Topics
Tides, Waves

Grades
K-2

Site
Indoors

Duration
45 minutes

Materials
- Dishpans (1 per group)
- Images of rocky shore animals from calendars, magazines or websites
- Rocks
- Clay or Plasticine
- Water
- Pitcher or other container to measure water (one per group)
- Plastic tubing to siphon water
- Wave maker (plastic lid or ruler)
- Notebooks or paper
- Pencils or pens
- **Dishpan Tide Pool Observations (page 5)**
- *Splash Zone* CD (optional)

Vocabulary
tides, tide pool, waves

Next Generation Science Standards

Practices

Developing and using models

Core Ideas

ESS3.A Natural resources
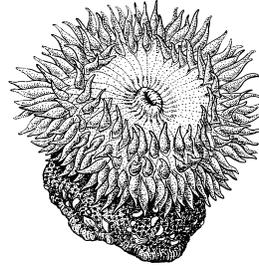
Crosscutting Concepts

Cause and effect

Performance Expectations

See page 4

Dishpan Tide Pool

Focus Question
What happens to rocky shore animals when tides and waves change?

Overview
Students create a model tide pool in a plastic dishpan to discover how tides affect rocky shore animals. As they slowly add water to their model, students observe that various animals in the tide pool are both underwater and exposed to air for various lengths of time. They then make waves and consider how animals may survive the changing tides and wave force.

Objectives
Students will be able to:
- Infer the impact of varying water levels on tide pool animals.
- Understand that tides and waves are different.

Background
Plants and animals living at a rocky shore face many challenges. Fluctuating **tides** require these organisms to spend part of the time underwater and part exposed to the air. **Waves** challenge these organisms to withstand the force and pull of crashing water.

Tides are periodic, short-term changes in the height of the ocean surface at a particular place. Tides are considered long-period waves (wave period is the time it takes for two successive wave crests to pass a given point). Many factors determine the height and timing of the tides. Tides are influenced by the gravitational forces of the moon, sun and Earth, the Earth's rotation and the shape of the shoreline.

At high tide, rocky shore animals are underwater. They compete for food and space while watching out for hungry predators. Anemones and barnacles are tide pool animals. An anemone is an animal that opens like a flower and uses the stinging cells on its tentacles to paralyze small animals. Barnacles are animals that use their feathery legs to sweep the water for plankton and detritus (non-living organic material).

At low tide, the ocean water recedes, leaving **tide pools.** Dozens of different animals and plants live in these pools of water. Others are left out of the water and must find a way to survive. Some animals with shells—like limpets, hermit crabs and snails—can close up tight to stay wet and safe from predators like birds. Others, like some soft-bodied worms, hide under moist rocks until the tide comes in again.

Waves, most commonly caused by wind, crash on the shore. Waves change in force depending on many factors, such as shape of the shore, the weather and tides. As the tide comes in, different parts of the rocky shore are impacted by waves. Animals, like sea stars, have suction cup-like tube feet that allow them to stay stuck to the rocks when forceful waves crash. Other animals, like purple sea urchins, use both their tube feet and their spines to burrow down into rocks, helping them withstand the pressure of forceful waves. Shells are an adaptation various snails have to help protect themselves from waves.

Procedure

1. **INTRODUCE THE FOCUS QUESTION TO THE CLASS.**
   Share the question: *What happens to rocky shore animals when tides and waves change?* You may write it up on the whiteboard or have students add it to their science notebook. Give students time to write their initial thoughts down or discuss with a partner. Depending on their prior knowledge, you may need to spend some time exploring the concepts of tides and waves first.

2. **CONNECT TO STUDENTS' PRIOR KNOWLEDGE OF TIDE POOLS.**
   As a class, talk about students' experiences with tide pools. *Where can we find tide pools in our area?* If possible, go visit a local tide pool. Ask students to share their experiences from visiting a tide pool. Go to www.montereybayaquarium.org and watch a tide pool video. *What kinds of animals live in tide pools? (anemones, crabs, snails, urchins, sea stars and so on)* Tell students they are going to build a model tide pool.

