GRADE LEVEL: 5-8 | TIME REQUIREMENT: 2 HOURS

EARTH AND SPACE SCIENCE: WEATHER

1 READING | 1 ACTIVITY

INTRODUCTION

Weather is a core topic of upper elementary and middle school science. It also is a topic that allows you to revisit physical science concepts that underlie weather phenomena, such as the gas laws, solutions, and heat transfer.

Weather was certainly important to the military planners in World War II. For every invasion or large action in World War II, there were detailed weather forecasts made. Every flight crew went through detailed weather forecasts before taking off, and every ship had someone making or receiving forecasts of coming weather.

Weather is also something that students see and experience in their daily lives, which means that they can apply what they learn both immediately and constantly.

OBJECTIVE

The reading asks students to consider why and how we forecast weather. It introduces one of the most important weather forecasts in modern history—the forecast for D-Day in the English Channel and Normandy on June 6, 1944. The reading also asks them to apply skills of weather-map reading. Then students learn about and create simple versions of thermometers, barometers, and hygrometers. Each weather tool works in very unique ways due to the physical properties of materials.

STANDARDS

NGSS DCI PS1.A
Structure and Properties of Matter

NGSS DCI ESS2.D
Weather and Climate

NGSS SEP
Developing and Using Models

NGSS SEP
Constructing Explanations and Designing Solutions

NGSS CCC
Patterns

NGSS CCC
Energy and Matter

PERFORMANCE EXPECTATIONS

5-PS1-1
Develop a model to describe that matter is made of particles too small to be seen.

5-ESS2-1
Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

MS-PS1-4
Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MS-ESS2-5
Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

READINGS (1)

1. WHY WEATHER?

Description
This reading asks why weather is important and how it has made an impact on history. As students read ask: Why does weather matter? How can we predict the weather? What data do we need to predict the weather? Have students work in groups and use your preferred Kagan strategies or cooperative learning methods to organize productive student conversation.

ACTIVITIES (1)

1. WEATHER TOOLS

Description
This activity can be used in conjunction with the Why Weather reading as a way to introduce weather data collection. This lesson is a good example of how we can make measuring tools when we know the physical properties of materials. Students need to apply knowledge of what temperature, pressure, and humidity are; making the tools will help them remember.

Supplies
For all 3 tool-making activities, safety goggles or glasses are necessary

Thermometer
1 Clear small plastic bottle (too large and you'll use too much alcohol; a small 8-16 oz water bottle would work)
1 Clear plastic straw
1 Ruler
Rubbing alcohol, colored with food coloring (can be only 50 percent)
Clay
Dropper

Barometer
1 Empty plastic bottle (an empty 16-20 oz bottle will work)
1 Length of plastic tubing (you can use aquarium tubing)
Water, colored with food coloring
Clay
Ruler

Hygrometer
1 Metal can (can be a bean or coffee can)
Water
Thermometer
Ice

Instructions
Thermometer
Have the students mark the straw in half-centimeter increments with the pen and ruler. Next, they will fill the bottle one-fourth full with alcohol, put the straw in the bottle, and seal the straw in the bottle's mouth with clay. The seal needs to be tight so that air can't get in or out of the bottle. The straw also needs to be straight and in the center of the bottle's mouth. Have the students fill the straw with alcohol so that the level in the straw is just a couple of centimeters above that in the bottle. This step is possible because the air in the bottle is trapped and pushing back against the added liquid in the straw.

Have the students hold the bottle in their hands or put the bottle in a sunny spot to see if the temperature changes. Finally, to calibrate the thermometer, have the students record the marks of the alcohol level at different temperatures.

Barometer
Have the students mark the tubing in half-centimeter increments with the pen and ruler. Then have them fill the bottle halfway up with water and put the tubing in the bottle. Students will need to make sure that the tubing is not pressed against the bottom of the bottle so that it will be able to suck the water up until it is a few centimeters above the level of water in the bottle. Finally they will seal the tube with clay.

