NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 45 MINS

Deep-Sea Ecosystems: Extreme Living

Students discuss how they and other organisms adapt to survive in different environments. They discover the characteristics of deep-sea extremophiles that help those organisms survive in several deep-sea ecosystems.

GRADES

3 - 5

SUBJECTS

Biology, Ecology, Earth Science, Oceanography, Geography, Physical Geography

CONTENTS

14 Images, 1 Video, 2 PDFs

OVERVIEW

Students discuss how they and other organisms adapt to survive in different environments. They discover the characteristics of deep-sea extremophiles that help those organisms survive in several deep-sea ecosystems.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/deep-sea-ecosystems-extreme-living/

DIRECTIONS

1. Activate students' prior knowledge.

Ask: *What do living organisms, like you, need to survive?* Elicit responses such as: sunlight/energy, freshwater, food, and shelter. Then ask: *How do you make sure that you have those things to survive?* Responses will vary, but make sure students understand how living organisms, including them, adapt to their environment to survive. Provide examples of how

students adapt to their environment, such as wearing winter clothes, putting on sunscreen, staying indoors, going to the store, and eating a variety of foods. Explain that an ecosystem is made up of living and non-living things in a particular environment. Ask: *How would you describe the ecosystem in which you live? What are some other ecosystems you have heard of? Where are they? What are their key characteristics? Are you adapted to survive in those habitats? Why or why not?* Summarize students' responses on the board. Then ask: *Are there any habitats on the planet where you think organisms are not adapted to survive? Where? Why?* Show students the blank or labeled Deep Sea Ecosystem illustrations and ask them to make observations about the environment. Elicit from students that certain habitats, like the deep ocean, seem to lack necessary sunlight, freshwater, food, and shelter.

2. Have students watch the National Geographic video "Into the Abyss."
Ask students to pay close attention to the characteristics of the ecosystem and the types of organisms that they see in the video as they watch. Afterward, independently or as a class, ask students to answer the following questions:

- *How would you describe the ecosystem in the video?*
- *What were some of the living things that make up the ecosystem?*
- *What were some of the non-living things that make up the ecosystem?*
- *Where do you think this ecosystem might be found?*
- *Did you expect to find organisms living there? Why or why not?*
- *Did any of the organisms you saw look like things you have seen before? Which ones?*

Elicit from students the needs and sources of sunlight/energy, freshwater, food, and shelter. Briefly discuss how the living organisms, including the humans, might be adapted to the non-living conditions of the ecosystem, such as extreme darkness, depth, cold, high pressure, lack of habitat, and lack of food/energy.

3. Ask students to match ecosystem, challenge, and adaptation descriptions to photos.

Distribute a copy of the worksheet Deep Sea Ecosystem Cards to each student. Invite a volunteer to read aloud a description of an ecosystem from an ecosystem card. Explain that you are going to display pictures of six different deep sea ecosystems. Scroll through the Deep Sea Ecosystems photo gallery. Ask students to tell you to stop when you reach the picture that was described by the ecosystem card. Ask: *Which ecosystem is this? How do you know?* Make sure students use the descriptive clues to justify their answers. Repeat this process with the remaining five cards. Next, distribute a copy of the worksheet Deep Sea

Challenge and Adaptation Cards to each student. Invite volunteers to read aloud each card until all descriptions have been read. Show students all six organism pictures. Scroll through each organism picture in the Deep Sea Organisms photo gallery, stopping at each one. Ask: *Which challenge is this organism adapting to?* Note that an organism may adapt to more than one challenge at once. For example, jellyfish adapt to high pressure levels and the dark.

4. Have students make connections between ecosystems and adaptations.
Have a class discussion to establish connections between the different ecosystems, the challenges the ecosystems present, and the organisms' adaptations to meet those challenges. Ask: *Which organisms do you think live in which ecosystem? Why?* Encourage students to make connections between the descriptions of the environments, the challenges, and the adaptations. As students share their ideas, discuss how the organism is adapted to its surroundings, or what adaptations might be necessary to live in the ecosystem.

Modification

You can also have students do this activity in small groups. For each group, print one copy of each worksheet on card stock and cut out the cards. One at a time, project and scroll through the two photo galleries, providing groups with enough time to read aloud cards and identify descriptive clues before matching descriptions to photos.

