INTRODUCTION TO ECOLOGY

Ecology deals with the relationships living things have with each other and with their environments (surroundings). Scientists who specialize in studying these relationships are called ecologists.

No living thing—plant or animal—lives alone. Every living thing depends in some way on certain other living and nonliving things. Animals and plants that live in the same area, or community, depend on each other in some way. For example, an elephant must have plants for food. If the plants in its environment were destroyed, the elephant would have to move to another area that had plants, or it would starve to death. Plants depend on such animals as the elephants for the nutrients (nourishing substances) they need to survive. Animal wastes and the decaying bodies of dead animals and plants provide many of the nutrients that plants need.

The study of ecology increases people's understanding of the world and all of its creatures. This is important because humanity's survival and well-being depend on relationships that exist on a worldwide basis. Change in distant parts of the world—even outer space—affect us and our environments.

One goal of ecologists is to intelligently manage and control the living and nonliving things in the world. Many ecologists study air and water pollution and how dirty air and water affect life. Ecologists try to foresee possible environmental problems, such as crop losses or losses in animal life that building a dam or straightening a river channel may cause. They study such things as insect pests, including the beetle that carried the Dutch elm disease from Europe to the United States where it killed millions of trees.

Ecologists are concerned about the rate at which people are using up such natural resources as coal, gas, and oil. Along with many other scientists, they are searching for ways to use sunlight and atomic energy for fuel and power. Ecologists also are concerned about the world's increasing population and its decreasing food supply. For example, along with marine biologists, they are trying to find new ways of producing food from the sea.

Ecologists use knowledge from many different fields of study including physics, chemistry, mathematics, and computer science. They also rely on other sciences, such as climatology, meteorology, geology, and oceanography, to learn about air, land, and water environments.

Adapted from *World Book Encyclopedia*

Recreational Fishing On An Artificial Reef

OBJECTIVES:

Students will be able to:

1. Compose captions to illustrate a fishing trip to an artificial reef.
2. Categorize the types of organisms that inhabit an artificial reef.
3. Describe the impact of recreational fishing on the habitats of an artificial reef.

Grade:
6-8

Subjects:
Science, Ecology, Art

Time Needed:
90 minutes

Materials:
description and sketch activity sheets for each student
photographs, drawings, videos, and posters of artificial reefs
large paper or blackboard for displaying information
crayons or markers

BACKGROUND:

In the 1930s, the first successful oil wells were constructed in the Gulf of Mexico. Over the years, hundreds of other platforms have been constructed or have been dropped into the Gulf. Oil well platforms, natural gas platforms, old tires, automobiles, concrete barges, ships, and prefab structures have been used as artificial reefs. The placement of any permanent structure immediately becomes home to a myriad assortment of organisms.

Microscopic bacteria reproduce quickly on any new substrate and begin to colonize. Protists, algae, barnacles, and larger marine invertebrates also begin to grow there. Fishes arrive to feed upon the smaller members of the food chain, and recreational fishing is immediately possible. Game fishes in the Gulf of Mexico are very diverse because both tropical and temperate species are available. During the summer months, tropical fish move closer to the shore, while temperate species occur close to the shore all year long. Some migrating fish move to deeper water during winter months, while others migrate south. Artificial reefs provide food and shelter for many fish throughout the year.

VOCABULARY:

artificial reef, habitat, substrate, game fish, invertebrates, colonization, migrate, bacteria, food chain, tropical, temperate, barnacles, protists

ADVANCE PREPARATION:

1. Prepare copies of the descriptions and activity pages for each student.
2. Collect photographs, posters, videos, and/or drawings of artificial reefs.

PROCEDURE:

Setting the Stage

1. Have students observe the collected pictures of artificial reefs and discuss what types of organisms can be found inhabiting a reef.
2. Make a list of the types of organisms shown on the reefs.
3. Survey students to determine if any have experience with artificial reef fishing.

Activity

1. Hand out student copies of the activity sheets and illustrate on the board or on an overhead projector the type of sketch expected (or have a student sketch an example). The sketches should reflect each item in the "Recreational Fishing on as Artificial Reef" description sheet.
2. Allow students to sketch their illustrations and write their captions. The sketches can be colored. Students should write a title for the worksheet.

3. Have students display the completed drawings for the class.
4. Use the completed drawings to make a list of all the types of organisms displayed in the drawings.
5. Discuss how recreational fishing impacts the organisms on an artificial reef, and write the list on the board or poster paper for extended viewing and discussion.
6. Have each student complete the final item (number 6) in which Ryan has to make a decision about the illegal fish. Discuss immediate and long-term consequences of each decision.

Follow-Up

1. Research the penalties for possession of illegal fish caught in the Gulf of Mexico.
2. Collect newspaper and magazine articles about illegal fishing and its impact on fish populations.

EXTENSIONS:

1. Have each student create another captioned and illustrated story or cartoon about fishing.
2. Have a commercial fisherman or shrimper speak to the class about size and quantity restrictions, penalties for illegal catches, and the benefits of artificial reefs.

ORIGINAL DEVELOPMENT RESOURCES:

Irby, B. N., McEwen, M., Brown, S., and Meek, E. M. (1984). *Marine and estuarine ecology*. Jackson, MS: University Press of Mississippi.

Fotheringham, N. & Brunenmeister, S. (1989). *Beachcombers guide to gulf coast marine life.* Houston, TX: Gulf Publishing Company.

www.dcnr.state.al.us: includes alabama Marine Resources Division and information on artificial reefs

www.reefball.org

Johnson, S. A. (1984). *Coral reefs*. Lerner Publications Company.

ADDITIONAL RESOURCES:

Cerullo, M.M. (1996). *Coral Reef: A City That Never Sleeps*. Cobblehill Books.

Recreational Fishing on an Artificial Reef

Description Sheet

Directions: Read each description below. In the corresponding block on the activity sheet, sketch a picture of what is happening in the description. Write a caption for each drawing.

1. Ryan and his family finished their lunch just as they reached their favorite fishing spot. The artificial reef, located six miles out in the Gulf of Mexico, was created from old automobiles.

2. Anxious to begin fishing, Ryan dropped his fishing line overboard while his dad slowly maneuvered the boat into position over the reef.

3. The hook and line drifted through a school of small minnows, barely missed a cluster of giant barnacles, and finally settled beside a sponge shaped like a puffball.

4. As the hook and line moved with the current, Ryan watched a school of bonita swim by, while a bright pink Portuguese man-of-war drifted with the current.

5. A yellowtail snapper feeding on the bottom spotted the baited hook and immediately swallowed it, only to be reeled quickly to the surface.

6. Ryan pulled the snapper onto the boat and measured it for legal length. The fish was two inches short of the legal length so Ryan decided to _____.

Title:_____ Student's Name:_____

Recreational Fishing on an Artificial Reef

1.	**2.**
3.	**4.**
5.	**6.**

Marvelous Manatee

OBJECTIVES:

Students will be able to:

1. Make a bulletin board that depicts how boating can hurt manatees and how awareness of this problem can protect them.
2. Adopt a manatee.

Grades:
6-8

Subjects:
Science, Social Studies

Time Needed:
Two 50-minute class periods

Materials:
bulletin board materials (border, pictures of manatees and their environment, letters, construction paper, scissors)
video or slides of manatees
references for student use

BACKGROUND:

Manatees are large aquatic mammals with whom we share our environment. They have seal-like bodies, have thick and stiff whiskers on their upper lip, and can hear well even though there are no external ear lobes. They can differentiate colors although their depth perception is somewhat limited. These amazing mammals even make sounds by squeaking or squealing when frightened, playing, or communicating. These sounds are most prominent between mother and baby. Reproduction is slow. Only one calf is born every 2-5 years. This contributes a lot to their becoming endangered. This playful "water-elephant" is non-aggressive and completely harmless.

Sadly, humans are the manatee's worst enemy. We are responsible for their well-being. Recreational boating accidents pose the greatest threat. Discarding monofilament line, hooks, or other litter into the water may cause the manatee to become injured or even die. Education is vital to the survival of the manatee. There are about 5,000 remaining in the southeastern United States as of 2011, concentrated in Florida year-round. During the warm summer months, a few manatees make their way into the estuaries in Alabama along the Gulf of Mexico, but eventually they find their way back home in the cold winter months. Debris in waterways, such as discarded fishing line and hooks, plastic 6-pack rings, and plastic bags, are dangerous to manatees. Entanglement in, or digestion, of these items have caused many injuries and deaths. Why not adopt a manatee? If you are interested, call 1-800-432-JOIN.

VOCABULARY:

manatee, recreational boating, monofilament line, entangle

ADVANCE PREPARATION:

1. Gather materials needed for the bulletin board. (This may be an assignment for students.)
2. Obtain a video or slides (if available) about manatees and their environment.
3. Collect information about adopting manatees.
4. Get permission to use several of the most visible bulletin boards located in your school.

PROCEDURE:

Setting the Stage

1. Show the video or slides (if obtained).
2. Use pictures of manatees in their natural environment if no video or slides are available.
3. Talk about the dangers of recreational boating to manatees.

Activity

1. Divide students into teams.
2. Have each team draw a design of a bulletin board illustrating manatees and their environment, dangers to them, etc. Students should create the board.
3. Explain that each team member will have a specific responsibility in the development of the bulletin board. This bulletin board will serve as an educational project to help other students and teachers understand how the manatee lives and how it can be harmed by motor boats.
4. Teams of students will be responsible for giving an oral report on manatees as well as sharing their bulletin board with the class.

Follow-Up

1. Have students present their designs for the bulletin boards.

EXTENSIONS:

1. Permission may be granted to put up a bulletin board in the public library or other similar public places.
2. Have students present their information at a PTO meeting when parents visit the classrooms.

ORIGINAL DEVELOPMENT RESOURCES:

The society of plastics industries. (l990). Washington, DC: Center for Marine Conservation.

Marine pollution bulletin. (l987). Vol. 18, No. 6B, International Ocean Disposal Symposium.

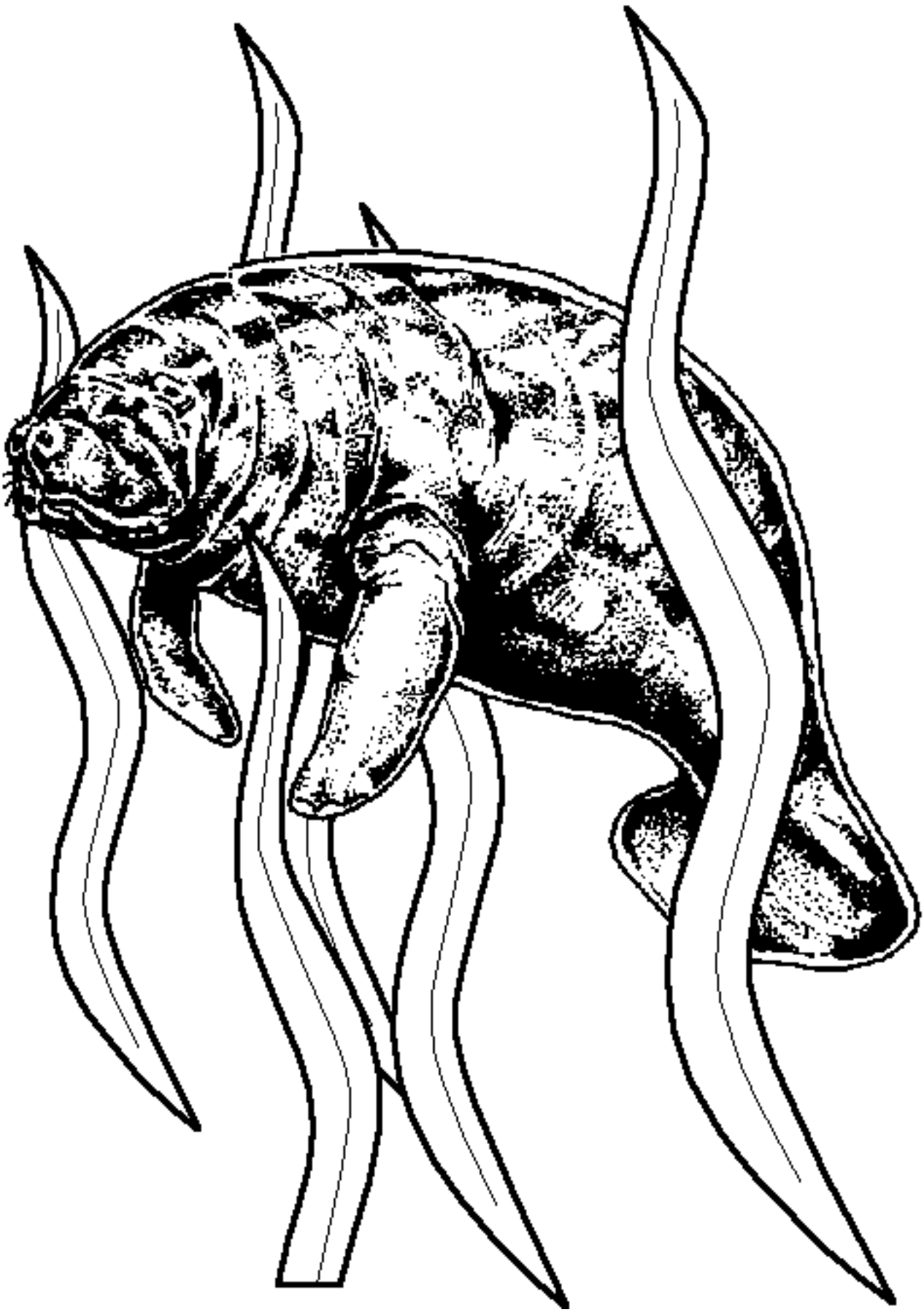
www.plasticsindustry.org/outreach/school

www.savethemanatee.org

www.manateeworld.net

ADDITIONAL RESOURCES:

www.manatees.net



Notes

Adaptations: Toothpicks In Hiding

OBJECTIVES:

Students will be able to:

1. Explain how animals of one color may be better adapted for survival in a particular habitat than animals of another color.
2. Explain the importance of camouflage in the survival of animals in the wild.

