ART to ZOO

TEACHING WITH THE POWER OF OBJECTS

Smithsonian Institution

November/December 1996

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Take-Home Page in English/Spanish

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4–9

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Publication of *Art to Zoo* is made possible through the generous support of the Pacific Mutual Foundation.

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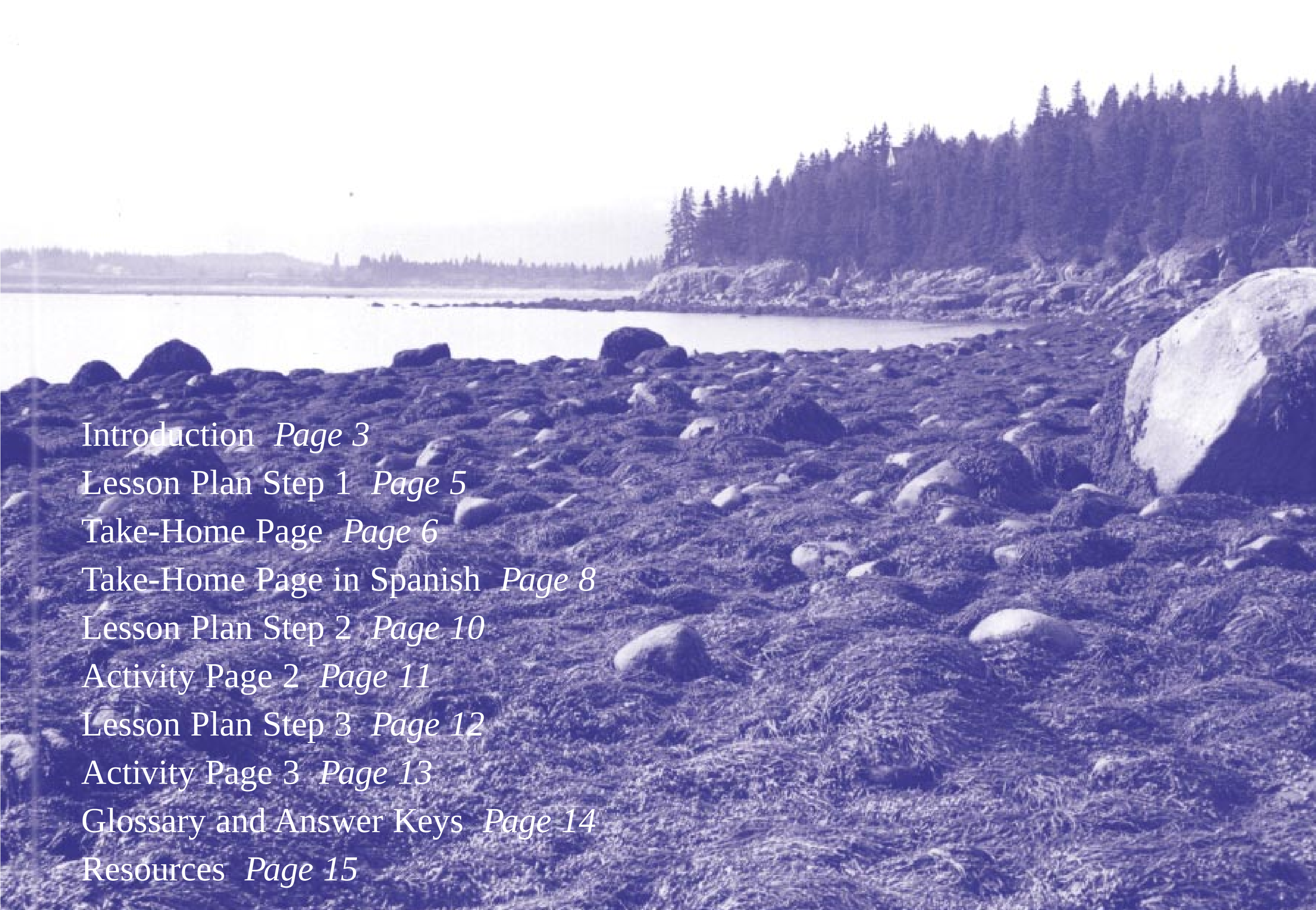


Art to Zoo's purpose is to help teachers bring into their classrooms the educational power of museums and other community resources.

Art to Zoo draws on the Smithsonian's hundreds of exhibitions and programs—from art, history, and science to aviation and folklife—to create classroom-ready materials for grades four through nine.

Each of the four annual issues explores a single topic through an interdisciplinary, multicultural approach.

The Smithsonian invites teachers to duplicate *Art to Zoo* materials for educational use.

You may request a large-print or disk version of *Art to Zoo* by writing to the address listed on the back cover or by faxing to (202) 357-2116.

Cover photo
Deep-water coral reef, coast of Belize. Hard and soft corals, sea fans, sponges, and algae are visible.

Above photo
A wide, boulder-strewn, intertidal zone at Pinkham Point, central Maine. The algae-covered rocks of this ecosystem provide organisms with protection from predators and the Sun's rays.

CONTRASTS IN BLUE: Life on the Caribbean Coral Reef and the Rocky Coast of Maine

A travel poster for the Bahamas features the clear azure water of the coral reef, where a diver encounters an electric blue and yellow angelfish. A Maine vacation brochure depicts gleeful children gathering mussels among the boulders, as powerful waves crash upon the rocky shore. These distinctive scenes describe two very different marine ecosystems: the coral reef of the Caribbean and the rocky coast of Maine.

The striking contrasts between these two dynamic ecosystems are the theme of this issue of *Art to Zoo* and are among the many topics visitors can ponder in *Exploring Marine Ecosystems*, a permanent exhibition at the Smithsonian's National Museum of Natural History. The activities that follow encourage students to consider the role of temperature, sunlight, waves, and tides in the creation of unique marine environments.

