

GRADES 9–12

**OCEAN EXPLORATION:
Aooogah! Aooogah! Dive! Dive!**

OVERVIEW

This lesson is designed to introduce students to submersibles used in deep sea exploration. Students will view an undersea world of the Galapagos Rift System through the camera of the Sea Cliff, a sister ship to Alvin which is based at Woods Hole, Massachusetts. In order to clarify the physical principle which enables a submersible or a submarine to dive to great depths, students will make a simulation of a submersible in a deep sea environment.

ITV SERIES

The Blue Planet, Part 2: Episode 2

LEARNING OBJECTIVES

Students will be able to

- ◆ explain how gas volumes are changed by pressure
- ◆ explain how changes in gas volumes enable submersibles to dive to great depths.

VOCABULARY

gas volume
pressure
beral pipette
submersible

MATERIALS

For each student:

- ✓ student notebook
- ✓ 1 liter clear soda or water bottle
- ✓ 1 beral pipette with a wide stem or extra large bulb
- ✓ metal bolt to fit the stem or bulb
- ✓ 10 cm of plastic coated wire to secure the bolt if necessary
- ✓ source of tap water

For each group of four students:

- ✓ 2 or 3 liter beverage container with the top cut off and filled three quarters with tap water.
- ✓ one pair of scissors

**PREREQUISITE KNOWLEDGE
AND ACTIVITIES**

Students will have a working knowledge of the functions of swim bladders of fish.

Students should know that gas can be compressed into a smaller volume.

PRE-VIEWING ACTIVITIES

Discuss the missions that Alvin has undertaken like discovering the wreck of the Titanic and the rift system organisms in the Pacific Ocean that have as the basis of their food web, chemosynthetic bacteria. This discussion is intended to highlight the capabilities of submersibles like Alvin. It is also a technique teachers may use to establish the baseline knowledge of their students.

FOCUS FOR VIEWING

To give students a specific responsibility while viewing, ask the students to describe the submersible in its initial descent. Once they have done this, they should look for other characteristics of the submersible.

VIEWING ACTIVITIES

Begin viewing when the scientist in a blue tee shirt on the white marine vessel says "The liquid environment is the largest environment on earth..."

Pause when the camera view is above the submersible. Ask the students what they saw coming from the submersible. They will answer that bubbles are coming from the submersible. Pause and fast forward through several segments of the video to a picture of the back of the white vessel. The narrator says..."A deep diving sea vessel named Sea Cliff..."

Pause when the interior of the Sea Cliff is shown.

Continue viewing the underwater world of the Galapagos Rift system until the Sea Cliff emerges from the ocean.

POST-VIEWING ACTIVITIES

Ask the students if they would travel to the Galapagos Rift system in the Sea Cliff. Tell them they don't have to decide because they are going to simulate such a dive in a submersible. Use the Activity Sheet.

ACTION PLAN

Students can send letters to Woods Hole Oceanographic Center on Cape Cod to inquire about the lat-

est missions of the Jason Project after conducting current research about submersibles. The address to inquire about the Jason Project is:

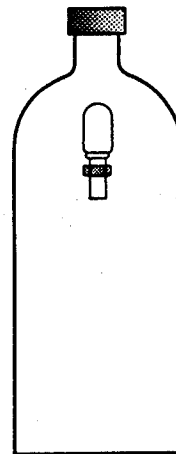
Woods Hole Oceanographic Institution
News & Information Office
93 Water Street
Woods Hole, Massachusetts 02543-1050

EXTENSIONS

- ◆ **Science.** Compare the use of a swim bladder of a fish and the release of gas pressure in a submersible. Discuss the power of metaphorical thinking in generating ideas to create man-made devices.
- ◆ **History of Science.** Find out the original depths at which a bathysphere was able to dive versus the current depths at which the most advanced submersibles are able to dive.
- ◆ **Social Studies.** Find dates for the following events in history and make a time line for them: Archimedes principle of buoyancy, Alexander the Great ruled Russia and was the first man to descend into the sea inside his crystal sphere to view undersea animals (*The Blue Planet* is a resource for this information), bathyspheres were first used by scientists, submersibles were first tested by scientists.
- ◆ **Math.** Ask students to give an example of something that is either 400 meters long or high. The submersible dives to 400 meters in one segment of the video. (A meter is a little longer than a yard. A football field is about 100 meters long.) About how many meters is one half mile. (A mile is 5,280 feet. One meter is about 3 feet. It follows that one-half mile is about 930 meters.)
- ◆ **Language Arts.** Write a report about the Galapagos Rift System food web or ask grandparents what they were told as children about deep sea creatures and make a class story of all the anecdotal information.

6. Place the beral pipette or "submersible" into the 1 liter bottle and fill the bottle with water to overflowing. Cap the bottle. Make sure there is no air in the bottle.

7. Squeeze or press the bottle at the top.



For Teachers Only: The "submersible" will go up and down with pressure on the bottle. Although the liquid in the bottle does not change volume, the pressure applied to the water molecules is distributed throughout the container and decreases the gas volume in the pipette.

8. Why does the submersible go up and down with applied pressure to the outside of the bottle?

For Teachers Only: Let the students manipulate their bottles for at least ten minutes. If they are still stumped, ask them to watch the water level in the beral pipette. What happens with added pressure? (The water level goes up with increased pressure from the top of the bottle. This means that the gas volume in the pipette is decreasing and allowing the water level to rise.) Ask the students what evidence from the film shows that submersibles use the same principle to control their depth levels. The bubbles show that with the release of a volume of gas, the submersible sinks. Let them manipulate their submersibles some more so that they can see the gas volume decreasing in the pipette as the bottle is squeezed.