



## OCEAN EXPLORATION

### Concepts

Pressure, temperature and light change as you increase in depth in the ocean. Specialized technology (like ROVs and submarines) allow scientists to study the deepest parts of the ocean.

### HCPS III Benchmarks

SC 6.1.1  
SC 6.1.2  
SC 6.2.1  
SC 6.2.2

### Duration

45 minutes

### Source Material

PRISM  
AIMS

### Vocabulary

Abyssal  
Bathyal  
Euphotic  
Light penetration  
Pressure  
ROV  
SCUBA  
Submarine  
Temperature

## Under Pressure: How deep can they dive?

### Summary

In this activity students will get their hands wet as they learn about the environment of the deep ocean. The students will construct a pressure tower that will provide a visual representation of how pressure increases with depth. They will also learn about the different ocean zones and how temperature, pressure and light will change as you increase with depth.

### Objectives

- Students will identify and describe the different ocean zones
- Students will test their theories on what will happen as you dive deeper in the ocean
- Students will be able to identify the environmental factors that change as the depth increases (temperature, pressure, light)
- Students will describe different ocean exploration technology

### Materials (for each group)

2 1-liter water bottles	Nail or Tack
Masking Tape	Scissors
Ocean Zones	How Deep?

### Making Connections

The previous lesson described how much space the ocean takes up on our planet and how long it takes to travel great distances across an ocean. This lesson will discuss the different zones of the ocean and how pressure increases with depth. Special equipment is necessary to study and observe life in each of the ocean zones.

### Teacher Prep for Activity

1. Get 2 plastic 1-liter water bottles (this is one set, so if you are having the students work in groups you would need 2 per group)
2. You may choose to have the students do the cutting – if not...
3. Cut the bottoms off #1. Cut the top off #2.
4. Stack them together in the order of #1 on top, #2 in the on the bottom.
5. Tape them together
6. Poke 1 or 2 holes in top and bottom bottle with a nail or tack, space them about 3 inches apart (holes should run vertically up the bottles)
7. Put tape over the holes and fill with water
8. Put the cap back on



9. Check for leaks and set aside
10. Go to <http://oceanexplorer.noaa.gov/technology/technology.html>
11. Print out the information (for example one for Alvin, SCUBA divers, etc. to get a range of depths) and put one in each folder for a group to work on.

## Background

This activity will represent how atmospheric pressure exerts a force on water. The pressure increases as you dive deeper in the ocean. Water pressure is greatest at the bottom of the ocean and this is one of the reasons that humans cannot tolerate diving in deep water. Not only is the water overhead exerting intense pressure, but the temperature and light availability decreases to levels that humans cannot tolerate. Some animals can tolerate these harsh conditions but humans need extra equipment to dive to those depths. When scientist want to study the animals that live at such great depths they have to use specialized equipment that can tolerate the intense pressure, low temperature and low light levels. Each type of equipment has a unique depth that it can tolerate the crushing pressure of the deep ocean. For example a SCUBA diver can go down about 165 feet (with proper training), the Alvin (a deep sea submersible) can take 3 people down to 13,000 feet (2.4 miles), and **ROVs** (stands for Remote Operated Vehicle, no people inside, it is remotely operated by people on land) can go down the deepest to about 35,000 feet, that is about 6.6 miles! **SCUBA** stands for Self Contained Breathing Apparatus it allows people to stay underwater for longer then breath holding techniques used in free-diving or snorkeling by breathing air from a oxygen tank attached to a vest on the back of the diver.

The open sea can be divided into 3 major zones, the **euphotic**, **bathyal**, and **abyssal** zones. The **euphotic** zone is from the surface of the ocean down 200 meters. This zone is also sometimes called the sunlight zone because there is enough sunlight to have photosynthesis. This zone has the highest levels of sunlight, photosynthesis, and dissolved oxygen. Many large predatory fish live here. The euphotic zone has the lowest amount of nutrients for all of the ocean zones. This can be mitigated by upwellings, cold water from lower zones that flow to the surface. Since the lower levels have more nutrients, upwellings provide a source of nutrients for organisms in the euphotic zone. In between the euphotic and the bathyal zone is the twilight zone, an area that still receives some sunlight, but not enough for plants to grow. The **bathyal** zone (aka midnight) is the middle zone that has no light. Many zooplankton and smaller fish live here. The abyssal zone is pitch black, extremely cold and intense pressure. The deepest zone, the **abyssal** zone, begins at about 1500 meters and continues to the ocean floor. Sunlight does not penetrate this far into the ocean, although there are many more nutrients here than in the euphotic zone. These nutrients often consist of debris and waste that floats down from the upper layers of the ocean. Because the abyssal zone is very difficult to reach for humans, many of the organisms that dwell here are unknown. The organisms that we do know of are unique in their adaptations to the lack of light and other conditions characteristic of this mysterious environment.

