Why study oceans?

The oceans are a great subject for teaching a wide variety of science topics—everything from chemistry and food chains to animal classification and environmental protection. Students are naturally attracted to ocean animals. The appeal of colorful fish, playful dolphins and menacing sharks is undeniable. Students learn best when they are interested in and engaged by the subject matter. Coral reefs are also appealing because they are exotic, unfamiliar yet fascinating environments. These distant environments can be used to teach scientific methods and principles that are applicable in our own backyards.

The oceans are also a timely topic in this era of increased environmental awareness. As we become more aware of the responsibility we have to take care of the earth, we understand that this includes taking care of the world's oceans. Students are never too young to begin to learn this lesson. The children of today will be the decision makers for tomorrow. Soon the future of this planet and its beautiful seas will be in their hands.

How do I use Oceans Live?

Oceans Live provides a link between your students and college-age student researchers at the School for Field Studies (SFS) Marine Resource Center on South Caicos Island in the Caribbean Sea. As the SFS students share their field experiences via journals and interactive question and answer forums, the excitement and challenges of scientific research will come alive for your students in the classroom. Your students will conduct research, learn new facts and experiment with scientific processes that parallel activities the SFS students are engaged in on the reef. This connection with a real research site will add an element of excitement and adventure that will make your students want to learn more.

By the end of the program, both groups of students will have gained an in-depth understanding of oceans and their special resources. They will appreciate the challenges of balancing human actions with the needs of nature. They will be more familiar with the research and management tools available to conserve and protect oceans and their many inhabitants. And it will all have been taught with a live link between your students and a real place, real people, with real problems and real solutions.

Introduction to SFS Site and Students

Where is The School for Field Studies (SFS) Marine Resource Center located?

The SFS research site is located on South Caicos Island. South Caicos Island is one of the Turks and Caicos Islands. These islands are located in the West Indies, a series of island chains that separate the Atlantic Ocean from the Caribbean Sea. South Caicos is about 600 miles southeast of Miami, Florida and about 890 miles northwest of Puerto Rico.

What is the geology of South Caicos Island?

The island is located on the southeastern edge of the Caicos Bank, a flat-topped undersea mountain. Over the bank the ocean is only 10 to 12 feet deep. But at the bank's edge, the depth drops off quickly to more than 6,000 feet. The island itself is about 2 miles wide and 5 miles long.

How's the weather?

The climate in South Caicos is hot and dry. The temperature is usually in the 80's. Hurricanes are frequent during the wet season from October through January, but it only rains an average of 28 inches per year.

What is the history of South Caicos?

The original inhabitants of the Turks and Caicos Islands may have been there when Spanish explorer Ponce de Leon visited in 1512, though they were gone from these islands by 1550. In the mid-1600s, Bermudans began to develop the island's salt industry. After the American Revolution, British loyalists emigrated to the island and tried to farm cotton, but this was unsuccessful due largely to the shortage of water.

When farming was abandoned, the island focused on salt production. Salinas, or sea water evaporation ponds, were developed in the center of the island and salt became the main industry. After World War II, competition from other salt producers began to affect the Turks and Caicos salt industry. In 1964, salt production stopped on South Caicos. Today, small scale fishing is the main industry. Conch and spiny lobster are the chief exports.

What is the government of South Caicos?

The island has been under the British flag for most of the past 400 years. Today the Turks and Caicos are a British Dependent Territory. The island language is English. The local currency is the U.S. dollar.

What is life like on South Caicos?

Almost everyone on South Caicos lives in the town of Cockburn Harbor. The population is about 800 to 1,000. Most of the islanders are of black African or mixed descent.

The School for Field Studies Handbook for student researchers gives this description of island life:

"The number of cars and trucks on the island is growing, but many people still get around by foot. Donkeys, cows, chickens, and pigs roam loose. Many locals carry their household water daily from a municipal supply. Telephone service is good but expensive. Basketball and soccer are the most popular local sports. There are a number of small stores, restaurants and 7 churches."

Everything is imported by air or sea, and most items are subject to a 30% duty. Prices, therefore, average nearly 200% of mainland U.S. rates. Many things we take for granted are not available locally and can only be imported with two weeks notice.

Who are the student researchers? What are they doing while living on South Caicos Island?

The student researchers are college students selected by The School for Field Studies who have come to South Caicos to learn about marine life and get involved in a real research project. They take courses, write papers and work with scientists to collect data about the waters and reef surrounding South Caicos. Working with the people of the island, the students use their research results to develop programs that help protect the island and surrounding waters.

Where will the SFS students live and what will they do each day?

The SFS students live in dormitory rooms at the Center for Marine Resource Studies, in Cockburn Harbor, South Caicos. It is not luxury living. Students help cook their own food—with only one choice at each meal and no snacks, unless they bring their own. The Center's only source of freshwater is captured rain water, so water conservation is an essential part of life. Only one quick cold-water shower a day is allowed. There are no washing machines. Laundry is washed in saltwater by hand with a quick freshwater rinse.

Students are expected to be physically fit and are busy from morning to night. A typical schedule is:

0730. . . . . Breakfast

0830 to 1200 . Lectures

1200. . . . . Lunch

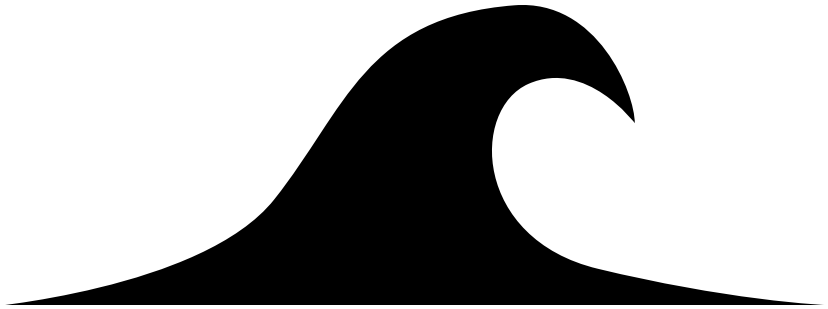
1300. . . . . Field work, generally including scuba diving or snorkeling

1830. . . . . Dinner

2000. . . . . Research workshop or lecture

Salinity

NEWSLETTER 1



Objectives

- ► introduce basic oceanographic concepts—size, depth, tides, salinity
- ► observe how salinity affects buoyancy
- ► work cooperatively to make scientific observations, predictions and conclusions

Vocabulary

tides salinity buoyancy
oceanography

Background

Oceans cover approximately 75 percent of the earth's surface. These enormous bodies of water are constantly moving with waves, currents and the effects of tides. In most parts of the world, the water level along the coast rises and falls twice a day due to tides. Tides are caused by the gravitational forces of the moon and the sun. The moon has the greatest effect since it is closest to the earth. High tides occur on the sides of the earth closest to and opposite the moon. Low tides occur on those parts of the earth at right angles to the moon.

The study of the ocean is called oceanography. Scientists who study the ocean are called oceanographers. Oceanographers learn about the ocean by measuring ocean characteristics like water depth, wave height, current speeds, temperature and salinity. All ocean water is salty, but the amount of salt in the water, its salinity, varies from place to place around the world. At the mouth of a river, for example, salinity may be low, since ocean water is mixing with freshwater. In a hot dry area, like the Red Sea, salinity may be high due to evaporation.

Scientists measure salinity in parts salt per thousand parts water. The average salinity of the world's oceans is 35 parts per thousand. Differences in salinity can affect ocean plants and animals. Salinity is one of many measurements SFS students learn to make while studying life in the waters that surround South Caicos.

Materials

for each team:

three 10 or 12 ounce plastic cups
table salt
measuring cup
tablespoon for measuring
teaspoon for stirring
one egg
Salinity Experiment Worksheet

Activity

Part I:

Begin your discussion of the oceans with a Trivia Quiz. See if students can answer these questions.

1. How much of the earth is covered by oceans? *Answer*: Three quarters.
2. Which is the world's largest ocean? *Answer*: The Pacific Ocean. It is equal in size to the Atlantic, Indian and Arctic Oceans combined.
3. What is the deepest place in the oceans? *Answer*: The 35,800-foot deep Mariana Trench in the western Pacific. The tallest mountain on land, Mount Everest at 29, 028 feet could be sunk in this trench and still be thousands of feet beneath the ocean's surface.
4. What is the difference in height between high tide and low tide in the Bay of Fundy in Maine? *Answer*: 40 feet. That's as tall as the average 4-story building.
5. What is the name of the undersea river off the southeastern coast of the United States? *Answer*: The Gulf Stream. This ocean current flows at speeds of up to 5 mph. It is about 50 miles wide and 1,500 feet deep.
6. Who is credited with inventing modern scuba diving? *Answer*: Jacques Cousteau was the first to use Self Contained Underwater Breathing Apparatus (SCUBA) for undersea exploration in 1950.
7. What is a tsunami? *Answer*: Giant ocean waves, also called tidal waves, caused by earthquakes and volcanic eruptions beneath the sea. They can travel at 450 miles per hour and may reach heights of more than 100 feet by the time they reach land. Most ocean waves are caused by wind.
8. Which freezes first, fresh water or salt water? *Answer*: Fresh water. The temperature of the Arctic Ocean is 31°F.
9. Which is heavier, fresh water or salt water? *Answer*: Salt water. In places where rivers flow into the sea, the fresh river water floats on top of the salty ocean water.
10. What is the name of the undersea mountain range between North America and Europe? *Answer*: The mid-Atlantic Ridge.

Part II:

Divide students into teams and have them conduct the salinity and buoyancy experiment using the Salinity Experiment Worksheet. When all teams have finished, discuss the results.

Extend the Activity

Have students investigate the effects of shape on buoyancy. Give each student team several pieces of modeling clay. Ask them to form a ball with the clay and place it in a cup of fresh water. Discuss: Does the ball of clay float? What happens if the shape is changed? Can they find a shape that floats?

Have students research the tidal cycle and draw diagrams showing how the tides change based on the position of the moon and sun.

Have students learn to record and analyze other kinds of data. Place an outdoor thermometer in a location visible from the classroom. Ask students to keep a daily record of air temperature. At the end of each week assign a team to graph the results. Continue to collect this data throughout the year. Discuss how the temperature changes from week to week and month to month. What effect do these changes in temperature have on the wildlife in your area? What effects to changes in temperature have on ocean animals (for example, corals need warm waters; penguins live in cold waters)?

Salinity Experiment Worksheet

Name:_____

Purpose of the Experiment: Observe the effect of salinity on buoyancy.

Procedure:

Step 1: Label cups 1, 2 and 3. Measure 1 and 1/4 cups of fresh water into each of the three cups.

Step 2: Place an egg in Cup 1. Do you think the egg will float or sink? Observe what happens. Record your observations below.