Grades:
6-8

Subjects:
Science, Math

Time Needed:
One hour

Materials:
250 colored toothpicks for each team (50 each of 5 different colors)
stopwatch or egg timer for each timekeeper
4 stakes for each team's grassy area

BACKGROUND:

What do a grasshopper, a snowshoe rabbit, and an army truck have in common? They all use camouflage, the ability to blend into their surroundings to hide from their enemies. The grasshopper's coloration allows it to hide among the grasses and other plants; the snowshoe rabbit changes color from brown in the summer to white in the winter to blend in with the snow; and the army truck is painted with mottled greens and browns to blend in with the trees and undergrowth of a forest.

Camouflage (protective coloration) is a type of adaptation, a physical or behavioral characteristic that increases an organism's chances of survival in a particular habitat. By blending in with its surroundings, an animal can avoid being discovered, can avoid being eaten by predators, or can sneak up on prey.

VOCABULARY:

camouflage, adaptation

ADVANCE PREPARATION:

1. Students should be divided into groups of 5 to 7 each. One member of the team should be assigned the job of time keeper.
2. Chart information should be filled in with the names of the team members and the colors of the toothpicks to be used.
3. Toothpicks may be bought already colored, or they may be dyed by soaking them in food coloring overnight. Extra toothpicks should be provided in case some get lost. Each team will have 250 toothpicks, 50 of five different colors. (Instead of toothpicks, strips of colored plastic lacing found in craft stores may be used.) This activity is more effective if one color closely matches the ground or grass color.
4. Mark the corners of a 10 meter by 10 meter grassy area with stakes. Do this for each team of students or allow students to measure.
5. Mix the different colors of toothpicks together and randomly scatter them in the marked-off areas.

PROCEDURE:

Setting the Stage

1. In this activity, colored toothpicks are used to represent prey animals. Toothpicks are placed in the grass in the marked-off area where they will be hunted by predators (students) in groups of 5-7 students. Toothpicks are used to represent prey animals. Students will observe how animals of one color may be better adapted for survival in a particular habitat than animals of another color. First, students will hunt for the toothpicks of various colors in the grass and then will determine how the coloration affects the toothpicks' chances of being found.

2. Each team should go to its staked area and should describe the terrain in the marked-off area. Note the color and height of the grass and how much bare dirt shows through.

Activity

1. Each team of students will be simulating a group of predators hunting for prey (the toothpicks) in the grass. The time keeper of each team should signal the beginning of the hunt, and the rest of the team members should start hunting. The goal of each hunter is to capture as many toothpicks as possible in a one-minute time period. The time keeper should signal for the predators to stop hunting at the end of one minute.
2. Each team should survey the catch by counting the number of toothpicks of each color captured by each predator on the team. Next, the team should add up the total number of toothpicks captured by each team member and should record all numbers on the chart.
3. Each team should determine the team total for each color and should record these numbers on the chart. Calculate the percentages of each color recovered.
4. Compare the results of all teams. Make a class summary table on the board to compare the results of all the different teams. Students can use the bottom portion of their data sheets to record the class data for comparison.

EVALUATION:

1. Have students answer the following questions:
   - Was there much variation in the number of prey captured by the different predators? Why or why not?
   - Based on experience, which color of toothpicks was best "adapted" (camouflaged) to its environment? Which was the worst "adapted" (camouflaged)? Explain.
2. If the toothpicks were actually living organisms, predict how the population of each color of toothpicks would change after being preyed upon for several generations.
3. Predict how the results of the experiment would differ if this activity were conducted in a different habitat such as an asphalt parking lot. On a sandy beach. In a thick red carpet. Explain.

EXTENSION:

1. Develop a new method of hunting for toothpicks in the same environment so that students will end up with approximately equal numbers of the different colors. Explain this method.
2. In the real world, adaptations are not always as obvious as the different colors of toothpicks. Suppose that butterflies were being studied in a area with butterfly-eating birds. Findings show that brightly colored butterflies survive better than the dull-colored ones, even though the dull colored butterflies seem to blend in better with the surroundings. What could account for these findings?

ORIGINAL DEVELOPMENT RESOURCES:

Arms, K. (1996). *Environmental science.* Austin, TX: Holt, Rinehart, and Winston.

Adaptations: Toothpicks In Hiding Data Sheet

Team# _____

Date: _____

Student Name	Number of Toothpicks Found						
	Color	Color	Color	Color	Color	All Colors combined	Percent
Team Totals							

CLASS DATA

Team Numbers	Number of Toothpicks Found						
	Color	Color	Color	Color	Color	All Colors combined	Percent
Class Totals							

Notes

Biome Bingo

OBJECTIVES:

Students will be able to:
1. Identify characteristics of different biomes.
2. List factors that determine how a biome is named.

Grades:
6–8

Subjects:
Science, Language Arts

Time Needed:
50-minute class period

Materials:
copies of game boards
pieces for marking
supplement

BACKGROUND:

Biomes are areas that have distinctive climates, soils, and organisms. The combination of climate, soils, and topography determine the vegetation that will be supported in a given area. These areas or biomes are often named for the dominant plants that are found there.

Forest biomes include tropical and temperate rain forests, temperate deciduous forests, and the boreal or taiga forests. The tropical rain forest, which has the greatest biological diversity of any biome, is characterized by a consistent warm, humid climate. They are located in the tropical band nearer the equator. Temperate rain forests have a humid, yet moderate climate. Climatic characteristics of the temperate deciduous forests include significant temperature changes from winter to summer months and a substantial amount of rainfall. Boreal forests are coniferous; that is, they are composed of cone-bearing trees with needle leaves. As evergreens, these trees drop their leaves throughout the year and are able to survive extremely cold temperatures. These forests are located just south of the Arctic Circle and in lower latitudes at higher elevations. Forests change in response not only to latitude but also to elevation. Therefore, a taiga forest may exist at the equator if the elevation is sufficiently high.

Grasslands, deserts, and tundra are characterized as open areas with little precipitation. Grasslands generally are found in the mid-latitudes in both northern and southern hemispheres. They support few, if any, trees and are known as savannas and velds in Africa, steppes in Europe, prairies in North America, and pampas in South America. Deserts may be hot or cold. These areas receive less than 25 cm or less than 10 inches of precipitation annually. The tundra is a treeless biome with extremely cold temperatures and only a brief cool summer that allows only the top few inches of soil to thaw. Lower soils remain permanently frozen.

VOCABULARY:

biome, tropical rain forest, temperate rain forest, temperate deciduous forest, taiga, savanna, prairie, desert, tundra, permafrost, equator, conifer, boreal, steppes, pampas, veld

ADVANCE PREPARATION:

1. Discuss characteristics of different biomes. Be specific with temperature ranges and amounts of rainfall for certain regions. Discuss different animals common to each biome.
2. Show pictures of animals and ask students to guess which biome they would occur in by the traits of the animal. Examples would be giraffe: Africa, savanna, long neck, vegetation; white hare: taiga, protection.
3. Prepare blank Biome Bingo cards for each student.
4. Have students prepare small squares (notebook paper) to mark their cards.

PROCEDURE:

Setting the Stage

1. On the board, list at least seven characteristics of different biomes. Characteristics may include the following: amount of rainfall (<10", >200", seasonal), average temperature (hot, cold, temperate, polar, altitude-dependent), common animals, common vegetation, location (tropical, mid-latitude, high latitude, polar).
2. After some discussion, have students come up with clues to be used in the Biome Bingo game.
3. Review rules of Biome Bingo (similar to Bingo).

Activity

1. Each student should have a blank Biome Bingo card.
2. Across the top of their cards, have students choose a different biome for each column and write the biomes at the top of the columns in random order. Have the students write in random order in the boxes under each biome the plants, animals, temperatures, rainfall, and location for each biome listed at the top. Students should fill in their own cards.
3. Draw a clue that the students wrote to begin the game. If, for example, the clue names a location, the students should mark on their cards the biome most identified with this location. Some students may not have chosen this biome and will not mark anything. Each student's card should be different, so it may take several clues for a student to have a Biome Bingo. Biome Bingo is five marked squares in a row, either horizontally, vertically, or diagonally.
4. Continue the game until all the clues are read. Provide rewards for the winners.

EVALUATION:

1. Review the biomes and their characteristics.
2. Require students to do a short essay on a biome. Have them include detailed information about vegetation and wildlife common to that biome.

EXTENSIONS:

1. After several games of Biome Bingo, have students exchange cards.
2. Visit an undisturbed habitat near the school and identify the vegetation there and its characteristics.

ORIGINAL DEVELOPMENT RESOURCES:

Arms, K. (1996). *Environmental science*. Orlando, FL: Holt, Rinehart, and Winston.

Biome Bingo

Instructions:

1. Write the names of five different biomes at the top of each column.
2. In the boxes under each biome, write the names of plants, animals, temperature, rainfall, and location for that biome -- in no particular order in the column, one name per box.

B	I	N	G	O
Biome: _____	**Biome:** _____	**Biome:** _____	**Biome:** _____	**Biome:** _____
		FREE SPACE		

Notes

Can You Dig Wetland Soil?

OBJECTIVES:

Students will be able to:

1. Describe physical (especially color) differences between wetland and upland soils.
2. Demonstrate the usage of keys to recognize wetland soils.
3. Explain why water affects both the biology and chemistry of wetland soils.

Grades:

6-8

Subjects:

Science, Ecology, Social Studies

Time Needed:

Two-three class periods depending on whether or not students take a field trip to gather samples

Materials:

shovel or trowel
buckets or roasting pans
soil samples (wetland)
soil samples (non-wetland)
soil color identification sheet
pictures of different types of soils
pictures of wetlands
crayons (96 pack required)

BACKGROUND:

Wetland soils, often called hydric soils, develop under low oxygen or anaerobic conditions created by permanent or periodic inundation or saturation. As water fills the air spaces between soil particles, the rate at which oxygen can diffuse through the soil decreases significantly. The lack of oxygen prevents plants and soil microorganisms from carrying out normal aerobic respiration, a process typical in most terrestrial plants. Anaerobic conditions usually favor the growth of hydrophytic vegetation.

The shape of the landscape creates unique drainage conditions that influence the formation and characteristics of soil. Soils can be classified according to the rate at which they drain water. Based on their composition, hydric soils are classified as either organic or mineral soils. Organic wetland soils contain a large amount of partially decayed plant and animal matter that creates a thick black or dark brown layer at the soil surface.

Mineral wetland soils contain significantly less organic material and more sand, silt, and clay. Typically they are lighter in color than organic soils. Mineral soils can be made from a variety of materials such as sand, silt, clay, or loam (a mixture of sand, silt, and clay). Mineral wetland soils can be gleyed (pronounced glade) or mottled. Gleyed soils are mostly gray but contain splotches of brown, orange, red, or yellow from being alternately wet and drained. Mottles—orange, yellow, or reddish-brown splotches—appear in mineral soils that are alternately wet and dry. For a number of reasons, not all hydric mineral soils will exhibit gleying and mottling.