## Vocabulary

**Abyssal** is the deepest zone with no light penetration, animals at this depth are very unique (1500 meters to ocean floor)

**Bathyal** is the zone (aka midnight) in the middle that has no light. Many zooplankton and smaller fish live here (200-1500 meters)



**Euphotic** is the zone that exposed to sunlight, therefore photosynthesis can occur (0- 200 meters)

**Light penetration** is the amount of sunlight that penetrates into the water column

**Pressure** is the force per unit area applied to an object

**ROV** Remote Operated Vehicle, they are underwater robots that are operated by people on a boat

**SCUBA** Self Contained Underwater Breathing Apparatus is a method of swimming underwater with an air tank allowing humans to breath underwater and stay down longer than free diving

**Submarine** is a type of watercraft that can stay underwater for long periods of time (6 months) with people inside

**Temperature** a physical property that indicates how hot or cold something is.

## Procedure

Talk with the class about pressure and swimming in the ocean (15-20 minutes). Has anyone gone diving in the ocean? Ask the students if they have ever felt their ears pop when they drive up a mountain, or when they dive deep when they are swimming. That feeling indicates a change in pressure!

1. Show the students the diagrams of the “ocean zones” (attached) Point out the zones and read the background information if desired.
2. Open the computer link to “how deep” and click on some of the different equipment to find out how deep they can dive.
3. Ask the class to predict what they think will happen when you fill up a bottle with water and poke holes in the side? Where will the water pressure be greatest? How do you know? How might you find out?
4. To test there hypothesis you can demonstrate OR you can have them work it small groups to cut and tape their own (20 minutes).
5. Go outside (or over the sink)
6. Have the class estimate which hole will squirt water the farthest.
7. Remove the tape and show the bottle to the class as you carefully unscrew that cap.
8. Ask the students to describe what they observe?
9. “Why do you think the water is flowing out at a stronger force and farther distance at the bottom versus the top?” (Discuss for about 5-10 minutes)
10. Students should be able to describe why... “Water pressure is greatest at the bottom of the bottle.”

## Assessments

Students are given a folder with different types of equipment used to study the deep ocean, then they work with their group and the rest of the class to get in order by which one they think will be able to tolerate the most pressure.

Class discussion of results after the experiment.



Drawing activity (optional can be homework) have the students draw and describe the different ocean zones.

## Resources

Ballard, Robert D. Adventures in Ocean Exploration. National Geographic Society Washington D.C. 2001. (Great information and pictures, this is the written by the man that discovered the sunken titanic using Remote Operated Vehicles)

Finch, Jenny ad Fran Baines. Ocean Atlas- An amazing ocean adventure. DK Publishing New York 2007. (Interactive disc included, great ocean depth pictures and diagrams)

Silvani, Harold. Off the wall science Grades 3-9 Activities Integrating Mathematics and Science (AIMS) Education Foundation Fresno, CA 1995. (Similar lesson using water bottle to experiment with pressure)

Interactive chart of diving depths: (can be used to have students select a specific type of equipment to describe)

[http://seawifs.gsfc.nasa.gov/OCEAN\\_PLANET/HTML/oceanography\\_how\\_deep.html](http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_how_deep.html)

Ocean Zones Chart with animals: <http://library.thinkquest.org/04oct/01590/intro/ocean.jpg>

Pictures and description of a variety of ROVs used by NOAA (can be used to have students select a specific type of equipment to describe)

