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Deep East 2001 Exploration

What on Earth is That, and How Can I Get One?

Focus
Blake's Ridge

Grade Level
5-6

Focus Question
What kinds of technology are used by the ALVIN to explore and make new discoveries?

Learning Objectives
Students will understand various sampling technologies used by submersibles in ocean exploration.

Adaptations for Deaf Students
Vocabulary:
- Additional vocabulary words to include are conductivity and substrate.

Background Section:
- The teacher should explain the purpose of CTD measurements during the Deep East Voyage of Discovery and ocean research in general, as this will be new information for most students.

Materials (per group of 4 students)
For Coring Activity:
- ❒ Two 8-foot clear polycarbonate tube lamp guards (fluorescent bulb covers – these available at hardware stores for about $3.00) cut into 16 12-inch sections. Use one section per group.
- ❒ One pair of scissors or a razor knife to cut the bulb covers (This is performed by the teachers).
- ❒ One 2-quart or 2-liter translucent round pitcher (opening as large as container diameter)
- ❒ Teacher-made substrate for each group that consists of a mixture of the following: 1 liter of beach sand or play sand, 1 liter of water, 20 various kinds of small shells (3 cm and smaller)
- ❒ One tray, at least 9"x12", tray for observing core samples
- ❒ Colored tape or masking tape to divide the bottom of the tray into four rectangular sections of equal size
- ❒ Sediment sieves with 1/2 cm, 1/4 cm and 1 cm mesh (optional)

For Salinity/Conductivity Activity:
- ❒ Simple electric circuit setup (one bulb, four wires, two batteries) See Learning Procedures for setup specifics.
- ❒ One cup of water
- ❒ 50g salt
- ❒ One teaspoon
- ❒ Student Data Table

Teaching Time
Two periods of 45 minutes each

Seating Arrangement
Groups of 4 students

Maximum Number of Students
30 students

Key Words
Organism, Sediment, Water quality, Technology, Core sampler

Background Information

Ocean exploration has changed drastically in recent years. Improvements in diving equipment, submersibles, still and video cameras, and advancements in computer technology have revolutionized the field of ocean exploration. However, even with all of these advances, very little of the Earth's oceans have been explored (only about 5%). The Deep East Voyage of Discovery is an effort to further explore three areas along the North American continental shelf break that have had very limited exploration to date, all of which have the potential to yield amazing new information, including new species and new energy sources. The three areas are the George's Bank in the Gulf of Maine, the Hudson Canyon off New York, and Blake's Ridge off the southeastern United States. It should be stressed that this voyage is for the purposes of exploration, to document what scientists find there, and to generate further questions about the organisms and their habitats. This is true scientific inquiry.

The vessels to be used for this voyage of exploration are the research vessel *Atlantis* and the submersible ALVIN, which are owned and operated by the Woods Hole Oceanographic Institute. The submersible ALVIN, which carries a pilot and two scientists, will be deployed for a series of dives at each of the three sites. Sampling will consist of temperature and conductivity by depth using a CTD (conductivity/temperature/depth) probe fixed to the ALVIN to look at temperature and conductivity by depth, tube and box cores, suction, grab and claw samples taken using the mechanical arms, imagery using video and still cameras, and human documentation using logs. For the purposes of this lesson, CTD data and core sampling will be targeted.

Learning Procedure

1. Go to the Deep East and ALVIN Web sites (www.oceanexplorer.noaa.gov/explorations/deepeast01/deepeast01.html and www.marine.whoi.edu/ships/alvin/alvin_history/alvin_history.htm) and have a discussion of ocean exploration, including the Deep East Voyage of Discovery using the research vessel *Atlantis* and the ALVIN. What would you want to know about a new site being explored for the first time and how would you collect your information? How does ALVIN collect samples? Chapter one in *Off to Sea* (see Resource section) has a good description of the *Atlantis*, the ALVIN, and their capabilities.

2. To collect core samples of different sediments using the bulb covers:
   a. Tell students that they will be collecting samples similar to the way ALVIN does.
   b. Give each group of four students one 12-inch section of a fluorescent light bulb cover and an empty pitcher, some sand, water, and shells.
   c. Have students measure 1 liter of sand and 1 liter of water. Pour the sand in the pitcher first. Mix shells with sand. Add water and mix all ingredients together.
   d. Challenge each group to determine how to use their bulb cover to get a sample of the substrate out of the pitcher.
   e. After students figure out that they need to put their hand on one end, take 4 samples of substrate to put in each section of the tray. Notice suction felt on hand.
   f. Have students observe cores for likeness and differences. Relate this to taking cores on the ocean floor. Not all samples are the same, even in the same area.
   g. Discuss how this demonstrates the way that the coring of bottom sediments is accomplished by ALVIN.
   h. Have students write a paragraph and illustration (journal entry) about how they made their cores (what was successful and what was not) and what they found in their cores.
   i. If time permits, allow students to experiment with many different sizes and shapes of containers as their "core sampler" to see which works best. Discuss with students the advantage of using a clear core to see vertical layers in the sediment.