When a hole is dug to examine or study wetland soil, horizontal layers of different soils may be found. The soil types will depend on the area. The makeup of the soil in an area may have been changed by human activity such as tilling for agriculture or draining or filling for development. If one is searching for hydric soil in a city, a housing community, or near farmland, one may have to dig deep to locate the soil, or the soil may have been removed entirely during the building process.

Students should have a clear concept that soil type is one of three characteristics that distinguish wetlands from non-wetland areas. Because wetlands are wet some or all of the year, the biological, chemical, and physical character of the soil is altered; therefore, hydrology (flooding patterns) are a second indicator of wetlands. Vegetation types (wetland plants) are the third indicator.

VOCABULARY:

anaerobic, gleyed, hydric soil, mineral soil, organic soil, wetlands, hydrophytic

ADVANCE PREPARATION:

1. Introduce the vocabulary terms.
2. Show the class magazine pictures, slides, and photographs of different wetland areas. (Search the Internet for wetland-related sites.)
3. Show the class pictures, slides, and photographs of different soil types.
4. Have the students find an area in their neighborhood, town, or city that they suspect is a wetland area. Have them collect (with permission - -see activity one below) a few soil samples and bring them to class. Have the students describe in their own words how their soil samples look, feel, and smell.
5. Arrange a classroom display of the collected wetland soil samples. Have the students attempt to identify the different types of soil. (See also activity section.)
6. Have the students prepare the Wetland Soils Color Chart as per the instruction sheet. Review the instructions on the color sheet with students.

PROCEDURE:

Setting the Stage

1. Read the background information about wetland soil types.
2. Have the students brainstorm why wetlands have different soil types. List these reasons on the chalkboard.

Activity

1. In this activity, the teacher needs to bring both wetland and upland soil samples to the classroom. If possible, students may also be able to bring in soil samples; however, emphasize that they must get proper approval before digging on private property. If the teacher is not familiar with wetland sites in the community, he/she should contact the local conservation commission or planning board to assist in locating wetlands. (This could also be a field trip activity.)
2. After a suitable location is found, dig a small pit or hole about two feet deep to find and study wetland soils. Place soil samples from various levels in the hole in a bucket to bring back to the classroom. Do the same thing in an adjacent upland area. Samples should be golf-ball size.
3. In the classroom, place the two soil types side by side. Ask the students to identify any differences or similarities they see (color, smell, texture, roots, insects). Students should record the information on the soil data sheet.
4. In the classroom, students should examine the soil, compare each sample to the Wetland Soils Color Chart, determine the nearest match to the colors (or no match, if applicable), and create a list of their wetland and non-wetland soils by wetter and dryer based on color differences.

EVALUATION:

1. Have the students answer the following questions and record the answers on the chalkboard:
   - What physical characteristics of the soil were observed?
   - What evidence can you find in the sample that shows from where the soil was taken?
   - What environmental conditions were observed that may have affected the condition of the soil?
   - Did you find anything that was not natural in the soil? How do you think it got there?
   - Compare wetland soil to soil observed at home and around school. How do the two differ or how are they alike?

EXTENSIONS:

1. Have the students perform a percolation test. Dig identical small soil pits in different locations sandy soils, wetland soils, upland forest, school play grounds—and fill the pits with water. Time how long it takes

each pit to drain water.

2. Have the students participate in the Adopt-A-Wetland Program. Contact the regional office of the Environmental Protection Agency for information, or search the Internet.
3. Identify certain students, or the entire class, as "wetland watchers" who keep an eye out for possible impacts or encroachment on wetlands in the local community.
4. Have the students write articles about their wetland, the activities they have undertaken, and what they have learned. Submit these to local or regional newspapers.
5. Have students conduct a survey to learn how their neighbors feel about wetlands and the need for protecting them. They should report the results of their findings to the class.
6. Have the students create public information fact sheets about wetlands in general or about a specific wetland they have studied. These information sheets may be distributed at a number of locations: city hall, local library, supermarkets, or as part of an Earth Day celebration.

ORIGINAL DEVELOPMENT RESOURCES:

Aquatic Project WILD. (1987). Western Regional Environmental Education Council.

Lynn, B. (1988). *Discover wetlands: A curriculum guide*. Washington State Department of Ecology.

Ranger Rick's naturescope: Wading into wetlands. (1986). National Wildlife Federation, Washington, D.C., Vol.2, No. 5.

Slatterly, B. (1991). *WOW! The wonder of wetlands: An educator's guide.* St. Michaels, MD: Environmental Concern, Inc.

www.epa.gov/owow/wetlands

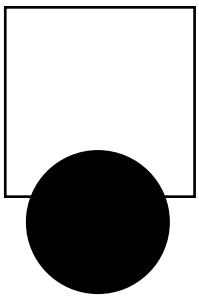
http://aquat1.ifas.ufl.edu/

***Note:** National Resource Conservation Service in each county can provide lists of sites of hydric soils.

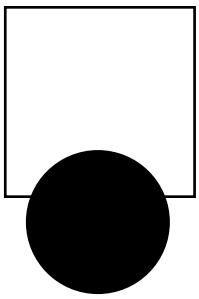
Wetland Soils Color Chart

Wet ← → **Dry**

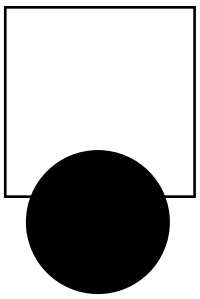
1. Gray Light) = White



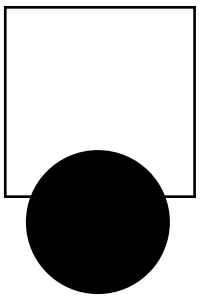
2. Olive green (light) + White



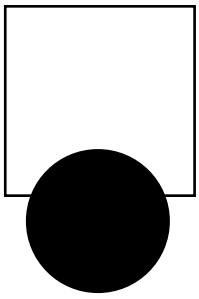
3. Peach



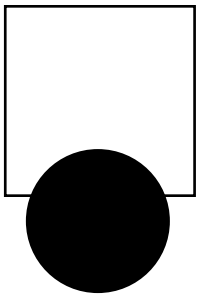
4. Goldenrod



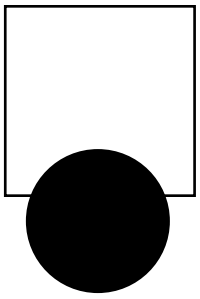
5. Gray



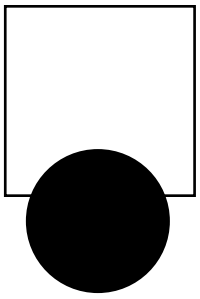
6. Brown + Gray



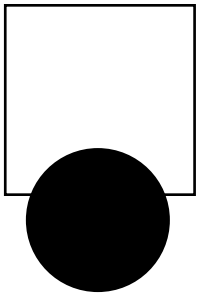
7. Tan



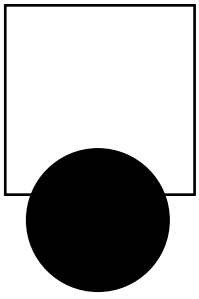
8. Bitterweet



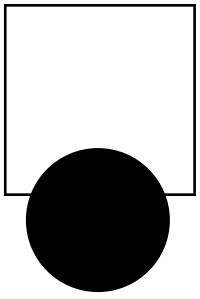
9. Black



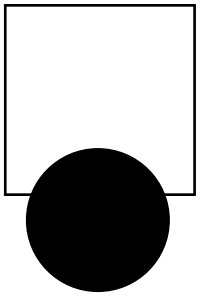
10. Black + Sepia



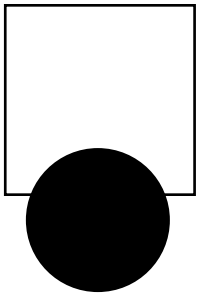
11. Olive Green + Raw Sienna



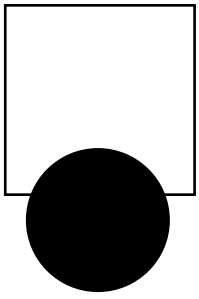
12. Indian Red



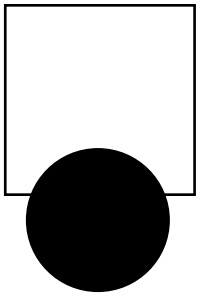
13. Sea Green + Gray



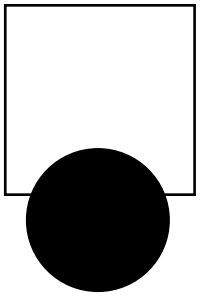
14. Forest Green + Gray



15. Pine Green + Gray



16. Sky Blue + Cornflower + Gray



Can You Dig Wetland Soil?

Name: _____

Date: _____

Instructions for making Wetland Color Chart to use with the activity

Use color crayons to complete this chart, the 96 Pack Crayola brand collection of crayon's is required, to color in the boxes on the chart. Be sure to use the correct colors. Press firmly when coloring, unless the name says light. Cut out the entire chart and paste it to a piece of poster board or half of a file folder. Carefully cut out the black circles through all the thicknesses.

The color chart can be used when working in the field. Hold the chart in one hand; in the other hand, hold a sample behind the chart so that it is visible through one of the holes. Move the sample around until the color is found that nearly matches the **main** color of the soil.

Numbers 1, 5, 6, 9, 10, 13, 14, 15, 16, and sometimes 2 are probably wetland soils; the others are probably not wetland soil.

Notes

Catchy Crustaceans!

OBJECTIVES:

Students will be able to:
1. Explain the life cycle of a blue crab.
2. Identify larval forms of a blue crab.
3. Identify male and female blue crabs.
4. Locate and identify the appendages of the blue crab.
5. Explain the importance of blue crabs to coastal Alabama.
6. "Create" a crab.

Grades:
6-8

Subjects:
Marine Science, Ecology, Biology

Time Needed:
Two 55-minute class periods

Materials:
compound light microscope
preserved or fresh blue crabs
prepared slides of crab zoea and megalopae
dissecting scissors
dissecting pan
forceps
tape
visual showing life cycle of a blue crab

BACKGROUND:

Callinectes sapidus (beautiful swimmer) is commonly known as the edible blue crab and has been an Alabama delicacy for a long time. Over 2,000,000 pounds are caught commercially every year in the United States.

Crabbing is also a summer tradition for many Alabama families. There are many ways to go "crabbing" along the shore. Many children accidentally catch crabs with a rod and reel while fishing. Dip nets are used to catch crabs along the shores of beaches and marshes. Lift nets are used off piers and jetties, and serious crabbers use crab traps to catch crabs.

The blue crab is a swimming crab. Its fifth pair of appendages is flattened and acts as paddles. Like other arthropods, the blue crab sheds its exoskeleton when molting so that it can grow. While it is waiting for its new shell to harden, it is known as a "soft-shell crab." After the female molts for the last time, she can mate with males. Spawning occurs from March through November, and the female may store the sperm until the next spring. In Alabama, female blue crabs spawn in the lower part of Mobile Bay where the water is saltier.

VOCABULARY:

abdomen, arthropod, crustacean, dorsal, exoskeleton, jointed appendage, larva, megalopae, molt, plankton, spawn, zoea, swimmeret, antennule, maxilliped, mandible, uropod, carapace, cheliped, maxillae,

ADVANCE PREPARATION:

1. Make copies of the blue crab information handouts attachments and copies of the "What to Look For on the Adult Blue Crab" (attachment 3).
2. Obtain prepared slides of crab larvae (zoea and megalopae); or, if you live near the coast, you may want to use a plankton net and capture larval blue crabs.
3. Obtain fresh blue crabs from the local seafood house or grocery store. Make sure that you have male and female crabs. Try to obtain at least one live specimen of each sex if you live near the coast.
4. Make copies of the "Crab Appendages" sheet, "Blue Crab Activity Sheet", and "Create a Crab" sheet. (Attachments 4, 5, and 6)

PROCEDURE:

Setting the Stage

1. Have the students observe a live blue crab, if available. Make sure they notice the appendages and understand how those appendages help the crab swim and/or walk.

2. Review the characteristics of arthropods with the students.
3. Have the students read the information on the blue crab. (attachments 1 & 2)
4. Have the students discuss other similarities between the blue crab and other crustaceans in Alabama.