3. **IN SMALL GROUPS, STUDENTS BUILD A DISHPAN TIDE POOL AND MAKE TIDE POOL "ANIMALS".**
   Give each group of students a dishpan and some rocks. Have students use the rocks to make a tide pool in the dishpan. Pass out clay to each group. Have each student mold a small piece of clay into a rocky shore animal. You may pass out images of various rocky shore animals to give students ideas. Have them place their animals in the tide pool. They should compare the location of each clay animal with the placement of other students' animals. *Which animals are higher on the rocks? Which are lower? If water were slowly added to the dishpan tide pool, which animals would be underwater first? How might they survive being both out of water and exposed to air?*

4. **STUDENTS CREATE HIGH TIDE IN THE DISHPAN TIDE POOL.**
   Pass out **Dishpan Tide Pool Observation** sheet to each student. Have them add one pitcher or other container (ensure the container will make a difference in which animals are under or above water) of water to the tide pool at a time. Record the number of animals underwater on the student sheet. As a class, decide if you are going to count an animal partially underwater or if their entire body needs to be underwater to record it on the chart. This protocol will ensure more accurate data.

5. **CREATE LOW TIDE IN THE DISHPAN TIDE POOL.**
   As a class, discuss what happens after high tides in real tide pools. (*water level drops to low tide*) Ask students to predict: *Which animals would be underwater the longest in the dishpan tide pools when the tide goes out? Which animals would be exposed to air first? What body parts and behaviors might the animals have to survive a low tide?* Have them draw low tide on their student sheet and/or record their ideas in their notebooks. Then help students siphon out a container of water at a time. Continue removing water until you reach low tide.

VOCABULARY

Tides: the rising and falling of the seas, usually two high tides and two low tides daily

Tide pool: a pool formed on rocky shores when ocean water levels fall with the tides

Waves: moving swells in a body of water often caused by winds

ELL TIPS

Create a word wall or vocabulary bank for new words to describe components of the tide pool and the animals who live there. Be sure to include pictures to support recognition of the word representing the item.

6. **STUDENTS CALCULATE THE CHANGES IN THE DISHPAN TIDE POOL.**

   Have students estimate, measure and compare the depths of the water in the dishpan at high tide and low tide (high tide may equal four containers and low tide may equal one container depending on the size of the dishpan). Then have them describe the changes in water level and exposure to air. *(the lower the water, the longer the animal is exposed to air)* There is no place to record this on the student sheet, so you may have them write it in their science notebook or in a class table on the whiteboard.

7. **CREATE WAVES IN THE DISHPAN TIDE POOL.**

   Have students set up the dishpan tide pool so it is low tide. Discuss the difference between waves and tides. Give them a ruler or have them make waves with their hands. *How far up does the water hit the rocks? What do you think would happen if the tide were higher? What animals are impacted by the waves?* Have them record their observations.

8. **COMPARE WAVES AT HIGH AND LOW TIDE.**

   Have students add enough water to their dishpan tide pool so it is high tide. Have students draw high tide on the student sheet (be sure to include the animals underwater). Challenge them to make waves again. *How far up does the water hit the rocks? What animals are impacted? How does it compare to those animals affected when it was low tide?*

9. **DISCUSS THE CHALLENGES OF LIFE AT A ROCKY SHORE.**

   Analyze and discuss the students' findings as a class. Discussion questions may include: *What are the effects of tides and waves on tide pool animals? (The higher the tide, the more animals are underwater. The lower the tide, less animals are underwater but they are exposed to the air.) What's the difference between getting splashed with water and being covered with water? Why would rocky shore animals live in different places along the rocky shore? What are some ways rocky shore animals may survive tides and waves? Any specific body part sor behaviors?*

10. **STUDENTS COMPARE THEIR MODEL WITH AN ACTUAL TIDE POOL.**

    As a class, read a book about tide pools or return to www.montereybayaquarium.org and watch a tide pool video. They should be able to answer these questions: *What are tides? (change in the height of the sea) How many tides are there? (depends on the coastline but often two low tides and two high tides daily) What kinds of animals live in tide pools? (anemones, crabs, snails, urchins, sea stars and so on) How are waves and tides similar and different? (See* **Background** *but both are waves though tides are gravity-driven and at consistent times of the day and year. Wave size and timing often depends upon how far the wind has blown, how long the wind has blown and how fast the wind is blowing.)* Have groups think, pair, share with another group: *How is your model similar to an actual tide pool? Different?*