The Distinctive Coast of Maine

Over millions of years, Earth's crust gradually lifted and squeezed layers of rock to fashion the mountains of the Northeast. Eventually hundreds of streams formed on these mountains and began to flow toward the Atlantic Ocean. About forty thousand years ago, massive glaciers crept along these same stream beds, scouring and straightening them.

During the last Ice Age, the land that constitutes the present Maine coast was several hundred feet above sea level and a hundred miles from the sea. When the glaciers finally began to melt about eighteen thousand years ago, sea levels began to rise. Although the land rose, too, as the groaning weight of the glaciers was lifted, the sea rose even higher. The waters flooded the basins and submerged the coastal river valleys, forming islands from the high ground as well as numerous bays and inlets. The rushing water also carried away molten lava and deposited it to form thick layers of sediment. These spectacular actions, combined with continual erosion by wind and water, resulted in Maine's irregular, jagged coastline.

Living things along this rugged, rocky shore endure many biological stresses. Rocks don't give plants or animals much protection. There is summer heat, winter freezing, the drying force of air, and the diluting power of rain. The rockiness and irregularity of the coast leads to great variations in water level between high and low tide. Many inlets become shallow at low tide, providing habitats where animals can hide and plants can flourish. Tidal pools form wherever water is trapped and left behind by the receding tide. The tide pools experience extreme fluctuations in temperature, salinity, and oxygen content. On any given rock, living indicators detail precisely where the water level rests at both high and low tides. From top to bottom, this tidal zone can be from twenty to forty feet in height. The living things (organisms) near the top are exposed to the air much of the time while those near the bottom are usually submerged.

Near the top of the rocks, rough periwinkle snails graze on dark stains of algae. Below them, barnacles cement themselves to the rocks and capture microscopic plankton with their feathery legs. Rockweeds cover the lower surfaces, where mussels attach themselves to these plants with silken threads. In the tidal pool, ribbons of marine grass, brown kelp, sea stars, anemones, crabs, and small fish thrive.

With every tide and season, the populations of organisms change. In the cold months of winter, lobsters head for the stable temperatures of the deep sea while the warming of spring brings pollack to hunt for smaller fish. In turn, people hunt the pollack. Humans have been so successful in pursuing the pollack that their continued survival in this ecosystem is threatened.

The Dynamic Coral Reef

Far from the northern latitudes of Maine, the diverse and productive ecosystem of the coral reef centers around coral, a group of organisms with a body design similar to that of an anemone. A single coral is called a polyp (POL-ip). Its tiny, saclike body comprises a stomach and a central opening lined with waving tentacles. Stony coral polyps use minerals from the sea to build supporting cups of calcium carbonate around their bodies, while "soft" coral polyps make flexible supports of protein. Polyps generally live together in a colony, their individual cups fusing together to form a large coral skeleton. As they grow and die, new polyps form along the outer surface of the coral and continually expand the structure outward. Some coral, like brain coral, may have many convolutions that appear like a human brain. This type of coral may live for up to a century on a reef that is ten times its age.

The growing calcium carbonate framework of coral creates habitats for other organisms. Brilliantly colored invertebrates and fish find their niches in the coral reef, along the sandy bottom of the sheltered lagoon, in the deep water of the outer reef, or anywhere in between.

The reef-building corals depend on photosynthetic algae, or zooxanthellae (zo-zan-THELL-lee), that live inside their tissues. These organisms produce food and oxygen that corals use to grow. In turn, the corals release waste products that the zooxanthellae use during photosynthesis. Through this mutually beneficial relationship, the coral and algae are able to exchange energy and important gases with each other. The exact nature of this relationship is not completely understood, but without algae the reef-building corals could not secrete their massive skeletons.

When corals become stressed from environmental conditions, they eject so much zooxanthellae that they turn white. Coral "bleaching" has been reported by more than ninety nations in reefs all over the world. Scientists attribute much of bleaching to increased human pressures (e.g., pollution, agricultural runoff, oil slicks, and overfishing) that often make it difficult for reefs to recover from natural stresses.

Within the reef exists a complex food web in which nothing goes to waste. Animals such as conch, sea urchins, and surgeonfish graze on algae, thereby preventing it from overtaking and killing the coral. Huge eyed squirrelfish feed along the reef at night and help keep the grazers in check. Sea fans and sea anemones wave back and forth in the water column, using their tentacles to catch particulates and tiny organisms floating in the water. Other reef animals eat the coral or the mucus that coats it.

The coral reef ecosystem displays a complex interdependency of organisms. Some depend more on each other than others and develop symbiotic relations. The corals and zooxanthellae are one example of a mutually beneficial relationship. Another example is the cleaners and their hosts. Organisms such as the scarlet banded shrimp and neon goby "clean" other organisms by removing parasites and food particles from their gills and mouths. The cleaners get food while the host organisms stay free of potentially harmful parasites.

Protecting the Balance

Both the coral reef of the Caribbean and the rocky shore of Maine have intrinsic value as unique marine ecosystems. They provide people with a variety of fishing, tourism, and recreational opportunities but are at the same time threatened by these and other human activities. As we learn more about these special places, we find that the world itself is one larger ecosystem—where our actions affect the lives of all species, including our own.

LESSON PLAN
Step 1

SETTING LIMITS

Objectives

- Identify environmental conditions of the rocky coast of Maine and the coral reefs of the Caribbean.
- Interpret the relations among latitude, temperature, and sunlight within the two ecosystems.
- Predict the location of marine ecosystems with similar environmental conditions.

Materials

- Copies of Take-Home Pages, pages 6–9.
- Globe or large world map.

