

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

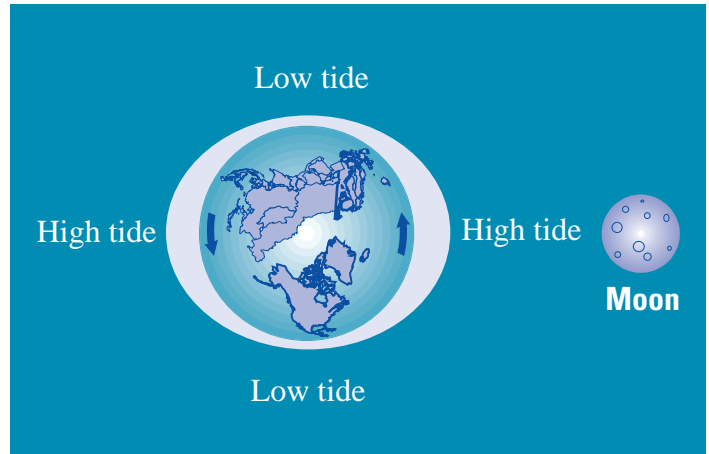
Procedure

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

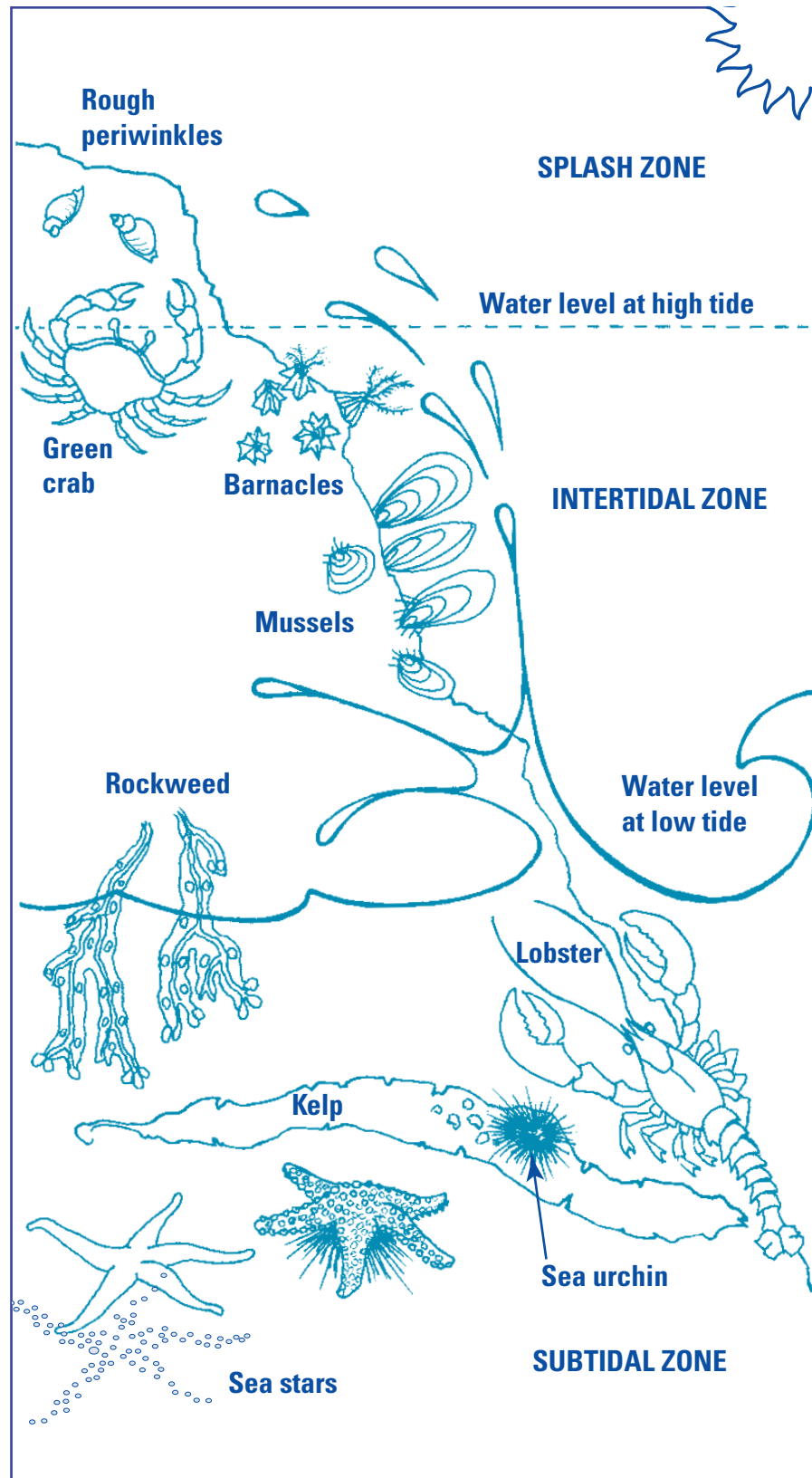
body structure consists of an exoskeleton of tiny spines and a mouth in the center of the ventral, or bottom, side. They use the suction of their tube feet to open the shells of their prey. Lobsters also live in this zone, eating almost anything, alive or dead. The tides, currents, and waves stir up 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