Step 3: Put one tablespoon of table salt in Cup 2. Stir to dissolve. When the salt disappears, gently remove the egg from Cup 1 and place it in Cup 2. Do you think the egg will float or sink? Observe what happens. Record your observations below.

Step 4: Put two tablespoons of table salt in Cup 3. Stir to dissolve. When the salt disappears, gently remove the egg from Cup 2 and place it in Cup 3. Do you think the egg will float or sink? Observe what happens. Record your observations below.

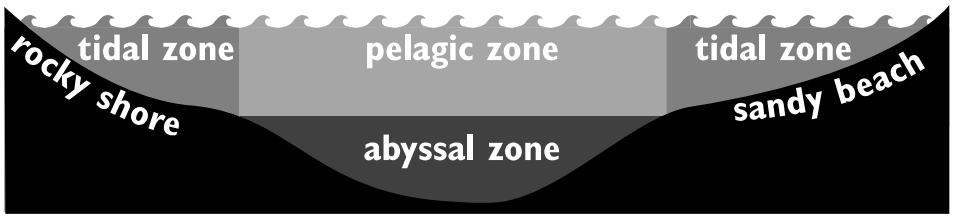
Results:

Cup 1 Fresh water I observed _____	Cup 2 +1 TBS. Salt I observed _____	Cup 3 +2 TBS. Salt I observed _____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Conclusions: What have you learned about salinity and buoyancy from this experiment?

Ocean Zones

NEWSLETTER 2



Objectives

- understand that the ocean has several different zones
- understand that the requirements for survival are different in each zone
- cooperate to create a mural showing the diversity of ocean life

Vocabulary

tidal zone
pelagic zone
abyssal zone
plankton

Background

The ocean is a huge environment. Along the shores of the continents it is shallow, but offshore it can be deeper than the highest mountain is on earth. Scientists refer to the different parts of the ocean as zones. Conditions in these zones can be very different. And the animals that live in each zone are different, too.

Life near shore in the tidal zone is tough. Animals here must be able to hold on tight to rocks or bury into the protection of the sand to keep from being washed away when the tide comes in. When the tide goes out, some of these animals follow the water. Others close up tight and hold water in their shells. All must be well protected with spiny skins, camouflage or shells since their enemies may come from either the land or the sea.

The open ocean, or pelagic zone, is for swimmers, floaters and drifters that never touch the bottom. Open ocean dwellers are some of the largest and fastest ocean animals, like sharks, whales and tuna. They are also some of the slowest and smallest, like the microscopic plants and animals called plankton that are carried along by the ocean currents.

Some of the strangest creatures live in the icy darkness of the deep sea, the abyssal zone. Hundreds of feet below the ocean surface, the sun never shines. Some animals, like the lanternfish make their own light to attract food and scare off predators. There are no plants, so food is scarce. Many deep sea fish, like the gulper eel have giant mouths and fang-like teeth to capture and swallow a meal of any size, even one larger than they are.

At the South Caicos research site, SFS students identify and study zones on the reef—the shallow lagoon behind the reef; the crest, where the waves break; the outer reef edge; and the deep reef. Their studies report on the different types of animals that live in each zone.

Materials

large roll of paper
markers
paint
reference books
photographs of ocean animals

Activity

Have students work in teams to create a mural showing ocean zones and the diversity of ocean life.

1. Draw a simple cross section of an ocean (like the one on the previous page) on a large roll of paper. Include the shallows near shore, the open ocean and the deep sea. This will be the base for the mural.
2. As a group, discuss the three ocean zones. Ask students: How do these zones differ? What kinds of plants and animals would live in each zone? How does a beach differ from a rocky tidal zone?
3. Divide students into four teams. Assign each team a zone on the mural: rocky tidal zone, sandy tidal zone, open ocean, deep sea.
4. Have each team use reference books to create a list of plants and animals that would live in its zone.
5. Ask each team to illustrate its zone on the mural. Students may draw, paint and/or use collage techniques. Each team member should be responsible for at least two features in his/her zone.
6. Display the mural. Have a spokesperson from each team describe its work.

Extend the Activity

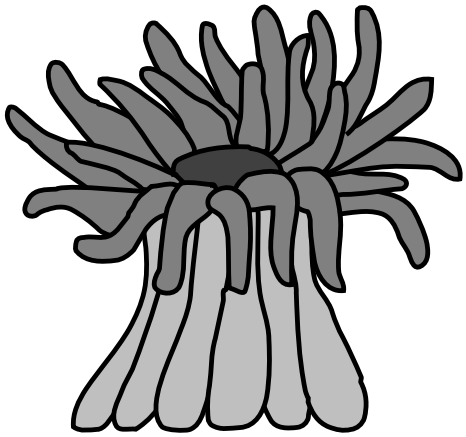
Reverse the ocean zones activity. Start with an animal or plant and ask students to predict the zone in which it would live.

What is the history of ocean exploration? Have students choose a famous ocean scientist or an historic expedition and write a report. Some examples: the *HMS Challenger* Expedition; Charles Darwin and the voyage of the *HMS Beagle*; Rachel Carson; Jacques Cousteau; Bob Ballard and the deep sea voyages of *Alvin* and *Jason Jr*; Sylvia Earle and Eugenie Clark.

If you have a local dive shop, arrange to borrow several pieces of scuba diving equipment and set up a display in the classroom. Inquire about local scuba diving clubs. Ask a club member to visit your class to demonstrate scuba diving equipment and answer questions about diving.

Corals and Coral Reefs

NEWSLETTER 3



Objectives

- understand that coral reefs are formed by coral animals
- understand the conditions corals need to grow

Vocabulary

polyp tropical colonies

Background

Coral reefs are formed by small, flower-like animals called polyps. The polyps have soft bodies surrounded by a hard limestone skeleton. The coral animals build their skeletons using minerals in seawater. Over time, these skeletons form the reef. The outer layer of the reef is alive. Below the layer of living coral are the skeletons of previous generations.

Coral reefs grow in tropical oceans all over the world. Most polyps are only the size of a pencil eraser, yet huge colonies of these animals form some of the largest natural structures on earth. The largest reef in the world, the Great Barrier Reef off Australia, is more than 1200 miles long. The largest reef in the Caribbean is the barrier reef off Belize in Central America. Coral reefs are also found in Hawaii, southeast Asia, the Indian Ocean, the coast of Africa and the Red Sea.

To survive, corals need warm water and sunlight. Sunlight is important because each coral animal has tiny plants living within its body. These plants make sugars that help feed the corals. The tiny plants also help the corals build their skeletons. If the waters around a reef become cloudy with dirt and pollution, the tiny plants cannot survive and the corals die.

Corals come in many shapes and sizes. At the South Caicos research site, SFS students identify and count coral colonies. Brain coral, star coral, elkhorn coral and mushroom coral are just some of the dozens of species the students identify while diving on the reef.

Materials

coral reef worksheet | globe or world map | reference books

Activity

As a class, discuss corals and their requirements for survival—tropical waters, salt water, sunlight. Individually or in teams, have students complete the Coral Reefs Worksheet.

Extend the Activity

Coral polyps have hard external skeletons that protect their soft jelly-like bodies. Other animals have internal skeletons to support their muscles and give their bodies shape. Ask students to brainstorm a list of reef animals. Discuss the following: Which animals have internal skeletons? Which have external skeletons? What are the skeletons made of? Do students know that shark skeletons are made of cartilage, not bone? That birds have tiny holes in their bones to reduce the weight? That lobsters shed their skeletons and make new ones as they grow? That the bones in a dolphin's flipper look like the bones in our hands?

Coral collecting can damage reefs. Most zoo and aquarium displays are made with artificial corals. These man-made corals are sculpted by artists or made from molds of selected pieces of coral. Have students look at photographs and drawings of corals. Or have them examine coral skeletons, if available. Distribute modeling clay and have students sculpt a colony of their favorite coral. Assemble the pieces to create a reef display. Draw a key that identifies each type of coral in this student-made reef.

Have students visit the web sites of one of these organizations:

- Coral Forest is a non-profit organization dedicated to the protection of coral reefs throughout the world. http://www.blacktop.com/coralforest
- The Coral Reef Alliance (CORAL) is a non-profit membership group that works with scuba divers and others to keep reefs healthy. CORAL is a co-chair of the International Year of the Reefs Conservation and Public Awareness Committee. http://www.coral.org

Answers to Coral Reefs Worksheet (page 16)

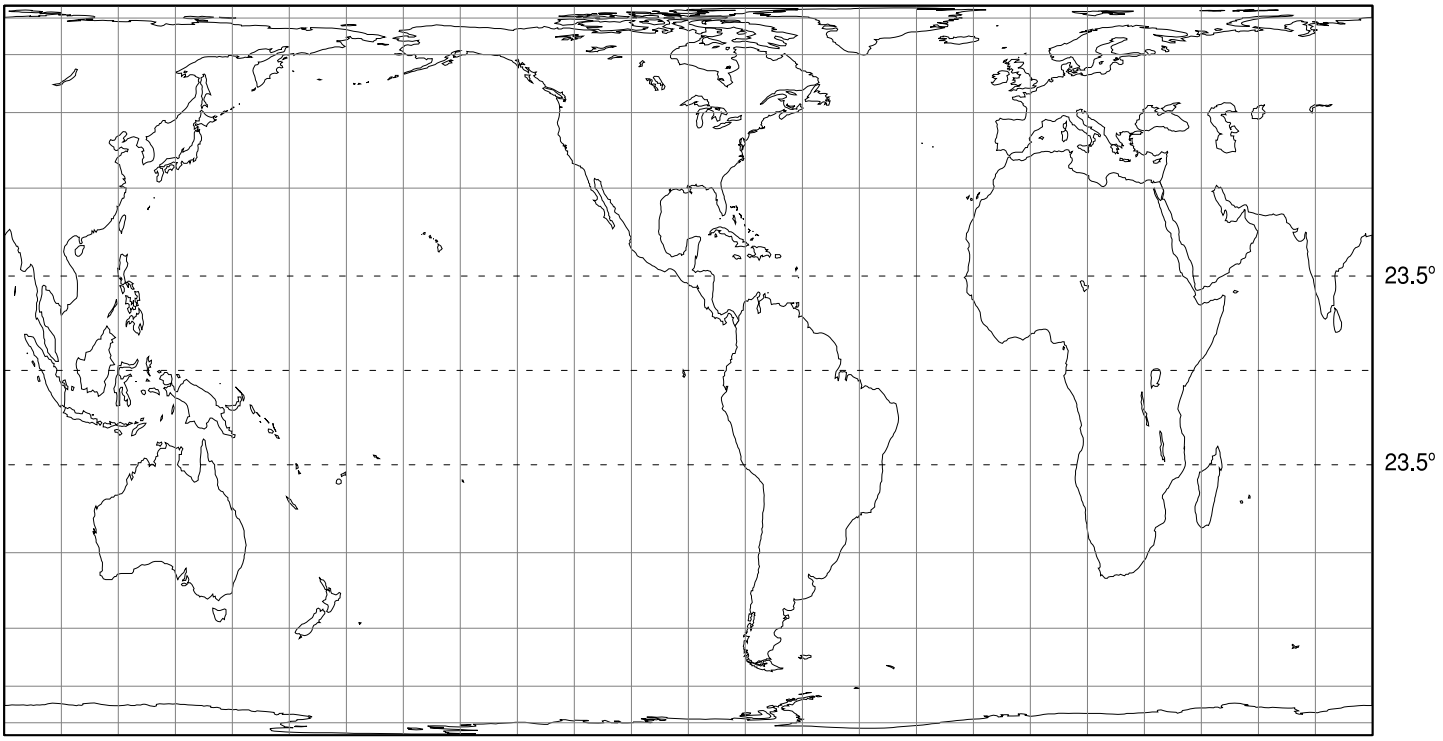
4. Corals are located in the ocean, around islands and continents, between the Tropics of Cancer and Capricorn. They need warm, salty, sunlit waters to survive.