Activity

1. Place the crab on the dorsal side across the width of a pan.
2. Observe the body form and appendages.
3. Remove the appendages from one side of the specimen. Hold the appendage with the forceps and cut at the base with scissors to remove the entire structure.
4. Tape each appendage into the appropriate box on the appendage sheet as soon as it is removed. This worksheet is a generic crustacean appendage sheet; not all crustaceans will have every part.
5. Using the "What to Look For on the Adult Blue Crab" handout, identify the sex of the crab.
6. Using a microscope and the prepared crab zoea and megalopae slides, observe and draw the larval stages of the blue crab.
7. Using the "Create a Crab" template (see attachment #6), identify the crab body parts and assemble as directed.

EVALUATION:

1. Have students complete the Blue Crab Activity Sheet (see attachment #5).

EXTENSIONS:

1. Have students explain how water pollution affects the recreational and commercial value of blue crabs.
2. Have students discuss how crustaceans can be indicators of water quality.
3. Have a classroom crab boil (see attachment #7).
4. Go crabbing! This field trip would heighten the students' awareness of some of Alabama's invertebrate resources.
5. Have students compare the blue crab to another crustacean found in Alabama coastal waters such as the white or brown shrimp.
6. Have students invent their own original invertebrate by using the characteristics of invertebrates (symmetry, locomotion, special structure, mouth parts, appendages).
7. Have the students create an art form that represents their invertebrate in its habitat.
8. Have the students name their invertebrates (common and scientific names).
9. Have the students write a short story describing a day in the life of their invertebrates.

ORIGINAL DEVELOPMENT RESOURCES:

Auburn University, Marine Extension & Research Center, 4170 Commanders Drive, Mobile, AL 36615, (334) 438-5690

Dauphin Island Sea Lab, P.O. Box 369, Dauphin Island, AL 36528, www.disl.org

Matthews, C. (1991). *Marine biology and oceanography experiments and activities,* Jacksonville, FL: Water Press.

Tatum, W. M. (1986, May/June). Crab fishing for fun and food. *Alabama Conservation.*

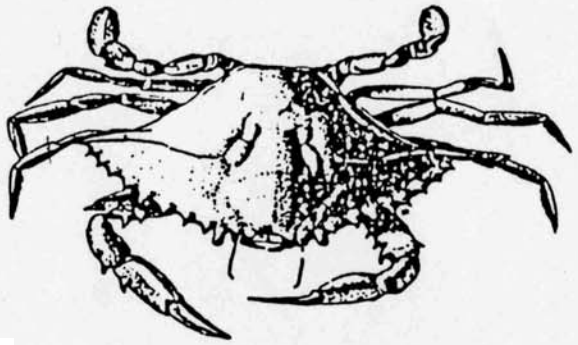
www.vims.edu/adv/ed/crab/contents

www.blue-crab.org

www.encyclopedia.com

BLUE CRAB

(Callinectes sapidus)



BLUE CRAB
(Callinectes sapidus)

MARINE EDUCATIONAL LEAFLET
NO. 5

published by
Gulf Coast Research Laboratory
J. L. Scott Marine Education Center
& Aquarium
A State Institution of Higher Learning
administered by the
University of Southern Mississippi

The edible blue crab (*Callinectes sapidus*) supports important fisheries along the Gulf and Atlantic Coasts of the United States. The generic name, Callinectes, is a combination of two Latin words meaning "beautiful swimmer." It is one of numerous crab species with a wide variety of forms and life habits found in Mississippi waters.

A member of the family Portunidae, the blue crab is characterized by a wide shell (carapace) with an enlarged spine or "tooth" on each side. Measured between the tips of the spines, the blue crab shell is about 2.5 times as wide as it is long. Like other members of its family, it has a pair of flattened fifth legs resembling paddles which make swimming possible and aid in burrowing. The abdomen, corresponding to the "tail" or edible portion of shrimp and crayfish, is turned under the body.

The shape of the abdomen indicates the sex of an individual crab. Immature females have triangular-shaped abdomen which become semi-circular when they molt for the last time and become adults. All males have a slender "T"-shaped abdomen.

Crabs are covered by a rigid, hard "shell" referred to as an exoskeleton. This "shell" is entirely different from mollusk (oysters, snails, etc.) shells. It is composed partly of a material called chitin, and the disposition of calcium salts adds strength.

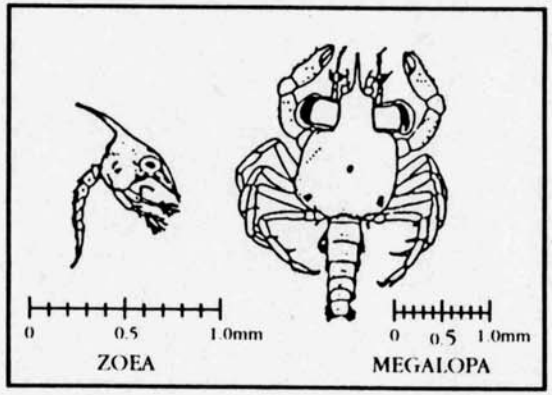
A crab grows by shedding its old, hardened exoskeleton and forming a new and larger one. This casting-off of an outer covering is called a molt. Before a crab molts, it forms a new, soft shell beneath the old one. Increase in size results from uptake of water by the crab which stretches the new exoskeleton before it hardens. A molt may result in growth up to 25 percent of the crab's former size. The entire molting process, also called an ecdysis, is completed in a few hours. Weight then begins to increase as soft structures inside the new shell continue to grow.

Female crabs do not molt after becoming sexually mature; males continue to molt and grow, often reaching a greater maximum size than females. This species undergoes approximately 25 molts during a lifetime, with the small ones shedding every few days and the interval between molts increasing as they grow. Growth in Mississippi waters is rapid. Under good conditions, a female may reach maturity and spawn in 12 months.

The female mates only once—during the soft shell stage at the time of her final molt. Prior to this molt, the male crab carries the female beneath him until she has shed. After fertilization, the male continues to protect the female until her shell has hardened.

After the eggs are spawned (laid), they are carried beneath the female in a mass known as a "sponge" that may contain close to two million eggs. Females carrying a "sponge" are also called "berried" females.

Initially orange or yellow in color, the sponge darkens as larvae develop and absorb the yolk, and it appears black just before hatching due to pigmentation of the eyes of the larvae. Eggs hatch as zoea larvae about two weeks after spawning. After seven molts in 31 to 47 days, they enter the megalopal stage which lasts from six to nine days. The megalopa has well-developed claws which it



can use much like an adult crab. The final larval molt produces the first crab stage which is less than 3 millimeters (1/8 inch) wide between the lateral spines.

Mating and spawning by this species in Mississippi Sound occur from March through November. Sperm transferred to the female crab remain viable for a year or more and are used for repeated spawnings when females survive to their second year. Spawning occurs throughout the Sound, but eggs hatch in high-salinity waters near the barrier islands.

Females that mature an d breed in the spring and summer usually spawn within two months, but those that mate in the fall may not spawn until the following spring.

This species is a migrant, occupying various habitats in Mississippi waters depending upon the physiological requirements of each stage. Salinity, temperature, availability of food, water quality and habitat preference all exert some influence.

Zoeae cannot survive in a salinity less than 20 parts per thousand (ppt). Megalopae live in a wide range of salinity and temperature, occurring year-round. Early crab stages seek protection and food in and around coastal marshes. Male crabs tend to remain in low-salinity areas, while adult females migrate toward areas where the salinity is above 20 ppt. and newly hatched zoeae can survive.

Zoeae are filter feeders, straining microscopic plants and animals (plankton)from the water. Megalopae feed selectively, using their well-developed claws (chelae) to capture food. Crab stages feed on both plant and animal materials including worms, clams, oysters, mussels, snails, fish, algae, seaweed, marsh grasses, and other detrital (disintegrating) substances.

One may see a blue crab with a claw (or leg) much smaller than the other. The smaller claw has been regenerated after being broken off or voluntarily amputated by the crab. This process, known as autotomy, is characteristic of crabs and may be used to escape, capture, or remove a damaged appendage. Severance occurs at a pre-formed breakage point near the base of the leg. After autotomy, a soft bud develops at the breakage point and the next molt produces a functional but sometimes smaller appendage. Normal size is usually achieved after the following molt.

Commercial landings of blue crabs in Mississippi were recorded for the year 1887 as 38,000 pounds. Mississippi landings have averaged over 1,407,000 pounds a year from 1981 through 1985, but with large year-to-year fluctuations. These fluctuations reflect economic conditions of the market as well as variations in abundance due to environmental factors such as temperature, salinity, prevalence of disease, and predation.

There is also an important recreational fishery for the blue crab. Familiar scenes during warmer months are the numerous sport crabbers who spread out along bridges, piers, and jetties to drop their nets and lines into the water in anticipation of a crab feast. (Revised 3/89, H.M. Perry)

J.L. SCOTT MARINE EDUCATION CENTER AND AQUARIUM

Purpose and History

The purpose of the Gulf Coast Research Laboratory's J.L. Scott Marine Education Center and Aquarium is to increase the awareness and understanding of marine and aquatic environments, thereby promoting the wise development, use, and management of these fragile areas. The Marine Education Center and Aquarium is the Laboratory's main public-use facility. The Center was opened in 1972 to provide information and educational opportunities for the general public. This purpose is accomplished through presentations by staff members, living and static displays of flora and fauna in the in the aquarium room and lobby, and audio-visual documentaries. Programs emphasize indigenous coastal, estuarine, and island natural resources.

When the Laboratory opened the Marine Education Center in 1972, it occupied a 2,000 square-foot building adjacent to the present Center and Aquarium on the Biloxi campus. This small structure was utilized to conduct classes, seminars, and workshops for students and the general public. This facility also housed numerous aquariums which began the Center's history as a "living" museum. In response to increased public interest and demand to provide a facility in which marine and aquatic research could be observed "in action," a larger public-use facility was constructed.

The current Marine Education Center and Aquarium was opened in 1983 and is housed in a 32,700 square-foot structure built by the state at a cost of $3.5 million. The building is named for Mr. J.L. Scott, a staff member for many years of the Board of Trustees of State Institutions of Higher Learning. The multi-purpose structure provides space for a variety of educational programs and selected research activities. A 313-seat auditorium is used for audiovisual presentations, meetings, and programs.

In addition, the Center includes a larger aquarium area. The central feature of the aquarium is a cylindrical, 30-foot diameter, 42,000 gallon capacity tank representing the Gulf of Mexico. Four aquarium alcoves surround this central tank in which animals are grouped by habitat, i.e., fresh, brackish, estuarine, and high-salinity waters.

Gulf Coast Research Laboratory
PO Box 7000, Ocean Springs, MS 39564-7000
J.L. Scott Marine Education Center & Aquarium
115 Beach Blvd., Biloxi, MS 39530
(601)374-5550

Attachment # 3

What To Look For On The Adult Blue Crab

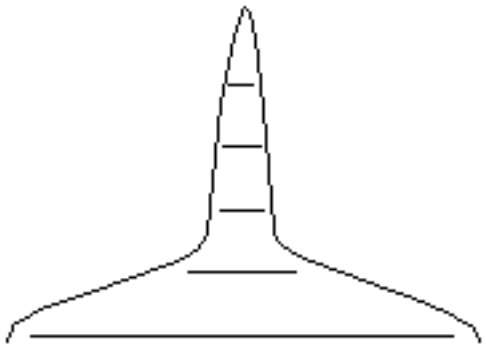
After you have caught a crab, look for the things listed below.

1. Claws - One of the most obvious features of a crab is the pair of claws that it uses to capture food and to defend itself. These claws have strong muscles that are a favored seafood item known as fried crab claws.

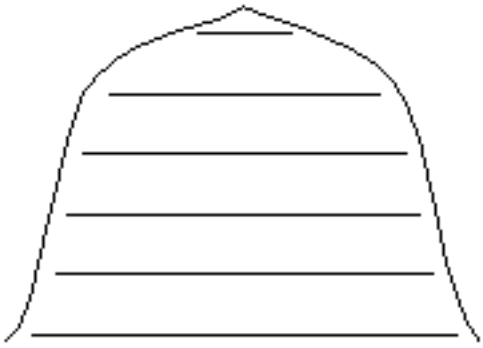
2. Exoskeleton - The hard shell of the crab is its exoskeleton. It provides support and protection for the crab.

3. Molting - You may catch a crab that is very soft. It has recently molted, and its shell is not hardened yet. Soft-shelled crabs are a fine delicacy and taste very good to many people.