<http://oceanexplorer.noaa.gov/technology/subs/rov/rov.html>

## Extension Activities

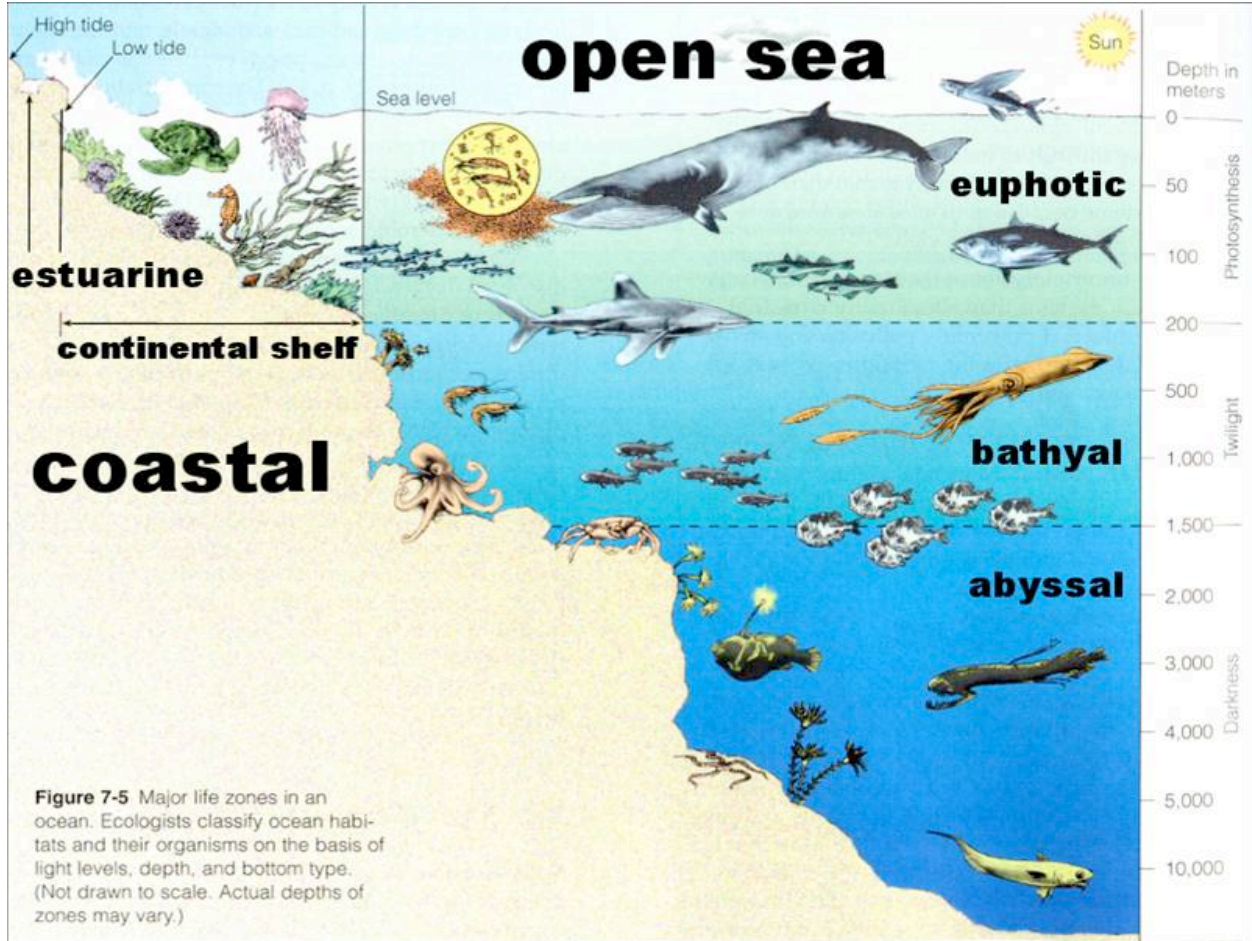
Have them make their own water bottle towers in small groups (add 15 minutes to the lesson) and measure how far each water spout goes. What groups went the farthest? What method were they using? How tall was it?

Show video that explains how pressure effects animals, humans, and items that go deep. Such as a Bill Nye the Science Guy Ocean Exploration Video that can be rented at most public libraries.

Have the class make their own ROV and participate in a ROV challenge. See link for Hilo competition information and contacts (This is a large commitment – maybe a month of extra time outside of class to work on, maybe a good project for robotics teams at your school).

