Ocean Habitats – The Intertidal Zone

Teachers: This lesson contains four activities with discussion questions related to the AFG video clips about ocean habitats. These parts may be used individually or together, depending on the needs of your class and your time constraints.

Note: You can access and view the video clips used in this lesson in the Teacher resources section of the AFG website (www.pbs.org/americanfieldguide/teachers).

Grade Level: 7-9

Background

The Intertidal Zone presents a unique set of challenges for the organisms who live there. Extreme fluctuations in moisture level, heat, salinity, and sunlight make it a habitat suitable for only a few species. However, conditions change dramatically over a very small area, going from only occasionally wet to usually submerged in a matter of a few feet. Therefore, the intertidal zone contains great diversity and has always been fascinating to children who love to collect shells and see the sea creatures who live there.

The activities contained in this unit are designed to enable students to investigate the creatures of intertidal zones and how they've adapted to the conditions that they live in.

Related National Standards

Content Standard C: As a result of their activities in grades 9-12, all students should develop understanding of

- Biological Evolution
    - The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms.
    - Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.

Content Standard C: As a result of their activities in grades 5-8, all students should develop understanding of

- Reproduction and Heredity
    - The characteristics of an organism can be described as a combination of traits. Some traits are inherited and others result from interactions with the environment
- Regulation and Behavior
    - All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.
    - Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.

- An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger is based in the species evolutionary history.

- Diversity and Adaptations of Organisms
  - Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Extension Websites from PBS

- **The Living Edens – South Georgia Island**
  http://www.pbs.org/edens/southgeorgia/class2.html
  An ocean food web activity for middle school.
- **Secrets of the Ocean Realm – In the School**
  http://www.pbs.org/oceanrealm/intheschool/
  This site contains a variety of hands-on activities for Middle School students.
- **The Living Edens – Etosha**
  http://www.pbs.org/edens/etosha/cr_lesson_bighideout.htm
  This is a lesson plan to teach students about adaptations for survival.

Activity 1: Describing Organisms - The Power of the Pen in Science

Time allotted:
20 minutes

Materials:
- A variety of shells (starfish, mussels, gastropods, limpets, etc.) enough for one per student
- Rulers

Objectives:
- Students will practice description skills using marine organisms.
- Students will learn the difficulty of painting a verbal picture.
- Students will develop an appreciation for the descriptive skills necessary for a scientist.

Teacher Instructions

1. Tell students to imagine that they are scientific explorers from around 1750. They have gone on an expedition to an uncharted part of the world and are seeing organisms that no one from their society has ever seen before. They are to try to write descriptions to illustrate the organisms to the people back home.
2. Explain to students that scientists have to rely on descriptive skills when identifying organisms. Especially before the widespread use of photography, biologists had to describe the features of organisms to distinguish between species. Today, careful description still is a foundation of scientific research.
3. Have the class divide in half. They should turn so that half the class has their backs facing the other half of the class. In other words, the two halves are back to back. They will need a pencil and a piece of paper.
4. Explain that they are to write a description of a shelly organism so that another person can draw the organism. They cannot use the name of the organism (like clam) or scientific terms (e.g. muscle scar). You should encourage them to include measurements and specific data about the size and shape. Have a number of rulers handy so that they can measure their shells if they choose to.
5. Distribute a shell to each student. Try to have a variety of types and sizes. Have them start writing.
6. As students from the two opposing sides complete their writing, swap papers and have the students attempt to draw the shell from the verbal description. Be sure that all students get a description to draw from. If you like, you can make it a contest to see whose drawing most closely resembles the original object.

Assessment Ideas

You may want to team with an English teacher to assess the descriptive writing in this activity.

Watch the AFG Video Segment "Oregon Tide Pools" for a tour of intertidal organisms.
Note: You can access and view the video clips used in this lesson in the Teacher Resources section of the AFG Web site (www.pbs.org/americanfieldguide/teachers).

Activity 2: A Virtual Tour of a Rocky Shore

Time Allotted:
15-30 minutes

Materials:
- Infocus Machine or other computer projector
- A copy of the "Rocky Shore Tour" PowerPoint presentation file. (Note: This file can be downloaded at *www.pbs.org/americanfieldguide/teachers/oceans/oceans_sum.html*. If you do not have access to PowerPoint, a web-based version of the presentation is also provided.)