7. No, if it is not in the tropics; and/or no, if it is not near the ocean.

8. salt water, warm water, sunlight

Coral Reefs Worksheet

Name:_____



Directions: Complete the following steps:

1. Label the world's continents, oceans and seas.
2. The equator is an imaginary line that circles the middle of the earth. Color it red.
3. The Tropics of Cancer and Capricorn are at 23.5° north and 23.5° south.
   These imaginary lines mark the northern and southern boundaries of the tropics. Color them blue.
4. Where would you expect most of the world's coral reefs to be found? Why?

5. The Great Barrier Reef is located off the northeast coast of Australia. It is the largest coral reef on earth, more than 1200 miles long. That's the distance between Dallas, Texas and Baltimore, Maryland! Mark the location of the Great Barrier Reef with a green X .
6. Locate the West Indies Islands. They separate the Atlantic Ocean from the Caribbean Sea. Color them purple. South Caicos Island is in the West Indies.
7. Draw a yellow star on your community. Could coral reefs live here?
   Why or why not?

8. Name three things corals need for survival:
   1. _____ 2. _____ 3. _____

Challenge Question:
The largest reef in the Caribbean is the barrier reef off of Belize. Mark its location with an orange star.

UNDERWATER RESEARCH

NEWSLETTER 4

CASE STUDY

Objectives

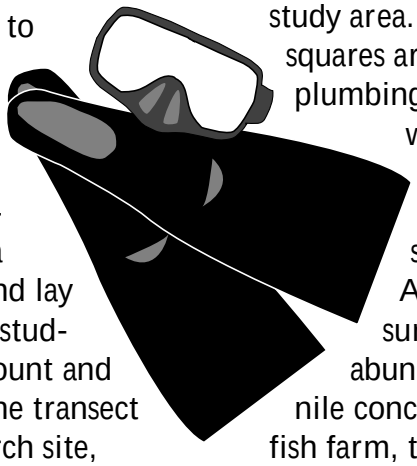
- experiment with two underwater research techniques
- understand the concepts of diversity and abundance

Vocabulary

transect
quadrat
diversity
abundance

Background

Two of the research methods SFS students at the South Caicos research site use to study the coral reef are the transect, or line survey, and the quadrat, or square survey. The line survey is used to study diversity—how many different types of animals are on the reef. The square survey is used to study abundance—how many of each type of animal lives on the reef.



To conduct a transect survey, researchers measure a length of string or rope and lay it down on the area to be studied. Then they identify, count and record each species that the transect line touches. At the research site, transect lines are laid on the reef, and SFS students use underwater slates to record the types and numbers of corals they identify along the transect line. This information will be used to compare diversity in coral communities at various locations around the island.

To conduct a quadrat survey, researchers construct a square and place it in the study area. For underwater research, the squares are usually made of plastic plumbing tubes and joints, weighted with sand. The researchers then identify, count and record the types and numbers of each species within the square. At the research site, quadrat surveys are used to study the abundance and movement of juvenile conch that were raised on a shellfish farm, then released to the wild.

Materials

scissors
string
poster board
yardstick
stapler
Transect and Quadrat Surveys Worksheets
green, red, and yellow construction paper

Activity

1. Divide students into teams.

2. Each team will need:

3 green squares	3 red squares	3 yellow squares
3 green circles	3 red circles	3 yellow circles
3 green triangles	3 red triangles	3 yellow triangles
3 green stars	3 red stars	3 yellow stars

3. Have each team measure and cut a three-foot length of string to use for the transect survey.

4. Have each team construct a one-foot square for quadrat survey as follows: Cut four strips of poster board 1.5 inches wide by 15 inches long. Assemble the strips to create a square. Overlap and staple the corners. The inside dimension should be 12” by 12”.

5. Have each team scatter its shapes in an area approximately 3’ by 3’.

6. Have students conduct transect and quadrat surveys using the worksheets.

7. Discuss the results.

Transect & Quadrat Surveys Worksheet

Name: _____

In this activity you will use the same research techniques that SFS students are using to study corals in South Caicos Island.

Part I - Transect Survey

Lay out your string in a straight line across the shapes in the center of your study area. Identify and count only those shapes that the string touches. Record your results in the chart below, as shown in the example:

	Type of shape	Number	Total
	Yellow △	𝍸 II	7
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Part II - Quadrat Survey

Place your square in the center of your study area. Identify and count only those shapes inside the square. Record your results in the chart below:

	Type of shape	Number	Total
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

Questions:

How many different types of shapes did you find with the transect survey?

How many with the quadrat survey?

If you wanted to find out how many different types of coral live on the reef, which method would you use?

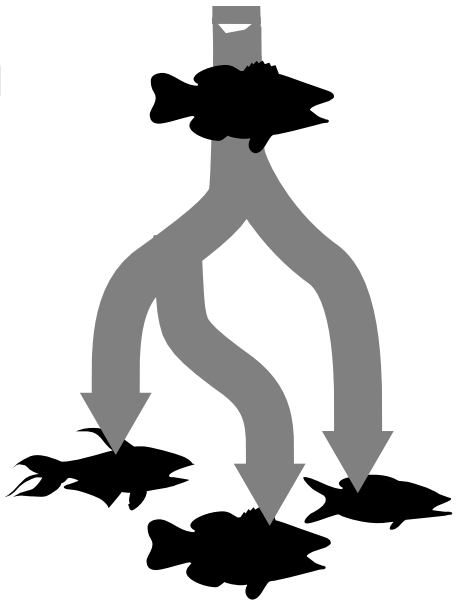
Why?

Which method would be best for counting how many corals of each type live on the reef?

Why?

Animal Classification

NEWSLETTER 5



Objectives

- create a classification system for familiar animals
- understand the classification system used by scientists today

Vocabulary

vertebrates
invertebrates
phylum
species

Background

The coral reef is home to an astounding variety of plants and animals. Some of these are vertebrates, animals with backbones. But most of the reef's many inhabitants are invertebrates, animals without backbones.

To help them identify and study the millions of animals in the world, scientists group or classify animals with similar features. For example, all vertebrates (fish, reptiles, mammals, amphibians and birds) belong to the scientific phylum, or group, known as *Chordata*. The invertebrates belong to several different groups. Some of the groups the SFS students study on the reef are:

Porifera - These are the sponges—animals that look more like plants or rocks than animals. The "sponge" part of the animal is its skeleton.

Cnidaria, also known as *Coelenterata* - These are the corals, sea jellies, and sea anemones. Most Cnidarians have stinging cells for stunning and catching prey.

Echinodermata - These are the sea stars, sea urchins, and brittle stars. Echinoderms are also called the spiny-skinned animals. Most are prickly on the outside like sea stars and sea urchins.

Mollusca - These are the conch, octopus, and clam. Many mollusks, like the conch and the clam, make their own hard shells for protection. Others like the octopus squirt ink as they jet away from danger.

Arthropoda - These are the spiny lobsters, cleaner shrimp, and hermit crabs. They have 8 jointed legs and two claws or feeding appendages. Their land relatives are the insects.

Materials

poster board markers reference books

Activity

As a group, have students brainstorm a list of 20 animals that are found in your community or in the ocean. Next, assign students to small groups and have them complete the following steps:

1. List the characteristics/features of each animal on the list generated from the brainstorm.
2. Look for characteristics/features that these animals have in common.
3. Look for differences between the animals.
4. Group animals according to their similarities and differences.
5. Create names and descriptions for each group.
6. Design a chart that shows the classification system and share with the class.

Display charts in the classroom. Have each group explain the steps they took to create their classification system. Ask students why using one classification system worldwide is important. Introduce some of the groups scientists use to classify animals and descriptions of those groups. Have students brainstorm names of animals that would fit in each group.

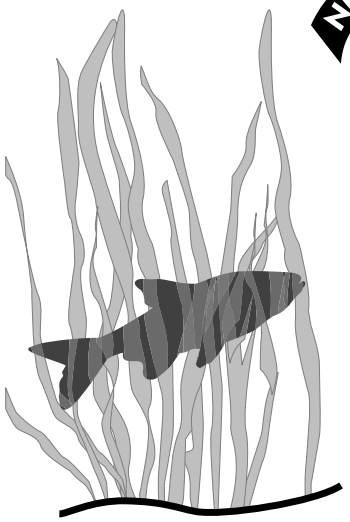
Extend the Activity

Choose a land community, such as the rain forest, the African plain, or a woodland pond and classify the plants and animals that live there. Have students discuss:
Are there any groups found on the reef that are not found in the land communities?
Are there groups on land not found in the reef community?

An animal's common name can vary from country to country or even within the same country. To avoid confusion, scientists give each animal or species a unique scientific name that can be used to identify the animal anywhere throughout the world. One of the first challenges facing the SFS students at the South Caicos research site is to learn the scientific names of the many new and unusual animals they study. The scientific name of an animal consists of two words: the first is the animal's subgroup or genus; the second is the species. For example, the scientific name of the spiny lobster is *Panulirus argus*. The queen angelfish is *Holocanthus ciliaris*, and the blue angelfish is *Holocanthus isabelita*. Use a field guide or reference book to find the scientific names of some familiar reef animals.

Habitats and Adaptations

NEWSLETTER 6



Objectives

- ► understand that adaptations help animals survive
- ► create an imaginary animal with adaptations for an unusual habitat
- ► describe habitats on the coral reef
- ► describe how reef animals are adapted to these habitats

Vocabulary

habitats
adaptations
predators
crustacean
barbels

Background

The clear tropical waters around South Caicos provide a variety of habitats, or homes, for marine plants and animals. Some animals live in the reef itself, never leaving the cracks, caves, and crevices of the corals. Others hide and graze in the beds of turtle grass that carpet the sandy shallows. Many of the larger predators live on the offshore banks, where the edge of the island platform meets the deep sea. These hunters are visitors to the reef, prowling its edges in search of a meal.