[http://www.marinetech.org/rov\\_competition/regional\\_contests/regional\\_contest.php?rov\\_competition\\_id=46](http://www.marinetech.org/rov_competition/regional_contests/regional_contest.php?rov_competition_id=46)

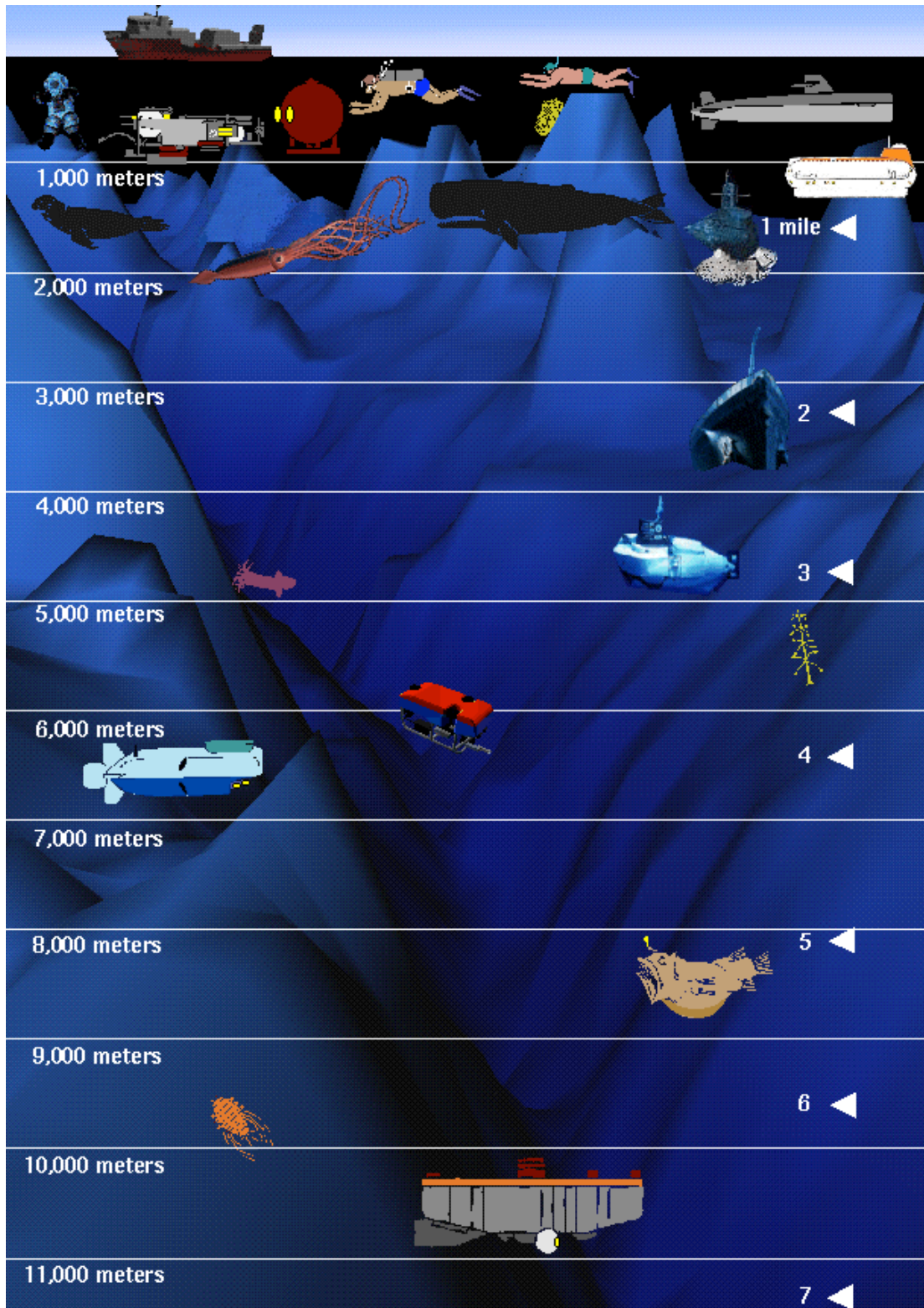
## OCEAN ZONES



<http://library.thinkquest.org/04oct/01590/intro/ocean.jpg>



How Deep?



[http://seawifs.gsfc.nasa.gov/OCEAN\\_PLANET/HTML/oceanography\\_how\\_deep.html](http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_how_deep.html)