Objectives:
- Students will use discussion to generate ideas about how organisms adapt to their environment.
- Students will learn specific adaptations for the Rocky Intertidal Zone.

Teacher Instructions:

Watch the AFG Video Segment "Northwest Beach – Tide Pools"
Note: You can access and view the video clips used in this lesson in the Teacher Resources section of the AFG Web site (www.pbs.org/americanfieldguide/teachers).

Ask your students to pay attention to specific information regarding conditions in the rocky intertidal zone and to adaptations organisms have for survival.

After watching, make a list of factors that might influence your life if you live in a shoreline area. These might include: salinity, heat, moisture, predation, finding food, sunlight, staying put, etc.

Show the PowerPoint presentation 'A Virtual Tour of a Rocky Shore'. Photos are accompanied by some background information about each species and zone for your information. Encourage students to use this presentation as a focus for discussion. Given the conditions present in each zone, how do they think organisms might survive. They should address the dif**f**erent factors that they listed after watching the video above. The objective of this exercise is for students to brainstorm and to be creative in thinking about adaptations.

Activity 3: Adaptations to Survival in the Intertidal Zone

Time allotted:
15-30 minutes

Materials:
Marine shells – at least one per group of two or three students

Objectives:
- Students will consider the various abiotic influences on organisms living at the edge of the ocean.
- Students will examine organisms to determine adaptations for survival.
- Students will learn that organisms use different strategies for survival.

Teaching Instructions

1. Introduce the idea of adaptations. Ask students to look for adaptations to survival while watching the video.

Watch the AFG Video Segment "Northwest Beach – Tide Pools"
Note: You can access and view the video clips used in this lesson in the Teacher Resources section of the AFG Web site (www.pbs.org/americanfieldguide/teachers).

2. Brainstorm:
    - Discuss factors that organisms living in the intertidal zone have to contend with. Some abiotic factors include changes in temperature, salinity, light, moisture, and wave action. Biotic factors include finding food, avoiding predation, and mating. List these factors on the board.
    - Discuss some of the adaptations referred to in the video
3. Break students into groups of 2 or 3.
4. Provide each group with the shells of one or two marine organisms.
5. Ask students to think about the factors they heard about in the clip and listed during the discussion. What special features do they think this organism has that enable it to survive in the intertidal zone.
6. You may want to have students share their results with the class. Ask them to choose one organism or one unique adaptation to explain to the group.

Extension Activities

Students might conduct research to discover more about the organisms they have selected. For information regarding Intertidal Zone organisms, try the following websites:

- http://web.mit.edu/corrina/tpool/intro.html
- http://www.enchantedlearning.com/biomes/intertidal/intertidal.shtml
- http://oceanlink.island.net/oinfo/intertidal/intertidal.html
- http://neptune.spaceports.com/~marine/

Activity 4: Hold On to Your Home!

Time Allotted:
One 45-minute class period

Materials:
- Student instruction sheet (attached)
- Observation worksheet (attached)
- An assortment of rocks, big and small, enough for each group to build a pile at one end of their tray.
- Sand
- Small Trays with sides that allow them to hold sand 9x11 is a good size.
- Small shells of different sizes and shapes or small objects like paper clips, coins, toothpicks, marbles, and monopoly houses. Either way, providing a small object with a suction cup will be useful.
- Large cups or beakers (100ml minimum) for creating storm waves

Objectives:
- Students will compare rocky substrates with sandy substrates to determine the difficulties of living in each environment.
- Students will experiment with models to determine how adaptations enable organisms to survive.
- Students will understand that organisms have a variety of adaptations to protect them from a variety of influences.

Background Information

Adaptations that are necessary for life on a sandy beach are different from those necessary for life on a rocky coastline. In both areas, one of the great challenges is to hold on but the techniques are much different. In this activity, students will experiment with sand, rocks, and water to determine some methods useful for "holding on" in each environment.

Watch the AFG Video Segment "Chincoteague Wildlife Refuge – Beach and Dunes"
Start at the beginning and stop after hearing "very common in the Atlantic Ocean offshore".

Watch the AFG video clip "Acadia National Park, Maine – Tide Pools"
Note: You may choose to skip this video if you watched a video clip as part of Activity 2.

Note: You can access and view the video clips used in this lesson in the Teacher Resources section of the AFG Web site (www.pbs.org/americanfieldguide/teachers).

