

HOT AND COLD

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MATERIALS NEEDED:

2 beakers, 600 mL
Density box demonstration (Flinn Scientific no. AP4784) Note: There will be minimal mixing of water between the two sides of the density box. This can be reduced by coating the edges of the separator with a small amount of petroleum jelly or a suitable, colorless laboratory grease.
Water
Food color
Hot plate
Optional: ice

SAFETY PRECAUTIONS:

Wear safety goggles or glasses

Do not heat the water to boiling. It should be warm, but not too hot to handle.

DISPOSAL:

All materials in this experiment can be disposed of down the drain.

PROCEDURE:

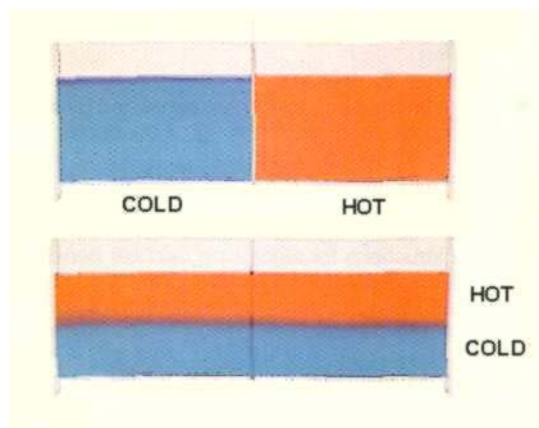
Heat about 500 mL of water, in a beaker, until it is warm (40° to 60°C). (Note: Hot tap water can be used to eliminate additional heating.)

Place about 500 mL of cold tap water into a 600 mL beaker (ice water can be used, but is not necessary).

Place a different food color in each beaker of water. (Suggested: red for hot, blue for cold)

Simultaneously, pour the water from both beakers into different sides of the water density box.

Allow the water to sit for about 30 to 60 seconds.
Remove the separator from the box.



EXPLANATION:

The density of water decreases with increasing temperature. When the separator is removed, there is almost no turbulence in the water, thus, only a minimum amount of mixing occurs. Since the cooler water has a higher density, it will tend to fall to the bottom with the warmer, less dense water on top.

To work effectively, the cool water and warm water should have a difference in temperature of at least 20°C.

After a while, as the water temperatures equilibrate, mixing will occur with “lines” of color extending vertically through the water layers. This is due to more rapid cooling at the top surface of the water due to evaporation effects, resulting in the cooled water falling toward the cooler lower layer. Cooler water, at the interface between the layers will become warmer from direct contact with the warm water layer and will rise through the upper layer.

UTILIZATION AND VARIATIONS:

In addition to demonstrating the difference in density between hot and cold water, this demonstration can be used to explain why water in a lake can be warm on top and cold on the bottom. On warm, sunny days, the surface of the lake will become warm. If there is little or no turbulence in the water, then there is minimal mixing between the upper and lower layers. When an individual walks into the water, they will experience the warm layer on their legs, and the colder, bottom layer on their feet.

In colder months, the surface of the lake will become cold from contact with the atmospheric temperature while the bottom of the lake will be warmer. When the temperature differential is great enough, the upper layer will fall to the bottom of the lake causing the lake to “turn over”.