

Inverted Bottles

The raise and fall of hot and cold.

Investigate convection by using food coloring and water of different temperatures.

Materials:

4 Identical wide mouth glass bottles

3x5 cards (card stock)

Food Coloring – two colors

A source of hot and cold water

2 catchments - like a plastic plate or aluminum pie pan.

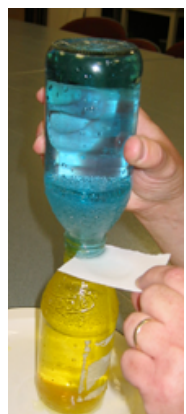


To do and notice:

1. Completely fill two bottles with hot water. Fill until a meniscus forms (an upward bulge) on the surface of the water.
2. Completely fill two bottles with cold water. Fill until a meniscus forms (an upward bulge) on the surface of the water.
3. Add food coloring to the bottles. Use the same color for the hot water and a different color for the cold water.

(In the Examples presented, I used blue coloring for the cold and yellow for the hot)

4. Watch how the drops of food coloring mix in the water (this can be made into a lesson unto itself).
5. Place two plastic plates (or other catchments) on the table.
6. Place one of the cold bottles on one plate.
7. Place one of the hot bottles on the other plate.
8. Take a small piece of the 3x5 card (slightly bigger than the mouth of the bottle) and place it on the mouth of other hot water bottle (the one not on the plate).
9. Gently tap the card stock. This will help to make sure that the card is in contact with the entire rim of the bottle.
10. Carefully and slowly invert the bottle without touching the paper (Yet another lesson - this portion of the activity can lead to discussions of air pressure and surface tension).
11. Place the hot water bottle with the card on it directly on top of the cold bottle on the plate.
12. Line-up the mouths of the hot and cold bottles (with card stock between).
13. Repeat these steps 8 – 12 for the cold water bottle. Invert it and place it on top of the hot water bottle on the plate.
14. You should now have two experiments set up: a hot water bottle on top of cold water bottle and a cold water bottle on top of a hot water bottle.
15. Try to do this next step at the same time to both sets of bottles. Carefully slide the paper out from between each set of bottles. You might need help with this step.
16. Watch what happens next.



What's going on?

The hot water stayed on top and the cold water stayed on the bottom in one set of bottles and the colors stayed pretty much the same. However, in the other set, something very different happened. The hot water rose and the cold water sank. As this motion occurred, the colored water mixed.

This all happened because of differences in density. Everything is made of molecules and hot molecules move more than cold molecules. Therefore things that are hot take up more volume than the same things that are cold. This means the hot water bottle needed less water to fill it to the top than the cold water bottle. The water in the hot bottle had less mass and therefore was less dense.

Gravity can separate fluids by their density (which can be caused by differences in temperature). Because the cold water is denser, it seeks a lower elevation than the hot water. This motion of cold fluid going downward caused the hot liquid to be pushed upward. This motion of fluids is called convection.



<p><i>Originally:</i> Cold was on top <i>After:</i> Cold sank and fluids mixed</p>	<p><i>Originally:</i> Hot was on top. <i>After:</i> Hot stayed on top...no mixing.</p>
--	--

So what?

The effect of gravity, density and temperature on fluids leads to the saying, “Hot things rise and cold things sink.”

This phenomenon affects the universe in many ways. It is an important part of the weather cycle, water currents, the motion of semi-solid rock within the earth and even the motion of material in stars.