Subjects

- Science, social studies

Procedure

1. Have students imagine they are going on a trip to the coast (to a famous resort or less visited spot) or designing a travel poster for a beach vacation. Ask them to think of words that characterize this location (e.g., *beach*, *sand*, *surf*, or *waves)* and have them describe the weather conditions they would expect to find there.

2. Using a globe or world map, ask students to locate the places that the class has mentioned. Then ask them to find the coast of Maine and the islands of the Caribbean, two locations that they will later compare in detail. Review the concept of latitude, measured in imaginary lines that circle the globe parallel to the equator. (*Latitude increases as one travels north or south toward the poles and away from the equator, which is located at zero degrees latitude*.) Have students estimate the latitude of each location they found on the map or globe. (*Maine and the islands of the Caribbean are located at about forty-five and twenty-five degrees north latitude, respectively.*) Ask students which location is closer to the equator and has a warmer, sunnier climate (the Caribbean); which probably has a cold winter (Maine); and which has the same warm temperatures all year long (the Caribbean).

3. Ask students to name an instrument that measures temperature (thermometer) and have them discuss briefly how temperature affects their daily lives (e.g., in deciding how to dress according to the weather). Ask your students if they know the names of the two most common temperature scales (Fahrenheit and Celsius). Then ask them how winter temperatures in Maine might be different from those in the Caribbean. (Maine has colder winter temperatures.) Would they expect to see the same plants and animals in each place? (No: Some animals live better in cold places, and others in warm.) Tell your students that temperatures limit the kinds of organisms that can live in a given location. Stress that close-in currents, which act like rivers flowing within the oceans, also influence a coastal region's temperature. Currents that begin near the equator, like the Northern Equatorial or the Gulf Stream, are warm. Currents that begin in Greenland or Labrador (show these locations on a globe) begin closer to the North Pole and are cold. (For more information on currents, oceans, and weather, see *Art to Zoo*, September/October 1995, *Tomorrow's Forecast: Oceans and Weather*.)

4. Hand out copies of the Take-Home pages. After students have completed the exercises individually, review the correct answers. Ask your students to predict which of the two locations has the greater average amount of sunlight. (*Be sure to remind students that the equator has a latitude of zero degrees and that lower latitudes generally have warmer climates and more hours of direct sunlight.*) Tell your students that sunlight is the source of energy that fuels each living community or ecosystem. Plants use the Sun's energy, nutrients in the water, and carbon dioxide to produce sugars that animals then eat. To conclude the lesson, ask students to predict the temperature conditions of other locations along the Atlantic coast as shown on the map. Students will conclude that coral reefs are located close to the equator and that rocky, temperate coasts are further north.

TAKE-HOME PAGE
Setting Limits

To the teacher
- Duplicate this page for students.
- Use with Lesson Plan Step 1.

Publication of *Art to Zoo* is made possible through the generous support of the Pacific Mutual Foundation.

Directions: Although the coast of Maine and the islands of the Bahamas are both in the Atlantic Ocean, each receives a different amount of sunlight and has a different water temperature. These conditions limit the kinds of plants and animals that can live in each ecosystem. Use the map on page 7 to complete the chart below.

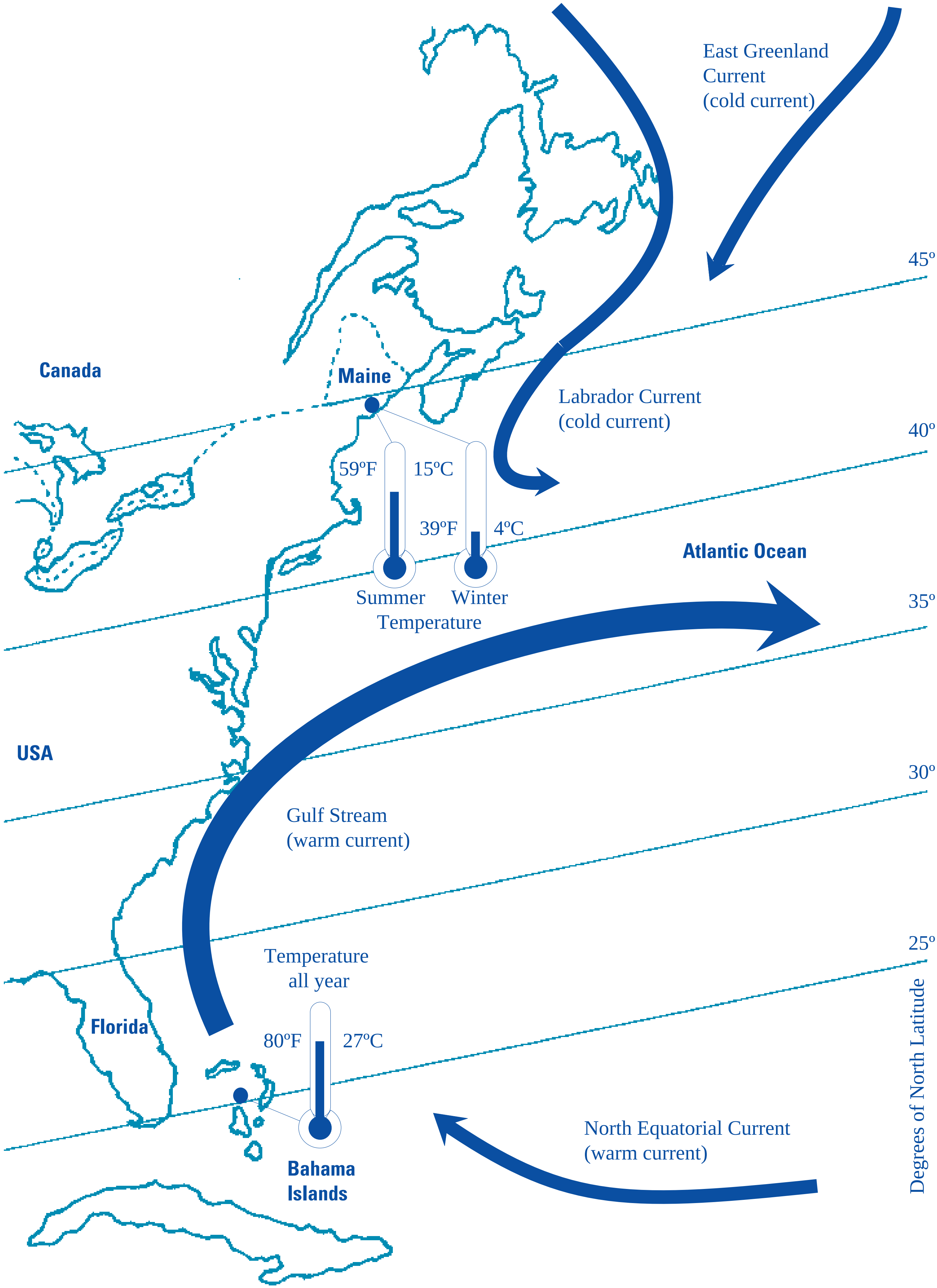
CONDITION	ECOSYSTEM	
	Caribbean coral reef	Rocky coast of Maine
Latitude		
Temperature *(summer and winter)*		
Two nearby ocean currents		

