NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 1 HR 30 MINS

Oil's Impact on Black Mangrove Trees

Students learn about the basic ecology of mangrove ecosystems. They build a model to understand how a black mangrove breathes in an anoxic environment. Then they simulate an oil spill in their mangrove model to investigate how the black mangrove tree is affected by oil.

GRADES

6 - 8

SUBJECTS

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

CONTENTS

1 Link, 6 Images, 3 PDFs

OVERVIEW

Students learn about the basic ecology of mangrove ecosystems. They build a model to understand how a black mangrove breathes in an anoxic environment. Then they simulate an oil spill in their mangrove model to investigate how the black mangrove tree is affected by oil.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/oils-impact-black-mangrove-trees/

DIRECTIONS

1. Build background on mangrove ecology.

Project the MapMaker Interactive and use it to geo-locate the Tropic of Cancer and the Tropic of Capricorn. Introduce climate in the tropics. Explain to students that the tropics are a climate region generally found between the Equator and the Tropic of Cancer and the Tropic of Capricorn. There are 70 species of mangroves that live in the tropics and also the subtropics. Explain to students that the subtropics are a climate region found north of the Tropic of Cancer and south of the Tropic of Capricorn. The subtropics are between 20-40 degrees latitude in both hemispheres. There are three primary species of mangroves that live in the tropics and subtropics in the United States. Distribute copies of the handout Mangrove Biology to each student and have students read it independently or in small groups. Then display the photo gallery of mangrove trees. Use the images to point out the different features of the red, white, and black mangrove trees that live in the tropical and subtropical regions of the world.

2. Preteach the vocabulary.

Make sure students know the terminology for the different parts of a mangrove tree. Write on the board the vocabulary terms *anoxic*, *drop roots*, *lenticels*, *pneumatophore*, *prop roots*, *sacrificial leaf*, *salt excluder*, *salt excreter*, *sediment*, and *substrate*. Use the definitions from the handout and the Background & Vocabulary tab to help familiarize students with the terms.

3. Introduce the model task.

Tell students that they will create a model of a black mangrove tree in a mudflat environment. Explain that they will learn how a mangrove gets air in a healthy environment and explore how oil affects mangrove health. Divide students into small groups of 3-6 students each and have them move to their assigned stations where materials are set out. Distribute a copy of the worksheet Mangrove Demonstration and Observation to each group.

4. Have each small group create a model of the black mangrove ecosystem.

- Have students place a mixture of sand and soil into the bottom of their pan. The pan should be half filled. Have students pour water into the pan, covering all of the soil/sand

mixture. The mixture should absorb the water. Keep filling with water until the mixture is saturated with water and there is ¼ inch of water over the soil/sand mixture.

- Ask students to group six straws together—placing the flexible portions of the straws at the bottom. Have students use 1-3 rubber bands to secure the straws above the flexible portion to create the "trunk" of their tree. Have students secure a piece of tape over each of the straws' openings near the bend. Have students use pins to poke 8-12 holes in each straw from the flexible section down. Most of the holes should be made in the side of the straws, with a couple at the bottom through the tape. Explain that these holes simulate the lenticels on the roots of the black mangrove tree. Ask students to think about why the model represents the habitat of a black mangrove, rather than a white or a red mangrove—and why black mangroves are especially vulnerable to the oil spill.
- After the holes have been made, have students fully stretch and then bend the straws so that the "roots" of the tree are sticking upward like the pneumatophores or snorkel roots of the black mangrove tree.
- Have each group choose one student to try to suck air through the top of the "tree." Ask the student to describe to the other group members how the air flowed through the trunk. Have them write down their observations on their worksheet as breathing trial 1.
- Have students carefully "plant" their tree in the sediment in the tray. Instruct them to keep the lenticels of the snorkel roots as clear of dirt and water as possible. Explain that this is how a black mangrove tree "breathes" in an anoxic environment. Have the same student suck through the straws again to ensure that the snorkel roots are still working. Ask the student to describe how the air flowed through the trunk to the other group members. Instruct the group to write down their observations on their worksheet as breathing trial 2.
- Prompt students to gently rock their tray back and forth to simulate waves and tidal changes. Explain that the rocking should cause the water to slosh but should be gentle enough to leave the sediment in place. Have the same student suck through the straws again to ensure that the pneumatophores are still working. Ask the student to describe how the air flowed through the trunk to the other group members. Have the group write their observations on their worksheet as breathing trial 3.

