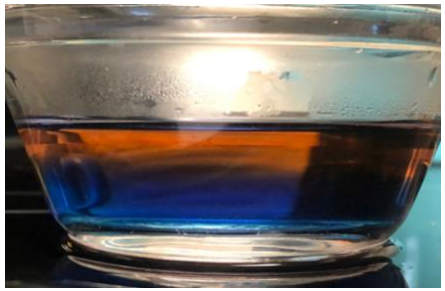
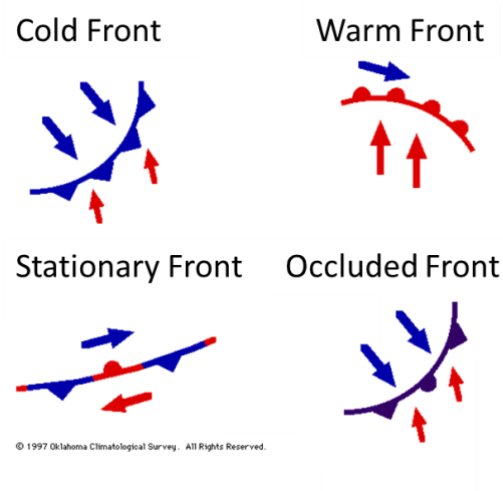
DIY Air Force Activities:

Wild Weather



Materials:

- water
- ice
- 2 mugs
- glass bowl, dish, or cup
- microwave
- blue and red food coloring
- cardboard
- scissors
- pen or pencil



Density is a topic we have covered in a variety of DIY activities (i.e. Density Diversions, Rainbow Density). Did you realize that density also plays a huge role in the weather? Heat is a form of energy, and when the molecules in liquids and gases are heated they become excited and spread out. Therefore, hot gas or liquid is less dense than cool gas or liquid. This scientific phenomenon can cause some wild weather! A weather front is a boundary between two air masses of different temperatures and densities. When the cold air meets warm air, the cold air pushes downward while the warm air surges upward. This creates atmospheric disturbances that are accompanied by changes in humidity and pressure. There are four different types of fronts: cold, warm, occluded, and stationary. Each result in a different type of weather pattern. They are named by the leading system, or the type of air in front. Warm fronts bring gentle rain or snow, cold fronts can result in thunderstorms, and stationary fronts can cause foggy weather, while occluded fronts can cause heavy rains. When multiple fronts collide, violent weather like hurricanes or tornados can occur. The following experiment will help you visualize front behavior.

1. Fill the first mug with ice and one cup of water. Then add one cup of water to the second mug and microwave it for 2 minutes. **Be careful!** This water will be very hot! Ask an adult to assist you.
2. Add one drop of blue food coloring to the cold water and one drop of red food coloring to the hot water. Note how the food coloring disperses quickly in the hot water and slowly in the cold!
3. Use your scissors to cut your cardboard into a shape that fits the contour of your glass dish (a). You want the shape close enough to create a seal (b). It should fit into the center and stand (c). Now get the bottom of the cardboard damp so when you insert it the fit is snug and water tight (d).
4. While supporting your divider in the center, CAREFULLY pour the cold blue water on one side and hot red water on the other. If the cardboard does not create a seal the water will mix and you will have to start over! Don't get discouraged, it may take a few tries!
5. Now pull the divider out! What do you observe?

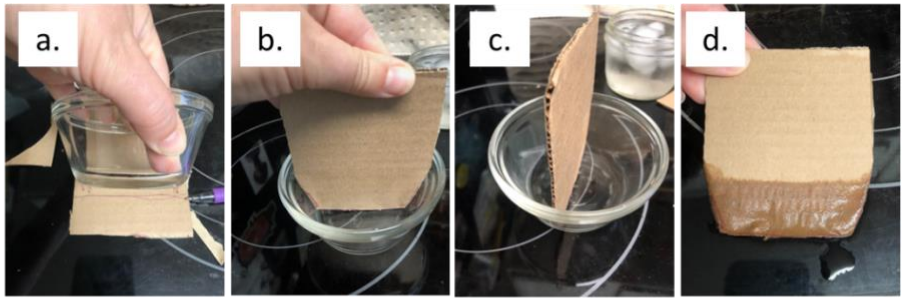
Take this experiment further! Try it with hotter and/or colder water. How does this alter your results?

