

Extension Activity – Water

Title of Activity - Descartes' Diver

Concepts/Principles Covered –

The Cartesian diver demonstrates density as a function of mass and volume.

When the bottle is not compressed, the diver floats to the top since it does not have enough mass in its volume to sink (the density isn't great enough).

Compressing the walls of the bottle causes the pressure inside the bottle to increase. This added pressure decreases the volume of the gas (air) in the bottle. The space left behind is filled with water and the mass of the diver increases; however, the volume is still the same and the density is greater. The density of the diver increases to the point where it is now greater than the density of the water surrounding it. The Cartesian diver sinks.

When the pressure on the outside of the bottle is released, the compressed air inside the diver expands and pushes some of the water back out of the diver. As the water level inside of the diver decreases, the diver floats back to the top.

Short Description –

Demonstrate Boyle's Law and the relationship between pressure and volume. Boyle's Law basically says that when pressure increases, volume decreases; when pressure decreases, volume increases (an inverse relationship).

The Cartesian diver also demonstrates buoyancy, the ideal gas law and Pascal's principle. The ideal gas law inversely relates changes in pressure to changes in volume for a closed system; as the pressure increases, the volume in the system must decrease if temperature is maintained at a constant.

Pascal's principle dictates that a pressure change in one part of a closed system is transmitted without loss to every portion of the system. In this example, the increase in pressure by squeezing is transmitted to all parts of the container. This increases the pressure inside the diver.

Standards Covered -

5-PS1-3: Make observations and measurements to identify materials based on their properties.

HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Length - 45 minutes

Age Group – Grades 4-9

Materials and Supplies -

- Sturdy clear plastic bottle with cap (label removed)
- 2 paper clips
- 2" segment of plastic straw

Step-by-step Instructions -

- Fill plastic bottle to neck.
- Fold straw section in half.
- Place first paper clip on open ends of straw so that the two touching sections only are clipped together.
- Attach a second paper clip to lower end of first clip.
- Place straw and clips in bottle and cap the bottle. Assure the “diver” is floating near the top.
- Squeeze bottle to see if the “diver” sinks.