5. Have students simulate an oil spill.

Tell students that they will simulate an oil spill. Have students measure six tablespoons of vegetable oil and use a fork or a whisk to mix it with 5-6 drops of food coloring and two tablespoons of molasses. Explain to students that the oil and molasses represent crude oil and the food coloring represents chemicals trapped inside of the oil. Make sure they understand

that the food coloring will not mix completely with the oil. Next, have students carefully pour half of the oil substance into the water. Ask students to gently rock their tray back and forth to simulate waves and tidal changes. Have students observe whether or not the oil is sticking to the roots of the tree. Explain that the texture of their model tree is smooth; plastic is not as rough and porous as real mangrove roots. In a real mangrove ecosystem, the oil would stick to the roots of the tree like glue. Ask students to have one group member rub the pneumatophores with the oil mixture until it thickly covers the roots. Have the same student that has been sucking through the straws try to do so again. Ask the student to describe how the air flowed through the trunk to the other group members. Have the group write their observations on their worksheet as breathing trial 4.

6. Discuss the ecological implications of oil in a mangrove environment.

Ask: *What do you think will happen to a mangrove tree that has roots covered in oil?* Then explain to students that dishwashing soap is an effective way of removing oil from wildlife. Ask:

- *After learning about mangrove environments, would it be possible to remove oil from all pneumatophores of all mangrove trees with soap?*
- *If oil contaminates a large mangrove ecosystem, what could it mean for the organisms that depend on the mangrove trees for food and substrate?*
- *If mangrove trees stabilize sediment and keep islands intact, what will happen if lots of mangrove trees die?*
- *What is the best way to save a mangrove forest during an oil spill?*

Explain to students that the best way to keep mangroves and other estuary environments safe during an oil spill is to keep the oil out. Cleanup teams use booms as barriers to try to keep oil out of fragile and vulnerable ecosystems like mangrove forests.

7. Have students make connections between the mangrove simulation and the Gulf of Mexico oil spill.

Download and display for students the map Gulf of Mexico: A Geography of Offshore Oil from the October 2010 issue of *National Geographic* magazine. Explain to students that the shorelines of Louisiana, Alabama, Mississippi, and Florida are made up of beaches, estuaries,

and mangrove environments. Ask students to read the map legend and identify where they would find mangroves. If students have difficulty, explain that anywhere the map key shows coastal wetlands, in light green, there could be ecologically important mangrove habitats. Ask: *How close are these areas to the* Deepwater Horizon *and other oil platforms?* Explain that people have made efforts to keep oil out of these environments by placing booms on the shoreline and by skimming, burning, and dispersing oil in the open ocean. There is no way to keep all oil out of all of these ecosystems from an oil spill that is as big as this spill. There are and will continue to be ecological consequences like the ones they witnessed from the simulation of the oil spill for years to come. Encourage students to download and use the Layers of Life diagram that accompanies the oil spill map to generate hypotheses about ecological impacts.

8. Encourage students to reduce their oil use and the threat of future oil spills.

Explain that after the spill, cleanup crews worked throughout the Gulf to skim, burn, and disperse oil. Booms were placed as barriers throughout the Gulf coast to prevent oil from entering fragile ecosystems. Encourage students to reduce their oil use. Explain that this can reduce the need for oil and the threat of future oil spills. Students can reduce their use by carpooling, not buying petroleum-based products, buying locally whenever possible, avoiding disposables, recycling plastics, and using less electricity. Have students brainstorm more solutions. Encourage students to share what they have learned, reminding them that education about these issues is the best way to make a change in energy consumption.

Informal Assessment

Observe student participation during the simulation portion of this activity. Ask questions about mangrove trees, the lenticels, and the oil as you circulate among small groups. Ask: *How do mangrove trees get air in anoxic environments? How do you think oil will affect the health of mangrove ecosystems? Why are mangrove trees important for the health of the ocean?* Evaluate data sheets based on accuracy of results.

Ask each student to independently write a reflection in response to the following prompt: *What did this simulation teach you about the implications of oil in a mangrove environment?* Collect and assess students' reflections.

