OIL SPILL RESPONSE/ROV BUILD: INTRODUCTION

A remotely operated vehicle, or ROV, is an unoccupied, submersible vehicle that can be used in deep or shallow underwater applications and is operated by a user above water. They can extend human exploration of ocean areas, especially those that are deep or hazardous, because they can travel deeper and stay underwater longer than human divers. ROV's may be particularly helpful in Arctic ecosystems, which are dark, remote, and characterized by extreme weather and water covered by ice.

KEY WORDS

ROV
Umbilical
Polynya

FOCUS QUESTIONS

1. What is an ROV?
2. How do we operate ROVs?
3. What are three environmental challenges to working in the Arctic?
4. How could using ROVs help us in the Arctic?

LEARNING OBJECTIVES

The student will:

define technology used in ocean exploration and clean up.
identify and name the different parts of an ROV.
work cooperatively to design and build an ROV in response to a mock oil spill.
demonstrate how to operate equipment similar to real-life oil spill response equipment.
determine how personal choices and actions have environmental consequences.

MATERIALS

ROV Build

- “ROV Design and Oil Spill Response” power point presentation
- “ROV Design and Oil Spill Response” worksheet
- “Points to Ponder When Designing ROVs” handout
- “ROV Frame Examples” handout
- “Oil Spill Response” point sheet
- “Oil Spill Challenge” diagram
- ROV motors (3 each team), control box and umbilical (1 each team) [pre-built by PWSSC]

- ROV power source (battery or wall adapter) and connection harness (1 each team)
- PVC pipe cut into various lengths (total 10 to 20 feet for each ROV) and drilled through to allow water to drain
- PVC connectors
    - 12" PVC (4)
    - 6" PVC (10)
    - 4" PVC (8)
    - 3" PVC (10)
    - L (90°) connector (10)
    - Side Outlet L (90°) connector (10)
    - T connector (10)
    - Side Outlet T connector (10)
    - Elbow (45°) connector (6)
    - + connector (2)
    - ___ connector (2)
- Foam pipe insulation
- Zip ties
- Electrical tape
- Fishing weights
- Netting
- Clippers
- Pliers

Water Challenge

- Volunteers
    - Judges and pool “seal”
- Hula hoops, weighted [floating in pool at depth]
    - hula hoop, weight, tether
- Medium sized rings, weighted [floating in pool at depth]
    - medium sized ring, weight, tether
- Hula hoops, floating on surface
- Square 1’ PVC frames, weighted [floating in pool at depth]
    - PVC square (1’x1’), weight, tether
- Ring hook
    - bucket with lid, PVC arm (1.5’ tall with 0.5’ arm)
- Beach balls
- Ping pong balls (inside) or popcorn (outside)

AUDIO-VISUAL MATERIALS

- Computer, projector/monitor, screen

LEARNING PROCEDURE

See "Lesson 6 Activity Instructions" for details.

A. ROV Build ***(3 hours)***
B. Water Challenge and Wrap-up Discussion ***(2 hours)***

STANDARDS

Alaska State Standards:

SA The student will demonstrate an understanding of the processes and applications of scientific inquiry.

- **(5) SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.
- **(5) SA1.2** using quantitative and qualitative observations to create their own inferences and predictions.

SA1 The student will develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend arguments.

SA2 The student will develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.

- **(5) SA2.1** supporting their statements with facts from a variety of resources and by identifying their sources.

SA3 The student will develop an understanding that culture, local knowledge, history, and interactions with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.

- **(5) SA3.1** identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survives.

National Science Education Standards
Content Standard A: Scientific Inquiry

All students will develop abilities necessary to do scientific inquiry.

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze and interpret data.
- Develop descriptions, explanations, predictions and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Communicate scientific procedures and explanations.

All students will gain an understanding about scientific inquiry.

- Different kinds of questions suggest different kinds of scientific investigations.

Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Scientific explanations emphasize evidence, have logically consistent arguments and use scientific principles, models and theories.

Content Standard B: Physical Science

All students will develop an understanding of properties and changes of properties in matter.

A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.

Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals are an example of such a group.

Content Standard E: Science and Technology

All students will develop understandings about science and technology.

Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials or effects of weather and friction; other constrains limit choices in the design, for example, environmental protection, human safety and aesthetics.

Technological solutions have intended benefits and unintended consequences. Some consequences can be predicted and others cannot.

Content Standard G: History and Nature of Science

All students will develop an understanding of the history of science.

Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.

Ocean Literacy Standards

6. The ocean and humans are inextricably interconnected.
    e. 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 (point source, non-point source and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.
    g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individuals and collective actions are needed to effectively manage ocean resources for all.
7. The ocean is largely unexplored.
    b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

c. Over the last 40 years, use of ocean resources has increased significantly, therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.
d. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

RESOURCES

Harry Bohm and Vickie Jensen, Build Your Own Underwater Robot and Other Wet Projects. Vancouver, B.C.: Westcoast Words, 1997.

"Build your own ROV," Monterey Bay Aquarium Research Institute website. http://www.mbari.org/education/rov/default.htm

National Research Council (U.S.), (1996). *National Science Education Standards: observe, interact, change, learn*. Washington, D.C.: National Academy Press.

Project 2061 (American Association for the Advancement of Science), (2001). Atlas of Science Literacy. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

FEEDBACK

We value your feedback on this lesson.
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