

UNDERSTANDING INVERSIONS

Background

When placing any two fluids (either two liquids or two gases) in proximity, the fluids will want to stratify or layer according to their densities (mass per volume). The variation in density can be linked to either what is dissolved in each liquid or the temperature of the two liquids or gases. The denser fluid will settle to the bottom; the warmer fluid will rise to the top, creating an inversion because it is opposite or inverted from what a typical temperature profile looks like in the lower atmosphere.

Creating an Inversion (Demonstration)

Objective

The objective is to create an inversion and show that it is stable (up and down motion is inhibited).

Materials

- A clear container at least 3 inches tall
- Tea or coffee at room temperature (any other type of colored water, including water with food coloring, will do)
- Cold milk (small amount)



Important Points to Understand

The milk in this demonstration is both colder and denser than the colored liquid into which it is being poured.

Procedure

1. Fill the container about two-thirds full with the colored liquid.
2. Gently pour some milk into the colored fluid (near the edge of the container) and allow it to settle.

Questions

1. Before pouring the milk into the colored fluid, ask students what they think will happen and why.
2. After observing the results of the pour, what do students notice? Can they explain how the fluid Layering replicates an atmospheric inversion?

Rain Falls on the Ocean (Activity)

Objective

The objective is to demonstrate what happens when fresh rainwater falls on salty ocean water. This activity presumes that the temperature of both liquids is about the same and that waves are not present to mix the fluids.

Materials

- Small clear containers (preferably taller than wider)
- Salt water (either from the ocean or mixed up by teacher)
- Colored fresh water (use food coloring, coffee, or tea to color)
- Pipettes or spoons

Important Points to Understand

The rainwater in this demonstration is less dense than ocean salt water. Less dense fluids will remain on top of more dense fluids.

Procedure

1. Fill the container two-thirds full with the salt water.
2. Gently drip some colored water onto the salt water. Students can also gently push small drops of colored water off a spoon into the salt water. Have students watch from the side of the container. The fresh water should sink into the salt water and then rise to the top of the salt water.
3. Continue for several minutes until a well-defined layer of colored water sits on top of the salt water.

Questions

1. Before dripping the colored fluid into the salt water, ask students what they think will happen.
2. What do students notice? Can they again explain how the fluid layering replicates an atmospheric inversion?
3. Why did the fresh water drops first sink into the salt water and then rise?

Extension Activity

Repeat the student activity. Change variables, making the salt water warmer than the fresh water. Observe what happens and compare to the classroom activity.