Extending the Learning

Have students use the National Oceanic and Atmospheric Administration (NOAA) website to research the amount of oil that was spilled in the Gulf of Mexico from the Deepwater Horizon incident. Encourage them to find information about how much spilled oil was:

- collected by skimmers
- burned
- absorbed
- dispersed

Ask: *Where is the oil now? What long-term implications could this have for the ecosystem in the Gulf?*

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- Oceanography

Geography

- Physical Geography

Learning Objectives

Students will:

- geo-locate the Tropic of Cancer, Tropic of Capricorn, and the location of the Deepwater Horizon oil spill
- describe the distinct features of red, white, and black mangrove trees
- explain how mangrove trees take in air in an anoxic environment
- describe some of the short-term effects of oil entering into a mangrove environment and hypothesize about long-term effects

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Discussions
- Hands-on learning
- Lab procedures
- Reading

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Learning and Innovation Skills
    - Communication and Collaboration
- Critical Thinking Skills
  - Analyzing
  - Applying
  - Understanding
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

- **Standard 14:**

How human actions modify the physical environment

NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard A-1:**

Abilities necessary to do scientific inquiry

- **(5-8) Standard C-4:**

Populations and ecosystems

- **(5-8) Standard C-5:**

Diversity and adaptations of organisms

OCEAN LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

- **Principle 6e:**

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- 10 lb. bag of moist topsoil
- 10 lb. bag of sand
- Bendable straws
- Deep-dish lasagna pan
- Pencils
- Forks or whisks
- Molasses
- Red food coloring
- Straight pins
- Tablespoons
- Rubber bands
- Transparent tape
- Vegetable oil
- Water
- Writing paper

REQUIRED TECHNOLOGY

- Internet Access: Optional

- Tech Setup: 1 computer per classroom, Projector

PHYSICAL SPACE

- Classroom

SETUP

Before starting the activity, set up a station for each small group with all necessary materials.

GROUPING

- Large-group instruction
- Small-group instruction

BACKGROUND & VOCABULARY

Background Information

The health of mangrove ecosystems is directly connected to the health of other ocean ecosystems. Mangrove trees build new islands, stabilize sediment, prevent erosion, reduce wave action, filter water, provide habitat, and serve as nursery grounds for many species of marine organisms. When oil enters into mangrove environments, it clogs the breathing pores located on the snorkel roots of black mangrove trees. These trees then suffocate and die. Keeping oil out of mangrove ecosystems is essential to the health of the ocean.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
anoxic	*adjective*	no oxygen in the environment.
climate	*noun*	all weather conditions for a given location over a period of time.
drop root	*noun*	root that drops down from the branch of a red mangrove tree and sets shoots into the ground.
ecology	*noun*	branch of biology that studies the relationship between living organisms and their environment.
hemisphere	*noun*	half of a sphere, or ball-shaped object.
latitude	*noun*	distance north or south of the Equator, measured in degrees.
lenticel	*noun*	small opening on the exposed roots of a tree that allows the plant to take in air to send to the rest of the root system.
mangrove	*noun*	type of tree or shrub with long, thick roots that grows in salty water.
ocean	*noun*	large body of salt water that covers most of the Earth.
pneumatophore	*noun*	specialized root that grows upward above water or mud into the air. Also called an aerial root.
prop root	*noun*	root of the some plants that grows above ground to help support the stem or trunk.
sacrificial leaf	*noun*	leaf of the mangrove tree that absorbs salt from the rest of the tree and eventually dies, allowing the tree to maintain a lower level of salinity.
salt excluder	*noun*	organism that will not allow salt to enter into itself.
salt excreter	*noun*	organism that pushes salt out through its pores.
sediment	*noun*	underwater soil.
species	*noun*	group of similar organisms that can reproduce with each other.
substrate	*noun*	base of hard material on which a non-moving organism grows. Also called substratum.
subtropical	*adjective*	bordering the tropics, just north of the Tropic of Cancer and south of the Tropic of Capricorn.
tropics	*plural noun*	region generally located between the Tropic of Cancer (23 1/2 degrees north of the Equator) and the Tropic of Capricorn (23 1/2 degrees south of the Equator).

For Further Exploration

Articles & Profiles

- National Geographic News: Gulf Oil Spill Anniversary: Resilience Amid Unknowns

Interactives

- National Geographic Magazine: Interactive—Layers of Life
- National Geographic Magazine: Interactive Map—The Geography of Offshore Oil

Maps

- NG MapMaker Interactive: Climate Zones

Websites

- National Geographic Environment: The Ocean—Gulf Oil Spill
- National Geographic Animals
- National Geographic Environment: The Ocean

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