

Post-Show

WEATHER

AFTER THE SHOW

We recently presented a Weather show at your school, and thought you and your students might like to continue investigating this topic. The following activities are designed to review and extend the ideas covered in the show.

Please remember to use appropriate safety measures for all activities. An adult instructor should always supervise students during experiments.

Visit us online at www.fi.edu/TSS or contact us at tss@fi.edu.



CLOUD IN A BOTTLE

FOR GRADES 1-4

Clouds are formed by condensation, or the process of turning a gas into a liquid. During the show, we used liquid nitrogen to condense water vapor into a cloud. We can't give you any liquid nitrogen to try this on your own, but in this activity, students will simulate cloud formation in a bottle.

EQUIPMENT

Clear 2-liter plastic bottle with cap

Water

Matches

PROCEDURE

1. Place about 1 tablespoon of water in the bottom of the bottle, not quite enough to cover the bottom.
2. Light a match and drop it into the bottle. Cap the bottle.
3. Squeeze the bottle as hard as you can, then release. What do you observe?

WHY?

Squeezing the bottle increases the air pressure inside the bottle, causing the temperature inside to increase. When you then release the bottle, the pressure and temperature both drop. This temperature decrease causes invisible water vapor in the air to condense, or change into little drops of liquid water. The smoke from the match provides tiny, solid particles for the newly formed drops of liquid water to grab onto. Meteorologists call these "condensation nuclei." When enough of these little drops of water condense onto the condensation nuclei, you have a cloud!



PRESSURE POINTS

FOR GRADES 3-6

During the show, we explored how air pressure influences weather. A barometer is a tool to measure air pressure, which gives valuable clues about the weather over the next few hours and days. In this activity, students will construct and use a simple barometer. Note that the barometer will give more accurate readings if used outdoors.

EQUIPMENT

Empty coffee can

Large balloon

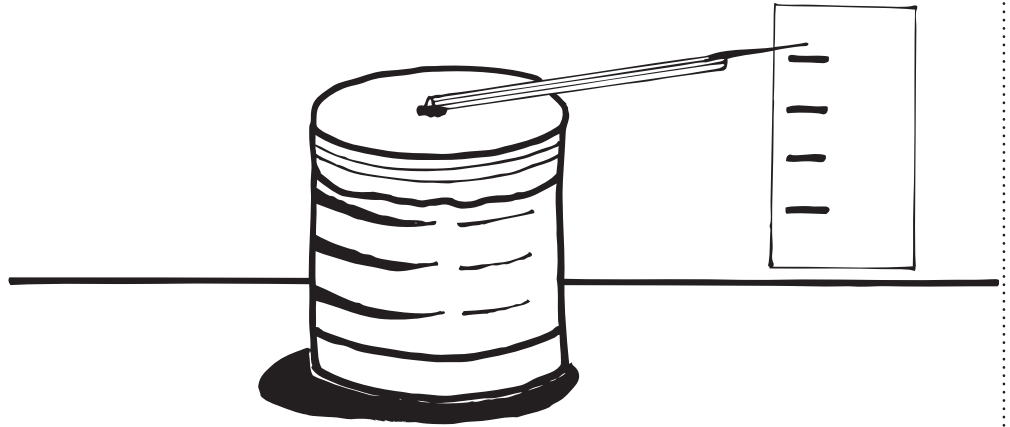
Rubber band

Drinking straw

Glue

Straight pin

Index card



PROCEDURE

1. Cut the neck off of the balloon. Stretch the top of the balloon over the opening of the coffee can. Use a tight rubber band to seal the balloon to the can.
2. Place a small amount of glue in the center of the balloon and lay the side of the straw down on top. One end of the straw should hang off the edge of the can.
3. Place another drop of glue on the other end of the straw and attach the pin.
4. Tape the index card to the wall. The lined side should be facing out. Number the lines, starting at the bottom.
5. Set the can so that the pin points to one of the lines in the middle of the index card.
6. Which line does the pin point to? Record the barometer readings in a data table three times a day for a week. Observe and record the weather conditions at the time of each barometer reading.
7. Discuss your results. How do the barometer readings differ during the day, or from day to day? What causes the readings to vary? What kind of air pressure existed during good weather? Can you predict tomorrow's weather based on today's barometer reading?

WHY?

As the air pressure increases, it pushes down on the balloon, causing the straw to indicate a high reading. When the air pressure is low, the opposite will happen. In general, low pressure indicates stormy weather is approaching.

HOLDING HEAT

FOR GRADES 5-8

In the show, we discussed how heat from the sun provides the energy that drives changes in weather. In this experiment, students will explore how solar energy affects land and water differently.

EQUIPMENT

Water

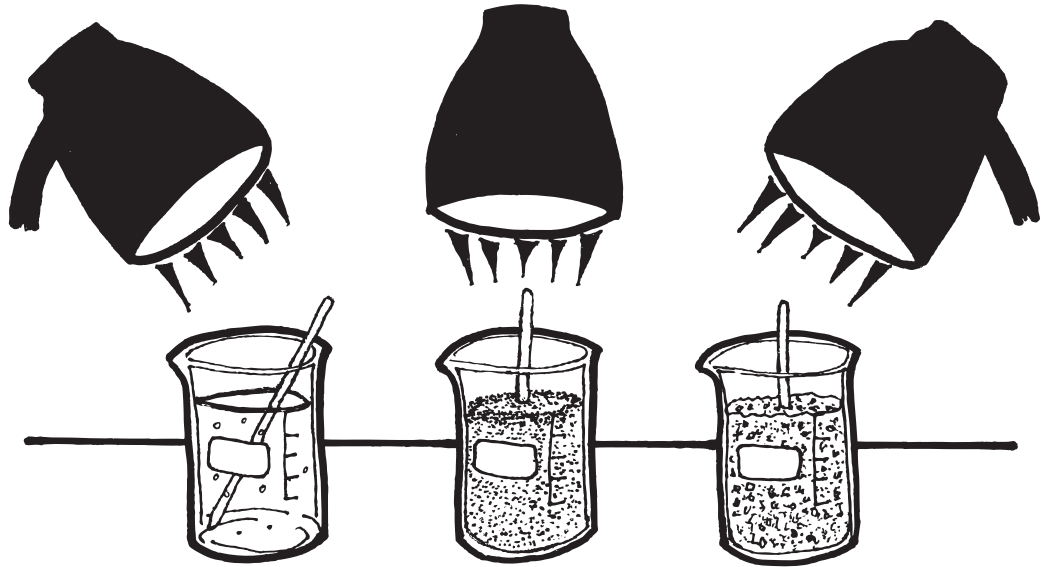
Soil

Sand

3 Glass beakers or cups

3 Thermometers

3 Hot lamps



PROCEDURE

1. Use a scale to measure 100 milliliters each of water, soil, and sand in separate glass beakers. Place each beaker under a lamp.
2. Put one thermometer in each beaker, holding it so that it is in the middle of the sample. Record the starting temperature of each material.
3. Simultaneously turn on the lamps. Record the temperature of each material every 5 minutes for 20 minutes.
4. Turn off the lamps. Record the temperature of each material every 5 minutes for 20 minutes.
5. Graph the changes in temperature. Which material heated up the fastest, and which the slowest? When solar energy reaches the surface of the Earth, do you think land or water experiences more temperature change?

WHY?

Heat capacity is the amount of energy required to change the temperature of an object or material. Water has an extremely high heat capacity, meaning that it takes much more energy to raise or lower the temperature of water than land. Large bodies of water, like the ocean, moderate the temperatures on nearby land. In coastal areas, the temperature doesn't change very much from day to night or season to season. Inland areas, however, experience much more extreme temperatures on average. For example, deserts get very hot during the day, when the sand absorbs solar energy, and then very cold at night when the sand cools down quickly.

MORE INFORMATION..

We've provided the following information to help refresh your memory about the topics we covered during the show, and to deepen your understanding about important meteorology topics.

Weather: The conditions of the atmosphere in a particular place at a particular time, including temperature, air pressure, wind, precipitation, humidity, and cloud cover. Climate is a description of the average weather experienced in a region throughout the year. For instance, Philadelphia lies on the northern edge of the humid subtropical climate zone, which experiences hot and muggy summers, mild autumns and springs, and cold winters with variable snowfall.