Air Force Associations:

In 2019 the Air Force partnered with Oak Ridge National Laboratory to obtain a high-performance supercomputing system from Cray Inc. with the purpose of improving the weather forecasting abilities of Air Force and Army operations globally. It will provide the operators with the ability to run high resolution models needed for advanced operations planning and evaluating environmental impacts. https://www.defenseone.com/technology/2019/08/supercomputer-will-help-us-air-force-predict-weather/159050/

Step 1:

Step 2:

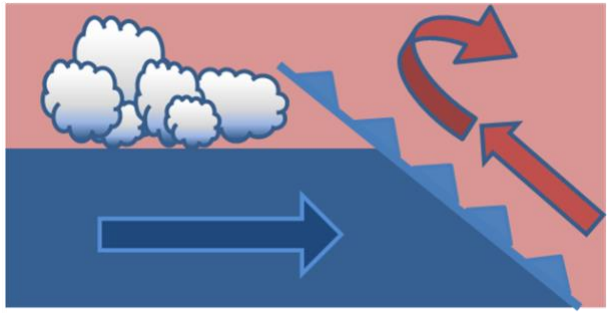


Step 3:

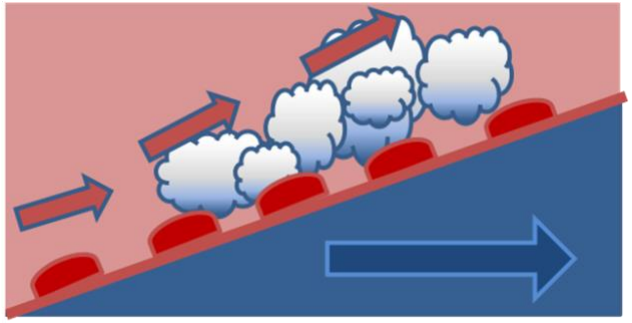
Step 4:

Step 5:

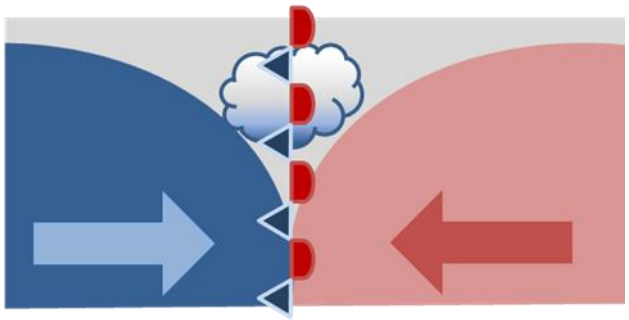
Cold Front



Warm Front

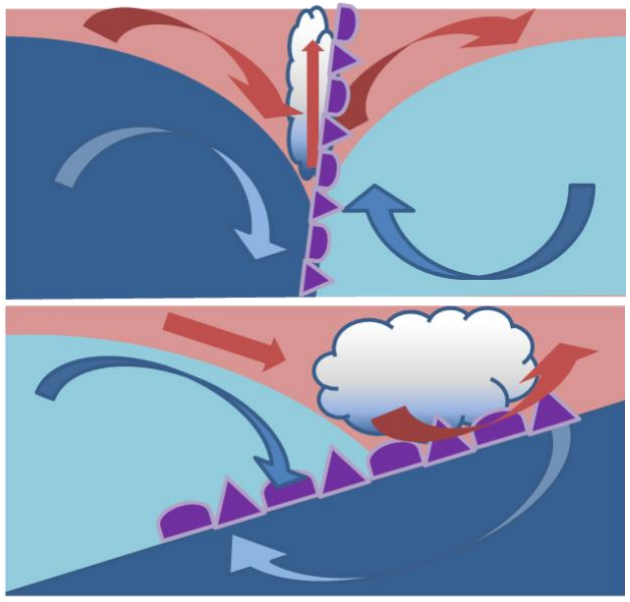


Stationary Front



At the beginning of the experiment the cup resembles a stationary front, with neither the cold nor the hot advancing. Once the divider is removed, the two "fronts" crash together, with the cold sinking to the bottom and the warmer rising to the top. The rapid change most resembles a cold front. The greater the temperature difference, the faster the separation occurs.

Occluded Front



The diagrams outline front behavior. Blue is for cold air, and pink is for warm air. The arrows describe the direction of air movement. Cold fronts move in fast, creating steep boundaries and causing warm air to rise quickly. Because warm fronts move in more gradually, the boundaries are less steep. An occluded front occurs when a cold front moves in right behind another front (multiple fronts colliding)! There are two types. A warm occlusion is when the cool air coming from behind is warmer than the air in front of it, while a cold occlusion occurs when the overtaking air mass is colder than the cool air in front of it.