4. Sex - The shape of the abdomen is an easy way to determine whether a crab is a male or female. If the crab is a male, the abdomen will look like an upside down "T." The abdomen of a female will be triangular in shape. The broad abdomen of the female will hold the mass of eggs after she spawns. This egg mass looks like an orange sponge.



Male



Female

5. Paddles - The fifth pair of legs are flattened. These flattened legs enable the crab to "swim."

6. Jointed appendages - Notice that all the appendages (legs and claws) of the crab have joints. This is a characteristic of all arthropods. Blue crabs are in the Class Crustacea and the Phylum Arthropoda.

Attachment # 4

Date _____ Class _____ Name _____

Data

Crab Appendages

swimmeret	swimmeret
antennule	walking leg
maxilliped	cheliped
mandible	maxillae
antennae	

Name: _____

Blue Crab Activity Sheet

1. What is the scientific name for the blue crab?

2. What does the scientific name mean?

3. What are some ways blue crabs are caught?

4. In what class is the blue crab?

5. In what family is the blue crab?

6. How can you tell a male blue crab from a female blue crab?

7. How many eggs can a female blue crab carry?

8. What is a “soft shell” crab?

9. What is the shell of a crab made of?

10. What is the minimum size limit for catching blue crabs in Alabama?

11. Why are blue crabs important in Alabama?

12. What would happen to the blue crab population if the coastal waters of Alabama were to become contaminated with too much pollution?

13. Why are crab larvae considered plankton?

14. What is the name for the first larval stage of a blue crab?

15. What is the name for the second larval stage of a blue crab?

16. Draw the two larval stages of a blue crab.

Attachment # 6

Create A Crab

Follow these steps for assembly:

1. Start with the **abdomen**. Place it colored side down in front of you. The "U"-shaped end should be closest to you. This will be the base to which you attach the rest of the body parts.

2. Find the **walking legs** (two sets) with attached gills. Place gills on the abdomen (colored side up); the legs should stick out.

3. Find the **pincers** (two). Place each pincer (colored side up) above the set of walking legs. Adjust to fit legs and pincers on both sides, then tape or glue in place.

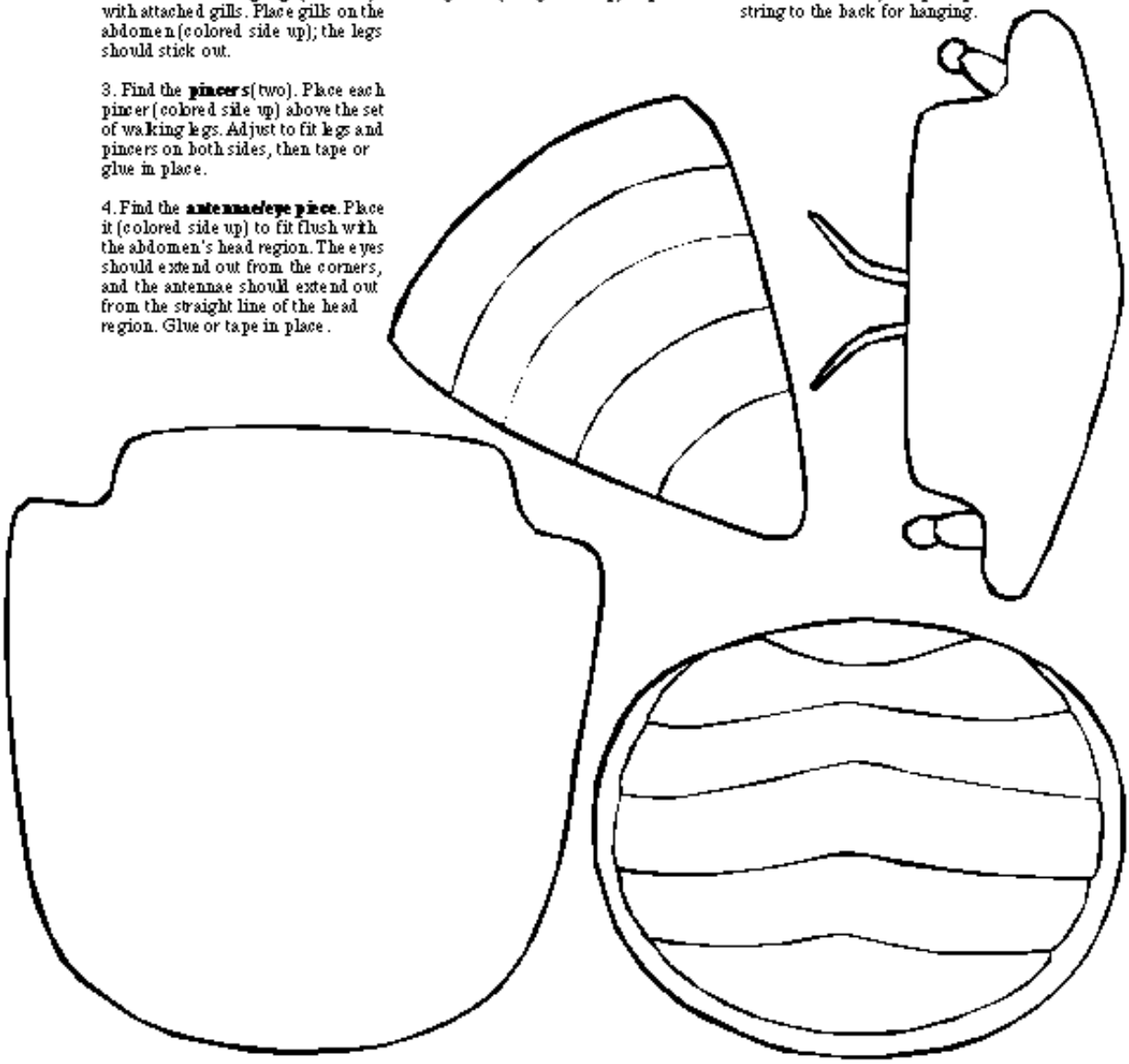
4. Find the **antennae/eye piece**. Place it (colored side up) to fit flush with the abdomen's head region. The eyes should extend out from the corners, and the antennae should extend out from the straight line of the head region. Glue or tape in place.

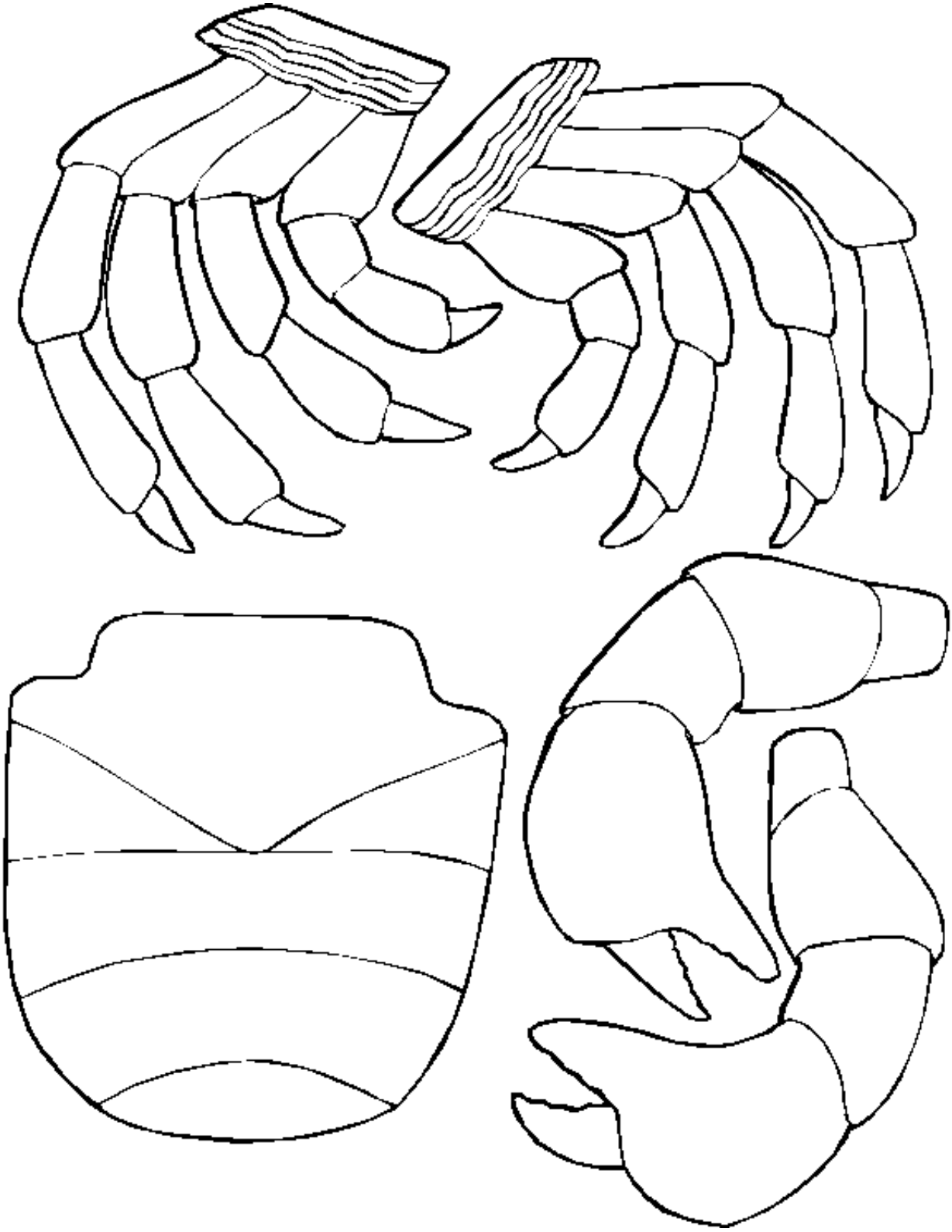
5. Find the back shell or **carapace**. Glue or tape it (colored side up) to fit over the assembled body. Be sure that eyes and antennae stick out!

6. Turn the crab over and decide if you want a male or female crab. Select the appropriate **plate** and tape or glue it (design side up) in place.

7. The teacher should now check to see that your crab is assembled properly. You may wish to color the underside to match the top.

8. You now have a crab model. If the paper is heavy enough, fold the legs inward near the base of the body so the crab can stand, or tape a piece of string to the back for hanging.





Boiled Crab

3-4 quarts water
salt or seasoning
1 dozen crabs
large pot

Bring 3-4 quarts of water and a pinch of salt or seafood seasoning to a boil in a large pot. Drop a dozen **live** crabs into the boiling water and cover. Reduce heat and simmer for 15 - 20 minutes. Drain and pick hot or cold.

Break off crab claws and crack open to get the meat. Tear off the carapace and crack the crab body in two. Remove all organs from the center of the body and the gills (sometimes called "Dead Man's Fingers"). Pick the crab meat from the sides of the shell.

Fried Soft Shell Crab

1/4 cup flour
salt and pepper
1 egg
3/4 cup fine bread crumbs or corn meal
6 soft-shell crabs
Crisco oil

Remove gills and other organs from the center of a newly molted blue crab. Rinse well. Mix flour with a little salt and pepper and place in a bowl. In a second bowl, beat one egg well. In a third bowl, place the bread crumbs (corn meal) mixed with salt and pepper.

Toss in one soft-shell crab at a time in the flour; dip into egg mixture; toss into bread crumbs to coat. Drop into hot Crisco oil (360 degree F) and deep fry quickly until golden brown.

Serve alone, with breakfast, or on a sandwich. A true Alabama delicacy!

Ecosystem Vocabulary Zipper Game

OBJECTIVES:

Students will be able to:
1. Define vocabulary words related to ecosystems.

Grades:
6-8

Subjects:
Ecology,Environmental Science, Biology I

Time Needed:
30 minutes

Materials:
vocabulary list/definitions list
index cards
clock or timer
pictures illustrating ecosystem vocabulary words

BACKGROUND:

An ecosystem consists of groups of organisms interacting in various ways with each other and with abiotic factors in the environment. Organisms (biotic factors) in an ecosystem include all members of the Monera, Protista, Fungi, Plantae, and Animalia kingdoms. Abiotic factors include chemical and physical characteristics of soil, water, and temperature. A specific area, such as a grassland,, desert, tropical rain forest, coral reef, or pond, can be called an ecosystem.

A group of organisms of the same species found within an ecosystem is called a population, and populations of different species interacting within the ecosystem make up a community.