Informal Assessment

Check students' comprehension based on their responses to the following questions:

- *Why is it hard for organisms to survive in the deep sea?*
- *What are some of the adaptations organisms have had to develop in order to survive?*

Extending the Learning

Have students draw and label their own imaginary organism that lives in one of the deep sea ecosystems they learned about, and their creature's adaptations. Post students' work in the classroom for the whole class to see and explore.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- Oceanography

Geography

- Physical Geography

Learning Objectives

Students will:

- compare and contrast the basic things that organisms need to survive in a variety of ecosystems, including sunlight/energy, freshwater, food, and shelter
- identify and describe a variety of deep ocean organisms and the ecosystems in which they live
- describe how different deep ocean organisms have adapted to survive the extreme conditions of deep sea ecosystems

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Multimedia instruction
- Visual instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Critical Thinking and Problem Solving

- Critical Thinking Skills
  - Analyzing
  - Understanding

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

• **Standard 7:**
The physical processes that shape the patterns of Earth's surface
• **Standard 8:**
The characteristics and spatial distribution of ecosystems and biomes on Earth's surface

NATIONAL SCIENCE EDUCATION STANDARDS

• **(5-8) Standard C-4:**
Populations and ecosystems
• **(5-8) Standard C-5:**
Diversity and adaptations of organisms
• **(K-4) Standard C-1:**
The characteristics of organisms
• **(K-4) Standard C-3:**
Organisms and environments

OCEAN LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

• **Principle 5d:**
Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (such as symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.
• **Principle 5g:**
There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Pencils
- Scissors
- White card stock

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Projector, Speakers
- Plug-Ins: Flash

PHYSICAL SPACE

- Classroom

GROUPING

- Large-group instruction

OTHER NOTES

In February 2012, scientific research was published contradicting the previously accepted belief that extinct hydrothermal vents are dead.

BACKGROUND & VOCABULARY

Background Information

The ocean is one of the least explored and understood frontiers on the planet. Many scientists use the cliché that we know more about the surface of the moon than we do about our own planet's oceans. Because of the extreme pressure in the deep ocean, scientists have historically had great difficulty in exploring the ocean depths. For a time, many believed that little lived outside of the photic zone—the top few hundred feet where sunlight can penetrate. However, during an expedition in the late 1960s, the ALVIN submersible plummeted to the ocean depths when the cables suspending it snapped. When the sub was

retrieved almost a year later, scientists discovered that food left on board was still edible. This changed scientists' thinking about the processes that occur on the ocean floor and allowed for new ideas about what types of organisms, habitats, and adaptations might be found below the photic zone. Today, we know that life can occur without light, and many ecosystems are supported in ways other than plant-based photosynthesis. For example, hydrothermal vents are based on chemosynthesis, in which organisms get their energy from sulfur and other "toxic" chemicals.

Despite these discoveries, the deep ocean remains vastly unexplored. Nearly every dive or sampling reveals new species, sometimes even new families or phyla. And yet, the open and deep ocean environments are some of the planet's most deserted areas. A submarine can travel along the ocean floor and not see visible life for miles; a ship can sail on the ocean surface for days without seeing visible life.

Organisms have found ways to adapt to the most extreme environments all over the planet, and the extreme ocean habitats of the deep sea offer some of the best examples of those adaptations. Many organisms have extremely large eyes to maximize their intake of light. Others have no eyes at all because there is not enough light to see. Often, animals have large mouths and jaws that unhinge so they can eat prey that is larger than they are. The majority of the deep sea is so sparsely populated that food is hard to find; a predatory animal has to be prepared to eat whatever it comes across. Many animals are red, pink, or black to blend into the darkness. Others have intricate photophore, or light, patterns on their bodies. Scientists think the organisms use these lights to communicate with their own species for warnings or mating, or to scare off predators. Other adaptations include the ability to chemosythnesize using heavy metals, and to withstand extreme temperatures and pressures.

Prior Knowledge

["animals' habitat needs and adaptations"]

Recommended Prior Activities

- Habitat Needs

Vocabulary

Term	Part of Speech	Definition

Term	Part of Speech	Definition
adapt	*verb*	to adjust to new surroundings or a new situation.
adaptation	*noun*	a modification of an organism or its parts that makes it more fit for existence. An adaptation is passed from generation to generation.
camouflage	*noun*	tactic that organisms use to disguise their appearance, usually to blend in with their surroundings.
ecosystem	*noun*	community and interactions of living and nonliving things in an area.
habitat	*noun*	environment where an organism lives throughout the year or for shorter periods of time.
organism	*noun*	living or once-living thing.
predator	*noun*	animal that hunts other animals for food.
prey	*noun*	animal that is hunted and eaten by other animals.
submersible	*noun*	small submarine used for research and exploration.

For Further Exploration

Images

- Census of Marine Life: Image Gallery

Websites

- The Encyclopedia of New Zealand: Deep-Sea Creatures

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