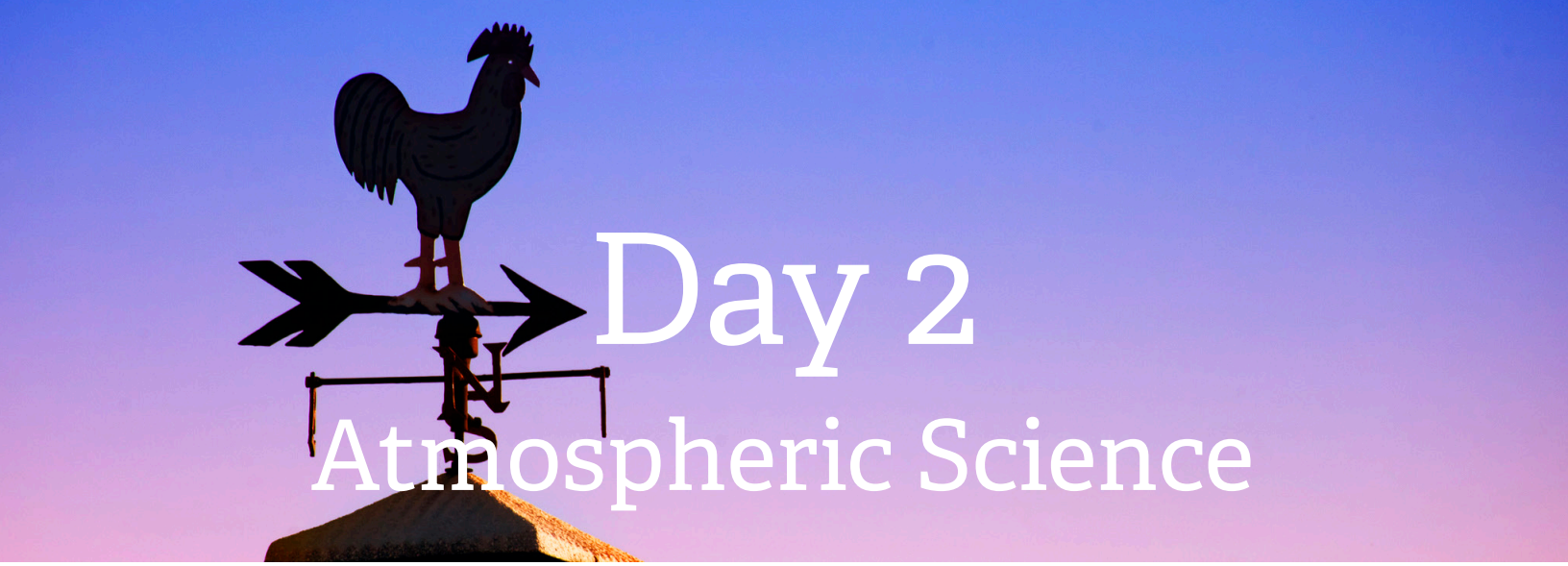
Day 2
Atmospheric Science



Day 2
Atmospheric Science

Introduction

The word **weather** describes what's happening in the **atmosphere** at a given point in time and geographic location. This day focuses on observations of atmospheric conditions, what tools or instruments can help people make those observations, and how those observations are used to predict future weather.

Questions to guide explorations and experiments

- How and where does weather happen?
- Why and how do people study weather?
- How does air pressure affect the weather?
- How are weather predictions made?
- What tools do meteorologists use to make weather predictions and track weather?
- How does the atmosphere affect weather and climate?

Books and activities

- **Books:** about predicting and forecasting weather, weather science, and weather scientists
- **Activities:** explore the atmosphere, build weather instruments and a weather station, create a terrarium, and learn about greenhouse gases, take a Weather Walk, and observe clouds

Children's Books

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Fiction

- *Cloudette* by Tom Lichtenheld (Ages 4-8)
- *Cloudy With a Chance of Meatballs* by Judi Barrett (Ages 3-9)
- *Freddy the Frogcaster series* by Janice Dean (Ages 3-6)
- *Groundhog Weather School* by Joan Holub (Ages 6-9)
- *Miss Newman Isn't Human!* by Dan Gutman (Ages 6-9)
- *Misty the Cloud: Fun Is in the Air* by Dylan Dreyer (Ages 4-6)
- *Nighttime Symphony* by Timbaland and Christopher Meyers (Ages 3-9)
- *The Weather Girls* by Aki (Ages 3-6)
- *When Cloud Became a Cloud* by Rob Hodgson (Ages 4-8)
- *The Wind Blew* by Pat Hutchins (Ages 4-8)
- *Windy Days* by Deborah Kerbel (ages 3-6)

Poetry

- *A Boy Asked the Wind* by Barbara Nickel (Ages 4-8)
- *Hear the Wind Blow* by Doe Boyle (Ages 4-8)
- *Make Things Fly: Poems About Wind* by Dorothy Kennedy (Ages 9-12)

Nonfiction

- *Boy, Were We Wrong About Weather!* by Kathleen V. Kudlinski (Ages 6-9)
- *Breaking Through the Clouds: The Sometimes Turbulent Life of Meteorologist Joanne Simpson* by Sandra Nickel (Ages 6-9)
- *I Face the Wind* by Vicki Cobb (Ages 6-9)
- *Inside Weather* by Mary Kay Carson (Ages 6-9)
- *The Kids' Book of Weather Forecasting* by Meteorologist Mark Breen and Kathleen Friestad (Ages 6-9)
- *The Layers of Earth's Atmosphere* by Elizabeth Borngraber (Ages 9-12)
- *Like a Windy Day* by Frank and Devin Asch (Ages 4-7)

Children's Books

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- *Meteorology: Cool Women Who Weather Storms* by Karen Bush Gibson (Ages 9-12)
- *Meteorology: The Study of Weather* by Christine Taylor-Butler (Ages 9-12)
- *National Geographic Kids Everything Weather: Facts, Photos, and Fun that Will Blow You Away* by Kathy Furgang *(Ages 7-12)*
- *National Geographic Little Kids First Big Book of Weather* by Karen de Seve (Ages 3-6)
- *Pika Country: Climate Change at the Top of the World* by Dorothy Hinshaw Patent and Marlo Garnsworthy (Ages 6-9)
- *Stickmen's Guide to Earth's Atmosphere in Layers* by Catherine Chambers (Ages 9-12)
- *Weather* by John Farndon, Sean Callery, and Miranda Smith (Ages 9-12)
- *Weather Forecasting* by Gail Gibbons (Ages 6-9)
- *What Is the Atmosphere?* by Joe Greek (Ages 6-9)
- *What Is Weather* by Robin Johnson (Ages 6-9)
- *What's the Weather?* by Fraser and Judith Ralston (Ages 6-9)

Activity 1: Under Pressure

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Introduction

Earth is surrounded by the **atmosphere**, a mix of gases held in place around the planet by gravity. Weather is the state or condition of the atmosphere and is caused by heat from the Sun and movement of the air. Moisture in the air, precipitation, cloudiness, and wind are all different components of our weather.