Organisms within communities can be grouped into three major categories: producers, consumers, and decomposers. Plants that can make their own food are producers. Producers use light energy from the sun to convert carbon dioxide and water into sugar, and they release oxygen as a by-product. This chemical conversion is called photosynthesis and requires chlorophyll, a green pigment. These food producers are called autotrophs.

A second category of organisms within an ecosystem is the consumers. Consumers cannot make their own food and must depend on other food sources. they also are know as heterotrophs. Consumers are grouped into primary consumers (herbivores), secondary consumers (carnivores), and omnivores (both herbivore and carnivore). A carnivore that attacks, kills, and eats another animal (the prey) is called a predator. Botanical carnicores, such as Venus Fly Traps, lure and trap their prey. Consumers that live in or on another organism and cause it harm are called parasites. Often, parasites feed on the same organism for a long period of time, typically injuring it.

The third group of organisms in an ecosystem is decomposers. Decomposers secrete enzymes that break organic compounds into simpler compounds that can be absorbed for nourishment. Detritus feeders include earthworms, millipedes, crayfish, ants, termites, and some beetles. These organisms often are grouped with decomposers because they feed on dead and decaying plant and animal matter (detritus). Primary detritus feeders (decomposers) feed directly on detritus, and secondary detritus feeders (protozoans, mites, insects, worms) feed directly on the primary detritus feeders.

Consumers, producers, and decomposers create pathways of feeding relationships called food chains. Food chains are interconnected to form food webs. The various feeding levels of consumers, producers, and decomposers are called trophic levels. All the successive trophic levels form a food pyramid. The food pyramid is a graphic representation of all the consumers (carnivores, herbivores, and omnivores) and producers. The total combined mass of all carnivores is the third trophic level (the top of the pyramid); the total combined mass of all herbivores is the second trophic level (the middle of the pyramid); the total combined mass of all producers is the first trophic level (the bottom of the pyramid figure).

An ecosystem is a complex arrangement of biotic and abiotic factors that form interconnected relationships. The environmental health of the ecosystem is dependent on each factor in the overall system. For an ecosystem to maintain itself, a balance of all components is necessary.

VOCABULARY:

See game vocabulary list.

ADVANCE PREPARATION:

1. Introduce the vocabulary terms listed on the Ecosystem Vocabulary/Definitions list.
2. Display magazine pictures or posters of different ecosystems.
3. Discuss the displayed pictures and have students relate the vocabulary terms to the objects shown in each ecosystem picture.
4. Acquire blank index cards—two for each vocabulary word. Cards can be designated with different colors or marked in some way to be separated easily into vocabulary words and vocabulary definitions.
5. Prepare a worksheet listing each word and its definition.

PROCEDURE:

Setting the Stage

1. Assign each student a vocabulary word and the definition for that word.
2. Have the students write the vocabulary word on one card and the definition on another card. Students should become familiar with the word and definition on their cards.

Activity

1. The teacher should collect and redistribute the vocabulary cards and definition cards so that each student has one vocabulary word and one definition, but not the definition for that word.
2. Beginning the zipper: One student should read the vocabulary word from his/her card. The student who has the definition for that word should then read the definition. If the definition is correct, that student should read the vocabulary word from his/her other card. The student who has the definition for that word should read the definition and then the next vocabulary word.
3. The game continues until everyone has responded by reading the definition to someone's vocabulary word. Sometimes the students' vocabulary words and definitions stop within a certain group. If this happens, call on a student who has not read his word or definition.
4. The teacher will time how long it takes for the entire list of words and definitions to be read. The amount of time needed for the entire zip around will decrease as students learn the words.

EVALUATION:

Students should construct a concept map using the words listed on the vocabulary list. A connecting phrase must be used between words on the concept map that illustrates knowledge of the definition.

EXTENSIONS:

1. A competition to decrease the time needed to have the class finish the zip around can be conducted and decreasing time to completion can be rewarded.
2. Students can illustrate vocabulary words by drawing sketches of the definitions.

ORIGINAL DEVELOPMENT RESOURCES:

Nebel, B. J. (1996). *Environmental science*, (5th ed.) Upper Saddle River, NJ: Prentice Hall.

Christensen, J. W. (1981). *Global science,* (3rd ed.) Dubuque, IA: Kendall Hunt Publishing Company.

Ecosystem Vocabulary/Definitions

abiotic factors ----------non-living factors in the environment
Animalia ----------kingdom of animals
autotroph ----------producers
biotic factors ----------living factors in the environment
chlorophyll ----------green pigment needed for photosynthesis
community ----------populations that interact in an area
consumers ----------organisms unable to make own food
detritus ----------decaying plant and animal matter
decomposers ----------gets food by breaking down dead organisms
detritus feeders ----------feed on detrius
ecosystem ----------community of organisms interacting with each other and the environment
enzyme ----------biological catalysts
food chain ----------the path of food energy passed from organism to organism
food web ----------interrelationships of food chains
heterotroph----------consumers
Monera ----------kingdom of one-called organisms; cell has no nucleus
parasite ----------organism that lives on or in another organism for food
Plantae ----------kingdom of plants
population ----------a group of individuals of the same species that live in an area
primary consumer ----------herbivores
primary detritus feeders ------decomposers; feed directly on detrius
producers----------organisms that produce food (photosynthesis) for themselves
Protista ----------kingdom of one-celled or more organisms; cells have nucleus
salinity ----------containing salt
secondary consumer ----------carnivores
secondary detritus feeders ----feed on primary detrius feeders

Notes

Encapsulated Ecosystems

OBJECTIVES:

Students will be able to:

1. Create a model of a fully functional ecosystem and biosphere.

BACKGROUND:

This activity represents a long-term, student-constructed ecology activity. The project consists of constructing and observing an encapsulated ecosystem made primarily from household and aquarium materials including a one-gallon glass pickle jar or two-liter soda bottle, aquarium plants and animals, gravel, and microorganisms. The ecosystem is a self- supporting, system of producers, consumers, and decomposers requiring no maintenance. These sometimes are referred to as biospheres.

The activity encourages students to develop an understanding of freshwater food webs, nutrient cycles, food pyramids, and energy pyramids. Students also will observe the establishment of a fresh water ecosystem with the interactions of organisms such as freshwater algae, snails, and aquatic plants.

VOCABULARY:

ecosystem, biosphere, aerobic

PROCEDURE:

1. Clean a large glass jar. It is very important that the jar be completely rinsed after cleaning; any residual soap or detergent may poison the organisms. Rinse with sodium bicarbonate (baking soda) and flush with clean water.
2. Fill the jar with clean, fresh water. Spring or surface water (lake, stream) is preferred. If chlorinated water must be used, check with a pet store for information about dechlorinating the water. If surface water is used, beware of introducing undesirable organisms such as macro invertebrates. Fill approximately 80 percent of the jar with the water (the exact amount is not important). The air pocket at the top serves several purposes, and it is better to err on the side of too much air if in doubt.
3. Using an air stone and an aquarium air pump, aerate the water for at least 15 minutes.
4. Fill the bottom of the jar with clean, washed sand/gravel. Avoid using clay, silt, or sand/gravel that contain clay or silt.
5. Place the elodea in the jar by burying about one inch of the stem into the gravel. The water sprite may be either "rooted" into the gravel or allowed to float. If the jar is large enough add 2-3 snails or snail egg clusters that may be found on the aquarium plants. Add 20 mL of cultured algae or pond water to inoculate the system and begin additional algae growth. A "pinch" of commercially prepared fertilizer should be added to ensure the presence of the nutrients, which the plants will need.
6. Seal the jar and place it in bright light but not in direct sunlight or too near light bulbs, which will raise the temperature.
7. A second ecosystem may be left open to provide additional observations.

EVALUATION:

1. Have students compare and contrast closed and open systems. The procedure should produce results

Grades:

6-8

Subjects:

Science, Environmental Science, Biology

Time Needed:

Ongoing

Materials:

freshwater snails
elodea
water sprite (optional plant)
pond or stream water
sand and gravel
fresh water
commercial plant fertilizer
large glass jar (1 gal. or larger)
airstone
aquarium air pump
baking soda
test for quantity of phosphates and nitrates

similar to these:

Several jars were assembled in November 2001 as part of an ecology course. Two of these jars were opened and tested on March 2, 2002. Both jars were started in the same manner and placed in the same classroom windows.

Original Contents:

One snail egg mass, 10 mL of cultured algae, three sprigs of elodea, 10 mL of pond water, well water, washed (using sodium bicarbonate) brook gravel, water aerated with an air stone for five minutes

Observations:

The water appeared clear and colorless throughout the jar. The gravel bottom had small tufts of algae attached and very small amounts of snail detritus. A few empty snail shells could be seen. Live snails were feeding on the glass sides and occasionally were wandering above the water line. The elodea had vanished from the jar. When the jar was opened, there was no immediate odor, which indicated that the system had remained aerobic.

Results:

water samples—pH=4.5-5.0, nitrates=0.03ppm, phosphates=0.16ppm, dissolved oxygen=9ppm biotics: algae (*Oedogonium, Chorella),* paramecium, common pond snails

2. Have students relate their findings to closed-vase aquariums that have plants on top and fish living among the roots.

EXTENSIONS:

1. Modify the lid to allow water samples to be drawn without opening the jar.
2. Place the jar on its side to observe any changes resulting from the increased gravel substrate surface area.
3. Modify the jar and lid to accept sensor probes for the remote measuring of temperature, pH, and dissolved oxygen.
4. Take the measurements at regular intervals during the project, and have students record and interpret the results.

ORIGINAL DEVELOPMENT RESOURCES:

BSCS (1992). *Biological science.* Dubuque, IA: Kendall/Hunt.

Environmental Stewardship: Salt Marshes

OBJECTIVES:

Students will be able to:

1. List several human activities that damage salt marsh habitat.
2. Apply information to predict how draining a salt marsh for real estate development may have adverse effects.
3. Become actively involved in communicating the value of salt marsh preservation to elected officials in the federal government.

BACKGROUND:

Salt marshes are among the most biologically productive environments on Earth. At the base of many salt marsh food webs is the grass *Spartina alterniflora*. Bacteria and fungi feed on decaying plants. Many invertebrates and vertebrates, such as clams, crabs, and birds, inhabit these areas for sources of food, living space, and breeding sites. In addition, salt marshes act as natural flood-control areas, and they filter pollutants from coastal waters. Land adjoining water has attracted humans for centuries. Access for shipping, housing, recreation, and industrial development are a few of the reasons marshes are drained for development. In order to meet the growing needs of the human population, is habitat destruction justified?

VOCABULARY:

policy, salt marsh

ADVANCE PREPARATION:

1. Compile a list of threatened and endangered species that inhabit a salt marsh.
2. Acquire local newspaper and magazine articles about salt marsh development.
3. Prepare an address booklet of the following:
   - Congressional representatives and senators.
   - Local environmental groups such as the Sierra Club and the Audubon Society.

Grades:

6-8

Subjects:

Biology, Environmental Science, Language Arts, Social Studies, Economics

Time Needed:

Two to five class periods

Materials:

threatened and endangered species list of salt marsh inhabitants
addresses of government officials
addresses of local environmental groups
salt marsh visuals (video, film, photographs)
newspaper or magazine articles on salt marsh development
roasting pan
modeling clay
water
muddy water
sponges

PROCEDURE:

Setting the Stage

1. Show a videotape, film, or pictures of a salt marsh to the students.
2. Have the students write a description of this ecosystem, and ask them to include ways in which humans are destroying these areas.
3. Distribute copies of newspaper and magazine articles concerning salt marsh development, and discuss factors involved in the issue. Allow the students to suggest solutions to the problems.

Activity

1. Construct a classroom model of a salt marsh.
2. Spread modeling clay along the bottom and up the sides of half a roasting pan, shaping the clay so that it creates a gentleslope toward the uncovered half. Contour a stream channel in the clay.

3. Place a small amount of water on the other side of the roasting pan to represent the ocean.
4. Allow some muddy water to flow down the clay landform.
5. Have the students note how fast and how much muddy water enters the clean ocean water.
6. Empty the water from the roasting pan, and cut a piece of indoor-outdoor carpet so that it will fit completely along the edge of the clay. Explain that the carpet represents a salt marsh.
7. Again, add the muddy water, noting the speed and amount of particles entering the clear water.
8. Describe how a salt marsh affects flood control, water purification, and soil erosion.
9. Divide the students into two teams, assigning each team one of the following activities to encourage participation in environmental stewardship.

Team A - Research all the facts and issues regarding salt marsh development, and record empirical data and statistics.

