

Understanding Elements of Weather

Activity Length: 45-60 minutes

Intended Learning Outcomes:

- Use science process and thinking skills.
- Manifest science interests and attitudes.
- Understand important science concepts and principles.
- Communicate effectively using science language and reasoning.
- Demonstrate awareness of the social and historical aspects of science.
- Understand the nature of science.

Lesson Objectives:

Standard 2: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Objective 1: Observe, measure, and record the basic elements of weather.

c. Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).

Objective 3: Evaluate weather predictions based upon observational data.

a. Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).

Vocabulary:

- Element: a part or characteristic of a larger whole
- Air pressure: The weight of air in the atmosphere pressing down upon Earth.
- Air temperature: Degree of heat or cold that the air measures.
- Precipitation: Rain, snow, sleet, hail.

Materials Required:

- Instruction cards for each center

Air is a substance center:

- 2-3 plastic syringes (most pharmacies will donate a few)
- 3-4 sheets of 8x11 paper (can be scratch paper)
- Scraps of paper
- Straws (enough for one per student)
- Balloons (either one for each student, or one deflated and one inflated for the activity)
- Balance scale or small electronic food scale



NATURAL HISTORY
MUSEUM OF UTAH

Rio Tinto Center | University of Utah

Understanding Elements of Weather

Materials continued:

Air is a substance center (continued):

- 2-3 small jars
- 2-3 plastic bags (grocery bags or gallon sized Ziploc-style bags) extras encourage incase any develop holes
- Rubber bands to fit around the neck of the jar

Air pressure center:

- Clear plastic small cups
- A bunch of plastic pony beads
- Paper filler to be placed in one cup
- Ruler with a groove in it

Anemometer center:

- Five 3 ounce paper Dixie cups
- Two straight plastic soda straws
- Pin
- Scissors
- Paper punch
- Small stapler
- Sharp pencil with an eraser

Optional Cloud center (if cloud types have already been previously taught):

- 8 x 11 colored construction paper
- Small sized cotton balls (about 5-8 per student)
- Liquid glue
- Black marker

Background Information:

- Air pressure is the weight of air in our atmosphere pressing down upon the earth. It can be compared to the weight of water pressing down on a person as they dive deep into a pool of water. People can feel the effect of air pressure on their ears as they hike up and down a large mountain. There is a huge amount of air above us that goes up as high as 100 miles. With all that air on top of us, it is like being at the bottom of the deep end of the swimming pool. But instead we are at the bottom of an ocean of air. Just like there is pressure at the bottom of a swimming pool, there is pressure caused by the weight of the air on all objects (including humans) on and above Earth's surface. At sea level there are about 15 pounds of air pressure per square inch. There is less air above us at higher elevations, causing lower air pressure, the higher you go in elevation.



NATURAL HISTORY
MUSEUM OF UTAH

Rio Tinto Center | University of Utah

Understanding Elements of Weather

Background Information continued:

- Air is a substance that takes up space, and moves as wind. It also causes pressure that is sometimes higher and sometimes lower. Sometimes there is a high pressure around us. Sometimes there is a low pressure around us. The instrument that measures the air pressure is called a barometer. A barometer helps us notice if there is a change in the air pressure. Watching it closely from day to day predicts what the weather will be like in the next day or two. If the needle of the barometer is 25 (or 30 if altitude is considered) or higher, it means that we will have fair weather for a while with increasing temperature. If the needle of the barometer drops below 25 (or 30), this means there will be a change soon in the weather that could cause wind, clouds, and/or precipitation. Low pressure always precedes a change in the weather. The pressure of the air above mountains is much less than that at sea level. At sea level, there are 30 pounds of air pressure per inch pressing down on the Earth. At higher elevations, such as the Salt Lake Valley, 4500 ft. in elevation, there are only about 25 pounds of pressure pressing down on the surface. When looking at weather reports, the weather data may report the air pressure as a number of 25, or at around 30 which. For students, this is not a big deal, as the important information is simply tracking the change or rising or dropping numbers, regardless of the starting point.
- Wind is one of the elements of weather. It is the movement of air that can be felt against our faces and bodies. We can see the effect of wind by the movement of objects. The direction, temperature, and speed of wind can help us predict changes in the weather.
- Wind is the result of pressure differences in the atmosphere. This is why the weather people on TV care so much about high and low pressure systems.
- Along with wind direction, meteorologists measure wind speed. Wind speed is a measure of how fast the air is moving. It is measured using an instrument called an anemometer. As the spinning cups of an anemometer turn, the speed of the wind is determined. Knowing wind speed and air pressure helps meteorologists forecast when an approaching storm will arrive or how long the weather in an area will remain.

Introduction:

- Students will prepare science journals or a sheet of paper for scientific note taking for the following activities.
- Review with students that when scientists learn or observe something new, interesting, or different, they write it down. They include drawings and diagrams that are labeled, and they include any inferences that can be made from their observations and experiments. They should record the name of each activity and organize their notes so they can learn from them after the activities are done.



Understanding Elements of Weather

Activity:

- Students will rotate through the three activity centers with about 15 minutes at each one. For large class groups, you can set up two stations each with the same activity to keep the group numbers small. Adult help would be most helpful at the anemometer center and the air pressure center.

Air center:

- Students use the various items at this table to demonstrate that air is a physical substance that has weight and takes up space. This is designed to be an inquiry-based activity for students to try and discover the concepts on their own through experimenting and making observations. Different students may need more or less guidance, use your judgement on how much instruction you offer
- Students can use the syringes to fill with air, then using their hand cover the opening and discover that the plunger cannot move down to the end because the air is taking up the space inside.
- The 8x11 sheets of paper can be folded into fans that when moved, move the air and create wind. If air was not a substance, it could not be moved or felt.
- The scraps of paper can be crumpled up and using the fans (made above), or by blowing through a straw (make sure that students don't share) students can see how air has substance that can actually move other objects
- Students can blow up a balloon to demonstrate that air takes up space, which proves also that it is a substance. Or they can make observations about an already inflated and a deflated balloon at the table. If you have balance scale available, or a small electric scale (that measures oz or grams), students can compare the weights of an empty balloon vs an inflated balloon. (Test the scale first to ensure that it can detect the small differences in mass, larger scales typically won't detect the small difference.)
- Plastic bag/jar demonstration: Place a plastic jar or bucket on a table so that everyone will be able to stand around the table and see and reach the container. Test plastic bags for holes by filling them with water. (Have extra bags handy as the bags may develop holes as you do the activity.) Put air into a plastic bag by blowing into it or waving it through the air. Clamp the opening of the bag around the mouth of the container and fasten it tightly by either wrapping string around it two or three times or by putting a rubber band around it. Students will investigate by carefully pressing the bag into the jar and pulling it back out. Making observations about what they see and feel as they move the bag.



Understanding Elements of Weather

Air pressure center:

- It is recommended that this be demonstrated prior to the center rotations, or have an adult to demonstrate to each group, before having students manipulate the beads to create different air pressures and wind.
- Students begin with two cups. Have kids put a few beads in each cup. If there are the same number of beads in each cup, then their weight/mass of the beads (air molecules) is the same. There will be no wind.
- If there are unequal numbers of beads, then the wind will blow from the cup with more beads to the one with fewer. Students should remove beads from one of the cups and then decide which way the wind will blow from (fuller cup to the less full cup). That determines the wind direction (the way the air/beads move from).
- