**Air Pressure Barometer Lab**

**Introduction:**

Wouldn't it be great to be able to predict when a storm was going to arrive in your area? Of course, you could always look at the weather page in the newspaper or internet or watch the TV news; but what if you could just observe the clouds and make a prediction based on your own knowledge of the different types of clouds? Would you be able to make a prediction from this information? How accurate would your prediction be? What other types of things might you need to know to more accurately predict the weather? You may want to also look at the change in temperature, air pressure, wind speed and direction and even humidity.

Weather has many things that affect it. Knowing each of its individual components may help us make more accurate predictions of the weather overall. If we can make measurements and calculations about air pressure, wind speed, temperature and humidity, then we can look at how all of those pieces of information interact to learn about what is really going on with the weather. This way, we can learn about the weather as a system of separate parts that work together. Engineers often look at a problem through a systems approach. They break down a problem into its individual parts, study each part, and then bring what they analyze from each part back together to learn how they interact with each other. Engineers help us do this with weather as well. Engineers design instrumentation that takes measurements of temperature, air pressure, wind and humidity. They design software programs to pull the information from these instruments together and give us a complete description of the weather. When you watch a weather forecast on TV, you are seeing the results of weather instrumentation that engineers have designed here on Earth and in space to help us predict the weather.

We have learned that much of our weather is caused by changes in air pressure. We know that hot air rises and cold air sinks. The rising hot air exerts less pressure on the Earth's surface, so air pressure decreases. Then cooler, dense air, that often carries moisture with it, comes in and replaces the hot air that has risen away. When the air fills with moisture, it releases that moisture in the form of rain, and we have a rainy day. Can we measure air pressure? How do we tell if the air around us is rising or falling?

Well, today we are going to design a weather forecasting instrument to help us predict one change in the system of weather around us. The instrument we are going to make is called a barometer, a device that measures air pressure. Our simple barometers consist of an empty bottle turned upside down in a cup. The wider sides of the bottle rest on the rim of the cup, so that the mouth of the bottle is not touching either the bottom or sides of the cup. Water that we put in the cup will rise to a certain level up the neck of the bottle. The reason that the water rises is that air is pushing down on the water in the cup and forcing it up into the bottle. We call this air pressure. If the air pressure goes up, then it pushes harder on the water in the cup and forces more water up into the bottle. We will be able to measure the change in air pressure by measuring how much the water level in the neck of the bottle goes up or down. If the air pressure goes down, then the air is not pushing as hard on the water in the cup and less water will be in the bottle. The water level in the bottle will go down. Falling air pressure usually indicates that a storm of some sort is approaching. Conversely, rising air pressure is usually an indication that the weather is clearing up.

We will act like engineers as we analyze one individual component of our weather system. What might be our next step if we were trying to help predict the changes in weather around us? Using a systems approach, we might look at other factors affecting the weather system, such as temperature, humidity and wind speed.

**Materials List:**

•clear bottle with a long, narrow neck, such as an empty and clean ketchup bottle with no lid

•large drinking glass

•ruler

•permanent marker

• Barometer Analysis Worksheet, one per student

**Procedure:**

***If a barometer shows that air pressure is decreasing, it indicates a chance for rain very soon. The more rapid the decrease in air pressure, the stormier it will be. The reason decreasing air pressure signals the arrival of a storm is that the decrease in air pressure indicates warm air is rising; the rising air carries moisture with it that forms clouds, and when the clouds fill with moisture, it rains. If the air pressure is increasing, the weather is going to clear up or stay fair.***

1. Starting at the top of the neck of the ketchup bottle, make a mark every two centimeters, going all the way to the bottom of the bottle. Refer to Mrs. Wolbach’s sample.

2. Turn the bottle upside down and number the marks, starting with "1" at the upside down bottom of the bottle (or, the actual top of the bottle). These numbers do not represent an actual unit of pressure; they are simply to help students measure and compare values.

3. Fill the bottle about half-way with water; hold upright.

4. Place the glass upside-down over the bottle.

5. Quickly flip the bottle and glass over so that the glass is upright and the bottle is upside-down. Some water will spill out, but the water level inside the ketchup bottle should be higher than the level outside of it (that is, inside the glass). If it is not, repeat steps 3-5, using a little more water.

6. Add about an inch more of water into the cup. This ensures that if the pressure increases and pushes more water up the bottle, the bottle opening will remain submerged. Note: The water level in the cup should be just a little higher than the lip of the ketchup bottle. To take a barometer reading, take note of where the water level is inside the ketchup bottle.

7. Place the barometers in a safe place where the temperature stays fairly constant, and where they can be easily observed. They can be stored inside.

8. Record the current water level by using the numbered marks. Record the current weather conditions on your worksheet.

9. Take more barometer readings and weather observations once each day for at least a week. Record the information on the lab worksheet provided.

10. Compare any barometer changes to weather changes and look for trends. Were there any changes in weather during the week? Did the barometer change when the weather changed? Did the barometer change without a change in weather? How well did the barometer work? Was the design of your barometer effective? What would you change if you could design the barometer again? How does a barometer help us understand the system of weather around us?