

THE CONFUSED BOTTLES

A. Question: *What are the necessary conditions for convection to take place?*

B. Materials Needed:

1. Four empty identical soda pop bottles.
2. Food coloring.
3. A 3X5" card

C: Procedure:

1. Fill two bottles (A1 and B1) with cold and two bottles (A2 and B2) with warm water (do not reveal to students the temperature difference).
2. Color the water in bottles A1 and B2 with a few drops of food coloring and mix the color evenly (cover the bottle with your thumb and turn upside down).
3. Cover the bottles A2 and B1 with a small piece of the paper card, and place them upside down on the colored bottles (one finger on the card will keep the water from spilling while turning it upside down: center the bottles A2 and B1 carefully over A1 and B2 and slip out the piece of card by holding the top bottle).
4. Let the students observe what is happening to the color.

D: Anticipated Results:

Students should observe a color change in the water bottles due to convection currents.

E: Thought Questions for Class Discussion:

1. Why did the top bottle B get colored and not Bottle A?
2. Do you think the temperature of all four bottles of water was the same?
3. Which of the four bottles were warmer?
4. Does bottle A2 ever get colored; if so, when?
5. What would happen to the color if the temperature of all four bottles were the same?

F: Explanation:

The water in bottles A1 and B1 was cold and that in A2 and B2 was warm. Warm water is lighter in weight or less dense than cold water and thus rises. Since the warm water in B2 was colored this water rises into the top bottle and the cold water sinks bringing with it convection currents. As the water in A2 is warm and already above the cold water in A1, no convection is occurring in this set of bottles, and thus no coloring of the top bottle.

When the water temperature of this top bottle gets to be equal to that of the lower bottle, diffusion of the color will occur, but no convection. This process is much slower than convection and is caused by the constant vibration of molecules.