Name _____

Cartesian Divers

The Problem

An object **floats** in a liquid when it is **less dense** than the liquid. Do you think that you could make a floating object sink without changing the density of the liquid? Does your answer change when you consider an object that includes a pocket of trapped air? Try the following activity and see what you find.

Materials

- beral pipet (provided)
- hex nut (provided)
- scissors
- tall glass or cup
- water
- plastic soft drink bottle with cap
- super glue or hot melt glue gun and glue (if available)

Exploration

1. Screw the hex nut onto the pipet up to the bulb.
2. Cut off the pipet stem below the hex nut, creating a "Cartesian diver." (See Figure 1.)

Figure 1: Screw a hex nut onto the pipet and cut off the stem.

3. Place the Cartesian diver in a tall glass full of water.
4. Adjust the amount of water in the diver so it floats with its top just at the water line. (You can control how much the diver sinks or floats by squeezing the bulb to draw in or release water.)

Q1: Why do the amounts of water and air in the diver cause it to sink or float?

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5. Fill the soft drink bottle with water to within 2 or 3 cm of the top. Place the diver in the bottle and screw the cap on tight. (See Figure 2.) Note the location of the diver. Squeeze the bottle firmly.

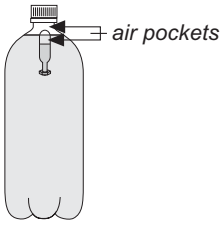

Figure 2: Float the diver in the bottle.

Q2: By squeezing the bottle, you are applying pressure to the air trapped in the air pocket. Does the volume of air in the air pocket increase, decrease, or stay the same as you apply pressure by squeezing?

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Q3: What happens to the volume of water inside the pipet when you squeeze the bottle? How does this affect what is happening with the diver?

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6. Remove the diver from the bottle. Place the diver in the glass of water and adjust it so it just barely sinks. Place it in the completely filled bottle.
7. Find a way to make the diver float to the surface. (There are several ways that you can do this.) Describe what you did and why it worked.
8. Remove the diver from the bottle. Place the diver in the glass of water and adjust it so it floats.
9. Seal the open end of the diver with a minimum of super glue, hot melt glue (if these are available), or tape. Allow the glue to dry. Place the diver in the completely filled bottle, and screw on the cap.
10. What happens now when you squeeze the bottle? How and why does this differ from the diver's behavior in Step 2?

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Discussion:

Q4: What relationship exists between the pressure exerted on a gas and the volume of that gas?

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