Because the air pressure outside won't change quickly, students won't see changes in the barometer quickly. Students can watch how the level changes daily and correlate it with the weather.

Hygrometer
Have students fill the can about halfway up with water and place the thermometer in the can. They should watch the thermometer until it stabilizes (just a couple of minutes) and then observe if there is any condensation on the outside of the can. If not, add a couple of ice cubes to the water and stir it, watching until the temperature stabilizes. Is there any condensation on the outside of the can? Repeat as necessary until condensation is seen. The temperature where condensation occurs is the dew point.

Generally, the humidity will be below 50 percent in a well-regulated indoor environment. If the hygrometer is taken outside into a more humid place, it may produce better results.

ACTIVITY

WEATHER TOOLS

INTRODUCTION

Knowing tomorrow's weather totally depends upon knowing what the weather was like in the past. Only by monitoring the weather can we understand its patterns and be able to predict what conditions will be like in the future. People have been collecting weather data for hundreds of years, and many of the tools they used in the past are similar to the ones we use today. These tools have of course been supplemented by modern technologies, and we now use computers to analyze weather data.

In this activity you will make three different weather tools. They won't be the most accurate tools you've ever used, but they WILL show you how the more accurate tools work and reveal some of science ideas behind these phenomena.

THERMOMETER

You will need the following from your teacher:

- **1 Clear plastic bottle**
- **1 Clear plastic straw**
- **1 Ruler**
- **Rubbing alcohol, colored with food coloring**
- **Clay**
- **Dropper**

1. Using a pen your teacher gives you, mark every half-centimeter increment on your straw.
2. Fill the bottle about 1/4 of the way up with alcohol.
3. Put the straw in the bottle and seal the top of the bottle with clay tightly. Make sure the straw is straight and goes through the middle of the clay lid.
4. With the dropper, add alcohol to the straw until the level is just a couple of inches above the level of the alcohol in the bottle.

Now you are ready to test your thermometer. Hold the bottle tightly in your hands to warm it up with your body heat. It may take a minute for it to absorb the heat from your hands, but watch the level of the alcohol in the straw. To test more extreme changes in temperature, try putting your thermometer in hot water or ice water. Calibrate your thermometer by indicating which line the alcohol level reaches at the different temperatures.

NAME: **DATE:**

BAROMETER

You will need the following from your teacher:

- **1 Empty plastic bottle**
- **1 Length of plastic tubing**
- **Water, colored with food coloring**
- **Clay**
- **1 Ruler**

1. Using a pen your teacher gives you, mark every half-centimeter increment on your tubing.
2. Fill the bottle about 1/2 of the way up with water.
3. Put the tubing in the bottle and secure it with tape so that the tubing doesn't touch the bottom of the bottle.
4. Now suck water up the tubing until it is halfway up the length of the bottle, and then seal the end of the tubing with the clay.

Changes in atmospheric air pressure are not immediate, so note where the water level in the tube is today and check it tomorrow. When the pressure goes up or down, do you notice a change in the weather? Air pressure changes in a place due to weather, but only by about 0.75 percent. Air pressure changes a lot by altitude—at the top of Mt. Everest the air pressure is only 1/3 of what it is at sea level.

HYGROMETER

You will need the following from your teacher:

- **1 Metal can**
- **Water**
- **Thermometer**
- **Ice**

1. First, put the water in the can, filling it about halfway up. Place the thermometer in the can.
2. Add a cube of ice to the water, and stir it as the temperature goes down and then stays constant.
3. Check to see if there is condensation on the outside of the can.
4. If there is condensation, record the temperature of the water in the can as the dew point. If not, repeat until there is condensation on the outside of the can.

It is usually not very humid inside, meaning that the dew point inside is very low. It may be easier to get a result if you go outside, unless you live in a part of the country that is very dry.