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Life on the Rocks
Classroom Activity Guide

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Life on the Rocks Program Overview

Summary: An engaging program in which students learn the differences between vertebrates and invertebrates and the adaptations which allow tidepool animals to survive. The class uses a wide variety of teaching strategies, from visual to kinesthetic, and allows children access not only to authentic artifacts but also the live animals themselves.

An Introduction to Tidepools: Students will have the opportunity to observe and touch a variety of live tidepool animals while discussing how each animal has adapted to life along the shore. Using the felt board as a visual, the class will learn about tide pool zonation and the strategies that various animals have developed to cope with the harsh environmental conditions.

California State Science Standards Addressed:

Grade 3:

3. Adaptations in physical structure or behavior may improve an organism's chance for survival.

b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.

Grade 4:

2. All organisms need energy and matter to live and grow. As a basis for understanding this concept:

a. Students know plants are the primary source of matter and energy entering most food chains.

b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:

a. Students know ecosystems can be characterized by their living and nonliving components.

Tidepool Theater: The classroom becomes an enormous tide pool where students act out the behavior of invertebrates at high and low tide.

California State Science Standards Addressed:

Grade 3:

3. Adaptations in physical structure or behavior may improve an organism's chance for survival.

a. Students know plants and animals have structures that serve different functions in growth, survival, and reproduction.

Grade 4:

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:

a. Students know ecosystems can be characterized by their living and nonliving components.

Artifacts: Students will examine the Aquarium's collection of invertebrate artifacts.

California State Science Standards Addressed:

Grade 3:

3. Adaptations in physical structure or behavior may improve an organism's chance for survival.

e. Students know that some kinds of organisms that once lived on Earth have completely disappeared and that some of those resembled other that are alive today.

Grade 4:

2. All organisms need energy and matter to live and grow. As a basis for understanding this concept:

b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.

d. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:

b. Students know ecosystems can be characterized by their living and nonliving components.

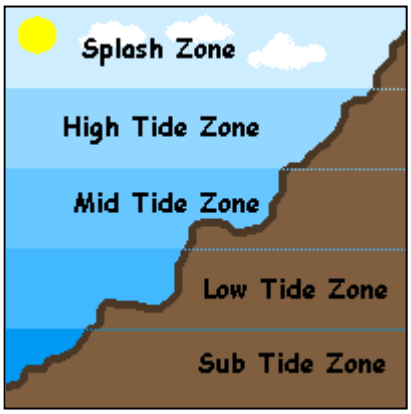
Conservation & Conclusion: Instructors lead a group discussion on conservation and provide age appropriate actions students can take to protect the environment.

Guided Tour: Students will be guided through the Aquarium to apply concepts learned during the classroom portion.

Life on the Rocks Background

Tidepools are a unique kind of habitat on the rocky shores of California. They provide a dynamic challenge to the organisms that live in them because of the daily rise and fall of the tide. A single rock might be exposed to the air in the morning, submerged under water in the afternoon, and surface again in the evening. An infinite variety of invertebrates like anemones, mussels, barnacles, and sea stars have specialized structures, known as **adaptations**, to help them survive the severe nature of tidepool existence, where sunburn, windburn, crashing waves, and airborne predation are daily facts of life.

Every day in San Francisco there are 2 high tides and 2 low tides, at intervals of approximately 6 hours. Because of the Moon's relatively short distance from Earth, its gravity pulls the ocean toward it. The ocean's ever-so-slight lurching toward the Moon is what we call "the tide." The Sun also plays a role in the cycle of the tides. Because of its great distance from the Earth, its enormous mass has a small effect; but when the Sun, Moon and Earth are in a line, tidal amplitude increases (high tide is higher, low tide is lower). When the Sun and Moon are not in a line with the Earth, tidal amplitude decreases. These are called spring tides (as in, "to jump") and neap tides, respectively. The best time to go tide-pooling is during low tide because the most tidepools are exposed to air. If you intend to visit a state park like the Fitzgerald Marine Reserve, park rangers can help you schedule your visit during low tide.



Rocky coastlines that form tidepools are divided into zones depending on how frequently they are exposed to sea water. The area above the highest high tides is called the splash-zone, below that is the high-tide-zone, then mid-, low-, and finally the sub-tidal-zone, where even low tides submerge the area. Here are some of the most recognizable tidepool invertebrates:
Barnacles are sessile crustaceans found throughout the tidal zones, but are heavily concentrated in the high-tide and splash-zones, where even the strongest surf cannot break their cement-like grip on the rocks. Their hard shell protects them from waves, predators, exposure to air, and sunlight. At high tide they open their shell to filter feed on plankton; at low tide they close up for protection.

Mussels are mollusks like snails, but have two shells instead of one to create a seal that retains water when the tide goes out. They filter feed on plankton by siphoning water through their gills at a rate of 2 liters per hour!

Sea Stars hold on to slick rocks with hundreds of sucker-like tube-feet. You may know them as "Starfish," but they are not fish (you have to have a spine to be a fish!). At low tide, sea stars can breathe water retained in their bodies for hours; they also move to the shade to avoid the sun. Sea stars love to eat mussels, which they open with their strong arms; then the sea star oozes out its stomach to eat the soft inside over the duration of 2 days.