The weight of the atmosphere, or the **air** or **atmospheric pressure**, affects what kind of weather and how intense our weather is. Weather changes are caused by pressure changes!

A **barometer** is an instrument used for measuring the change in atmospheric pressure. With this activity, kids can get to know the atmosphere, learn more about atmospheric pressure, and make their own barometers.

Supplies

- clean, empty glass jar or tin can
- balloon (round and new — never blown up)
- thick rubber band
- plastic drinking straws or similar lightweight item, like coffee stirrers or wooden skewers
- markers and pencil
- paper
- tape or glue
- scissors and ruler
- Weather Journals (see Appendix)

Activity 1: Under Pressure

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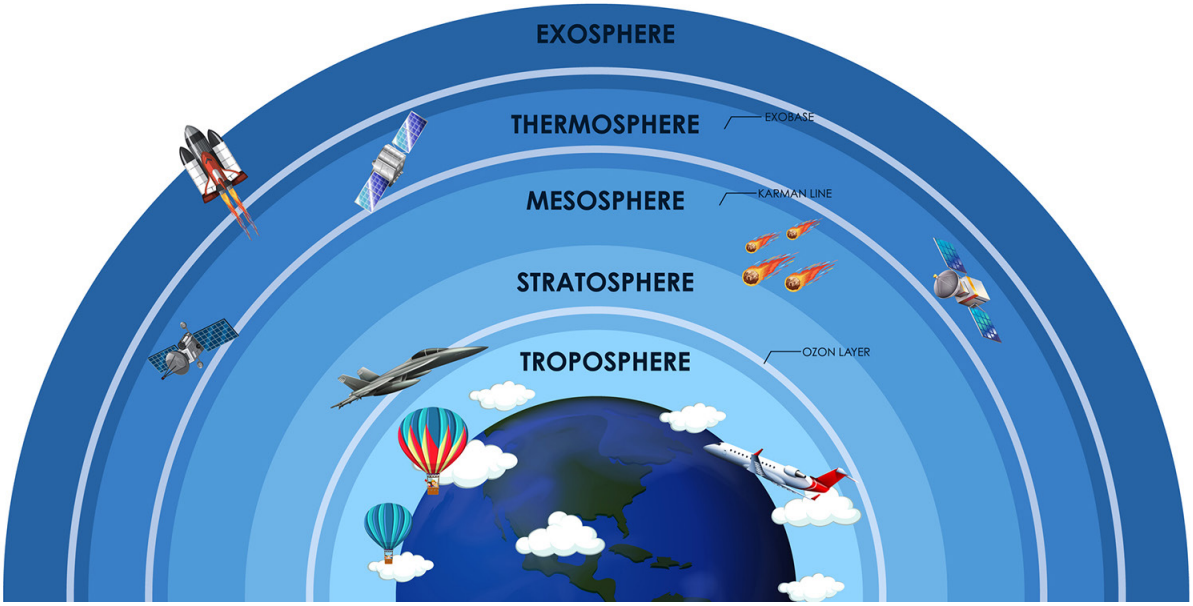
Get kids thinking ...

Ask kids about their experiences with atmospheric pressure. Have they ever been in a car going up a steep hill or taken off in an airplane and had their ears "pop"? What do they think causes that to happen? Talk about how the air pressure outside of their bodies changes as altitude changes. Ears "pop" when the pressure of the air inside their ears tries to match decreasing or increasing atmospheric pressure outside as they go up or down. **Ask kids** what they think air pressure has to do with the weather?

Let's get started!

Kids may have heard our atmosphere talked about as a jacket or blanket of air that surrounds the Earth, keeping us warm and providing oxygen to breathe. That air also has weight. As gravity pulls the blanket of air to Earth, it presses on everything.

Start with a book such as *Stickmen's Guide to Earth's Atmosphere in Layers* that offers details about our atmosphere and shows kids how weather and the atmosphere are connected. Talk with kids about how changes in the atmosphere, including changes in air pressure, affect the weather.



Activity 1: Under Pressure

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Atmospheric pressure changes with temperature and also lessens with altitude, so there are areas of high pressure and low pressure all around the Earth. How much air pressure there is also depends on the density of the air. Density is how closely the molecules of air are packed together.

High pressure causes air to sink down slowly and generally leads to clear skies because sinking air stops clouds from forming. Low-pressure air is warmer and cools as it slowly rises, making clouds form from any moisture in the air and precipitation likely. Wind is also caused by differences in air pressure within the atmosphere. When air moves from high-pressure areas to low pressure-areas and the greater difference in pressure, the faster the wind blows.

Ask kids if they have ever heard a weathercaster on the news talking about low and high pressure. Take a look at the National Weather Service's Daily Weather Map and ask kids what they notice. Do they see the letter "H" and the letter "L"? What does that mean for today's weather?

The letters "H" and "L" for "high pressure" and "low pressure" got on the weather map because meteorologists use barometers to measure atmospheric pressure and predict changes in weather. Discuss the importance of knowing the air pressure and how a barometer can be used to help predict the weather as kids build their own barometers. **Note:** a simple (but unofficial) way to know the difference between highs and lows is "H = Happy" and "L= Lousy"!

National Weather Service: https://www.weather.gov/

Explore high and low pressure: https://scijinks.gov/high-and-low-pressure-systems/

Build a barometer

There are several different types of barometers, the scientific instrument used to measure atmospheric pressure. The barometer kids will be building is a dry barometer, which is similar to the aneroid (air) barometer. Before kids start building their own, show them examples of different types.

Types of Barometers: https://education.nationalgeographic.org/resource/barometer/

Weather Works: What is a barometer and how does it work? https://youtu.be/gblJW

Activity 1: Under Pressure

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Figure out the best place for the barometer. Placing the barometer against an indoor wall keeps it from getting moved around and makes it easy to note changes in pressure on the paper gauge. Get kids to help find a spot that keeps the barometer away from any extreme sources or heat or cold. **Ask kids** why that might be important to their pressure measurements, and talk about the effects of temperature on air pressure.

Before kids get started building, demonstrate these steps:

Step 1: Cut off the stem of the balloon.

Step 2: Stretch the balloon head over the opening of the jar. Smooth until you have a flat surface.

Step 3: Use a thick rubber band to secure the balloon to the jar. Make sure the jar is sealed tightly with no way for air to come in or leak out.

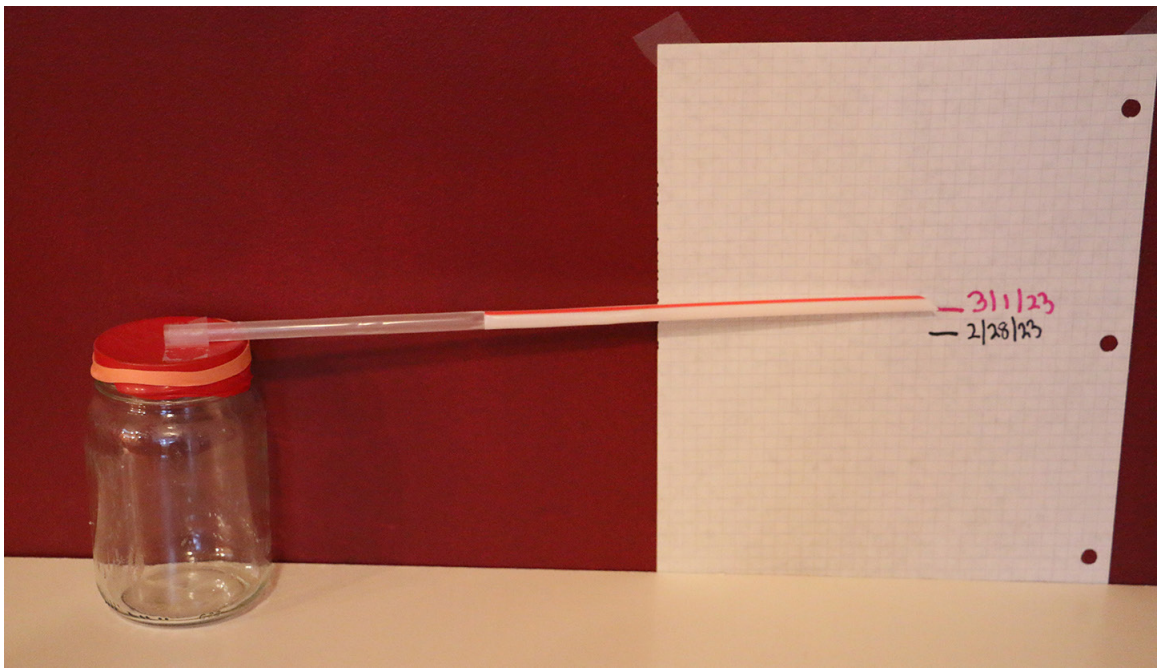
Step 4: Next, make a pointer for the barometer. Longer pointers make for more accurate readings of atmospheric pressure. Get a good length by squeezing the end of one straw into another or gluing coffee stirrers together. If you are using a straw or stirrers, cut one end of the pointer at an angle to create a fine tip.

The pointer will show how much the balloon moves up and down when pressure changes, so it needs to be very straight.

Step 5: Glue or tape the non-pointy end of your pointer on top of the balloon, right in the center. If you use glue, wait for it to dry completely.

Activity 1: Under Pressure

Step 6: To track the movement of the pointer, you need to create a gauge. Get a piece of lined paper or draw your own lines using a ruler. Tape the paper to the wall and place the barometer along the wall, so that the pointer is in front of the paper. Make a mark on the paper that shows where the pointer is. Put the date next to the line you make and draw a symbol that shows what the weather is like on this day.



As kids build their barometer, talk about how it will work. The pointer rises and falls because of air pressure. When there is higher atmospheric pressure, air presses down on the balloon and the pointer will rise. When the air pressure decreases on the balloon, the pointer will drop. Discuss the importance of knowing the air pressure through the use of a barometer. **Ask:** How can understanding the change in atmospheric pressure help forecast the weather? What kind of weather happens when atmospheric pressure is high? Or low?

Kids should observe the barometer over time. Have kids check their barometers daily, mark the gauge, and record the results in their Weather Journals, noting the date, the direction of the pointer and if it is indicating higher or lower pressure, current weather conditions, and their weather predictions. Kids can compare their results with atmospheric pressure readings and the weather forecast from a news source.

Activity 1: Under Pressure

More air pressure activities

Interactive activities:

Scroll up, up, up into the different layers of Earth's atmosphere
https://climatekids.nasa.gov/whats-in-the-atmosphere/

Virtual ballooning to explore the atmosphere
https://scied.ucar.edu/interactive/virtual-ballooning

Get hands on:

Experiment with temperature and air pressure
https://www.sciencebuddies.org/stem-activities/balloon-barometer

5 Ways to Demonstrate Air Pressure
https://www.asme.org/topics-resources/content/5-ways-to-demonstrate-air-pressure-to-children

Atmospheric Pressure Experiment. Get ready to crush some cans!
https://youtu.be/-53nNVX5RDU

Build a water barometer
https://youtu.be/k4lQ9zvAE4U

Activity 2: Weather Station

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Introduction

Meteorology is the scientific study of Earth's atmosphere, especially how the atmosphere affects the weather. Scientists who study and work to understand the processes in Earth's atmosphere that determine weather and climate are called **meteorologists** and **climatologists**.

To **predict** weather, meteorologists use instruments to measure atmospheric conditions. A weather station is a collection of those instruments, which may include a **weather vane**, **anemometer**, **hygrometer**, **thermometer**, **barometer**, and **rain gauge**. Using these instruments and other tools such as **radar systems**, **satellites**, and **weather balloons**, meteorologists study the past and present **atmospheric patterns**. With the data they gather, they are able to predict the future weather and make a **weather forecast**.

While you can buy basic weather station instruments, it is a fun learning experience to have kids create their own tools for gathering weather data. Making their own instruments will help kids build their understanding of how the instruments work, learn more about the tools meteorologists use, and take their own first steps into weather forecasting by observing, measuring, and collecting weather data.

When choosing which weather instruments kids will make, determine what best fits into your day and suits kids' interests and abilities. You can have each child create all the weather station instruments (other than a thermometer) or have kids work in pairs or small groups to make one set of the instruments and set up a community weather station to observe the weather over the week or a period of weeks. If your schedule doesn't allow for a longer term collection of weather data, focus on having kids make one or two of these instruments and put an emphasis on testing them out and understanding how they work.

Get kids thinking ...

The first step in studying weather is to observe it! **Ask kids** to think about what it means to observe something. How can they observe weather? What tools might they use to help them make and record observations about different components of weather?

Activity 2: Weather Station

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Let's get started!

Start with reading aloud a fiction book about the weather such as *Cloudy with a Chance of Meatballs* by Judi Barrett. Talk about what kind of weather the characters in the book experienced. How did they know what kind of weather to expect? How do we know what kind of weather we are going to have for the day or week? Read from a nonfiction book such as *Inside Weather* by Mary Kay Carson and discuss what information and words related to weather they already know or want to learn more about.

Ask kids: What ideas did both these books give them about how to find out what the weather will be like? Where do they get their information about the weather forecast?

Meteorologists study the weather by recording and analyzing data. They make their weather predictions based on information about past weather. **Ask kids** what kinds of weather information they think these scientists collect and record. Talk about why tracking changes in temperature, pressure, humidity, wind, and precipitation would be important in predicting the weather.

