

**For Teachers:****Student Learning Objectives**

Students will:

- learn that water and air are both fluids,
- observe that hot & cold fluids such as air can have different densities depending on their temperatures
- create a model of a weather front, where two masses of air with different temperatures meet,
- learn that convection is the transfer of heat in a fluid such as air and water by its movement or flow.

Class time

- 20 minutes

Grades

- K - 6th grade

National Science Standards

- A: Science as Inquiry
- D: Earth Science

Students observe that a change in the temperature of air will determine its place in the atmosphere. Water, which behaves very similarly to air, is used in this demonstration. It flows in fluid currents in a visual manner in a see-through density tank.

What you'll need:

- clear, narrow container or fish tank (see suppliers below)
- red and blue food coloring
- 2 measuring cups with pour spouts
- 2 funnels
- ice water
- heated water
- 1 red and 1 blue wrist band (or glove or pipe cleaner) for each student

Preparation for Demonstration

1. Fill the clear plastic tank halfway with water at room temperature.
2. Place funnels of the same size at each end of the tank.
3. Place 1-cup of warm water in a measuring cup with a spout and handle for easy pouring. Add a few drops of red food coloring at the appropriate time (see below).
4. Prepare 1-cup water with crushed ice. Add a few drops of blue food coloring at the appropriate time (see below).

Directions

1. Ask students if they can see the air in the room. Tell them that air is a fluid, just like water, but water can be seen. Consequently, we are going to use water as a model for air in the atmosphere. The water in the tank is representing air in the sky. The hot and cold water we are going to add to this model represent a cold air mass and a warm air mass.
1. Ask the students to recall the motion of air when it warms (it quickens), and when it cools (it slows). Based on this information, ask students to predict if a few drops of food coloring will need to be stirred into the warm water or into the cold water to mix quickly and fully. (The cold water will need to be stirred while the warm water can mix itself due to its heat content.) Add blue food coloring to the cold water and red food coloring to the warm water to illustrate.
2. Select two student volunteers, one to be "Hot" and one to be "Cool." Give "Hot" the cup of warm water and "Cool" the cup of ice water. If the tank you are using has a method to divide the tank evenly in two, do so by placing the divider in place.
3. Ask the class to predict the color that the water will become once the red and blue water (hot and cold air mass) are added. On the count of three, have "Hot" and "Cool" add their 'air mass' to the 'atmosphere' and then sit down to observe with the class. Make sure the tank can be seen by all students and have them articulate and record what they observe.
4. Once the two colors reach the middle of the tank, introduce the concept of a weather front to the students. Give each student one blue wrist band to represent the cold air mass to wear on their left hand, and one red wrist band to wear on their right wrist. Tell them that a weather front is where two different masses of air come together. Have students put their cold (red) and warm (blue) fists together, and show them that this represents a weather front, just as the red and blue 'air' in the tank.

Directions cont.

5. Next slowly lift the divide between the two different colored 'air' masses. The dense red cold 'air' mass will extend below the blue warm 'air'. This is what happens in the larger atmosphere to bring about a change in the weather. And it all starts with heat from the Sun putting air in motion. We call this process **convection**.

Background Information

Convection is the transfer of heat by the movement or flow of a substance from one position to another. It is how heat is transferred in a fluid, which includes air and water. Temperature, on the other hand, is a measure of the average speed of molecules. Higher temperatures increase their motion while lower temperatures reduce their speed. This is apparent when you add food coloring to hot water or cold water. The food coloring will readily mix in the hot water, but you will need to stir the cold water to mix color into it.

Density is the mass found in a volume of gas, liquid, or solid. Since all atoms and molecules weigh something (have mass), the more of them you pack into a given space, the greater the density. The cool water in this demonstration is more dense, which is why it sinks to the bottom of the tank. The warm water's molecules are moving faster and requiring a greater volume of space. Consequently, the warm water is less dense because there are fewer molecules in a given space. (When you submerge a less-dense substance in a more dense substance, the more dense substance exerts an upward force on the less dense substance.)

Molecules in Earth's atmosphere constantly bounce off each other and everything else around them. The force exerted by these air molecules is called air pressure. The mixing of air due to the rising and setting of the sun, which changes the heat being added to the atmosphere, creates the daily convection currents that mix our air from top to bottom creating one of the components in our daily weather patterns.



Weather Front Model

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