Anemones are like a jellyfish turned upside-down. Their stinging tentacles sway in the water to catch food like plankton, shrimp and fish. Anemones close up when exposed to air to prevent drying out, and they collect pebbles on their sticky exterior like a sunscreen.

It's fun to go tide-pooling and turn over rocks to see what they hide, but make sure to put everything back in its place, and resist the temptation to touch the animals. Too much human contact can disturb the animals and deplete the energy they need for survival.

The Wave

Activity Description: Students will explore how tidepool animals are adapted to survive the impact of waves by creating their own tidepool animal and testing it against "the wave".

Objective: Students will understand that tidepool animals have adaptations to survive the impact of waves.

Grades: 3rd – 5th

California State Standards:
Grade 3: 3a, 3b, 5c
Grade 4: 3b, 6c

Vocabulary: adaptation, tides

Subject: Science

Time: 60 minutes

Materials:

- 4lb bag of birdseed, rice, or beans (this your "wave")
- duct tape and freezer bags to reinforce the "the wave" packaging
- shells
- string
- index cards or cardstock
- scissors for students
- masking tape
- "The Wave" worksheet

Teacher Preparation:
To construct your "wave," leave the contents inside the original packaging. Place inside a gallon size freezer bag. Cover the bag with a strong tape. This is to prevent the bag of rice, birdseed or beans from braking open during dropping. Prepare enough copies of the "The Wave" worksheet for each student.

Activity Procedure:

1. Discuss with students the environmental challenges that tidepool animals face (exposure to sun, waves and weather).
2. Use pictures and discuss the many adaptations that tidepool animals have to survive these challenges (hard shells, holding onto rocks, etc). Refer back to what the students learned on their field trip to Aquarium of the Bay.
3. Introduce "the wave" by having a student feel how heavy "the wave" is. Place a shell on the floor and ask students to predict if they think "the wave" will break the shell. From a height of 4-5 feet, drop "the wave" on the shell. Remove "the wave" to see if the shell was damaged (the shell should

remain intact, but have a few extras just in case). Discuss the shape and structure of the shell and how it protects the animal inside from pounding waves.

4. Tell students that they will be creating their own tidepool animals to see if their creature can survive "the wave" using the provided materials (cardstock, masking tape, string). Note: Depending on the availability of the materials, you can ration the materials to each student, i.e., 1 piece of cardstock, 12 inches of tape and, 12 inches of string. Masking tape tends to be used quickly.
5. After the creature is complete, have students complete the "Before" section of the worksheet.
6. Have each student lift "the wave" above their head (approximately 4-5 feet) and drop "the wave" onto their creature.
7. Students should record their results in the "After" section of "the wave" worksheet and answer the analysis question.
8. After each student tests their creature, discuss the shapes or strategies used that were successful or not so successful.
9. Wrap up the activity by reviewing the adaptations.

Adapted from New England Aquarium, Boston Harbor Seaside Educator Guide

California State Science Standards:

Grade 3.

3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:
   a. Students know plants and animals have structures that serve different functions in growth, survival, and reproduction.
   b. Students know examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
5. Investigation and Experimentation
   c. Predict the outcome of a simple investigation and compare the results with the prediction.

Grade 4

3. Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:
   b. Students know in any particular environment, some kinds of plants and animals survive well, some survive less well.
6. Investigation and Experimentations
   c. Formulate and justify predictions based on cause-and-effect relationship.

The Wave Worksheet

Before

Prediction

Do you think your creature will survive?

Why or Why not?

After

Results

What happened when you dropped the wave on your creature?

What would you do differently?

Destination Tidepool

Activity Description: Students will design a travel brochure that discusses the animals that live in tidepools.

Objective: Students will research tidepool ecosystems and use creative writing skills to create a travel brochure.

Grades: 3rd – 5th

California State Standards:
Grade 3: 3a, 3b
Grade 4: 3b

Vocabulary: ecosystem, tides

Subjects: Science, Language Arts, Creative Arts

Time: 2-4 hours

Materials:

- An assortment of travel brochures
- Computer and internet (optional)
- Page layout software (optional)
- Various reference materials about tidepools (books, periodicals, etc)
- Paper
- Colored pencils

Teacher Preparation: Collect a variety of travel brochures to use as examples for students.

Activity Procedure:

1. Have students work in small groups to look through the travel brochures.
2. Discuss with the groups what makes the travel brochures effective (interesting pictures, provides information on the location, does the brochure want to make you visit the place, etc). After the discussion, the students can work individually.
3. Students can choose to create a travel poster or brochure.
4. Write the following questions in a visible location to help guide the students in their design process.
   - What does a tidepool look like?
   - What living and nonliving things will you find there?
   - What does a tidepool food chain look like?
   - What can you do while visiting a tidepool?
   - What should you NOT do while visiting a tidepool?
   - Where would you find a tidepool?

   (Encourage older students to find specific locations of tidepools)

5. Have students research tidepool ecosystems using books or the internet to find information that can be used in their travel brochure.
6. Using the information gathered about tidepool ecosystems, have students create their travel brochure using text and pictures. The brochure can be hand drawn or created using page layout software.

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