Explore weather forecasting: https://scijinks.gov/menu/weather-forecasting/

Talk with kids about weather information they can collect themselves by building their own weather station instruments and keeping a record of their measurements. Help them understand that the instruments they can build will not provide exact readings. For example, a homemade anemometer can help them calculate an approximate wind speed, but it will not provide an exact reading. But the data they collect can still help them predict the weather!

Deciding on what data to collect will help kids determine what instruments they will need or want to have in their weather station. Most weather stations include the following instruments:

- **Weather vane:** shows the direction of the wind
- **Thermometer:** measures air temperature
- **Anemometer:** measures wind speed
- **Hygrometer:** measures humidity, or moisture in the air
- **Rain gauge:** measures the amount of rain or snow that falls
- **Barometer:** measures atmospheric pressure (see Activity 1)

Activity 2: Weather Station

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Explore weather instruments

- **Weather Tools and Instruments:** https://videoguru.com/video/third_grade_earth_science_a07/
- **Weather Instruments:** https://youtu.be/zNmtns2Z3Xc
- **Weather Instruments Woo Woo Rap:** https://youtu.be/p9rQpme2Vlw

Use the activities on the following pages to create instruments for a weather station. Kids can work alone, in pairs, or small groups.

Activity 2: Weather Station

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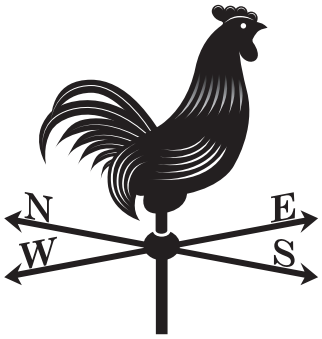
Station 1: Make a weather vane

A weather vane is an instrument that shows where the wind is blowing from, or wind direction. Knowing the direction of the wind is important in predicting weather because wind usually blows from high-pressure areas to low-pressure areas and this affects our expected weather. To use a weather vane and understand wind direction, kids need to know where north, south, east, and west are. Provide kids with supplies and these instructions to have them build their own weather vane.



Make a Wind Vane to Measure Wind Direction: https://www.amnh.org/explore/ology/earth/make-your-own-weather-station/make-a-wind-vane

Explore wind: https://scijinks.gov/wind/

Supplies and steps

- cardstock or a file folder
- piece of cardboard (something from the recycling bin)
- arrow template and a plate or circle to trace
- sharpened pencil with new eraser
- plastic-headed straight pin
- piece of modeling clay
- nonflexible plastic drinking straw
- scissors and ruler
- pencils and markers
- compass or compass app (current iPhones and most other smart phones have built-in compasses)

Step 1: Find a piece of cardboard in the recycling bin. Use a plate or another circular item and trace a circle approximately 10 to 12 inches onto the cardboard. Cut out the circle.

Step 2: Use a marker and a ruler to draw a line down the center of your circle. Label the top of the line "North" and the bottom of the line "South." Then draw another line across the center of the circle. Label the line to the left "West" and the line to the right "East."

Activity 2: Weather Station

Step 3: Use the template (see page 75) to cut out an arrow point and an arrow tail from a piece of cardstock.

Step 4: Use scissors to make two 1/2-inch slits, directly across from each other, into one end of the straw. Slip the flat edge of the arrow point into the slits in the straw.

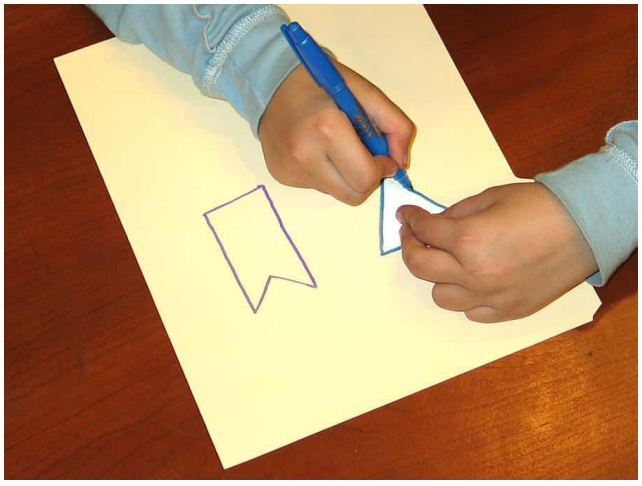
Step 5: Cut two 1/2-inch slits on the other end of the straw, making sure the new slits match up with the ones that hold the arrow point. The arrow point and arrow tail need to be at the same angle. Slip the arrow tail into the slits.

Step 6: Use a tiny amount of glue or small pieces of tape to secure the arrow point and tail in place.

Step 7: Push the straight pin through the middle of the straw and then into the pencil eraser.

Step 8: Push the sharp end of the pencil into a lump of modeling clay. Place the clay in the center of the cardboard circle. Press and mold it to the pencil and the cardboard so that the pencil is straight and secure.

Step 9: Blow on the arrow tail gently to make sure it can spin freely. Make any adjustments.



Photos: American Museum of Natural History

Activity 2: Weather Station

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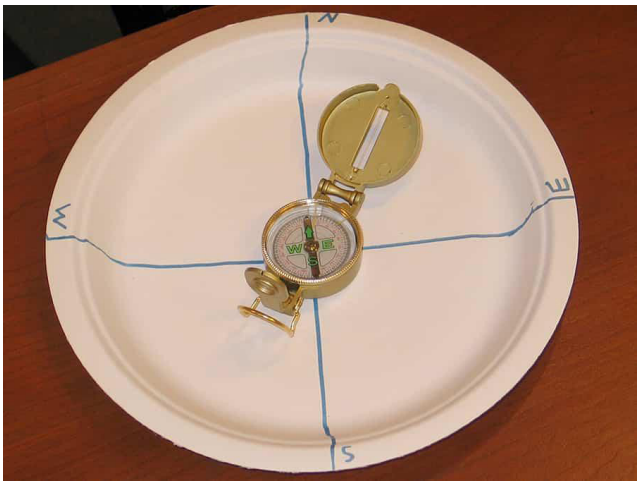
Step 10: Head outside to find a spot for the weather vane where nothing will obstruct the wind direction. Use a compass to find which direction is "North." Set up the weathervane so that "North" on the cardboard circle faces the correct direction.

Observe what happens when the wind begins to blow! (If it is very breezy, weigh down the weathervane with rocks or other heavy objects to keep it from blowing over.)



Photos: American Museum of Natural History

If the air is moving, the arrow on the weathervane will point to the direction the wind is blowing from. Consider adding more directional information to the circle on the weather vane: Northeast, Northwest, Southeast, and Southwest.

Have kids note the wind direction in their Weather Journals.

Test this instrument!

Use a compass to position a box fan in various directions and have kids use their weather vanes to determine wind direction. Kids can also place obstacles in front of the "wind" to learn more about how the instrument works.

