**COSEE Hands-On Activities**

**USA Science & Engineering Festival**

**Grouping: Physical Oceanography**

**Lesson/Activity:** Cartesian Diver

Teaching Physical Concepts in Oceanography: An Inquiry Based Approach (Activity 3.4, Buoyancy)

<http://www.tos.org/hands-on/teaching_phys.html>

*This classic science experiment is named after René Descartes, a French philosopher, mathematician, and scientist. It demonstrates buoyancy (Archimedes’ Principle) and the relationship between pressure and volume in gases (Ideal Gas Law). Note: for instructions on how to build a Cartesian diver, see, for example: http://www.raft.net/ideas/Pipette%20Diver.pdf.*

**Materials**

* A sealed soda bottle filled with tap water (colored water works best)
* A plastic pipette weighted with metal nuts and/or washers

**Instructions**

1. Squeeze the bottle. Why is the half-closed pipette inside the bottle sinking? Why does the pipette rise when you release the bottle?
2. Explain the behavior of the pipette in terms of pressure and Archimedes’ Principle.

**Explanation**

According to Pascal’s Law, pressure applied to a fluid is transmitted throughout the fluid. When you squeeze the bottle, you increase the pressure within the bottle and the open pipette within it. The pipette in the bottle contains air. As a result of the increase in pressure, the volume of the air trapped inside the pipette decreases and water rises within the pipette, replacing some of the air space. (Recall the Ideal Gas Law: PV = nRT, where P is pressure, V is volume, n is the number of moles of gas, and R is the universal gas constant. For constant temperature, increasing pressure results in decreasing volume.) Because the density of water is greater than that of air, the density of the pipette system (pipette + air bubble + water) increases enough that the pipette sinks.