With so many organisms living together in one place, competition can be fierce. Most reef dwellers have special shapes, colors or behaviors that help them to survive in the reef environment. These features, called adaptations, help reef dwellers find food, shelter and mates, and protect them from being eaten. At the South Caicos research site, SFS students may observe some of these animals and their adaptations while diving on the reef:

- Damselfish are small but fiercely territorial herbivores. They stake out sunlit areas on the reef where algae grows, then carefully tend and defend their undersea gardens. Even scuba divers, many times the damsels' size, may be nipped if they intrude.

- The colorful cleaner shrimp feeds itself by setting up a cleaning station on the reef. Larger fish visit the cleaner and float motionless while the shrimp removes parasites and dead skin. Some fish even invite the shrimp into their mouths to clean, but never harm the bite-size crustacean.

- Nurse sharks "taste" along the ocean bottom with fleshy whiskers called barbels. When they detect a tasty crab or spiny lobster hidden in the coral, they open their mouths and suck their prey from its hiding place like a living vacuum cleaner. Nurse sharks have flat teeth and powerful jaws for grinding and crushing shells.

- The four-eyed butterfly fish fools predators with color. Its true eyes are camouflaged in black stripes on its head but it has two large "false eye" spots on its tail. The false eyes may confuse predators. Mistaking these for the true eyes, a hunter is likely to attack the eye spots and miss the fish's head, allowing the butterfly fish to swim off in an unexpected direction.

Materials

drawing paper
colored pencils or crayons
copies of Habitats and Adaptations Worksheet
reference books

Activity

Part I: Hand out different habitat and favorite food cards and ask students to design and draw a creature adapted to eat each food and to live in each habitat. The more unusual the habitats and foods, the more inventive the exercise. For example, have students design an animal that lives on checkerboards and eats peanut butter and chocolate syrup. Or an animal that lives in a school knapsack and eats popcorn and pizza. As students design their animals, ask them to think about the following questions:

1. What color is this animal?
2. How big is it?
3. How are its mouth and body parts specialized for "catching" and eating its food?
4. How does it move?
5. Does it have any enemies?

Part II: Have students research and describe the habitat and adaptations of a reef animal by completing the following steps:

1. Choose a favorite reef animal.
2. Use reference books to identify its habitat, preferred foods, and adaptations for survival.
3. Record research results on the reef animal worksheet. Include a sketch of the animal.

Extend the Activity

Have students write "A Day in the Life" stories for selected reef dwellers. Have them describe each animal's appearance, its home, its meals, and any escapes from predators or other reef adventures.

Humans are adapted for life on land, not in the water. What equipment do scuba divers use to adapt to the underwater environment? How does this equipment work? Compare the adaptations of a scuba diver with the adaptations of a fish and/or dolphin.

Habitats and Adaptations Worksheet

Name:_____

Sketch Your Animal:

Common Name: _____

Scientific Name: _____

Habitat: _____

Food: _____

_____

How it moves: _____

_____

How it catches food:_____

_____

How it protects itself: _____

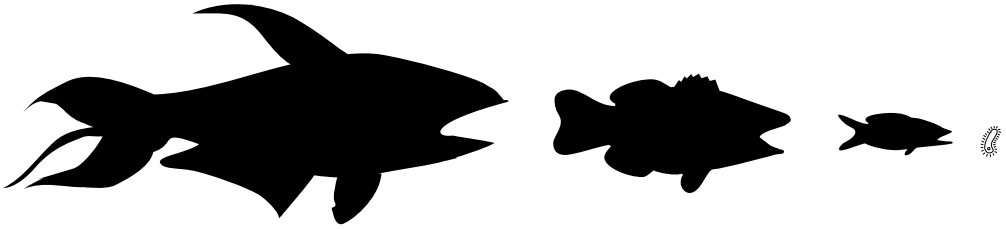
_____

Other facts: _____

_____

Food Webs

NEWSLETTER 7



Objectives

- work in teams to create an ocean food chain
- create a food chain and food web display

Vocabulary

photosynthesis
producer
herbivore
carnivore
scavenger

Background

In the sea as on land, plants capture and store the energy of the sun through the process of photosynthesis. Seaweeds, turtle grass and tiny floating plants, called phytoplankton, are the food producers on the reef. Herbivores, like sea urchins and sea turtles, are animals that eat the plants. Sharks, dolphins and barracuda are carnivores, animals that eat the herbivores and other carnivores. Scavengers, like spiny lobsters, are garbage collectors. They eat the leftovers and clean up when other organisms die.

Scientists study the hunters and the hunted and develop food chains to show who eats whom. Connections between food chains make a food web.

Materials

drawing paper and crayons
photographs of reef animals
balls of colored yarn
reference books

Activity

Part I: As a class, discuss the various levels in a food chain from producer to top level predator. The food web below gives examples of several food chains that the SFS students at the South Caicos research site may observe on the reef. Now divide students into food chain research teams and complete the following steps:

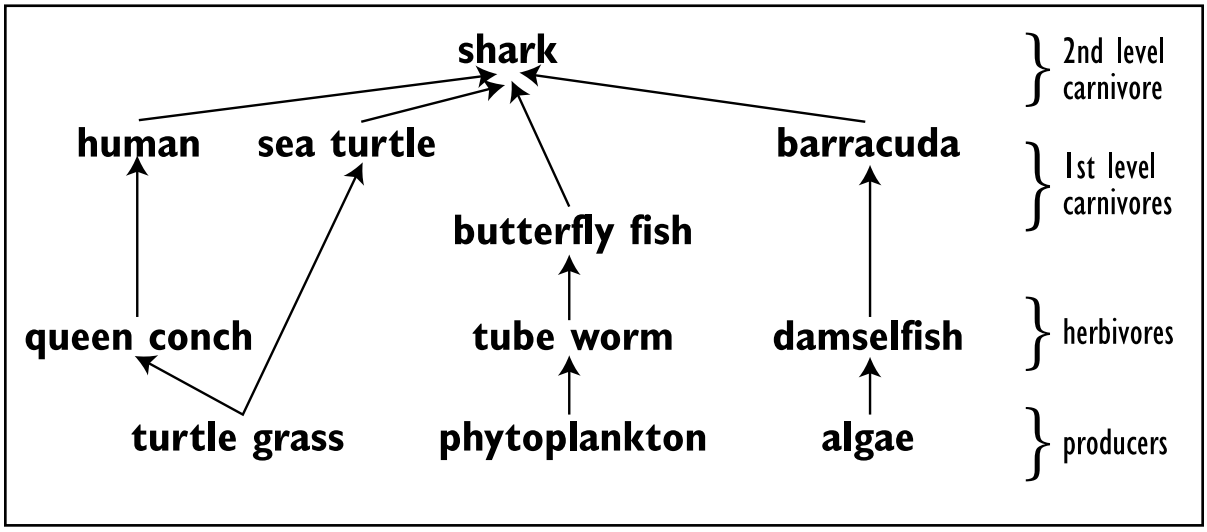
1. Give each team the name of a producer and a second level carnivore. Have each team answer the following: What animals would eat this producer? What animals would this carnivore eat? Have each team research two food chains, one for the producer and one for the carnivore.

2. Ask each team to illustrate its food chains. For example:
   sea lettuce (producer) ➔ sea urchin (herbivore) ➔ angelfish (carnivore) ➔ shark (carnivore)

3. Have students draw or find photographs to illustrate each link in the chains.

4. Create a bulletin board display as follows: (a) Put all of the producers along the bottom, the predators at the top, and the herbivores in the middle of the board. If the same animal or plant is used more than once, group the illustrations together at a single food "station." (b) Using different colors of yarn, have each team connect the plants and animals in its chains. (c) As students work, discuss any food webs that appear. Can students identify other possible connections?

Example of Reef Food Web



Extend the Activity

Have students stand in a circle or several small circles. Give each student an identification badge with the name and/or picture of a reef plant or animal. Have students identify the producers, herbivores and carnivores in each circle. To start the game, give one of the producers a ball of string and ask them to hold onto the loose end. Then ask an herbivore to walk across the circle, take the ball of string from the producer and slowly unwind it as he/she returns to his/her place in the circle. Next a carnivore should take the ball from the herbivore and so on. When the first food chain is complete, give a different colored ball of yarn to the next producer in the circle and repeat the steps to create a second food chain. Hint: Be sure to have an herbivore for every producer in the circle, and include both small and large carnivores

Research and display food webs for other ocean environments: the salt marsh, a tide pool, the polar seas (remember, polar bears don't eat penguins—one lives at the north pole, the other at the south).

Humans are at the top of the food chain. Keep a journal of what you eat for one day. Draw some food chains or food webs with you at the top.

NATURE TRAILS

NEWSLETTER 8

CASE STUDY

Objectives

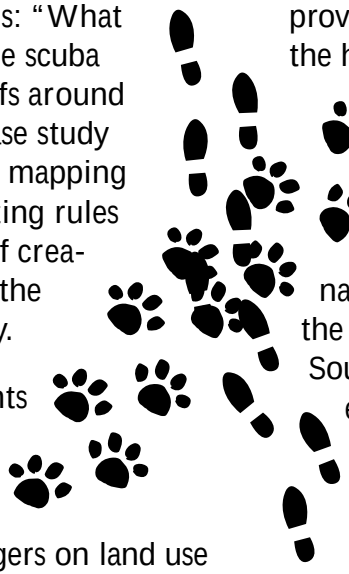
- use knowledge of reefs and reef inhabitants to create an "underwater" nature trail
- write rules to protect the reef

Vocabulary

nature trail
dive site

Background

One of the questions SFS students at the South Caicos research site will try to answer this semester is: "What is the best way to manage scuba diving activity in the reefs around South Caicos?" Their case study will involve locating and mapping good dive sites and writing rules to protect corals and reef creatures at these sites from the impacts of diving activity.



One tool the SFS students may consider to control the way divers use the reef is an underwater nature trail. Park managers on land use nature trails to guide visitors to selected special places. Signs along nature trails provide facts that help visitors appreciate the habitats, plants and animals they see. The signs also state the rules for using the trail. Rules like: Stay on the trail. Keep our park clean. Please do not pick the wildflowers. An underwater nature trail would introduce divers to the wonders of the reef surrounding South Caicos and protect this special environment from diver damage.

Materials

shoe boxes
colored pencils
markers
construction paper

Activity

1. As a class, brainstorm several favorite habitats to use as "dive sites" on the underwater trail. For example, the cave of an octopus, the den of a moray eel, the cleaning station of a cleaner shrimp, or the reef edge.

2. Divide students into teams. Assign each team a dive site on the nature trail.

3. Have each team research its site. Ask each team to write a description of the habitat at its site and to list the plants and animals that would live there.

4. Have students recreate each dive site in the classroom. This may be done in three dimensions using a shoebox diorama, or students may create posters or murals using drawings or photographs.

5. Have teams create an information station for each dive site. This should be a sign that identifies the habitat at the site and lists the plants and animals the "diver" may see at this dive site. Students can include small illustrations to help "divers" identify each of the listed animals. They should also include fun facts about what the animals eat, how they behave and how their adaptations help them survive.

6. With students, set up the "dive sites" and information stations in the classroom, gymnasium or library. Number each site and make a map of the underwater trail.

7. As a group, discuss rules for protecting the habitats and animals along the trail. Have students make signs and choose the best locations to post these rules.

8. When everything is ready, have students put on face masks and fins, strap on their scuba tanks and GO! Invite other classes to "swim" the reef trail.

Extend the Activity

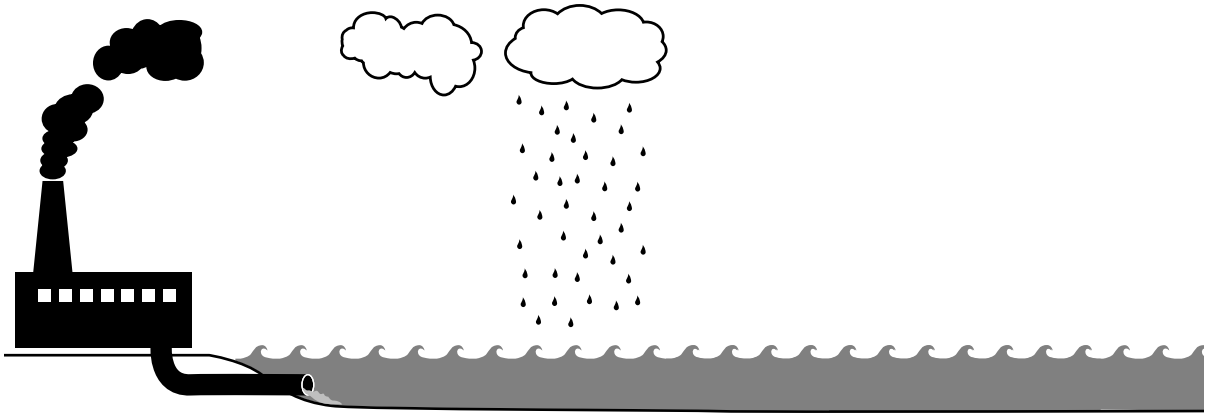
Work with students to create a nature trail to highlight habitats, plants and animals on school grounds. Or get permission for the class to visit another site and map out possible trail stations.

Field Trip

As a class, visit a local park or nature center and walk one of their nature trails. Have each student bring a field journal. Ask them to sketch their favorite trail station and answer these questions: What plants and animals are supposed to live here? Which ones can you see? Are there any rules posted to protect animals and plants along the trail?

The Water Cycle and Sources of Pollution

NEWSLETTER 9



Objectives

- understand the water cycle
- understand sources of water pollution
- experiment with techniques for cleaning polluted water

Vocabulary

water cycle evaporate condense

Background

The earth's water is constantly on the move in a circle of events called the water cycle. On a warm day, water from the surface of the ocean, a pond or even a puddle evaporates and rises into the atmosphere. As water vapor rises, it cools and condenses to form clouds. The clouds become heavy with water until they can hold no more. Then raindrops form and fall. On land, the water runs downhill, eventually finding its way to a stream or river, then back to a lake or to the ocean where the cycle begins again.

As the water runs off of the land and back to the oceans, it carries with it many substances that it picks up along its way. It could run through a pool of gasoline spilled at the pump, loose dirt from the construction site, or fertilizers from the golf course. All of these cause pollution in the marine environment; pollution that not even the most modern equipment can clean up.

For many years, scientists have worked to stop pollution that is piped into the ocean from sewage treatment plants and factories. Now they must also try to stop pollution on land before the water cycle picks it up and carries it to the sea.

Materials

Containers
dish pan
2 pie plates
watering can
clear plastic cup

Materials to make land
modeling clay
dirt
sand

Pollution and trash
vegetable oil
food coloring
perfume
rice (raw or cooked)
small pieces of plastic
foil and paper

Cleaning materials
spoons
slotted spoons
strainers
cheesecloth
cotton balls
tongs

Activity

As a class, discuss the steps in the water cycle. Ask students to complete Part I of the Water Pollution Worksheet. The following activity will demonstrate how the water cycle and water pollution can be related.

1. Work with students to make an island by filling one of the pie plates with modeling clay. Mound clay slightly in the middle of the island. Place a layer of dirt, approximately 1/2 inch thick, in the center of the island to simulate a construction site. Layer sand around the edges to simulate beaches.
2. Select students to spill simulated pollution and trash (vegetable oil, food coloring, perfume, plastic, foil and paper) on the top of the island.
3. With students, invert the second pie plate in the dish pan. Pour clean water around the bowl to simulate the ocean. Place the "island" on top of the inverted pie plate.
4. Fill the watering can with clean water. Select a student to slowly pour the water over the island to simulate rain. Observe how the rain washes dirt, sand and pollution off the island and into the ocean. Ask students to record their observations on Part II of the worksheet.
5. Have students take turns using the spoons, strainer, cheesecloth and cotton to try to remove pollution from the water. Have students record their clean up methods and results on the worksheet.
6. Ask students to observe the water in the dish pan after they have tried to clean it up. Discuss: Is it clean? Which pollutants could students remove? Which cannot be removed?
7. Pour some of the water from the dish pan into the clear plastic cup. Ask the class: What color is the water? Why? Can students see through the water? Could plants living in this water get enough sunlight for photosynthesis?
8. Ask students to smell the water. Discuss: What can they smell? Why? Chemical pollution, food coloring and perfume, dissolves in water. This type of pollution is especially difficult to remove.

Extend the Activity

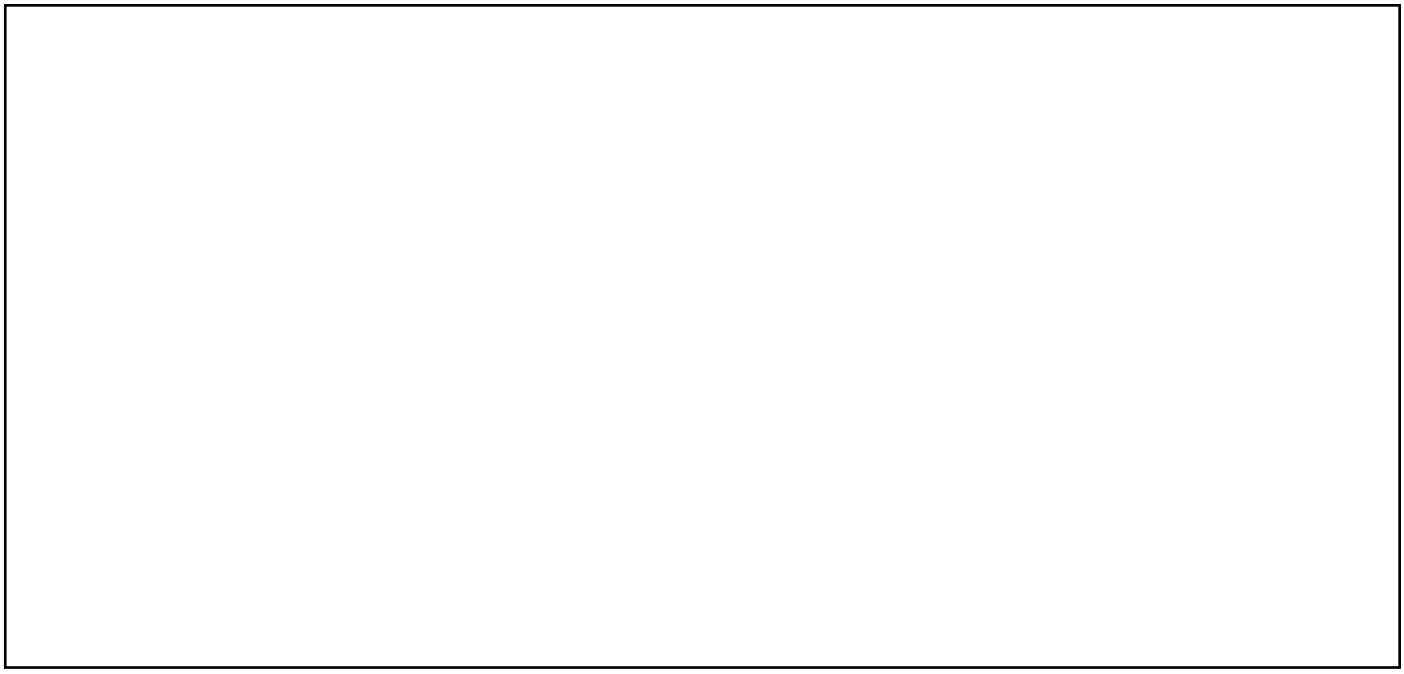
Have students research water supply and water treatment facilities in your community. Ask students to develop a water cycle which includes a stop at the school water fountain. Work with students to create a display which follows the path of this water from raindrop, to reservoir, to school, to water works, to ocean and back to the clouds. Post it near the water fountain for other classes to enjoy.

Challenge students to keep a daily journal of the water they use and the solid waste (trash) they generate for one week. Do they try to conserve? Do they recycle? Ask them to list at least five ways to save water or create less trash.

Water Pollution Worksheet

Name: _____

Part I: Draw the water cycle. Use arrows to show how the water moves.



Part II: Record your observations and conclusions about the experiment.

1. What happened when water was poured on the island?

2. Which tools did you use for clean up? How did you use them?

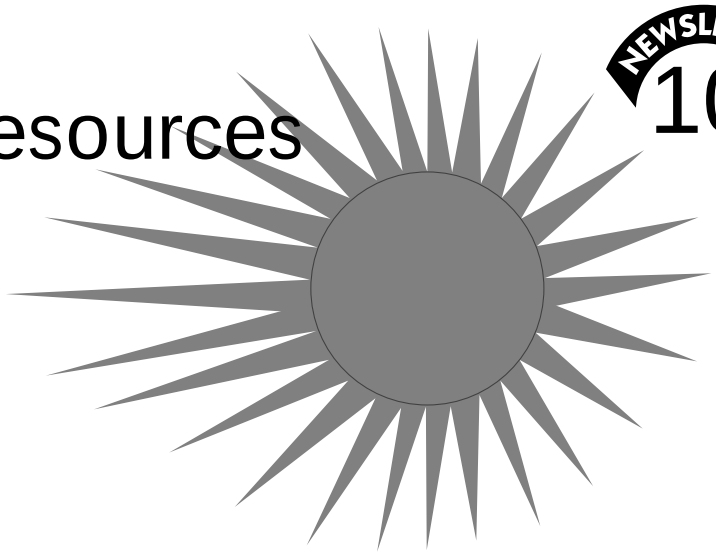
3. Which types of pollution could you remove?