Activity 2: Weather Station

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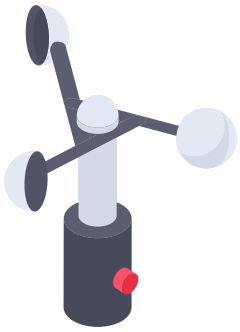
Station 2: Make an anemometer



The anemometer is an instrument that measures wind speed. It rotates at the same speed as the wind. This anemometer has four cups which catch the wind and make the anemometer spin. The more spins per minute, the greater the wind velocity!

Provide kids with the supplies and these instructions for making their own anemometer.

Explore estimating wind speed: https://www.weather.gov/pqr/wind

Supplies and steps

- 4 small paper cups
- 2 nonflexible plastic drinking straws
- plastic-headed straight pin (long enough to go through the 2 straws and securely into the pencil eraser)
- pencil with a new eraser
- tape (electrical tape works well)
- scissors
- stapler
- marker
- stopwatch or timer

Step 1: Use the two straws to make a cross shape. Use tape to secure the straws together in that shape.

Step 2: Push a straight pin through the center of the cross and into the eraser of the pencil. Spin the straws several times in both directions to make sure the straws rotate well.

Activity 2: Weather Station

Step 3: On the underside of each straw "arm," staple a paper cup to the end of each straw. All the open ends of the cups should face the same direction.

Step 4: On one of the cups, use a marker to make one of the cups look different from the others. The marked cup will be the one to use for counting the spins of the anemometer.

Step 5: Have kids mount or hold the anemometer in a place outside where they can feel the wind from all directions. Try to place it high above the ground and away from anything that can obstruct the flow of air. When the cups catch the wind, the anemometer should spin. To measure the wind speed, have kids watch and count how many times the marked cup completely spins around. About 10 complete spins per minute equals a wind speed of about one mile per hour.

Have kids record their counts in their weather journal and calculate the wind speed.

Test this instrument!

Kids can also explore how their anemometer works with a box fan. Have kids hold their anemometer in front of a fan, testing different fan speeds and collecting data on spin counts to build understanding.

Related resource

Build an Anemometer

https://www.nasa.gov/sites/default/files/atoms/files/build_an_anemometer.pdf

Activity 2: Weather Station

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Station 3: Make a hygrometer

A **hygrometer** is an instrument that measures the amount of humidity or water vapor in the air. Water vapor is an important weather-making part of air. It is the source of all forms of condensation and precipitation!

Explore humidity: https://scijinks.gov/what-is-humidity/

There can be a lot or very little water vapor in the air. Water evaporates when it gets heated by the sun. Water vapor gets into the atmosphere by evaporation. Winds move the water vapor in the atmosphere from one place to another.

Talk with kids about what the weather feels like to them when there is a lot of water vapor in the air and humidity is high. In nature, pinecones will respond to changes in humidity. To stop its seeds from being released in cold, wet weather, a pinecone will close its scales to protect its seeds. When the weather is dry and warm, the cone will open up so the seeds can fall out and be spread to spaces where there is enough room for a new tree to grow.

Even once it has released all of its seeds, the pinecone will continue to open and close as humidity changes, making it a natural hygrometer. Provide kids with supplies and these instructions for adding a pinecone hygrometer to their weather instruments.

Supplies and steps

- pinecone
- plastic-headed straight pin
- small cardboard box or other small container from the recycling bin
- glue and tape
- scissors and markers, black and red

Step 1: Choose a scale in the top third of the pinecone, but not at the very top. Kids should have adult help to carefully stick the straight pin into the end of the scale. This is the pointer for the instrument.

Activity 2: Weather Station

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Step 2: Find a small cardboard box that is just a little bigger than the pinecone. Cut the box so that it has a bottom and three sides.

Step 3: Glue the bottom of the pinecone to the bottom of the box, positioning the pinecone so that the pointer is near the back side of the box. Let the glue dry.

Step 4: Use the red marker to make a small line on the box wall where the pin head is pointing. This mark is for reference as a starting point.

Step 5: Try the instrument! Place the pinecone hygrometer outside in a shady location where it won't be disturbed overnight.

Before you have kids check the instrument the next day, have them check your local weather and make note of the current humidity in their weather journal. When they check the hygrometer, if the head of the pin has moved, kids should mark the new position with a black marker and label it with the date and the humidity reading from the local weather report. Have them do this for several days or until they have enough data points to use the pinecone hygrometer to estimate humidity without checking the local weather.

Activity 2: Weather Station

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Test this instrument!

Kids can explore how their hygrometer works by using a spray bottle to mist the pinecone with water. Have them observe what happens when the pinecone is exposed to wet conditions. Ask kids to think about other ways they could simulate wet, humid, or dry conditions to further test the hygrometer.

Related resource

Pine Cone Weather
https://thehappyscientist.com/content/pine-cone-weather

Activity 2: Weather Station

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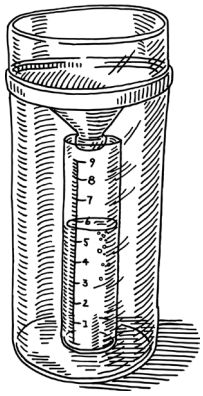
Station 4: Make a rain gauge



A rain gauge works by collecting and capturing rainwater in one location. Data from rain gauges in other locations can show what areas had the heaviest rain and can help predict if other locations will get heavy rain or if flooding is possible. Rain gauges are also important in monitoring droughts and in predicting weather patterns based on historical rainfall records.

Explore rain and precipitation: https://www.usgs.gov/special-topics/water-science-school/science/rain-and-precipitation

Supplies and steps

- straight, thin cylinder-shaped clear jar from the recycling bin with label removed
- ruler
- rubber band (optional)
- funnel (optional). If the diameter of the opening of the jar is exactly the same size as the diameter of the bottom of the jar, you don't need a funnel. If the bottom of the jar is bigger than the opening, use a funnel with the same diameter as the bottom of the jar.)
- fine-tip permanent marker
- clear packing tape

Step 1: Prepare a straight, thin cylinder-shaped clear jar from the recycling bin by removing any labels and making it clean and dry.

Step 2: Cut a piece of clear packing tape that is the same height as the jar. Affix the tape vertically to the jar.

Activity 2: Weather Station

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Step 3: Stand up a ruler so that the zero mark is even with the bottom of the jar and the numbered marks are next to the strip of tape. Have someone hold the ruler in place or secure it to the jar with a rubber band.

Step 4: Use a permanent marker to mark the inches on the tape. Add the lines between each inch to note 1/2 and 1/4-inch measurements.

Step 5: Put the ruler aside and cover the markings with a second piece of clear packing tape to protect from water.

Step 6: If a funnel is needed, put it in the jar and secure it in place with more tape.

Step 7: Try your instrument! Have kids find a spot not too near buildings or under trees where they can leave the rain gauge outside. (If the rain gauge can't be safely kept outdoors for an extended period, have kids put it out when they anticipate rain.)

When the rain gauge collects rainwater, kids should record their measurements in their Weather Journal. The rain gauge should be emptied after each rain.

Test this instrument!