3. Salinity/Conductivity

CTD Data from ALVIN – ALVIN will be able to provide, on a daily basis, salinity/conductivity-temperature-depth.

a. Students will make a simple electric circuit using one bulb, four wires and two batteries.
b. First, use one cup of water. Put the two non-insulated wire ends into the water and observe. Record your results on the Student Data Table. Add one teaspoon of salt at a time and record results on the Student Data Table.
c. Have students determine the amount of salt necessary to light up the bulb and discuss what causes the bulb to light. As salt is added to water, the salt molecules break apart, or dissociate, into ions of sodium, which is positively charged, and chloride, which is negatively charged.These charged particles in between molecules of water increase its ability to conduct an electric current.
d. Record data in the Student Data Table.
e. Explain that this is how that a CTD determines the salinity of water. It measures how conductive the water is. The more electrical current that is conducted by the water, the higher its conductivity.
f. CTD data – Prepare ahead one large graph (flip chart) of temperature vs. depth and one for salinity vs. depth and post them at the front of the classroom.
g. Give each group four data sets (temperature and salinity from a given depth) from a dive to add to the class graphs.
h. Have each student in each group add one point to the class graph. Discuss how the variables are related.

The BRIDGE Connection

http://www.vims.edu/bridge/data.html

Choose Ship Mates for a great site with data from the Gulf of Maine, Hudson Canyon, and Blake's Ridge and an explanation of what it means.

The "Me" Connection

www.vims.edu/bridge/elementary.html

Click on 5th or 6th grade. Go to Ocean Planet: Interdisciplinary Marine Science Activities and choose Ocean Planet from the list. Once there, choose Sea Secrets and Sea Connections.

Chapter 5 in *Dive to the Deep Ocean*. (See Resource section.)

Have a general discussion of discoveries at hydrothermal vents in the Pacific Ocean and the potential for new discoveries at the areas being explored during the Deep East Voyage of Discovery. While the organisms that are found at each of these habitats are different due to the very different temperatures, the types of potential beneficial discoveries are similar.

The ocean has long been known to be a source of many products important to humans, as well as a source of information regarding the events that have formed the Earth and determined its weather. Exploration of deep-sea habitats never studied before with submersibles has the potential to yield even greater discoveries of great benefit to mankind. Just in the past 20 years, over 300 new species have been identified from deep-sea habitats. Many of these species use chemosynthesis rather than photosynthesis as their source of energy and use bacteria rather than enzymes to digest their food.

Other potentially beneficial discoveries include things such as new medicines, food products, ores, mineral salts, products such as algin used as thickeners, and new geologic discoveries that help us better understand the formation of continents and oceans. Use the Ocean Planet Web site referenced in the Resource section. There is much more detail regarding discoveries that have been made near thydrothermal vents and cold seeps.

Connections to Other Subjects

Language Arts – Evaluate journal entry about core samples

Mathematics – Mixing and measurement in salinity activity

Mathematics – Graphing (temperature/depth and salinity/depth)
Mathematics – Measurement of sand, water, and shells in Core Sample Activity.

Evaluation

Evaluate the paragraph on the coring activity and the illustration for accurate content and effort.

Evaluate group temperature/salinity graph for accuracy and effort.

Science Extensions

1. Sorting, sizing, and identification of "organisms" in core samples. Use Brock scopes, magnifiers, and field guides.
2. Use sieves to look at grain sizes of dry sand.
3. ALVIN Simulation – Discuss how ALVIN moves to collect samples using its grab arm. Have students simulate being ALVIN by lying on their stomachs (on the grass outside or carpet inside) and provide certain "specimens" (pine cones, etc.) to be "collected" without using their hands (they will need to use some type of "claw.")
4. Visit http://library.thinkquest.org/18828/data/sc_8.html and learn more about Dr. Cindy Van Dover, Principal Investigator for the Blake's Ridge leg of the Deep East Voyage of Discovery. She is also a certified ALVIN pilot.
5. Try collecting samples using the fluorescent bulb tube in different places on the playground. Observe similarities and differences to the core sampling conducted in the classroom.
6. Have students find out about air pressure and how this affected their ability to collect a core sample. Try using a straw to pick up and move a liquid. Relate this to collecting core samples.

Resources

www.oceanexplorer.noaa.gov – Click on Explorations, then Deep East for background information.
www.whoi.edu/science/science.html
www.vims.edu/bridge/elementary.html – Choose Ocean Planet, then Ocean Market, Sea - Connections or Sea Secrets to learn more about things that we already get from the ocean and potential new products and discoveries.

Kovacs, Deborah. *Dive to the Deep Ocean: Voyages of Exploration and Discovery*. 2000. Raintree Steck-Vaughn Publishers.

Kovacs, Deborah.*Off to Sea: An Inside Look at a Research Cruise*. 2000. Raintree Steck-Vaughn Publishers.

National Science Education Standards

Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard C: Life Science
- Populations and ecosystems
- Diversity and ecosystems of organisms

Content Standard E: Science and Technology
- Abilities of technological design
- Understandings about science and technology

For More Information

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Student Handout

Student Data Table
(Use with Learning Procedure #3)

Salinity/Conductivity

# of teaspoons of Salt	Description of Light Bulb's Appearance