4. Which pollution could not be removed? Why not?

5. List two things you have learned about water pollution from this experiment.

Renewable and Non-renewable Resources

NEWSLETTER 10



Objectives

- understand the difference between renewable and non-renewable resources
- understand that renewable resources must survive long enough to reproduce or they become non-renewable
- identify resources that reef animals need to survive
- understand that renewable resources need protection

Vocabulary

renewable resource
non-renewable resource

Background

Renewable resources can be harvested or collected over and over again. They are living resources, like farm crops and trees, that grow back or renew themselves, cycle after cycle. Non-renewable resources can be harvested or collected only once. They don't renew themselves or grow back. Once used, they are gone forever.

The lobsters, conch and fish of South Caicos Island are renewable resources. But renewable resources like these can quickly become non-renewable resources if they are not cared for properly. To keep their fisheries healthy, the South Caicos fishermen must leave enough lobster, conch and fish behind to reproduce and start the next generation. They must also protect the habitats and foods these animals need to grow to a harvestable size. The information that SFS students at the research site are collecting about conch and lobster will help the fishermen of South Caicos understand and manage their valuable renewable resources.

Materials

Lobster Bingo Worksheets
game pieces such as pennies or paper clips (9 per student)
17 index cards

Activity

Explain that the fish and shellfish of South Caicos are renewable resources. Use the lobster as an example to discuss how these resources are renewed: Lobster babies hatch. With clean water, food and shelter they grow to adults. Fishermen take some of the adults but leave others on the reef to mate and lay eggs. Lobster babies hatch and the cycle begins again.

Ask students to predict what would happen if: fishermen took too many of the adult lobsters, the lobsters could not find clean water, food and shelter, fish ate all the baby lobsters, or sharks ate all the adult lobsters. The Lobster Bingo game (see directions on page 37) will demonstrate how human activities and natural events affect lobsters by impacting three of the things they need to survive: the shelter of the reef, food, and clean water. To play, follow these directions:

1. In advance, label the index cards with the 17 categories described on the bingo worksheet: Reef 1, Reef 2, Reef 3, Clean Water 1-3, Food 1-3, Hurricanes, Anchors, etc. These cards will be used to call the bingo game.

2. Give each student a bingo worksheet and game pieces. Review the instructions for play with them. Emphasize that to get "BINGO!" students must have at least one game piece in each of the three columns. They do not need three in a row.

3. To demonstrate how the game works, call out the following resources and impacts: Food 1 (see Figure 1), Clean Water 2 (see Figure 2), Oil Spill (see Figure 3), Food 2 (see Figure 4), Reef 1, Grass Gone, Shark, Food 3, Reef 2, Hurricane, Clean Water, Sewer, Reef 3, and Clean Water. Discuss each step with students.

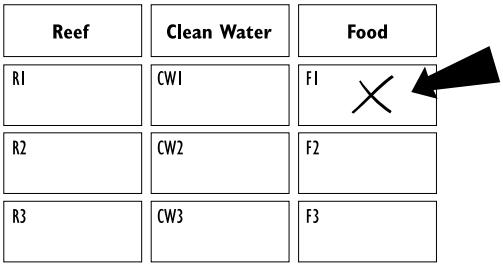


Figure 1

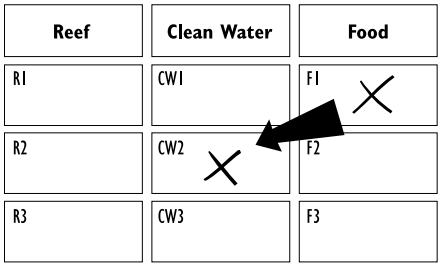


Figure 2

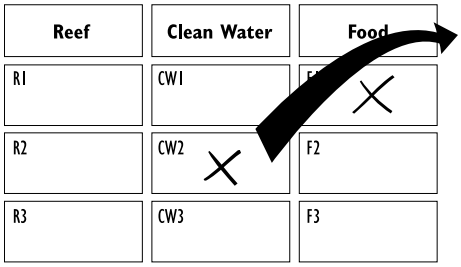


Figure 3

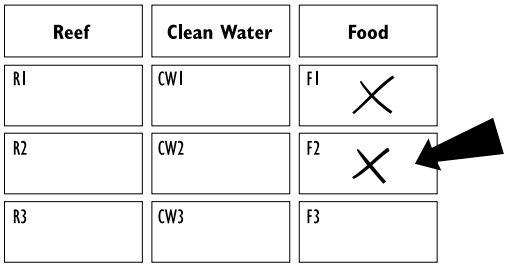


Figure 4

4. Continue to call cards while students place and remove game pieces.

5. When students call "BINGO!" (all students should at the same time), discuss the game. Ask students: Why did it take several tries to get all three of the resources the lobster needs for survival? What calls would you need to play the fastest game (all resources, no impacts)? Would it be possible to never win (run out of resource cards)? In the real world, what can humans do to help lobsters survive? Are there things we can't control?

6. Shuffle cards. Play again. Ask students to describe this game. Was it different from the first? Why?

   Variation: Divide older students into teams of three. Choose a caller, a player and a note taker to record events for each team. Give each team a bingo worksheet and set of call cards. Ask each team to shuffle its cards then start all teams at once. Stop when the first team gets "BINGO!" Ask the winning team to report on the events leading to its win. What events did other teams experience that slowed them down? Could similar situations occur on the real reef?

Extend the Activity

Discuss the concepts of threatened, endangered and extinct. Can students name any animals that fall into these categories? Discuss the habitats, foods, and other survival needs of these animals. Why did some become extinct? Why are others in danger? Is there anything humans can do to save them?

Have students research several world fisheries using library resources. Where are these fisheries located? What is the natural history of each fishery? What fishing methods are used? Is the fishery healthy or in danger? How is it managed? Discuss results. Are there similarities in issues between the various fisheries worldwide?

Lobster Bingo

You are a lobster living in the waters surrounding South Caicos. To survive you need the shelter of the Reef, Clean Water and Food. Get all three and "BINGO!"—you win!

Reef	Clean Water	Food
R1	CW1	F1
R2	CW2	F2
R3	CW3	F3

Directions:

Each time one of the things lobsters need for survival is called, place a game piece in the matching space on your worksheet. For example: When you hear "Reef 1", place a game piece on space R1. "Clean Water 2" would be space CW2, Food 3 would be F3, and so on.

If something that impacts you or the things you need to survive is called, take away pieces as follows:

Hurricanes and **Anchors:** These damage the reef where you live. Take away one piece from the Reef column.

Oil Spills and **Sewers:** These dirty your clean water. Take away one piece from the Clean Water column.

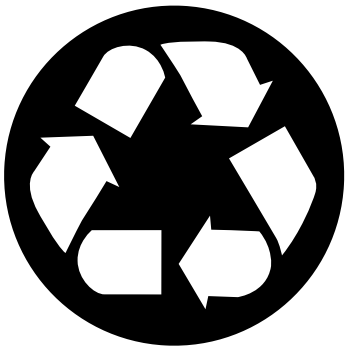
No Grass or **Another Hungry Fish:** There goes your lunch. Take away one piece from the Food column.

Shark or **Fishermen:** You're caught! Take away all pieces.

To win, you must have at least one game piece in each column. You do not need three in a row.

Conservation and Environmental Protection

NEWSLETTER 11



Objectives

- understand the need for environmental protection
- learn some of the tools used to protect sensitive environments

Vocabulary

conservation

Background

Many environments, like the coral reefs in South Caicos, can be easily damaged or even destroyed if humans aren't careful. Corals are easily broken and killed by boat anchors and careless scuba divers. Reefs can be killed by pollution from the land or an oil spill at sea. Too much fishing can turn an active reef into an ocean desert. To stay healthy reefs need protection.

But environmental protection is not always easy. Why not? First, protecting the environment can be expensive. People want clean air and clean water, but they don't like having to pay more for it. Second, protecting the environment may be less convenient. It takes more effort to recycle than to throw away. Finally, most people don't worry about protecting the environment until it is in trouble, but by then, it may be too late.

Some of the tools planners and government leaders use to protect sensitive environments are:

- Laws, which prohibit activities that damage the environment.
- Parks and Conservation Areas, which preserve environments in a natural state.
- Education, which helps the public appreciate the importance of an environment and teaches them how to protect it.

At the South Caicos research site, SFS students explore ways to use all of these tools to protect the reef and other island habitats.

Materials

poster board
markers

Activity

As a class, have students brainstorm a list of environments and animals from around the world that need protection. For example: coral reefs, rainforests, wetlands, and woodland forests; or whales, sea turtles, tigers, and condors. Talk about why these environments/animals need protection. Ask students to suggest some ways to protect them.

Next, ask students to select one of the animals or environments from the list and complete the following steps.

1. Imagine that you are the leader of an environmental protection group. Write a slogan that asks people to protect your environment/animal, such as: "Save our reefs. Don't collect living coral.", "Wetlands are nature's wonderlands. Don't build here!", "Will the tigers of today be here tomorrow?"

2. Design and create an environmental protection poster using your slogan and a picture of your environment/animal.

3. On the back of the poster, write two reasons why this environment/animal needs protection.

4. Write two reasons why people might not care about protecting this animal.

5. Write two reasons why people should care about protecting this environment/animal.

6. Write two things people could do to protect this environment/animal. Display posters in the classroom. Have each student make a speech or write a press release that will convince others to save this environment/animal.

Extend the Activity

Have students write to one of the environmental protection organizations listed below. Can they get answers to these questions: What kinds of environments/animals does this organization protect? How do they protect them? Do they have a research program? What can you do to help their cause?

- The Cousteau Society, 930 W 21st St., Norfolk, VA 23517
- National Wildlife Federation, 1412 16th St., NW, Washington, DC 20036
- The Nature Conservancy, 1815 N. Lynn St., Arlington, VA 22209
- World Wildlife Fund, 1250 24th St., NW, Washington, DC 20037
- Greenpeace USA, 1436 U St., NW, Washington, DC 20009

Create an "Environmental News" bulletin board that features newspaper and magazine reports on current problems and successes in environmental protection. Try to include articles on local, national and global issues.

Have students write to your Congressman or Senator and ask him/her to support laws that protect the environment.

