic at the grocery store. (If you do use plastic grocery bags, return them to the recycle bin in the entrance of most grocery stores.) Newspaper, glass and aluminum cans may be recycled. Use a compost bin to recycle leaves and grass clippings rather than send them to a landfill.

Vote for politicians and laws that are good for the Bay.

If you live on a farm, contact your soil and water conservation district about a conservation audit. They can help make your farm a better place for the Bay.

Be Part of the Solution, Not Part of the Problem

Reduce your nutrient input to the Bay.

Start a compost pile instead of using a garbage disposal. Limit the amount of fertilizers spread on gardens and lawns. Plant native vegetation that requires less fertilizing and watering. Leave grass clippings on lawns and gardens, instead of fertilizing. If you have a septic system, make sure it is functioning properly.

Reduce the use of toxic materials around your house and yard.

Use cleaning agents made from natural substances. Talk to a cooperative extension agent to find natural pest controls and alternatives to herbicides.

Reduce erosion.

Plant strips of vegetation along streams and shorelines. Divert runoff from paved surfaces to vegetated areas.

Save water.

Use water-saving devices in toilets and sinks. Turn off water when not in use. Wash cars in grassy areas to soak up soapy water.

Drive less.

Join a carpool or use public transportation.

Obey all fishing, hunting and harvesting regulations.

Be a responsible boater.

Avoid disturbing shallow water areas and submerged aquatic vegetation beds. Pump out boat waste to an onshore facility.

Get involved.

Join a citizen's environmental advocacy group or start your own. Talk to your city, town or county elected officials about your concerns. Join or start a watershed association to monitor growth and development locally. Participate in citizen monitoring and cleanup activities.

Facts

A two-minute shower used about 24 gallons of water.

A ten-minute shower used more than 100 gallons of water.

An average full-tub bath uses more than 40 gallons of water.