

Fronts and Air Masses in a Shoe Box

To accompany: <http://serc.carleton.edu/eslabs/weather/3b.html#fronts>

Gather the following materials:

- clear plastic shoebox
- a sturdy cardboard shoebox, large enough to support the water-filled plastic shoebox
- 2-cup pyrex measuring cup or beaker
- red and blue food coloring
- dropper or pipette (a turkey-baster works well)
- frozen cup of water, colored with blue food coloring
- extra red and blue food coloring
- a thermos of very hot water
- marker or pencil
- box cutter or knife



1. Read the information about air masses and fronts, below. As you read, relate the information on the card to the steps in your demonstration.

2. Assemble and practice your demonstration of air masses and fronts.

- a. On top of the cardboard box trace around the top of the measuring cup with a pencil or pen. Then use a sharp implement, such as a knife, to carefully cut a hole in the box just large enough for the heat to move from the cup to the plastic shoebox.
- b. Fill the plastic shoebox with cool, room temperature water. This represents the atmosphere.



- c. Place a very full measuring cup of hot water inside the shoebox, under the hole in the lid. This is your heat source for the atmosphere. Quickly close the lid of the box.
- d. Carefully, set the clear plastic shoebox on top of the cardboard box.
- e. Wait until the water in the shoebox has settled, (1-2 min). You are now ready to begin the demonstration.
- f. Using the pipette, carefully place about 2 tablespoons of the red food coloring on the bottom of the water, near the end of the container and over the area in

- the cardboard box where you cut the hole and placed the cup of hot water.
- g. Watch what happens. As water (or air) is heated, it expands, becomes less dense than its surroundings, and rises. Colder air (or in this model, water) moves in to replace it. This creates the winds in the atmosphere.
 - h. Slowly, add the frozen block of water that has been colored blue into the opposite end of the shoebox. Away from the heat source. Try not to disturb the water. You may need to hold the block in place with one finger. Observe the motion of the cold, blue water. You will be able to see the movements of the fluid in your container as cold blue water sinks and replaces the warm red water that is rising. This is like an advancing cold front.
 - i. Observe how the layers in the shoe box change with time. Give the demonstration at least 5 minutes.
 - j. Draw diagrams of what you observe. You will use these diagrams in your demonstration and explanation.

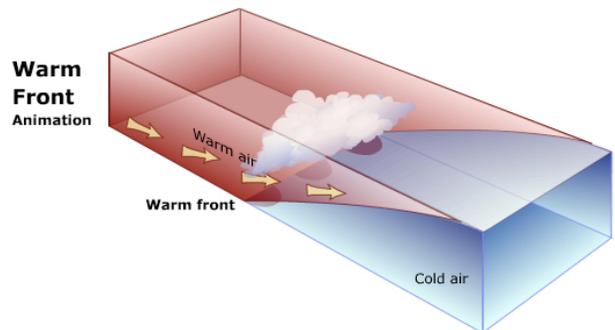
3. Review the information about air masses and fronts on your station card a second time; relate the information on the card to the steps in your demonstration. Practice using the terminology: cold front, warm front, and density.

4. Prepare to share your demonstration with the class. Be sure everyone in your group has a role in the demonstration.

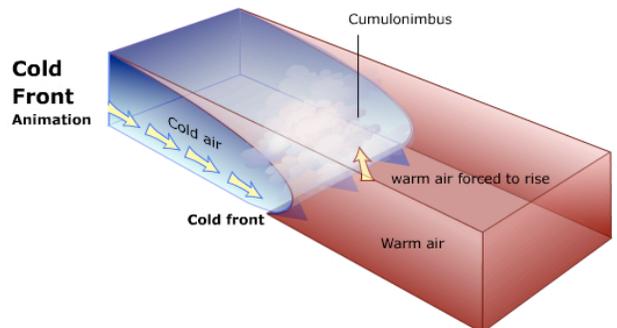
Fronts

Fronts are boundaries between air the masses. Fronts separate air masses with differences in temperature and humidity. Warm fronts are shown on maps with red, semi-circular shapes; cold fronts are marked by blue triangles.

Cold fronts tend to move at faster rates than warm fronts; cold fronts move in a scale best measured with hours, while warm fronts are slower and are better measured by days. A cold front occurs when cold air advances into a region; a warm front occurs when warm air moves in. Often you will notice that the wind speed and direction change on either side of a front.



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