11. **RETURN TO THE FOCUS QUESTION.**

    Now that students have created high and low tide and experimented with waves, have them revisit the question: *What happens to rocky shore animals when tides and waves change?* Students may think on their own or discuss with a partner. Then in their science notebook, you may have them draw a line of learning under which they add to their original thoughts about the question.

CONSERVATION TIPS

Children are more likely to grow up to care about nature when they've experienced it with an adult as a child. Bring children to visit natural areas such as tide pools or a park. Be sure to walk carefully over the animals' homes and to leave things where you found them.

THE MISSION OF THE MONTEREY BAY AQUARIUM IS TO INSPIRE CONSERVATION OF THE OCEANS.

Extensions

- Find *Sea Searcher's Handbook* online at www.montereybayaquarium.org. Go to page 15 to learn more about the rocky shore habitat and activities you can do with your students.

- Sing along with "Tide Pool Heroes" (track 11) on the *Splash Zone* CD. What happened to Rocky and Sandy? Draw pictures of various parts of the story and create a story timeline. What do you think might happen next? You may even make Rocky and Sandy stick puppets. Use the stick puppets when you sing along with "Tide pool Heroes."

Resources

Website

Monterey Bay Aquarium   www.montereybayaquarium.org
Find information about habitats and animals on exhibit.

Recommended Books and Music

In One Tide Pool. Fredericks, Anthony. Dawn Publications, 2002.
Seashore Life on Rocky Coasts. Connor, Judith. Monterey Bay Aquarium, 1993.
Splash Zone CD. Linda Arnold. Monterey Bay Aquarium, 2000. ("Tide Pool Heroes" on track 11)

Standards

Next Generation Science Standards   www.nextgenscience.org
*Performance Expectations*
Relates to K-ESS3-1: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

Relates to 2-ESS2-2: Develop a model to represent the shapes and kinds of land and bodies of water in an area

Common Core State Standards   www.corestandards.org
Mathematics, MP.2
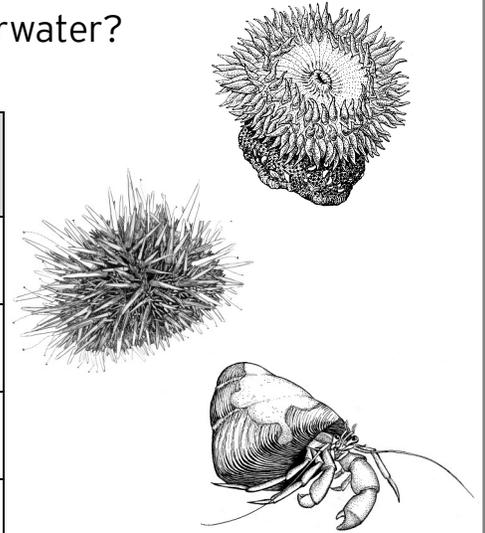Math Practice: Reason abstractly and quantitatively
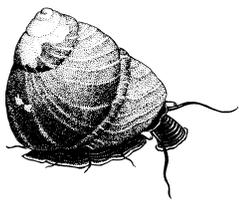
Name: _____

Dishpan Tide Pool

1. Add water to your tide pool. How many animals are underwater? Record below.

Number of containers of water	Number of animals underwater
1	
2	
3	
4	

2. Draw a picture of what you saw at low tide and high tide. How many containers represent low tide? High tide? Include below.

<table>
<tr><th><div align="center">Low Tide
_____ containers</div></th><th><div align="center">High Tide
_____containers</div></th></tr>
<tr><td>

</td><td>

</td></tr>
</table>

3. Conclusion

  As the tide rises, there are _____ animals underwater.
  <div align="center">(more/less)</div>