Deep Earth Academy
CONSORTIUM FOR OCEAN LEADERSHIP

Activity of the Month

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Activity of the Month – June, 2009

A "Bit" of Engineering

Summary

This Earth science coring activity provides an opportunity for students to look at ocean drilling through the eyes of the driller and the engineer. Student teams test three different drilling tools on a variety of ocean bottom substrates to discover which type of drill allows them to retrieve the most intact core for study.

Learning Objectives

Students will be able to:

- Explain that engineering requires experimentation and problem solving.
- Choose and experiment with or model a device to remove a core sample with minimal disturbance.
- Describe a core sample.

National Science Education Standards

A. Science as Inquiry

D. Earth and Space Science

E. Science and Technology

Ocean Literacy Principles

1. The Earth has one big ocean with many features

7. The ocean is largely unexplored

Target Grade: 5–8 (can be modified for earlier grades)

Time: 45 minutes

Materials

3-4 plastic buckets, deep aluminum pans, or other containers

Colored substrate:

2½ cups flour
1 cup salt
1 cup water
Food coloring

Moist sand or schoolyard dirt

4–5 peeled oranges

paper towels

Several drilling and coring devices: Plastic tubing (size of a turkey baster), clear jumbo plastic straws, and slim colored straws

Thin coffee stirrers (for core removal)

Colored pencils

Drawing paper and IODP drill site map (with 3–4 starred/selected sites)

Optional: *Internet access and/or printouts of core photos, coring tools, and career profiles at www.deepearthacademy.org*

Background

The *JOIDES Resolution* is an amazing ship that is almost completely self-sufficient. The ship contains all the necessary equipment to drill into the ocean floor for samples of rock and sediment: a derrick, drill pipe, drilling tools, and drill bits. Once the cylindrical core sample arrives on the rig floor, the drill crew passes the 10 m core to technicians who carry it to the catwalk where it is cut into 1.5 m sections and labeled for the laboratory.

After the core is brought up on deck, the technicians notify the rest of the crew by yelling, "CORE ON DECK!" Technicians handle the core very carefully so they do not disrupt the contents. Finally, the cylindrical core sections are cut in half lengthwise so that lab techs and scientists can take samples and write descriptions of the contents in hopes of discovering new information. But who brings the core from the sea floor to the deck and who figures out how to drill? Drillers, drilling technicians, and engineers.

What to do

Preparation

1. Use the colored substrate recipe to make 2-3 different colored ocean bottom substrates. Store in an airtight container or plastic Ziploc bag. It is OK if the food coloring doesn't mix completely.
2. Moisten the sand or collect some dirt from the schoolyard for additional substrate.
3. Layer different combinations of the substrates in each of the containers, including the orange peel. Label each station with an IODP drill site number found on the IODP drill site map.
4. Take 10 minutes to try the drilling procedure below before class!

Engage

1. Get students excited about and familiar with scientific ocean drilling and the JR:
   - Explore the *JOIDES Resolution* website at *http://joidesresolution.org/* and use the Get Onboard the JR Using the *JOIDES Resolution* Website activity at *www.oceanleadership.org/files/pdf-files/Get_On_Board.pdf*.
   - Use the drilling videos available at *joidesresolution.org/node/52* to show how coring is done.
   - Use A Treasure Chest of Cores to show students pictures of real cores. Visit *http://www.oceanleadership.org/classroom/treasure_chest.html*.
   - Use Core on Deck at *www.oceanleadership.org/files/activities/CORE_ON_DECK.pdf* to show students what happens to cores once they get onboard the JR.
2. Discuss the need for problem solving when coring the ocean floor. Ask students the following questions:
   - Why it is important to keep the core intact?
   - What would happen if the sediment being drilled in is too hard or too soft?
   - What would happen if the drillers and/or technicians were careless with a cored sample?

Explore

Explain to the students that they will be drilling their own core samples, simulating the procedure of producing good core samples that can be described accurately by scientists (students). And remember, a driller cannot see what he is drilling into.

Drilling Activity

1. Show students the IODP drill site map . Have each student select where he/she would like to drill. Explain that the goal is to figure out the best tool and method for collecting cores for study.
2. Separate students into groups based on their selected drill sites. In their small groups, ask students to discuss what they expect to find at their drill site based on location and surroundings.
3. Give each group all three drilling tools (plastic tubing, jumbo straw, slim straw) and a coffee stirrer. Have students hypothesize which tool would be appropriate for drilling.
4. Have each group designate a driller who will use all three tools to drill. Once the cores are collected, allow students to remove the cores (if possible) and draw and describe their data. It is important that students not bend their tools while drilling! A bend represents a break in the drill bit or drill pipe! Twisting the drilling device enhances capture.

Explain – Drilling Analysis

Remix the groups so students can share and discuss their results – focusing on the following questions (groups should have students from different drill sites):

a. Which tool worked most efficiently at your drill site? Why?

b. How did you use each tool? What method did you use (shove, twist)?

c. How did the drilling process affect the core sample? Was there any damage?

d. How are the core samples from different sites similar? How are they different?

e. Did you encounter any problems while drilling? How did you solve them?

f. What types of rock/sediment could these samples represent?

g. Which substrate was the easiest to drill or to sample? Why?

h. Which sample was the most difficult to drill or to sample? Why?

i. Could a scientist have used your core sample for accurate research? Why?

Extension Idea

1. Conduct a class discussion about actual core drilling problems and safety concerns while drilling. Learn about the "rough life" of a drill bit at *www.sciencebuzz.org/museum/ocean_drilling/drill_bit*, visit the IODP website *http://iodp.tamu.edu/tools/specs.html*, or download pages about different drilling tools and drill bits used for drilling into different types of rock (Advanced Piston Corer, Rotary Core Barrel, Extended Core Barrel, and different kinds of bits).
2. Show students images of real cores from A Treasure Chest of Cores at *www.oceanleadership.org/classroom/treasure_chest.html*. Ask them to explain how their cores differ from real cores.
3. Compare the diameters of each model core barrel (tool – straws). Which worked the best? Would it be a good idea to collect cores with larger core barrels? Why/why not? This activity replicates drilling in sediment; what might happen when you drill in hard rock?
4. Check out the career profiles for a driller, a toolpusher,and an operations superintendent (tool engineer) at *http://www.oceanleadership.org/learning/profiles*. Ask students to describe what it takes to have one of these careers.
5. Try coring in your schoolyard. What would you expect to find? What tools would you need?

Activity written on the School of Rock Expedition by Debbie Faulkner and Julie Marsteller, 11/2005; edited by Nancy Felix, 6/2006; edited by Jennifer Collins 5/2009

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Student Page

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Drilling Activity

1. Learn about scientific ocean drilling and the *JOIDES Resolution* research vessel using the resources provided by your teacher.
2. Your teacher will divide the class into drill site teams.
3. Once in your team, select one person to be the driller. Go to your drill site as a group and hypothesize which tool is most appropriate for the ocean substrate at your drill site. Record your answer here.

4. Locate your drill site on the map. If you were truly drilling at that location, what would you expect to find?

5. Have your driller use all three tools to sample your ocean bottom substrate. Be careful! A bend in the tool represents a break in the drill pipe. Remove the cores if possible, then draw and describe each core here.

Drilling Analysis

Discuss the following questions and record your answers here.

a. Which tool worked most efficiently at your drill site? Why?

b. How did you use each tool? What method did you use (shove, twist)?

c. How did the drilling process affect the core sample? Was there any damage?

d. How are the core samples from different sites similar? How are they different?

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