PARADISE ISLAND

NEWSLETTER 12

Objectives

- understand the environmental impact of human activities
- work as a team to set goals and resolve conflicts

Vocabulary

tourism

Background

One of the questions government leaders of South Caicos have asked the SFS research team is: "How can we expand tourism in a way that benefits the economy without destroying our natural resources?" After all, it is the beauty, natural resources and culture of these islands that attracts tourists in the first place. If these resources are destroyed, there will be no reason for tourists to come back. The island paradise will be gone.

Using the knowledge they have gained from their research on the reefs, the SFS students will develop recommendations to help government leaders manage the impacts of expanding tourism, while preserving the unique natural resources of these islands.

Materials

copies of role play descriptions

Activity

Have students role play to debate the pros and cons of island development.

1. Introduce students to the challenge facing Paradise Island as described below:

   Summary of the Situation
   Paradise Island is a small tropical island, like South Caicos. It is surrounded by clean waters and beautiful reefs. There are sandy beaches, mangrove lagoons, a small town and a research station. The local fishermen catch conch and lobster.

   There are no large hotels on Paradise Island. The few tourists who visit each year stay at small inns in the town. Some local business leaders would like to expand tourism, build new hotels, and start dive operations. The local environmental group wants to make the waters surrounding the island a Marine Park. The Island Council has called a Town Meeting to discuss the pros and cons of expanding tourism and to make some decisions about the future of Paradise Island. You are there...

2. Divide students into groups of five. Assign each group member one of the roles listed on the next page.

3. Begin role play. Have students present their points of view to others in their group. Then ask each group to work together as a team to make a list of the most important and least important goals for the future of Paradise Island.

4. Have each team make a plan for the future of Paradise Island that will meet these goals. Choose team leaders to present these plans at a Town Meeting.

5. Have each team make its presentation. Ask students to vote for the best plan. As a class, discuss why it is the best plan. Use these questions: Does it protect the reef? Does it provide jobs? Will it impact the fishermen? Will it be good for business? If the island follows this plan, what studies could the scientists do to see if it is working?

Extend the Activity

Create a map of Paradise Island showing its natural resources, roads, existing village and airport. Have students work in teams to create master plans for future development showing nature preserves, marine parks, hotels, new roads, housing developments, new school, etc. Use these plans to create a bulletin board display.

Obtain a copy of a local zoning map or master plan. Discuss this plan with the class: Does it set aside areas for parks or nature? Where are the residential zones? Is there an industrial zone? What other zones are shown? Ask a Town Planner to make a presentation to the class about local planning issues.

Role Play Descriptions

Business Leader

I'm a business person and I think expanding tourism is great. I want to build a big hotel on Sunshine Beach. My guests will have beautiful views of the ocean and the flamingoes in the mangrove lagoon. We will run two scuba diving trips a day to the reef from a dock next to the hotel. The restaurant will serve conch and lobster caught by local fishermen. The hotel shops will sell island arts and crafts. There will be lots of jobs. Everyone will benefit.

Reef Protector

I am a member of Save Our Reefs and I think expanding tourism is a bad idea. All that new construction. All those people. It will pollute the water. They will cut down the mangroves and the flamingoes will leave. Dive boats will drop their anchors on the reef and SCUBA divers will collect coral and shells until there is nothing left. They will rename our island Paradise Lost. I say "Tourists go home!"

Island Council

I am a member of the Island Council and I don't know what's right. I know more tourism will mean more jobs, but I don't want to do anything that will damage the environment on our beautiful island. If we had a master plan we could conserve the areas near the reef and the mangroves and let businesses build in other parts of the island. We could also write new laws to protect the environment. I need more information to make these decisions.

Research Scientist

I am a scientist who has been studying your reefs and fisheries. I think you can expand tourism, but you must do so carefully. If you build hotels, you must not let them pollute your water. If you build roads, try to go around the mangroves, not through them. Start to expand slowly, and watch what happens to your island as tourism grows. Maybe my research will help you.

Fisherman

I am a fisherman with two children. Tourism could help me and my family. If there are more restaurants, I will be able to sell more conch and lobster. The hotels will pay taxes that will help the schools and our hospital. But what if we start to take too many fish and lobsters from the reef. And what if our sewage treatment plant can't handle all the waste from the hotels? Maybe we should just leave things as they are.

Careers in Science

Many people who love the ocean and coral reefs make it part of their jobs. Here are some ocean-related careers your students might find interesting.

Oceanographer: These scientists study the physical features of the ocean—the currents, waves, tides and the sea floor. Many do their jobs at sea, taking measurements and collecting data from research vessels that travel all over the world. Oceanographers study math, chemistry and physics.

Marine Biologist: These scientists study the animals and plants that live in the ocean. Some marine biologists study just one type of animal, trying to learn everything possible about where it lives and how it survives. Others study an entire ecosystem to understand how a variety of plants and animals get along in their habitat and with each other. Marine biologists study biology, chemistry, math and physics.

Environmental Leader: Environmental leaders work to protect ocean animals and habitats. Some make speeches and write articles to educate the public about environmental problems. Others raise money that can be used to buy and conserve special coastal areas or to fund environmental research. Environmental leaders can be scientists, writers or business people.

Coastal Zone Manager: These are planners and law-makers who work to protect the coast and the ocean from human impacts like construction and water pollution. Some work for the United States government in Washington, DC, making decisions that affect the whole country. Others work for states or for cities and towns. They can be scientists, writers or business people.

Professional Diver: There are many different and unusual jobs for professional scuba divers. They may help salvage shipwrecks, inspect underwater supports for bridges or serve as underwater guides for tourists on the reef. Professional divers need special training and often work under dangerous conditions.

Aquarium Staff: Aquariums employ scientists to care for their animals, artists to design their exhibits, teachers to present school programs, and business people to raise money and pay the bills. Many aquariums have volunteer programs to give students a chance to help out with some of these jobs.

Activity

Invite a parent or friend with an ocean-related career to speak to the class about his/her job. Some questions students might ask: What do you do on a typical day? What are the best parts of your job? Are there any parts you do not like? What did you study in school to prepare you for this job?

GLOSSARY

abundance: the quantity, or number, of a particular species or type of animal or plant

abyssal zone: the deep ocean zone that begins where light penetration ends

adaptation: a characteristic, like a body part or behavior, that helps a plant or animal survive in its environment

barbels: fleshy whiskers used to "taste" the bottom of the ocean

buoyancy: the ability of an object to float

carnivore: an animal that eats other animals

colonies: groups of animals of the same type that live or grow together

condense: to come together

conservation: the act of saving something from loss or harm

crustacean: a type of aquatic arthropod with ten appendages, such as a crab, shrimp, or lobster

dive site: a location on the reef often visited by scuba divers

diversity: the number of different species or types of animals

evaporate: to convert into vapor

habitat: the place where a plant or animal lives; its home

herbivore: an animal that eats plants

invertebrates: animals without backbones

nature trail: a marked trail designed to lead people through a natural environment in a way that highlights and protects resources

non-renewable resource: a resource that can not be replaced after harvesting

oceanography: the science of studying the oceans

pelagic zone: the open sea

photosynthesis: the process through which plants use energy from the sun to make food from water, carbon dioxide and nutrients

phylum: major scientific groups used to classify animals

plankton: ocean plants and animals that float and drift with ocean currents, usually microscopic

polyp: the individual coral animal

predator: an animal that hunts and eats other animals

producer: an organism that produces food

quadrat: a square used to conduct scientific surveys

renewable resource: a resource that replaces itself after harvesting so that it can be harvested again

salinity: the concentration of salt in a solution

scavenger: an animal that eats dead plants and/or animals

tides: the rise and fall of sea level along the coast twice each day

tidal zone: the area of the coast covered at high tide and exposed at low tide

transect: a line used for conducting scientific surveys

tropical: a region where the climate is always warm, located between the Tropics of Cancer and Capricorn at 23.5° north and south latitude

vertebrates: animals with backbones

water cycle: the movement of water via evaporation from the ocean, lakes, and other water bodies to the atmosphere, then back to the water body through condensation and precipitation

RESOURCES

Reference Books

Niesen, Thomas M. *The Marine Biology Coloring Book*. Barnes and Noble, New York. 1982.

Engel, Leonard and the editors of Life. *The Sea*. Life Nature Library. Time Incorporated, New York. 1963.

Buchsbaum, Ralph. *Animals Without Backbones*. The University of Chicago Press, Chicago. 1948.

Literature Links

Arthur, Alex. *Shell*. (Eyewitness Books series) Alfred A. Knopf, New York. 1989.

Barrett, Norman. *A Coral Reef*. Franklin Watts, New York. 1991.

Cerullo, Mary M. *Coral Reef: a city that never sleeps*. Cobblehill Books, New York. 1996.

Cole, Joanna. *The Magic School Bus on the Ocean Floor*. Scholastic, Inc., New York. 1992

Cousteau Society. *Corals: the sea's great builders.* (Books for Young Readers series) Cousteau Society, New York. 1992.

Ganieri, Anita. *The Oceans Atlas*. Dorling Kindersley, New York. 1994.

Gunzi, Christiane. *Tide Pool*. (Look Closer series) Dorling Kindersley, New York. 1992.

Parker, Steve. *Seashore.* (Eyewitness Books series) Alfred A. Knopf, New York. 1989.

Parker, Steve. *Fish.* (Eyewitness Books series) Alfred A. Knopf, New York. 1990.

Sargent, William. *Night Reef*. Franklin Watts, New York. 1991.

Taylor, Barbara. *Coral Reef.* (Look Closer series) Dorling Kindersley, New York. 1992.

Tayntor, Liz, Paul Erickson and Les Kaufman. *Dive to the Coral Reefs*. Crown, New York. 1986.

Field Guides

Familiar Seashore Creatures. (The Audubon Society Pocket Guides series) Alfred A. Knopf, New York. 1990.

National Audubon Society Field Guide to North American Seashore Creatures. Alfred A. Knopf, New York. 1981, sixth printing 1994.

Peterson First Guide to Seashores. Houghton Mifflin Company, Boston. 1992.