Answer these questions

1. Which location has greater temperature differences between winter and summer? Why?

2. Which location has a greater amount of sunlight? Why?

3. Find the latitude where you live and mark it on the map. How do the conditions where you live compare with those of the Maine coast and the islands of the Caribbean?


East Greenland
Current
(cold current)
45º
Canada
Maine
Labrador Current
(cold current)
40º
59ºF
15ºC
39ºF
4ºC
Atlantic Ocean
Summer
Winter
Temperature
35º
USA
30º
Gulf Stream
(warm current)
25º
Temperature
all year
Florida
80ºF
27ºC
North Equatorial Current
(warm current)
Bahama
Islands
Degrees of North Latitude

TRABAJO PARA HACER EN LA CASA
Fijando Límites

Al maestro (a)
- Copie esta página para los alumnos.
- Usela con el tercer paso del plan de la lección.

Esta publicación ha sido posible gracias al generoso aporte de la Pacific Mutual Foundation.

Instrucciones: Aunque las aguas de Maine y quedan en el Océáno Atlántico, cada cual recibe una cantidad diferente de luz solar y tiene, por lo tanto, una temperatura diferente. Estas condiciones limitan las clases de animales y plantas que viven en estos ecosistemas. Usa el mapa en la página 9 para completar el cuadro.

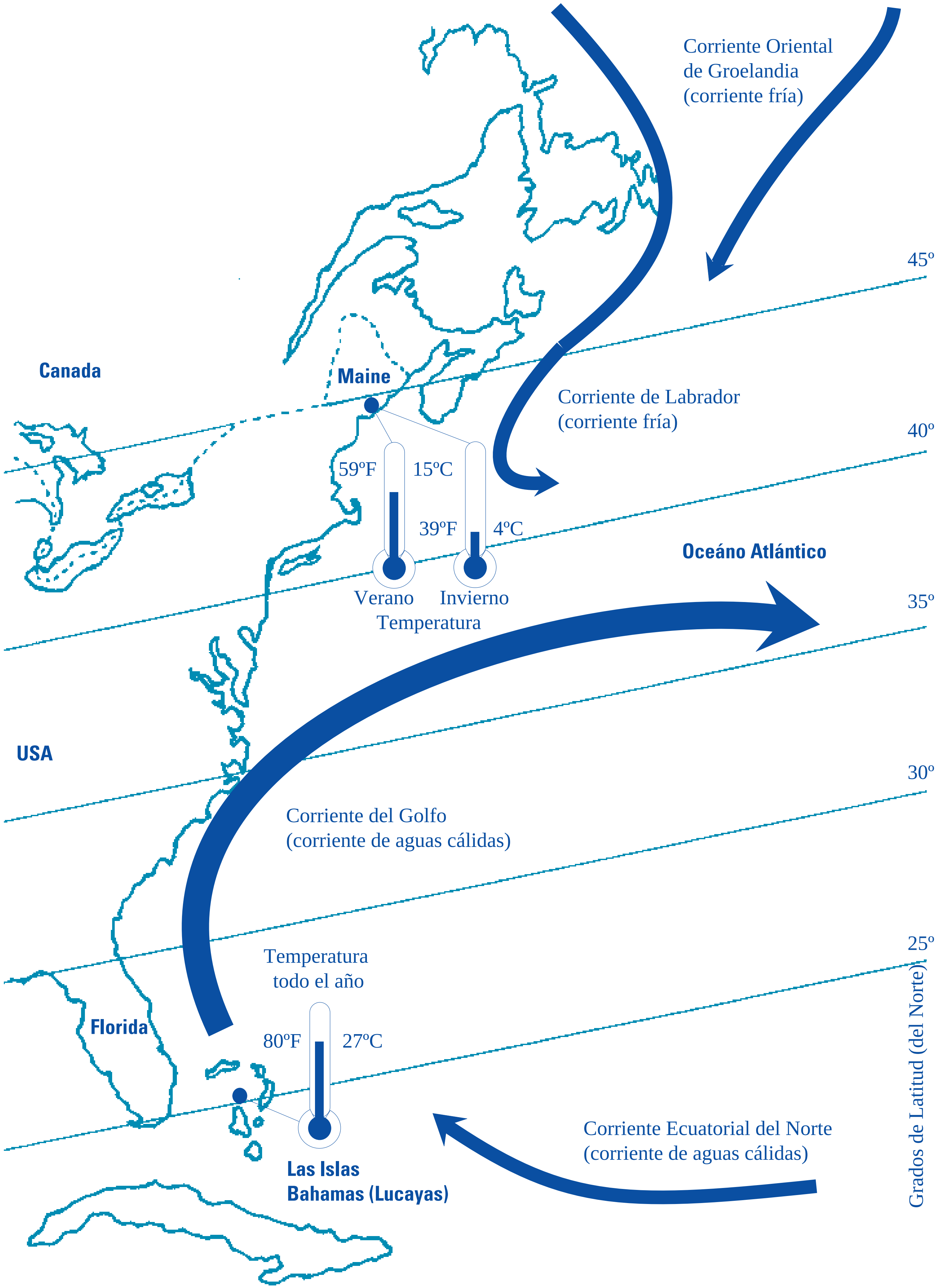
CONDICIÓN	ECOSISTEMAS	
	Arecife en el Caribe	Costa Rocosa de Maine
Latitud		
Temperatura (*verano e invierno*)		
Dos corrientes oceánicas cercanas		