Team B - Conduct an opinion poll with each group member asking ten people outside of the class their position on the issue of whether or not salt marshes should be available for development. Record the number "for," "against," and "undecided."

EVALUATION:

Students should:

1. state the results of the environmental poll.
2. include the facts about the issue compiled from the library research.
3. use a positive tone and offer practical suggestions for a solution.

EXTENSIONS:

1. Encourage students to join an environmental interest group or donate money for the protection of the environment. Emphasize that becoming personally active, when multiplied by many concerned citizens, can influence decisions made by elected officials.
2. Have students organize a debate on the development of a salt marsh for the construction of an airport.
3. Students can represent individual interest groups such as business organizations, the construction industry, politicians, environmentalists, industry.
4. Have the class decide which arguments are the most convincing and vote on the issue.
5. Have the students discuss how factors such as culture, tradition, and economics, may limit the ability of any level of the government to intervene with certain issues.
6. As a class, write letters to the elected government officials in Washington, DC.
7. Have a classroom discussion summing up what was learned about communicating with government officials.

ORIGINAL DEVELOPMENT RESOURCES:

Bernstein, Winkler, Zierdt-Warshaw. (1996). *Environmental science*. New York, NY: Addison-Wesley Publishing Company, Inc.

Environmental News Coverage

OBJECTIVES:

Students will be able to:
1. Survey different media coverage for environmental issues.
2. Write and produce a video news show.

BACKGROUND:

People are exposed to a wide range of media coverage of environmental issues. Media coverage typically influences the attitudes of society toward environmental practices and issues. Media coverage no longer merely reports facts but often presents them in such a way that viewers/readers/listeners must learn to sift through coverage looking for the facts and to use those facts to form opinions separate from those of the media.

VOCABULARY:

environment, issue

PROCEDURE:

1. Ask of scientists, environmental agencies, teachers, or others about possible fallacies in a media version of an event or issue.
2. Have students watch the national and local news for a certain period of time noting environmental issues in their notebooks.
3. Discuss the observed topics and issues highlighting the facts. Newspapers and magazines also can be brought into class and examined.
4. Teacher should model writing a news report as an example for the students.
5. After looking at media sources, students should create an environmental news report. News reports may even be generated from school happenings.
6. Peer editing should occur as the writing process takes place.
7. News anchors can be chosen and can write their news scripts with lead-ins and comments about the news reports.
8. After practicing, the final show can be filmed with a video camera and played back for other classes to view.

Grades:

6-8

Subjects:

Science, Language Arts, Drama

Time Needed:

Several weeks to survey newspapers, radio, and television environmental coverage; two to eight 30-45 minute class periods (time may vary depending on the amount of spare time used for writing and editing)

Materials:

notebooks to use as news logs
newspapers
magazines
video camera for taping (optional)

EVALUATION:

1. Students can be tested on their ability to distinguish between fact and opinion.
2. Students' writing for accuracy, clarity, and thoroughness should be evaluated. Informational (scientific reporting) writing skill development is important and can be fostered in grades 6 - 8 as expository or persuasive modes in Language Arts.

EXTENSIONS:

1. Invite a media representative into the classroom to discuss reporting procedures.
2. Have students continue to maintain the news log. At the end of the school year, have students report on the number and types of environmental issues presented in the printed media and/or television and radio.

Gotta Have Energy

OBJECTIVES:

Students will be able to:
1. Discuss the types and uses of energy.
2. Research energy resources.
3. Create a benefit versus cost chart.

Grades:
6-8

Subjects:
Math, Environmental Science

Time Needed:
Outside research and at least two 40-minute class periods for sharing information

Materials:
Energy Worksheet
Alabama Map

BACKGROUND:

We use energy every day. If you have ever been in a blackout during a storm, you know the ways we depend on electrical energy. Lights, refrigerators, TVs, air conditioners, and computers require electrical energy. Power plants convert energy from oil, coal, sun, water, atoms, and wind to electrical energy for use in our homes and factories. Energy comes from many sources: natural gas, oil, fission, coal, the sun (solar energy), rushing water (hydropower), and wind. Sun, water, wood, and wind are called "renewable" energy sources. fossil fuels such as natural gas, oil, and coal are called "nonrenewable" because, one they are used, they are no longer an energy source. Most current modes of motorized transportation also require fossil fuel for energy.

Most of the energy we use comes from fossil fuels—oil, coal, and natural gas. Plants and marine plankton died and became buried in the Earth. Over millions of years, heat and pressure changed the marine organic matter into pockets of oil and natural gas. The plant matter turned into coal.

If nonrenewable resources are used carelessly, some time in the future we will no longer have them to fuel cars, homes, and factories. We need to make our fuel supply last over time by conserving it. Another reason to conserve our nonrenewable resources is that most of the world's oil is found outside the United States. We depend largely on fuel brought from foreign countries, and this dependence can be very expensive and can cause instability in availability.

VOCABULARY:

nonrenewable resources, nuclear fission, hydropower, fossil fuels, renewable energy sources

PROCEDURE:

1. Discuss these questions in class:
   - How many different types of energy can you name?
   - Which of these do you use in your own life? How often?
   - What kinds of energy resources does your electric utility company rely on? (Most utility companies in Alabama rely on fossil fuel and supplement that with hydroelectric power generation.)
2. Have students individually or in small groups research an assigned energy source. Sources include solar (passive and active), wind, hydropower, geothermal, natural gas, coal, biomass, and nuclear. The students first should find out basics about how their source works; whether it is used currently or is being researched for future use; what kind of pollutants it emits (including a CO_2 count); how cost-effective it is (now and in the future); and whether it is renewable.
3. Have the students complete the Energy Worksheet for their assigned energy source.
4. Have the class create a "benefits versus potential environmental impacts" chart listing energy sources and possible impacts for each source.

5. Once the students have collected their information, the groups can debate the advantages and disadvantages of each source. The teacher should mediate and present questions from the Energy worksheet before the debate begins. If the students have done their own research and have it in hand for reference, the debate will be more of an intelligent trading of information than a heated argument.

EVALUATION:

Students should be able to explain at least one energy source and the advantages/disadvantages of this resource in energy production.

EXTENSIONS:

1. Ask a utility company representative to speak to students about the energy resources the utility uses and what is being done in terms of alternative energy research and development. Encourage the students to ask questions and remind them that different groups and individuals hold different opinions toward energy use.
2. On a map of Alabama, locate the coal, nuclear, and hydroelectric plants. Contact Alabama Power Company, the local rural electric cooperatives, the Corps of Engineers, and the Tennessee Valley Authority for an updated listing of those facilities.
3. Ask someone from a nearby university to talk with students about energy. If the university has a geology department, that would be a good place to start. There also may be professors in the chemistry department or the civil engineering department who can be guest speakers.

ORIGINAL DEVELOPMENT RECOURCES:

Adapted with permission from *Growing Greener Cities Education Guide.*

Geological Survey of Alabama (for maps showing locations of coal, oil, etc., in Alabama), P.O. Box 869999, Tuscaloosa, AL 35486- 6999, www.gsa.state.al.us

Energy Worksheet

Benefits and Costs:

1. Name of energy source such as wind, hydropower, solar, nuclear.

2. Is this an energy source you use every day? If so, how?

3. How is this energy source harnessed to supply electricity?

4. What pollutants are emitted by the development and use of this energy source (carbon dioxide, nitrogen oxides, sulfur dioxides, sludge, radioactive waste)?

5. What are other environmental costs involved in using this technology?

6. Is the energy source renewable? Why or why not?

7. Does this technology produce electricity cost-effectively? What do you think are its future possibilities?

Notes

Hide And Seek

OBJECTIVES:

Students will be able to:
1. Demonstrate the concept of natural selection.
2. Demonstrate the adaptive value of camouflage.
3. Construct bar graphs from data.

BACKGROUND:

Any population has natural variation in the expression of traits because of independent assortment of chromosomes, crossing over of genes, and mutations. In the environment that the population inhabits, some of this natural variation is going to have adaptive value–that is, it's going to help the organism survive in a particular environment. Survivability may mean a trait that helps the organism find food, such as keen night vision or sense of smell, or perhaps an adaptation that would prevent the organism from being eaten such as speed or an ability to hide. Organisms that survive into sexual maturity are going to pass those genetic traits to succeeding generations, eventually increasing the incidence of those adaptive traits in the gene pool. This process is called natural selection.

Grades:
6-8

Subjects:
Biology, Ecology

Time Needed:
One-two class periods

Materials:
squares of colored, patterned backgrounds
black and white environments
colored construction paper
hole punch
graph paper

One adaptive advantage for both predator and prey animals is *camouflage,* which allows an animal to blend into the background so that it cannot be seen. A prey animal, which is camouflaged, may not be seen by a predator; a predator, which is camouflaged, may be able to sneak up on its prey.

VOCABULARY:

natural variation, adaptation, natural selection, camouflage

ADVANCE PREPARATION:

1. Using a hole punch, punch out holes in sheets of construction paper of every color. Mix the dots well, and divide into small containers for each group.
2. Collect sheets of wrapping paper, cloth, wallpaper, or aquarium backgrounds that have busy patterns or designs in different colors.
3. Find colored pictures of different environments—grasslands, jungle, forest, coral reef—and copy them. Create dime-sized circles covered with various patterns, such as stripes, circles, dots, bars, blotches, checkerboard, as well as black and white.

PROCEDURE:

Setting the Stage
1. Review natural variation, natural selection, and adaptation strategies with the students.
2. Discuss camouflage as an adaptive advantage. Be sure to include pattern, interrupted design, extra "eye," and other strategies besides color since all animals don't see in color.
3. Help the students understand the concept that animals that are camouflaged in one environment may not be protected in another environment.
4. Review data table concepts and the construction of bar graphs.

Activity

1. Divide the students into small groups. Give each group a colored, patterned background (cloth, wrapping paper, etc.) and a container of colored dots.
2. Spread 50 dots of the assorted colors randomly on the colored background.
3. The students should shut their eyes, open their eyes, and pick up the first dot they see. They should record the color of the dot. They should repeat this sequence until 10 dots have been picked up and recorded. Don't forget to have them shut their eyes *each time* before picking up the dots.
4. The dots should be returned to the background in a random manner, and the next student in the group should repeat the process until each student in that group has picked up 10 colored dots and has recorded the colors.
5. Make a data table with the total number of dots of each color picked up, plus the first, second, and third selection each student. Construct a bar graph of the data. What colors were most vulnerable to predation in this environment? What will happen to the gene frequency for that color in succeeding generations?
6. Now place 100 dots, including the same number of dots of each color, randomly on the background. Allow the group of students to repeat the shut eyes, open eyes, pick-up-a-dot sequence until 80 of the dots have been removed. Shake off the remaining 20 dots onto the tabletop and, for each "survivor," add 4 "offspring" dots of the same color. Repeat for 3 more generations.
7. Make another bar graph from the remaining 100 dots. Which colors were adaptive in this environment? What would have happened to the gene frequencies for camouflaged colors and contrasting colors?
8. Either allow groups to switch backgrounds and repeat, or have each group display its background and report to the rest of the class on the data.
9. Repeat the experiment (or just the first part) with black and white circles on black and white backgrounds. Why use only black and white? How can the bright orange stripes of the tiger be an example of camouflage?

EVALUATION:

1. Using the data tables and bar graphs, have the students extrapolate the data to construct a line graph of color frequencies over a period of time such as 10 years.
2. Create scenarios in which the colors selected would no longer be adaptive. What would happen then?

EXTENSIONS:

1. Let the students choose a background and create an animal—predator or prey—that would be well adapted to that environment. Have them draw that animal in the environment, and have them describe the adaptations that would enable it to survive.
2. Show the students pictures of animals that may not be familiar to them. Ask them to guess the animal's habitat by observing its coloration.

ORIGINAL DEVELOPMENT RESOURCES:

Biology: The dynamics of life. (1995). Lab manual. Glencoe Publishing.

Mode Of Marine Life Mobile

OBJECTIVES:

Students will be able to:

1. Compare and contrast the ocean's life zones: planktonic realm, benthonic realm, and nektonic realm.
2. Identify an organism's mode of life as related to the marine environment.
3. Construct a mobile illustrating an organism's mode of life in a specific life zone.