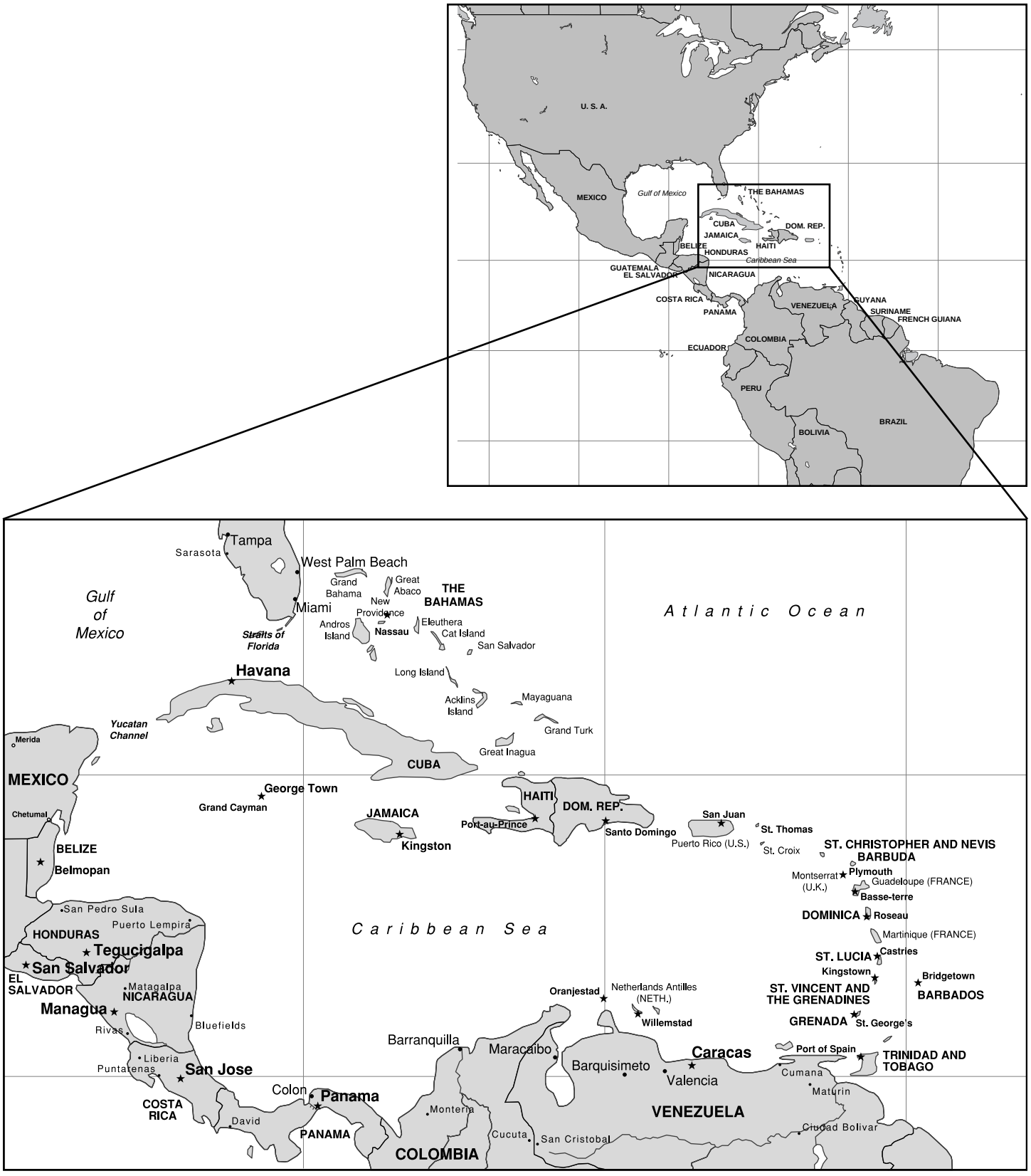
The Audubon Society Field Guide to North American Fishes, Whales and Dolphins. Alfred A. Knopf, New York. 1983, third printing 1986.

Internet

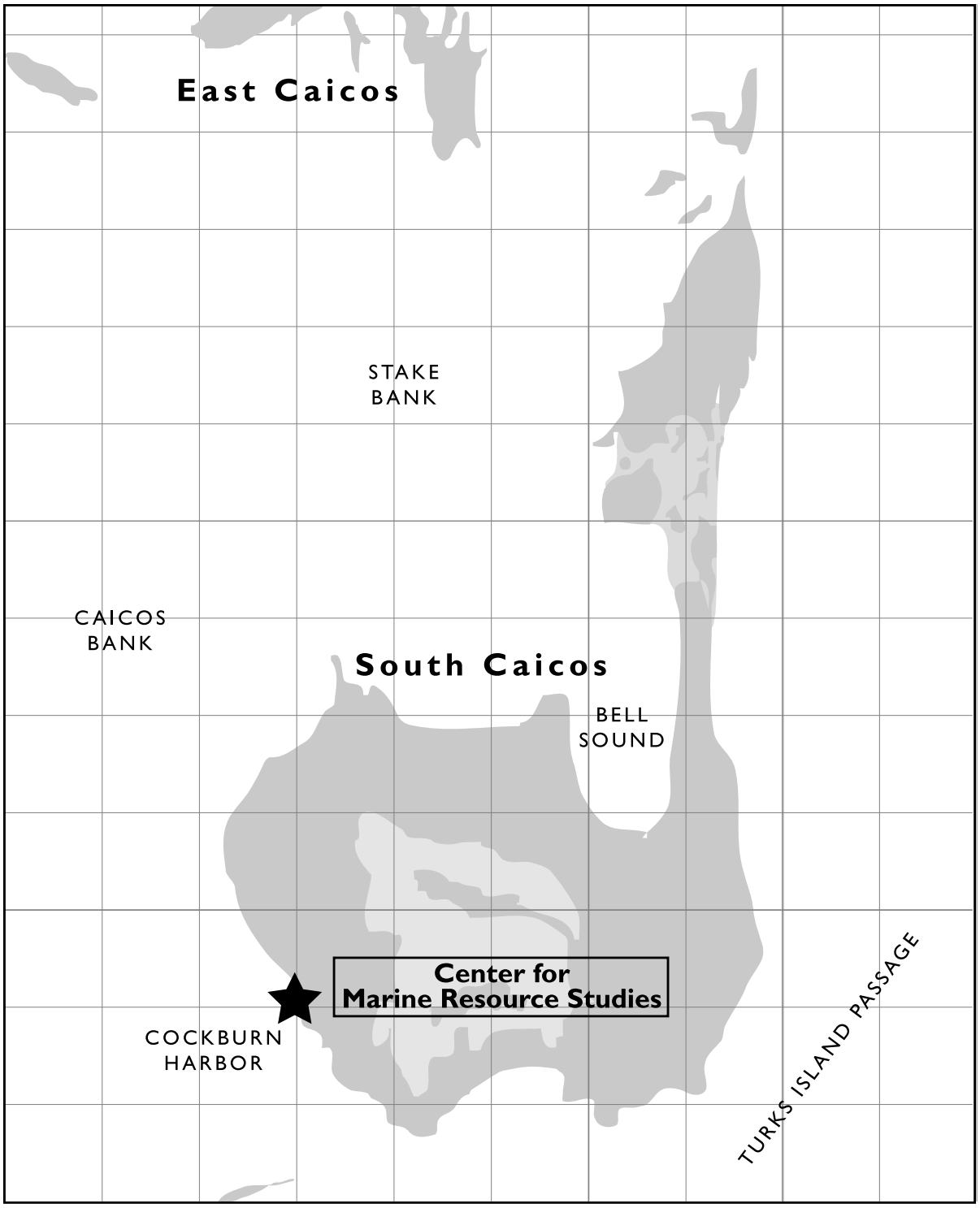
www:http://www.blacktop.com/coralforest

Coral Forest is a non-profit organization dedicated to the protection of coral reefs throughout the world. It has a lot of interesting information at its web site and is a link to other related sites. Go to Reef Links in the Main Menu. Then in Reef Links, go first to the Reef Resource Page which describes and evaluates the other web sites.

Map of the Caribbean Sea



Map of South Caicos Island



Oceans Live Newspaper In Education

Newspaper In Education Activities

Newspaper In Education (NIE) is a program sponsored by many newspapers that provides education content to classrooms. Ocean Challenge, Inc., the producer of *Oceans Live* and the **sitesALIVE!** education series, has formed alliances with many publishers to bring our programs into the classroom through local and regional newspapers. The *Oceans Live* NIE program provides weekly in-paper and online updates, and each of these updates includes a special newspaper-based activity for the classroom. Following is a series of newspaper activities that can be used during the semester to enhance your students' learning about marine science and to give your students experience using the newspaper.

Week #1 Activity: Environmental Attitudes

Look for articles in today's paper about the ocean or about a body of water in your community. Make a list of people's attitudes and relationships to these bodies of water. Does your behavior affect the world's oceans?

Week #2 Activity: Animal Ads

Search today's newspaper for ads that portray animals. What can you tell about people's relationships to animals from these ads? Choose one animal, research it, and present an oral report to the class about its natural history. Include whether it is an endangered species or not. Why was the animal used in the ad?

Week #3 Activity: Environmental Reporting

Find articles in the paper that address environmental problems. Write a 1-page article of your own summarizing these problems and posing possible solutions.

Week #4 Activity: Tools of the Trade

Review several newspaper articles in the business section that report on different professions. Make a list of any tools mentioned in the articles that are used by these people. Do you use any of the tools on the list? What kinds of tools do you use at school and around the house.

Week #5 Activity: Newspaper Classification

How is today's newspaper organized? What are the different parts of the newspaper? Are there different types of articles? Are there different types of ads? Make a list of the different sections in the paper and then assemble a scrapbook that shows the different types of articles, ads, etc.

Week #6 Activity: Current Event Adaptation

Animals in the wild are not the only things that are adapted to their environment. In

today's paper find out how people adapt to different environmental and political conditions.

Special Edition Activity: Weather Patterns

In today's paper, look in the weather section and see how your local weather (temperature, precipitation, etc.) compares to the weather on South Caicos Island. Compare the local weather to other locations around the world. Do you notice any patterns regarding where you find warmer and cooler temperatures? Write the temperatures on a map to find out!

Week #7 Activity: Food Web Ads

Find three ads about food in today's newspaper. Where did the food come from (e.g., a hamburger comes from a cow)? In what part of the food web does this food belong? Is it a producer, an herbivore or a carnivore?

Week #8 Activity: Teamwork

The SFS students need to cooperate and work in teams on their directed research projects. Find an article that shows people working together for a common goal. Why do people work together? What are the benefits of cooperation?

Week #9 Activity: Rain Survey

Look in the weather section of today's newspaper and make a list of towns and cities where it is raining. Into what major rivers and oceans might this rainwater eventually be deposited? Use a map to help you answer this question.

Week #10 Activity: Newspaper Resources

The newspaper-making process requires the use of many resources and raw materials. Brainstorm a list of possible resources with your class. Which of these resources are renewable? Non-renewable? Contact your local newspaper to find out about newspaper resources.

Week #11 Activity: Resource Conservation

Find and read an article in today's paper about a natural resource (fish, oil, water, trees, etc.). Is the resource in danger of being overused? Should it be conserved? Explain.

Week #12 Activity: Industrial Impacts

Look in the business section of today's paper. How are companies affecting the communities, cities and countries in which they are located? Are these effects good or bad? Make a list.