Situate the rain gauge under a sprinkler and kids can try out their rain gauge, and practice taking and recording measurements.

Related resource

Make a Rain Gauge to Measure Rainfall

https://www.amnh.org/explore/ology/earth/make-your-own-weather-station/make-a-rain-gauge

Activity 2: Weather Station

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Setting up the weather station

Some of the instruments — the rain gauge, anemometer, and wind vane — need to be placed outside. If you can't leave them outside, bring them out to the same location each day for taking readings. The barometer can be kept and monitored inside. For taking the outdoor temperature, the thermometer should be outside but protected from precipitation and direct sunlight. (Be sure to talk about how the type of thermometer you have works and discuss with kids why the temperature of the air is always changing.)

Once the weather station is set up, talk about how the data they will collect can help them make weather predictions. **Ask kids** how long they think they will need to collect data in order to find weather patterns that help them to forecast the weather.

As kids observe, collect, and record weather data, have them make weather predictions in their Weather Journals and then note the weather forecast from a trusted source. In the following days, have them compare the actual weather to the predictions.

When making their predictions, have them reference the data they've collected. These questions can help them think about what both they and meteorologists look for in their data:

- What have you observed in the sky?
- Has the barometer been rising or falling?
- Has humidity been rising or falling?
- Has the wind been blowing from the same direction?
- Has the daily temperature been rising or falling?
- Has there been any precipitation?

Activity 2: Weather Station

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More weather instrument activities

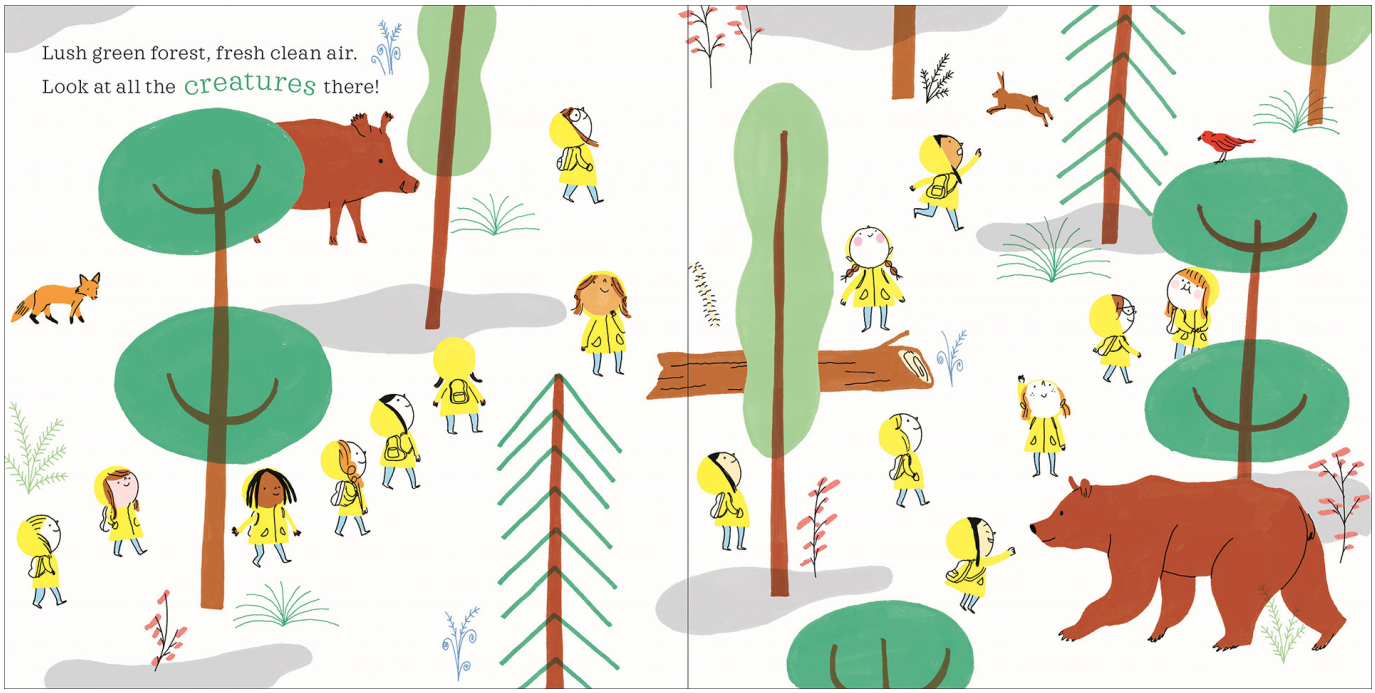
Wind Detectors (The Franklin Institute)
https://www.fi.edu/en/science-recipes/wind-detectors

Hair Hygrometer (Exploratorium)
https://nylearns.org/module/content/search/item/4211/viewdetail.ashx#sthash.R8DTH77L.dpbs

Make a Hygrometer to Measure Humidity
https://www.sciencebuddies.org/stem-activities/humidity-meter-hygrometer

Weather Activities Pack
https://www.weather.gov/media/hun/outreach/kids/Weather_Activity_Pack_singles.pdf

Build Your Own Weather Station
https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/education/activity-book/pdf/NOAA_DYW_2017_16_Weather_Station.pdf



Page spread from *The Weather Girls* by Aki

Activity 3: Climate Check! Greenhouse Effect

Introduction

The mix of gases in Earth's **atmosphere** is what helps protect the planet from cold, like a warm blanket. Sunlight coming through the atmosphere warms the Earth's surface. The atmosphere holds in or traps some of that warmth.

Gases in the atmosphere that trap heat are called **greenhouse gases**. The primary greenhouse gases on Earth are water vapor, carbon dioxide, methane, nitrous oxide, and ozone. When these gases trap heat from the sun, it is called the **greenhouse effect**.

These gases, which come from both natural and human-made sources, are increasing in the atmosphere. This results in the atmosphere holding in more warmth and the Earth's temperature increases. An increasingly warmer atmosphere affects our weather — and our repeated weather patterns, or **climate**.