Contesta estas preguntas

1. ¿Qué lugar tiene las mayores diferencias de temperatura de invierno a verano? ¿Por qué?

2. ¿Qué lugar recibe una mayor cantidad de luz solar? ¿Por qué?

3. Encuentra la latitud donde vives y márcala en el mapa. ¿Cómo se comparan las condiciones donde vives con esas que se encuentran en la costa de Maine y las islas del Caribe?


Corriente Oriental
de Groelandia
(corriente fría)
45º
Canada
Maine
Corriente de Labrador
(corriente fría)
40º
59ºF
15ºC
39ºF
4ºC
Oceáno Atlántico
Verano
Invierno
Temperatura
35º
USA
30º
Corriente del Golfo
(corriente de aguas cálidas)
Temperatura
todo el año
25º
Florida
80ºF
27ºC
Corriente Ecuatorial del Norte
(corriente de aguas cálidas)
Las Islas
Bahamas (Lucayas)
Grados de Latitud (del Norte)

LESSON PLAN
Step 2

DINNERTIME ON THE REEF

Objectives

- Identify the main parts of a coral reef.
- Describe a coral reef food chain.

Materials

- Copies of Activity Page 2, page 11.
- Additional reference books with pictures of coral reefs.

Subject

- Science

Procedure

1. Using the Introduction as a guide, present the coral reef as an example of a dynamic ecosystem. Within every ecosystem, physical conditions such as temperature and the amount of sunlight affect and are affected by the organisms in an environment, such as plants, animals, and microscopic organisms. Ask students if they have ever visited a coral reef or seen pictures of one. Perhaps they can name some of the fish that live there. (*Angelfish and barracuda might be two fish that students can recognize.*) If an aquarium or fish supply store is nearby, you might arrange for a class visit. You might also refer students to one of the many reference books with colorful photographs of coral reefs.

2. Tell your students that each dynamic ecosystem consists of many interacting parts, each using energy and producing wastes. Ask them to speculate why coral reefs host an abundance of marine life. (*The key is that the coral reef receives a wealth of sunlight, which causes algae within the reef to produce an abundance of food. The waves crashing over the reef distribute oxygen and food throughout the ecosystem, creating a hospitable environment for animals*). Tell your students that many kinds of living things make up the coral reef community: producers (plants), filter feeders (animals that take in microscopic plants and animals from the water), grazers (algae eaters), predators (animals that eat other animals), and scavengers (animals that eat the remains of dead creatures). A complex food web connects all of these living things. *You might wish to write the five organism types on the blackboard and ask students to suggest an animal that fits into each type.*

3. Give each student a copy of Activity Page 2. Tell the class to examine carefully the diagram as you describe some of the following organisms found along a coral reef:

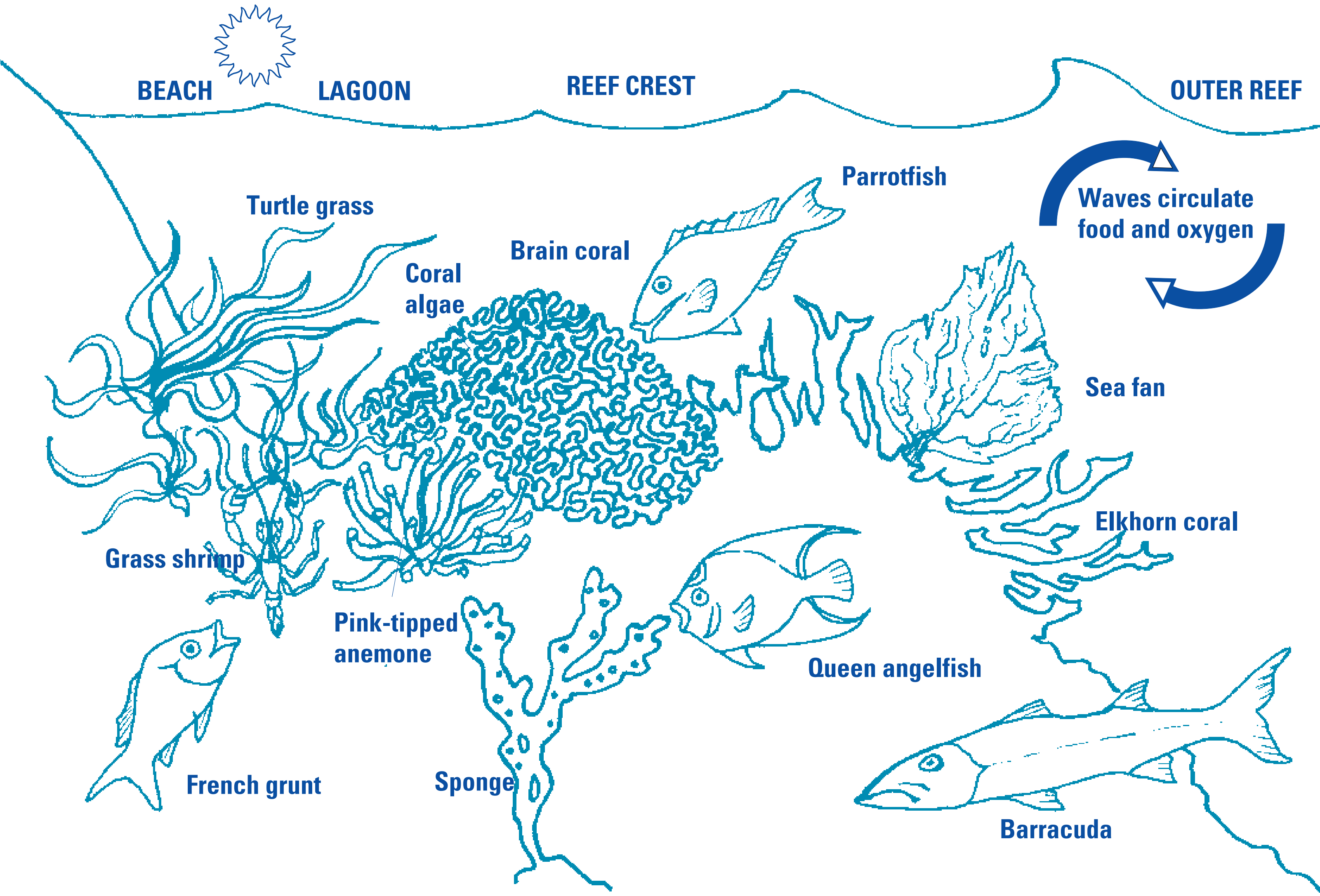
- At the highest point (crest) of the reef, large, dome-shaped, brain coral forms huge boulders. Colorful parrotfish, their large front teeth fused together like a parrot's beak, scrape algae off the coral rock. (*Refer to the Introduction to remind students that coral grows with the help of algae.*) Nearby, the queen angelfish sports an electric-blue, crown-like growth and eats sponges, which in turn feed on microscopic life.
- On the outer reef, Elkhorn coral extends its branches like sign posts and withstands the constant pounding of the waves. Sea fans expose themselves to the prevailing current to receive food, while predators like the barracuda ready themselves for the hunt.
- Between the reef and the shore is a quieter environment known as the lagoon. Here the turtle grass is dense, protecting the young members of reef species. Schools of French grunts who stay among the corals all day move to the grass beds at night to hunt for small crustaceans like grass shrimp. Nearby, a pink-tipped anemone floats food its way by waving its tentacles.

4. Ask your students to complete Activity Page 2 by writing their answers on a blank piece of paper. When they finish, discuss the correct answers with them. Be sure to emphasize that all of the organisms depicted in the diagram are related to each other in a vast food web.

ACTIVITY PAGE 2

It's always dinnertime for some animals on the coral reef. Fill in the missing words as you observe what's on the menu for these reef organisms.

Corals such as the __1__ coral live in the highest part of the reef, the _____2_____. Corals are tiny animals that live together in large, stony colonies as big as boulders. Inside the coral are __3__ that produce food and oxygen using sunlight. A __4__ grazes on the coral to get food. The crashing waves circulate __5__ and __6__. A nearby _____7_____ is a filter feeder that uses waves to capture its dinner. The __8__ is a predator that patrols the __9__ reef, looking for other fish. In the calmer waters of the __10__, a little _____11_____ scavenges through the lagoon. Watch out! A hungry _____12_____ is coming closer. Nearby, a _____ __13__ _____ waves its tentacles to take in its food.



LESSON PLAN
Step 3

RIDE THE TIDE

Objectives

- Identify the zones of life along the rocky coast of Maine.
- Describe the cause-and-effect relation between tides and the rocky coast ecosystem.
- Interpret the interrelations of organisms within a rocky coast food chain.

Materials

- Copies of Activity Page 3, page 13.

Subject

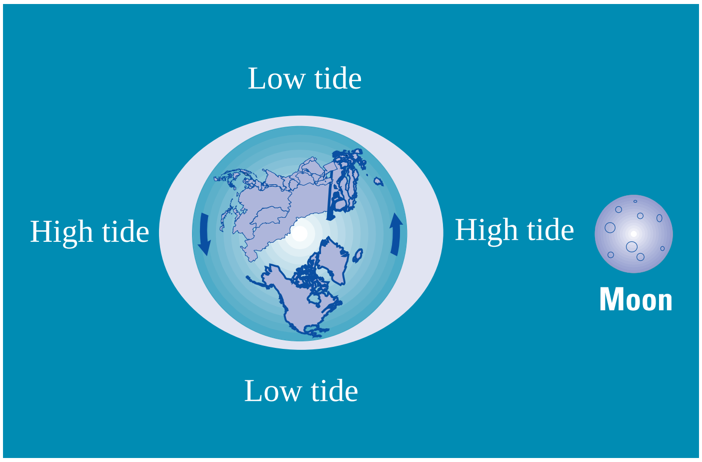
- Science

Procedure

1. Begin the lesson by reminding students that waves deliver food and circulate oxygen to organisms on the coral reef. Emphasize that tides play a similar role in Maine's rocky coast ecosystem. Explain that tides result mainly from the gravitational pull of the Moon on the rotating Earth (see diagram, above right). On the side of Earth facing the Moon, gravitational pull is greatest. Here, and on the opposite side of Earth, the sea bulges, causing high tide conditions. These bulges take water away from the remaining areas of the oceans, resulting in low tide conditions elsewhere. During a full moon, when the Sun, Earth, and Moon are aligned, the tides are highest. Such high tides, and their corresponding low tides, occur twice each day. The many bays and inlets along the northeast coast of the United States may experience considerable variation in water level between high and low tides.

