Pressure in the Deep Sea
Teacher materials

Key Concepts

1. Air and water pressure are exerted on an object from all directions.
2. The pressure of gases can be manipulated more easily than the pressure of liquids.
3. If the internal and external pressures on a container are not balanced, the container my not be able to withstand the difference.
4. Water pressure increases with depth.
5. Water pressure has a tremendous impact on marine life and the people who explore the deep sea.

The properties of the container determine how much pressure it can withstand. As long as the internal and external pressures are equal, then nothing happens to the container. If the pressures are not balanced, then the container may collapse or may explode.

When you swim underwater, you can feel the pressure of the water acting against your eardrums.

What causes this pressure: simply the weight of the water pushing against you.
the deeper you swim, the more water above you, the greater the pressure.

There is pressure against us when we are not in the water too. The pressure of the air or atmospheric pressure is caused by the weight of the air.
We don't sense that pressure because the pressure inside is equal to the pressure outside our bodies.

At sea level, atmospheric pressure is about 5 pounds per square inch. Pressure is exerted equally against all surfaces of your body. You don't feel more pressure on your face than on your back, or on your arms, because pressure is exerted evenly against all surfaces.

Pressure is dependent on depth, not on volume.
Liquid pressure is exerted equally in all directions. Pressure in a liquid at any point is exerted in equal amounts in all directions.

At greater depths, the pressure is greater and the speed of the escaping liquid is greater.

The primary difference between a gas and a liquid is that the molecules in a gas are further apart and move around more easily. In a liquid, the molecules are closer together and their motions are more restricted.

A gas will expand to fill all the space available to it. and it exerts a pressure against its container. The pressure that it exerts depends upon how much gas is inside the container.
Gas can easily be compressed.

There are three ways to compress a gas.
Reduce it's temperature.
Put more gas into a container.
Increase the pressure on the outside of the container to reduce the volume of the container.

Marine organisms at depth are subject to tremendous pressure from the weight of the water above them, but it presents them with little difficulty because pressures inside and outside the animals are virtually the same.
Great pressure does have some chemical effects. Gases become more soluble at high pressure, some enzymes are inactivated and metabolic rates for a given temperature tend to be slightly higher.
Unless marine animals have gas-filled spaces in their bodies, a moderate change in pressure has little effect.

Pressure in the Deep Sea
Student Materials

Look:

1. Fill a 500 ml plastic water bottle to the top. Make sure there are no air bubbles. Secure the top. Squeeze the bottle. What happens? As you increase the pressure on the outside of the bottle, the water on the inside exerts an equal pressure. How do you know? The water is not compressed.

Stop squeezing. What happens to the bottle?

2. Carefully remove the top of the bottle. Squeeze the bottle. What happens? Why? Place the top on the bottle and stop squeezing. What happens? Where is the pressure greater? On the inside of the bottle or on the outside of the bottle? How do you know? Slowly open the top of the bottle. What happens? Does something move into the bottle? Why? Where does it come from?

3. Empty the 500 ml plastic water bottle. Seal the cap. Demonstrate that by adding pressure on the outside that you can reduce the volume of the air on the inside. Has the air left the bottle? What has happened to the air molecules? How does this compare to when you squeezed the bottle full of water? Release the pressure on the bottle? What happens to the shape of the bottle? Has more air been added to the bottle? How do you know? Where is the pressure greater?

4. Open the top of the bottle. Squeeze the bottle and seal the bottle. Release the pressure on the bottle. What happens to the shape of the bottle? Does it return to normal? Why not? Compare to your first bottle. Which bottle has more air in it? How do you know? Open the bottle. What happens? Why? Where is the pressure greater?

5. Carefully fill your bottle with about 50 ml of very hot water. Quickly seal the bottle. Set the bottle into a container of ice water. Observe. What happens to bottle? Why? Did any air get squeezed out of the bottle? What happens to gases as they cool down? What happens to the volume of a gas as it cools down?

6. Place your hand and arm in a plastic garbage bag. Slowly submerge it in the water. Describe the feeling of the plastic bag against your arm. Is the plastic bag pressed more firmly against your hand or your elbow?

7. Look carefully at the 2-liter bottle. Notice that there are three holes in the side of the bottle which are covered with tape. Fill the container with water. Place the container in the pan and place a ruler in the bottom of the pan. Predict how far the water will flow from the holes when you remove the tape. Will the results be the same from all of the holes? Remove the tape and measure. What happens to the flow of the water as the volume of water in the container decreases? What causes the water to flow out of the bottle? Where is the pressure the greatest?

Guess: For every 10 meters you descend in the water, you experience an additional atmosphere of pressure.

Complete the following chart.

Depth in feet	Pounds of pressure per square inch
0	
33	
66	
99	
330	
660	

What happens to a plastic bottle at 33 feet? 99 feet? 330 feet?