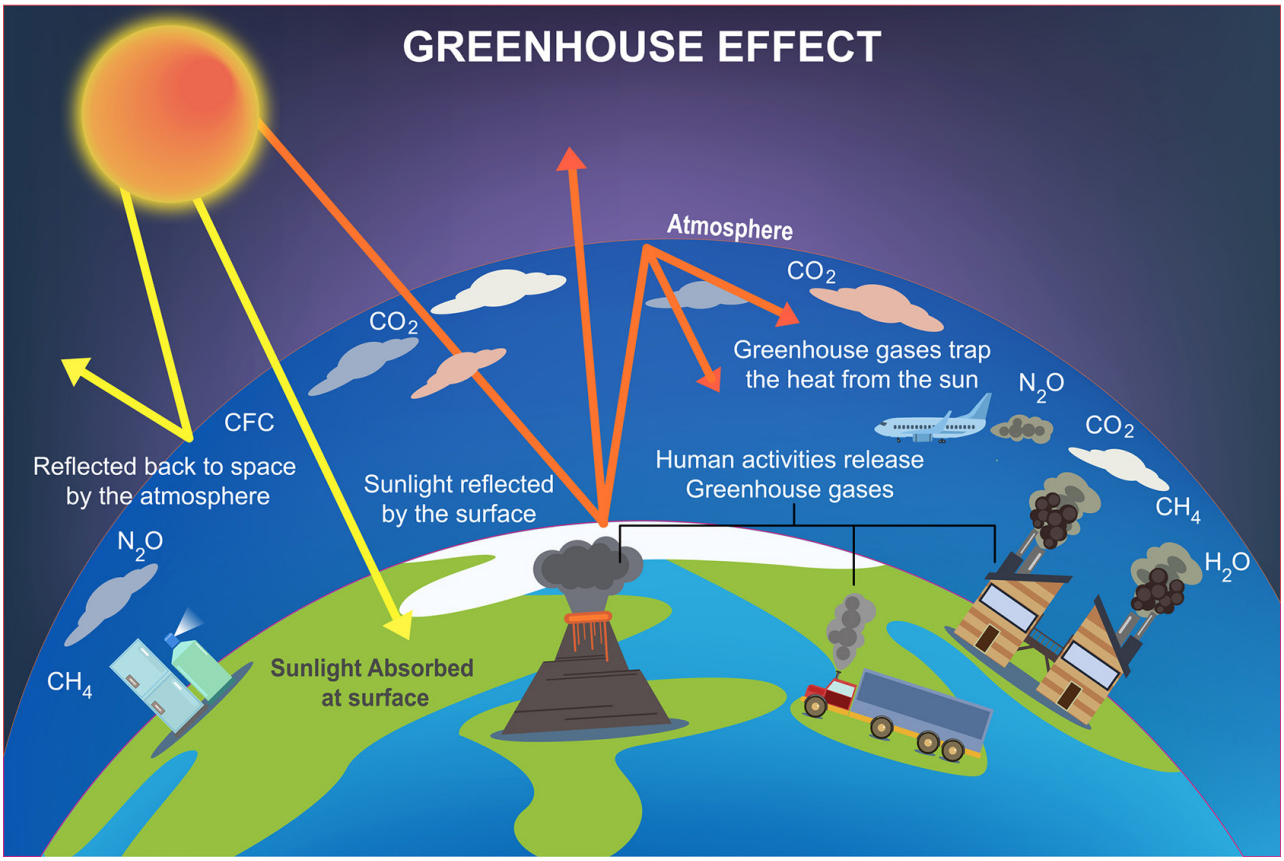


Illustration: iStock

Activity 3: Climate Check! Greenhouse Effect

When kids create their own terrarium, they can learn more about and make connections between trapped sunlight, greenhouse gases, the temperature of an environment, and climate's influence on ecosystems.

Supplies

- clear glass container from the recycling bin, such as a pickle jar; or repurpose a vase or canning jar. (Make sure the opening is big enough for kids' hands)
- marble-sized rocks
- activated charcoal (NOT charcoal for BBQ)
- potting soil (sterilized)
- small plants (plants that are slow-growing and like moisture) or seeds
- tablespoon or other tool for filling the jar
- water

Ask kids what they know about how a greenhouse works. Talk about how sunlight enters the glass enclosure of a greenhouse and warms the air, soil, and surfaces inside. A greenhouse stays warm inside because the glass roof and walls trap the Sun's heat.

The greenhouse effect works in a similar way. Greenhouse gases in the atmosphere, such as carbon dioxide and methane, trap heat like the roof and walls of a greenhouse. These heat-trapping atmospheric gases aren't solid like glass, but making a miniature greenhouse or terrarium is a good way to get an idea of how the greenhouse effect works and learn more about its impact on climate.

Explore the greenhouse effect

The Greenhouse Effect (EPA): https://youtu.be/VYMjSule0Bw

The Greenhouse Effect (University of Illinois Extension): https://www.youtube.com/watch?v=7bgk2cFc4Fc

Activity 3: Climate Check! Greenhouse Effect

Let's get started!

Step 1: Kids should first make sure their containers are clean and dry.

Talk about the thickness of their containers. **Ask:** What effect will the thickness of the container have on what will grow inside? What effect will having an open or closed container have?

Step 2: Have kids add a layer of rocks one-inch thick in the bottom of their container.

As kids add layers to their containers, ask them questions about what they think the layers are for and talk about the needs of plants and other living things.

Step 3: On top of the rocks, have kids spoon on a 1/2-inch-thick layer of activated charcoal.

Step 4: Have kids use a cup to add potting soil to the container until the container is half-full.

Ask kids: What do you think will happen when plants are completely enclosed in the glass container (or one with a small opening)? How do they think the Sun's energy will affect the terrarium? Have them make predictions about what could increase or decrease the amount of trapped heat in their terrarium.

Step 5: Help kids get the plant ready to add to the terrarium. Have them gently shake old soil from the roots before putting the plant in the container into an appropriately sized hole in the potting soil. They should press the plant firmly in place and add some additional soil to fill the hole and cover the roots. Depending on the size of the container and availability of plants, kids may have more than one plant in their terrarium. Have them water the plants before closing the container.

Explore the water cycle in a terrarium: https://youtu.be/0vu4wdHNo4Q

Step 6: Kids should find spots for their terrariums in indirect sunlight. Have them monitor their terrarium, checking for temperature and excess moisture and making observation notes. It may be that they will need to try several different locations to find the spot with the most favorable conditions for plant health.

Talk with kids about why the greenhouse effect is important. **Ask:** What do greenhouse gases in the atmosphere do for Earth's climate? What would happen to life on Earth without the greenhouse effect?

Activity 3: Climate Check! Greenhouse Effect

Community connection

Kids have explored the benefits of the greenhouse effect in keeping Earth a comfortable place to live. But human activities are increasing the amount of greenhouse gases in our atmosphere, making it hotter than it should be. Carbon dioxide is the most common greenhouse gas created by human activities.

Let kids brainstorm ways they can help reduce carbon dioxide emissions, such as reducing use of electricity and adjusting thermostats, biking, walking, or using public transportation instead of driving, or planting trees. Talk about ways they could share their messages and get others to take responsibility and take action.

Try turning a community space into a canvas for creative collaboration! The visual elements of a mural are a great way to beautify a space — inside or outdoors. As a work of public art, a mural often has a message or theme. A mural creates an enjoyable space but is also a call to action. And as a collaborative work of art, a mural can bring communities closer together.

Activity 3: Climate Check! Greenhouse Effect

Before starting a mural, you need to know where it will be placed. While murals can be painted directly on walls, painting them on plywood or canvas panels may be safer and easier for kids to work on (without ladders) and offer more flexibility for placement and maintenance. You may want to engage support from an artist in your community to have them talk with kids about their ideas for placement as well as what images and colors they think will be most effective in a mural that urges others to take care of the environment.