Solar energy: The sun, a star 93 million miles away, is the Earth's only external source of heat energy. About 30% of the solar energy reaching the Earth is reflected. Another 20% is absorbed at various heights in the atmosphere. The remaining 50% is absorbed by the ground and oceans. The ground heats up and cools off relatively quickly. Water in oceans and lakes heats up and cools off more slowly, moderating the temperatures for shorefront locations.

Atmosphere: The "ocean" of air that extends up above us for over sixty miles, where it gradually merges into space. There are several layers in the atmosphere, each of which has distinct characteristics. Weather takes place in the troposphere, the layer directly above the Earth's surface. The troposphere is 11 miles thick and contains 75% of the atmosphere's mass.

Convection: The movement of air vertically through the atmosphere. As the ground and oceans are heated by solar energy, they conduct heat to the air directly above. This warmer, less dense air rises up (an updraft) into the atmosphere, loses some of its heat energy, and cools down again. When the air is cooler and denser, it sinks back to the ground, where the cycle begins again.

Air pressure: The pressure exerted by the weight of the air over an area of Earth's surface. Air pressure is created by the force of molecules moving and colliding. It varies from location to location, and from one hour to the next. The air pressure at any given time provides meteorologists with important clues about the weather in the next several hours or days.

Water cycle: The continuous exchange of water between the atmosphere and the oceans and land on Earth's surface. The water cycle includes water in three states: ice (solid), water (liquid), and water vapor (gas).

Evaporation: The process by which liquid water at Earth's surface is heated and converted to a gas (water vapor), which returns to the atmosphere. The heat energy for evaporation is usually provided by the sun. However, evaporation can whisk heat away from our bodies in a process called evaporative cooling – the cooling effect experienced when we sweat.

Condensation: The process by which water vapor is cooled and converted to liquid water. The water vapor in the air is turned into rain or ice, depending on the atmospheric temperature. Condensation results in clouds, which are collections of water droplets and ice crystals.

Precipitation: All moisture that falls from the atmosphere. Rain is precipitation that reaches the ground as large liquid droplets, while snow is precipitation that is still frozen solid when it reaches the ground. Sleet is precipitation that hit the ground as hard, transparent pieces of ice. Hailstones are larger than sleet, up to the size of a softball; hail is the only kind of frozen precipitation that can fall in warm weather.

Humidity: A measure of how much water vapor is in the air. Humidity makes the air feel even warmer because the rate of evaporative cooling, which removes heat from our bodies, is reduced.

Lightning: A short-lived, bright flash of light produced by a 100 million-volt static electrical discharge. Lightning heats the air through which it travels to 50,000° F; this intense heating causes the air to expand explosively, creating a sound wave that we hear as thunder. The time lapse between lightning and thunder indicates the distance of the thunderstorm. As a rule of thumb, it takes thunder about 5 seconds to cover 1 mile. So if you hear thunder 7 seconds after you see the flash of lightning, the thunderstorm is 1.4 miles away.

Tornado: A rapidly spinning column of air from a thunderstorm cloud to the ground. Tornadoes are rated on the Fujita Intensity Scale based on wind speed and damage caused. The most violent tornadoes have wind speeds above 250 mph. These high winds can cause walls to buckle, roofs to be lifted off, and trees to be uprooted. A waterspout is a tornado over water.

Hurricane: A series of tightly coiled bands of clouds (called rain bands), which spiral around a calm center (known as the eye). When it moves onto land, a hurricane causes tremendous destruction. While the high wind speeds are dangerous, flooding caused by torrential rains and an intense storm surge result in the majority of fatalities and building damage.

MORE RESOURCES...

The Franklin Institute: On your next field trip, check out Changing Earth, an interactive exhibit about the forces shaping our air, water, and land. You can even star in your own weather forecast! Go to <http://www.fi.edu/teacherresources/> for a guide to the exhibit.

Weather and Climate: Visit <http://www.fi.edu/msp/weather/index.html> for a collection of resources on meteorology. You'll find lesson plans, games, videos, and more!