2. Tell your students that conditions along the Maine coast change from hour to hour, day to day, and season to season. Short summers give way to long, stormy winters. Cold winter temperatures drive intertidal animals close to the low-tide elevations or out of the intertidal region entirely. Many vertebrate animals fly or swim out of the cold shallows into deep water or to the south, where temperatures tend to be warmer. The invertebrates that cannot migrate have breeding cycles that closely align with seasonal and even tidal cycles.

3. Give each student a copy of Activity Page 3. Ask your students to examine the diagram carefully as you describe some of the living things found along the rocky shore. Emphasize that the changing tides expose many organisms to varying amounts of water and direct sunlight. In the splash zone, algae, periwinkles, and other shelled animals fix themselves to rocks to withstand the awesome power of crashing waves. By some estimates, the pressure exerted by a pounding wave may be one and a half tons per square foot of rock.



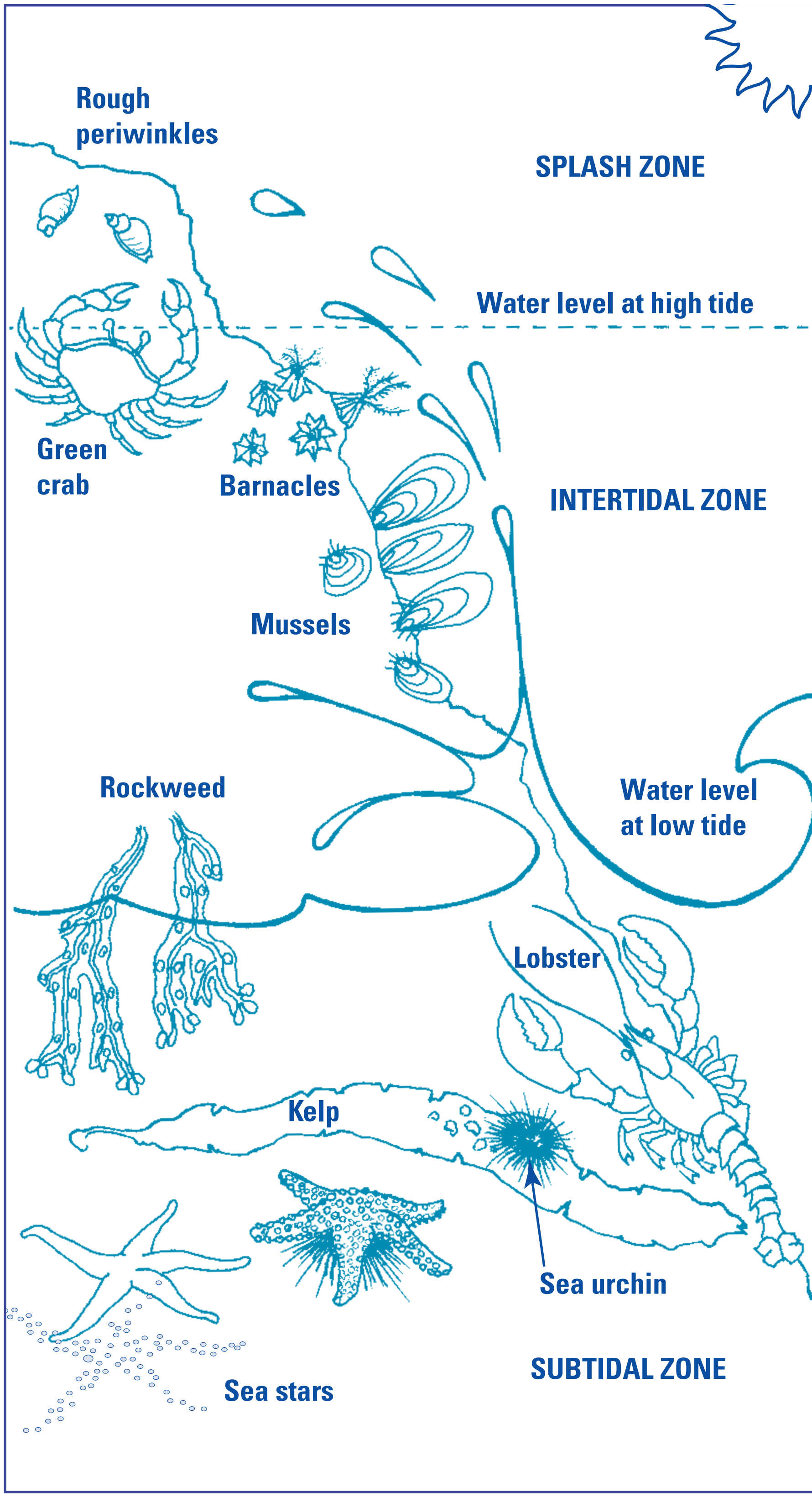
- In the intertidal zone, barnacles build limestone forts around themselves. Then, as some scientists explain, they spend their lives lying on their backs kicking food into their mouths with their feet. Below the barnacles are the rockweeds, which need to be submerged at least an hour during each tide. Mussels live among the rockweeds, attaching themselves to rock by silken threads. These organisms close their shells when the tide is low and then open them to filter-feed when the tide is high.
- Sea stars make their homes in the subtidal zone and prey upon mussels and sea urchins. Their five-sided body structure consists of an exoskeleton of tiny spines and a mouth in the center of the ventral, or bottom, side. They use the suction of their tube feet to open the shells of their prey. Lobsters also live in this zone, eating almost anything, alive or dead. The tides, currents, and waves stir up nutrients, delivering food to many organisms that attach themselves to the ocean floor. Inside the mud and among the waving grasses, worms, clams, and bacteria digest dead organisms and recycle wastes.