Related resource

Make a Terrarium Mini-Garden
https://climatekids.nasa.gov/mini-garden/

More greenhouse effect activities

DOT Mural
https://ourclimateourfuture.org/activity/dot-mural/

WEATHER WALK

2

Take kids outside to observe the weather. After the **Daily Data Collection** and **Sky Sketch**, ask kids if they found any clues or evidence of any precipitation or significant weather changes.

Do they see any clues that could help them predict the weather? When clouds are in the sky, kids can observe their shape, color, and placement to predict what the weather will do. Being able to identify different types of clouds helps meteorologists understand current weather and make predictions. Kids can do the same!

Like long rows or strings of popcorn		Altocumulus cloud	**Cold front** coming. When it is warm and sometimes humid, may turn into thunder-storms when a cold front approaches.
Low, blurry, and gray, covering the sky		Nimbostratus cloud	**Rain**, but not too heavy.
Big, tall, thick, and maybe dark on the bottom		Cumulonimbus cloud	**Thunderstorm**. These clouds produce heavy rain, thunder, lighting, and possibly hail and tornadoes.

WEATHER WALK

2

Invite the kids to share their observations, why they think what they see is an indication of precipitation or changing weather, and write them in their journals.

Find additional cloud observation and identification resources:

Cloud Identification Chart
https://www.globe.gov/documents/348614/24331082/GLOBE+Cloud+Chart

National Weather Service Cloud Chart
https://www.weather.gov/jetstream/cloudchart

Follow up on your **World Weather Wise** activity and talk more about the weather and climate of this location. Discuss what weather this location is currently experiencing and ask kids to imagine what the sky looks like in this location and sketch it in their Weather Journal.

If you have the opportunity, take the kids outside more than once during the day to observe how the weather changes.

Repeat the Weather Walk every day.

Weather Movement

2

Simon (the Weatherman) Says

When you play Simon (the Weatherman) Says, give players a chance to act out several of these silly interpretations of weather before giving an order without saying "Simon the Weatherman Says."

- Fall down like heavy rain
- Stomp your feet like loud thunder
- Spin like a tornado
- Clap your hands like lightning
- Drift your hands down like quiet snow falling
- Blow like a hurricane
- Float around like a cloud

Let someone else have a turn as Simon the Weatherman and see what other weather moves in!

Writing About Weather

2

Weather report

Find a recent news broadcast online and let kids watch the meteorologist's segment. Then have them imagine they have to give the next weather report on the local news! Ask them to use the weather data they have collected to write their script, which could include:

- Their observations on today's weather
- Current, high, and low temperatures
- Their forecast for tomorrow and the next few days
- Something they find interesting about the current weather

Kids can read their scripts aloud or create their own weather forecast video to share.

Memorable weather

Most people have strong feelings about weather. Some love hot, sunny days; others enjoy gentle spring rain. Some people complain about snow and cold; others dislike thunderstorms. Talk with kids about their feelings about different types of weather. Heading outside and looking at nonfiction books about weather may stimulate thinking. Encourage them to offer descriptions of how different types of weather look, smell, feel, and sound, then write down their ideas. Then encourage them to brainstorm to create an alliterative poem about their most memorable weather experience.

Alliteration is the repetition of initial consonant sound in two or more neighboring words or syllables, such as "the wintry wind whistles." Talk with kids about other examples of alliteration that have likely encountered in brand names and advertising — like Best Buy, Red Robin, Krispy Kreme — and why the alliteration helps make words and phrases memorable. Alliterative words twist the tongue and are fun to read and say! A poem full of alliteration is like a tiny tornado in your mouth.

Writing About Weather

2

"Beaufort wind force scale" poetry

The Beaufort wind force scale is a table that describes the force of the wind and can be helpful in estimating wind strength without the use of instruments. The scale, from 0 - 12, shows the strength of the wind from calm to hurricane.

Read together, the Beaufort scale descriptions and observations sound like poetry. Read the scale aloud as a poem and share "Hear the Wind Blow" by Doe Boyle, an illustrated poem where each stanza represents, in order, one of the 13 categories of the Beaufort wind-force scale. Talk about how words can be used to describe something that you cannot see. Have the kids incorporate Beaufort's descriptions and observations when they create their own "found poem" that defines the wind or conveys a theme of their own choosing. A "found poem" is created by using words or phrases that have been selected and rearranged from another text.

Beaufort Force	Description	Observations	Wind (mph)
0	Calm	Smoke goes straight up	Less than 1
1	Light air	Wind direction is shown by smoke drift but not by wind vane	1-3
2	Light breeze	Wind is felt on the face; leaves rustle; wind vanes move	4-7
3	Gentle breeze	Leaves and small twigs move steadily; wind extends small flags straight out	8-12
4	Moderate breeze	Wind raises dust and loose paper; small branches move	13-18
5	Fresh breeze	Small trees sway; waves form on lakes	19-24

Writing About Weather

2

Beaufort Force	Description	Observations	Wind (mph)
6	Strong breeze	Large branches move; wires whistle; umbrellas are difficult to use	25-31
7	Near gale	Whole trees are in motion; walking against the wind is difficult	32-38
8	Gale	Twigs break from trees; walking against the wind is very difficult	39-46
9	Strong gale	Buildings suffer minimal damage; roof shingles are removed	47-54
10	Whole gale (storm)	Trees are uprooted	55-63
11	Violent storm	Widespread damage	64-72
12	Hurricane	Widespread destruction	73+

Kid-friendly Digital Media

2

Apps

Weather Bug
https://www.weatherbug.com/

GLOBE Observer Clouds
https://observer.globe.gov/about/get-the-app

Online games

Pressure and Flow: Using Water Tanks to Explain Why the Wind Blows
https://scied.ucar.edu/interactive/pressure-flow-water-tanks-virtual-lab

Climate Time Machine (NASA)
https://climatekids.nasa.gov/time-machine/

HotSeat: You Be the Forecaster
https://www.nssl.noaa.gov/education/hotseat/

Websites

What's in the atmosphere
https://climatekids.nasa.gov/whats-in-the-atmosphere/

Old Farmer's Almanac for Kids
https://www.almanac.com/kids#weather

Predict the weather
https://kids.nationalgeographic.com/nature/article/predict-the-weather

Weather Wiz Kids
https://www.weatherwizkids.com/

Kid-friendly Digital Media

2

Online books

The Air We Breathe
https://www.nasa.gov/pdf/62452main_The_Air_We_Breathe.pdf

Video

TED Ed: The History of the Barometer (and How It Works)
https://youtu.be/EkDhlzA-lwI

NASA's Earth Minute: Gas Problem
https://youtu.be/K9kga9c0u2I

Crash Course Kids: Weather Channels
https://youtu.be/RD-2dvaG4UY

How to Read a Weather Map
https://youtu.be/GkE3F5AuWBQ

Activity 2 (Station 1): Weather vane template