Teacher Instructions

1. Divide the class into groups of 3 or 4.
2. Each group should get a tray with sand, some rocks, and a variety (at least four or five) of small organisms or objects representing organisms.
3. Their goal is to experiment with the variety of organisms on each of the different substrates to see what adaptations might be useful for living on there.
4. In the first part of the student instructions, they are asked to brainstorm factors related to survival in a shoreline area. If you have done Activity 2 in this lesson, they should be able to do this on their own. If not, you may want to do that part as a class after the video clip and before having the students work on their own.
5. Students will build models of the shoreline. They should pile sand or rocks at one end of their tray and they should fill the tray about half way with water at the other end to represent the ocean. They will then experiment with the different organisms as described in the student instructions. They should then clean the sand out of the tray and repeat with the rocks.
6. Encourage them to try different methods to get organisms to stick and be prepared to provide extra materials such as tape or string. They might bury them, orient them differently, tie them down, use tape, etc. Remind them that a sandy beach often has thousands of feet of sand below it, so a limitation of their model is that the tray has a bottom. They may not use the bottom of the tray to attach their organisms.

Assessment

Answers to the Analysis Questions:

1. On a sandy coast, the substrate is constantly shifting while on a rocky coast it is not. However, on a sandy coast, the sand is able to absorb some of the energy of the waves while the rocks cannot.
2. Answers will depend on the organisms you use. Things that can stick will do better in rocky areas, things that can dig will do better in sandy areas.
3. Storm waves can wash away the sand or will increase the energy present on the rocks, uncovering or unsticking many organisms. This is often reflected by the increase in shells at the beach after high waters.
4. Answers will vary. For example: Once an organism can avoid being washed away, it still has to deal with other influences. For instance, if the students buried an organism, how does it avoid predation? It won't be able to move quickly but the fact that it is buried gives it some protection. It might get food by sticking out a tongue-type organ that allows it to filter the water. Etc.

Student Instructions
Hold On to Your Home!

Imagine you are a small, shelly creature at the coast. You live in a place called the intertidal zone, or the area between the lowest low tide and the highest high tide. As an intertidal creature, what are some challenges you might have to deal with? Make a list here:

_____, _____

_____, _____

_____, _____

Coastlines generally can be divided into two types: sandy and rocky. In this activity, you are going to experiment with each type to determine some adaptations that can help you survive there. Your challenge in this activity is to find ways to help the creatures stay put.

Materials:

Be sure you have the following materials ready.

- Tray
- Beaker or cup
- Sand
- Rocks
- Water
- Various organisms or models of organisms

Procedure:

1. Use the attached observation worksheet for this activity. List each of your organisms in a separate row. Use enough rows so that you can test each of your organisms in both a sandy coast and a rocky coast (for instance, if you have five organisms, you will need ten rows). You may need to use an additional worksheet in case you do additional tests.
2. Place the sand in the tray. Mound it at one end so that it looks like a beach. Add water to the other end so that it fills the tray about half way.
3. Gently swish the water around by lifting one end of the tray. This is to simulate waves. Watch what happens to the sand while you are creating waves. Write your observations in the space provided on the worksheet.
4. Experiment with the different organisms to see how they might avoid being washed away on a sandy beach. In particular, you should observe how the differently shaped organisms might use different methods to stay put. As you place the organisms, gently swish the water to observe what happens to them. Write your observations in the table on the worksheet.
5. Place the organisms in their most stable positions, take a beaker or cup of water, and slosh it onto the beach. This is to represent storm waves. Did the organisms behave differently with the sudden motion?

6. Take the sand out, place rocks in the tray to simulate a rocky coast and repeat steps 2-5. Write your observations of what happens in the space provided on the worksheet.
7. Be sure to clean up your station before finishing the exercise.

Analysis Questions:

1. What were the differences in trying to survive in a rocky coast versus a sandy coast?
2. Were some organisms better equipped to survive on a rocky coast than on a sandy coast?
3. How did the storm wave affect the organisms? How does this relate to what really happens on beaches during storms?
4. Choose one of the organisms that you found was able to stay put fairly well in one of the experiments you did. How might this organism deal with some of the other factors that it might face on a coast. For instance, how could it adapt to avoiding predation, to finding food, etc.

Observation Worksheet

Sandy coast observations:

Rocky coast observations:

Organism	substrate (rock or sand)	What I did	What happened	Questions this raised