4. Ask your students to complete Activity Page 3 by writing their answers on a blank piece of paper. When they finish, discuss the correct answers with the class. To conclude the lesson, ask students to describe what the diagram might look like at high tide. (Water would be up to the high-tide line, and only the periwinkles would be out of the water.)

ACTIVITY PAGE 3

Imagine you are a nature photographer along the rocky coast of Maine. Watch your step! The rock is slippery and the tide is coming in. The algae and shelled animals pictured here live in special regions where they get just the right amount of water.

1. The picture shows that the water is still at ____ tide.
2. The ____ _____ live closest to the top of the rock, where they only get splashed with water.
3. Nearby, a _____ _____ scurries up the rock.
4. Barnacles, periwinkles, and mussels are covered with a hard _____. This covering keeps them from drying out in the ____. As the tide comes in, the barnacles and mussels become covered with ____ and can filter-feed.
5. The animals of the _____ zone have to be adapted to both wet and dry conditions.
6. Under the water, a sea urchin grazes on a long ribbon of ____.
7. Suppose you want to take a picture of a _____ _____eating a sea urchin. You'll have to look in the ____zone.
8. A ______ in the subtidal zone eats plants, animals, even dead things—anything it can get with its big claws.



GLOSSARY AND ANSWER KEYS

GLOSSARY

Algae A large group of simple plants that are mostly aquatic and lack true stems, leaves, and roots. This group includes the microscopic zooxanthellae that live in the tissues of coral and the twenty-foot-tall kelp that thrive in colder water habitats.

Ecosystem Communities of plants, animals, and microbes interacting with each other and their environment. The term ecosystem describes both the living and nonliving components of an area that interact with one another.

Food chain The transfer of energy, in the form of food, through a chain of organisms, starting with producers and ending with consumers. Every time an organism in the chain is eaten, some of its energy is transferred to the organism that has eaten it.

Food web A series of interconnected, interlocking food chains. Food chains become interconnected because most organisms eat more than one kind of food and therefore are involved in more than one food chain.

Habitat The place where an organism lives.

Invertebrate An animal without a backbone.

Plankton The small floating or weakly swimming plants (phytoplankton) and animals (zooplankton) that are carried by the currents and serve as a food source.

Vertebrate An animal with a backbone.

Zooxanthellae The tiny, single-celled algae that live symbiotically with corals.

Splash zone Portion of rocky shoreline above the high-tide mark that is splashed by waves rather than submerged underwater.

Intertidal zone Portion of rocky shoreline that is submerged during high tide and exposed during low tide.

Subtidal zone Portion of rocky shoreline that is always underwater.

Lagoon Area of shallow water between a coral reef and shore.

Exoskeleton Hard outer covering of an animal without a backbone, such as a crab.

ANSWER KEY TO TAKE-HOME PAGE

Latitude

Coral reef: twenty-five degrees north latitude; Maine coast: forty-five degrees north latitude.

Temperature

Coral reef: about twenty-seven degrees C (eighty degrees F) all year. Temperatures of twenty-four to thirty degrees C (seventy-five to eighty-five degrees F) are best for coral reefs worldwide. Maine: fifteen degrees C (fifty-nine degrees F) in summer and four degrees C (39 degrees F) in winter.

Ocean currents

The Gulf Stream and the North Equatorial Current help keep coral reefs warm. The surrounding cool Labrador and East Greenland Currents as well as Maine's high latitude make the coast of this state relatively cold.

Questions

1. Maine, because it has a higher latitude and winter is severe.
2. The Caribbean Islands, because they are closer to the equator. This location makes for a climate that does not differ from winter to summer, so there is a lot of sunlight all year.
3. If your school's latitude is shown on the map, help students locate it. If not, provide a suitable map so students may learn their latitude. Briefly discuss climate in your region.

ANSWER KEY TO ACTIVITY PAGE 2

1. brain 2. reef crest 3. algae 4. parrotfish 5. food 6. oxygen 7. sea fan 8. barracuda 9. outer 10. lagoon 11. grass shrimp 12. French grunt 13. pink-tipped anemone

ANSWER KEY TO ACTIVITY PAGE 3

1. low 2. rough periwinkles 3. green crab 4. shell, sun, water 5. intertidal 6. kelp 7. sea star, subtidal 8. lobster

RESOURCES

BOOKS

Audubon Society Guide to North American Seashore Creatures. New York: Alfred A. Knopf, 1990.

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PERIODICALS

Marine Conservation News, a quarterly publication of the Center for Marine Conservation, contains a host of student activities on ocean issues. To subscribe, call (202) 429-5609 or write to Center for Marine Conservation, 1725 De Sales Street NW, Washington, DC 20036.

You can read about current oceanography research and issues in the quarterly publication *Sea Frontiers*. For more information, write to *Sea Frontiers*, 400 SE Second Avenue, 4th floor, Knight Centre, Miami, FL 33131.

ELECTRONIC RESOURCES

The web site of the Smithsonian's traveling exhibition *Ocean Planet* (**http://seawifs.gsfc.nasa.gov/**) offers a vast array of text and images related to marine science.

Teachers and students interested in the sights and sounds of marine animals can visit the Electronic Zoo at **http://netvet.wustl.edu/e-zoo.htm**.

Bigelow Laboratory's web site (**http://www.bigelow.org/**) offers information on some current research activities along the rocky shore of Maine.

Visit **http://photo2.si.edu/uw.html** to see how Smithsonian Institution photographers have chronicled underwater scenes from Belize, Panama, and the Florida Keys.

The Woods Hole Oceanographic Institution maintains an extensive research catalog of marine species at **http://www.mbl.edu/html/MRC/specimens.html**.

The U.S. Geological Survey web site (**http://www.usgs.gov/education/learnweb/Maps.html**) offers lesson plans on map reading.

PHOTOGRAPHS

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