Grades:

6-8

Subjects:

Science,Marine Science, Environmental Science, Biology

Time Needed:

90 minutes

Materials:

audiovisual about the marine environment
list and pictures of marine organisms
3 x 5 cards
glue stick
construction paper
hanger (per student)
miscellaneous items to construct individual marine organisms
visual showing marine life zones

BACKGROUND:

The Gulf of Mexico is an important source of educational, commercial, and recreational activities. This marine environment is an integral part of the state since part of Alabama lies along the coast.

The marine environment consists of three major zones in which organisms thrive. These zones are identified by location in the ocean as related to the open water (pelagic) and the sea floor (benthic). Each zone is occupied by marine organisms that are limited by depth, sunlight penetration, and biotic factors. These three zones are the planktonic realm, benthonic realm, and nektonic realm.

The planktonic realm consists of plants and animals that "drift" on the ocean surface. The bulk of this realm contains phytoplankton consisting of diatoms, dinoflagellates, and coccolithophores, which are dependent on sunlight. Both microscopic and macroscopic forms of zooplankton also are present. Some common examples are arrow worms, sandworms, crab larvae, spiny lobster larvae, foraminiferans, radiolarians, krill, jellyfish, pteropods, and copepods.

The benthonic realm consists of plants to a depth of approximately 100 feet (30 m) and animals consisting of creepers, crawlers, and burrowers. Representative animals that may occupy this realm are poriferans, mollusks, annelids, echinoderms, and cnidarians. This zone begins at the shallow shoreline and ends at a depth of approximately 20,000 feet (6000 m).

The nektonic realm includes not only fishes, which can manipulate their position in the water column, but also marine birds, reptiles, and mammals. Here, large animals face many challenges. In the ocean, the region near the surface may be brightly lit while deeper regions present a realm with little if any light. Because most nekton are both hunters and hunted, they must carefully adapt to light intensity.

VOCABULARY:

plankton, phytoplankton, zoo plankton, benthos, nekton, planktonic realm, benthonic realm, nektonic realm, producer, consumer, food web

ADVANCE PREPARATION:

1. Introduce the terms planktonic realm, benthonic realm, and nektonic realm.

2. Show prepared posters or diagrams from textbooks illustrating marine food webs.
3. Identify the roles of producers and consumers in the food web.
4. Discuss the types of organisms that may occupy different areas of the food web.
5. Pictures of marine organisms that will be illustrated should be available for students to view.
   *Examples of marine organisms which can be assigned to students in the Activity section are as follows:
   Planktonic Realm
   diatom, dinoflagellate, coccolithophore, arrow worm, crab (zoea larva), Nauplius (shrimp larva), spiny lobster larva, Foraminiferan, Radiolarian,krill (Euphasid), jellyfish, pteropod (sea butterfly), copepod
   Benthonic Realm
   sandworm (Nereis), feather duster worm, scallop, sponge, snail,clam, horseshoe crab, seastar, sea urchin, sea anemone, nudibranch, sea cucumber
   Nektonic Realm
   squid, sea turtle, sea snake, whale, pelican, cormorant, shark, trigger fish

PROCEDURE:

Setting the Stage

1. Show the class an audiovisual relating to the marine environment highlighting the realms.
2. Ask the students to list the organisms common to these realms.

Activity

1. Students, individually or in cooperative groups, should construct a hanging mobile of an organism, identifying its mode of life in a marine environment.
2. This is to be a three-dimensional model of an assigned marine organism.
3. The following information should be put on 3 x 5 cards and hung neatly from the mobile along with a picture of drawing of the marine organism: (print all words)
   • Identify the organism's mode of life (planktonic realm, benthonic realm, or nektonic realm). If planktonic, identify whether it is phytoplankton or zooplankton.
   • Identify the organism by name:
   Phylum
   Class
   Genus
   Species
   Common Name
   • Identify the organism's role in a food web by giving a minimum of three facts.
4. Mobiles are to be presented by each student to the class and then are to be hung at random or grouped according to the appropriate realm.

EVALUATION:

1. Have students write a story about their organism entitled "A Day in the Life of . . ."
2. As a class, arrange the mobiles to display a large food web.

EXTENSIONS:

1. Have students bring in pictures of marine organisms and discuss their roles in the marine environment.
2. Plan a field trip to collect marine organisms, identifying the mode of life and discussing their roles in the food web.

ORIGINAL DEVELOPMENT RESOURCES:

Lerman, M. (1986). *Marine biology.* The Benjamin/Cummings Publishing Company, Inc.

Vancleave, J. B. (1996) *Oceans for every kid*. New York, NY: John Wiley & Sons, Inc.

Center for Environmental Education. (1989) *The ocean book: aquarium and seaside activities and ideas for all ages.*

Nye, B., Saunders, I. & Dykes, J.S. (1999). *Bill Nye the science guy's big blue ocean*. Disney Press.

Notes

Succession In A Clearcut Area

OBJECTIVES:

Students will be able to:

1. Investigate an area of disturbance over a period of time.
2. Observe and enumerate the changes in plant diversity and density. Predict long term effects of clearcutting versus selective cutting.

BACKGROUND:

Clearcutting is a method often chosen for harvesting trees as a cash crop. It is used because it is economical and, some argue, ecologically effective. Clearcut sites often are replanted for continued or repeated harvesting. These wide-open areas provide some cover and feeding resources while the forest regenerates.

Another method used for harvesting trees involves selective cutting in which areas of trees are taken from within, and along the margins of, forests. Research provides the forester with data on how large these areas need to be to allow sufficient light for succession to be successful.

The public as a whole should evaluate the need for biodiversity in forests, the consumers' demands for wood products, and the economical importance of the forestry industry in Alabama. Hardwoods are seldom, if ever a part of replanting programs. Most clearcuts are planted in monotypic vegetation. That is, only one species of tree replaces the diverse forest. The public and forestry industry should plan for ensuring biodiversity.

VOCABULARY:

clearcutting, succession, secondary succession, monotypic vegetation, selective cutting

Grades:

6-8

Subjects:

Biology, Ecology

Time Needed:

At least two field studies of 90-120 minutes each

Classroom time to compare data, make graphs, write reports, make presentations

Materials:

several 1-meter square templates (ideally one per group)
notebooks
pencils
graph paper
cameras
film
field books for identification
magnifying glasses
plastic bags (to bring back specimens)

ADVANCE PREPARATION:

1. Contact forestry or timber industry officials in the area to locate an area of recent clearcutting. Get written permission to visit this area with your class. The owners may ask to have your students sign a waiver of responsibility.
2. Set up the visit to the clearcut area as a regular field trip. You will want to visit this same area several times.
3. Prepare one-meter square templates for each group.

PROCEDURE:

Setting the Stage

1. Show the students pictures of clearcut areas, and ask them to describe what they see.
2. Introduce the concept of secondary succession, and ask the students to predict what will happen in a clearcut area and how long it will take.

Activity

1. Take the students to an area that has recently been clearcut.
2. Take pictures and write general descriptions of the site.
3. Divide the students into groups and provide each group with a one-meter square template. Let them choose an area to examine, stake it off, and flag it so that they can return to the same area on their next visit.
4. Lay the template on the ground. Count and identify the plant species within the template area.. If there are problems of identification, collect one example of the organisms to take back to the classroom. Be aware of threatened or endangered species and do not remove those.
5. Note any animal species that are observed.
6. Do at least one follow-up trip to the same site. Follow the same instructions as above.
7. Graph beginning, interim, and ending plant diversity and plant density numbers for each area of observation. Compare pictures and descriptions from first to last observation as well as among groups.
8. Compare the data with the predictions that were made. Discuss the short- and long-term effects of the harvesting procedure. Compare and contrast the long-term effects of clearcutting to selective cutting methods.

EVALUATION:

Make a notebook, scrapbook, or bulletin board including the descriptions, pictures, and data from the site investigations.

EXTENSIONS:

1. After several months have passed, visit the site again; or wait until the next year and visit with a new class after showing them the pictures and accounts from the previous year.
2. If no clearcut area is available, clear a small area on or near the school campus. At the end of your succession experiment, plant the area in wildflowers, shrubs, or trees to beautify the campus.
3. Compare clearcut areas that have been replanted to clearcut areas that have been allowed to fill in naturally.
4. Make a video or slide show of the investigations for presentation to other classes.
5. Clear small (1 meter square) plots in various microhabitats and compare the diversity and density of plants and animals. Compare the time required for different microhabitats to fill in.

Wasted Wetlands

OBJECTIVES:

Students will be able to:

1. Design and produce a mural that illustrates marine and estuarine pollution.
2. Demonstrate an understanding of how humans impact wetlands.

Grades:

6-8

Subjects:

Science, Ecology

Time Needed:

Two weeks–One month

Materials:

samples of marine litter
large sheets of paper or poster board
paint
paint brushes
glue
seine net (optional)
photographs and pictures of wetlands marine organisms
references on flora and fanna of wetlands and salt marshes

BACKGROUND:

Salt marshes and estuaries are coastal water ecosystems. Estuaries are places where salt water mixes with fresh water. A salt marsh is a tidal wetland that is covered at least part of the time with salt water and is dominated by nonwoody vegetation such as cord grass and black needle rush. Salt marshes often are found adjacent to estuaries. Plants use the sun's energy, carbon dioxide, water, and nutrients to make their own food through photosynthesis. This energy is then passed up the food chain. Along the Gulf Coast, these marshes are flooded by rising tides. When the tide recedes, it carries detritus with it and deposits it in the shallow bay and coastal waters. The detritus, an important part of the food web, is eaten by phytoplankton, zooplankton, shrimp, and crabs.

Salt marshes and estuaries are important because they are the nursery grounds of many young animals that spend much of their lives there. They provide protection and an abundance of food for those young animals. The marshes also act as filtering systems for coastal waters because many pollutants are taken up by the marsh plants as nutrients. The vegetation in this ecosystem traps sediments and acts as a storm buffer.

Wetlands are very delicate ecosystems, and humans are gradually destroying these areas by pollution and physical destruction. The estuaries trap wastes that are emptied into rivers that feed them. Marshes receive garbage dumped offshore and carried by the tides. Toxic chemicals become concentrated in the plants and animals. Decomposition of dead plants and animals uses up oxygen thereby reducing the oxygen supply in these waters. Thermal pollution occurs when industries empty warm water into these areas.

Marine debris is a serious problem that is multiplying. Compounding the problem, there are many different types of debris or litter, inadequate disposal of solid wastes, and trash being deposited in low-lying coastal landfills. Within a short period of time, this litter ends up on the shores of coastal areas. This debris poses a life-threatening problem to wildlife. As human demands continue to increase with very little action from different sources, more destruction will occur.

VOCABULARY:

black needle rush, cord grass, debris, ecosystem, estuary, food chain, food web, phytoplankton, wetlands, zoo plankton, salt marsh

ADVANCE PREPARATION:

1. Introduce the vocabulary terms.

2. Show pictures and slides of areas designated as wetlands.
3. Show a map of Alabama indicating areas with a lot of wetlands.
4. Show magazine pictures, photographs, and slides of various types of wetlands.
5. Have the students design a wetland display for the classroom showing the importance of wetlands to the health of our planet.
6. Show pictures and slides of wetland destruction. Prepare a classroom chart showing the causes of this destruction.

PROCEDURE:

Setting the Stage

1. Read the background information on the characteristics of wetlands and estuaries. Have the students brainstorm flora and fauna found in wetlands (estuaries). List their identifications on the chalkboard.
2. Have students prepare a "wetland" journal recording each day's activities relating to estuarine wetlands. Have them speculate in their journals what would happen if these wetlands disappeared.

Activity

1. Divide the students into cooperative groups, or this activity could be done by classes. The students will design and make a mural, diorama, or structure that illustrates marine and estuarine pollution. These can be displayed throughout the school campus. The students also can develop information to be announced at school each day for a week, making other students aware of this problem and giving them the cause/effect solutions. This could be extended into a month-long school activity to coincide with Wetland Awareness Month (May). If school space allows, display a wetland awareness table that would contain pamphlets and brochures the students have acquired.

EVALUATION:

1. Students can develop a food web of a marine environment on index cards linking them together with yarn. Have them remove a certain organism from this web. Discuss what may have caused it to disappear. Discuss what effects this loss has on the food web. Continue until the food web is completely destroyed.

EXTENSIONS:

1. Have students participate in a coastal beach clean-up or in the Adopt-A-Marine Environment Program.
2. Take a field trip to a local wetland or salt marsh. Pull a seine net through the marsh canals, lagoon, and adjacent waters. Observe the collected organisms. Examine the beach area for signs of pollution.
3. Visit a local seafood packaging business. Discuss the effects of wetland pollution with workers.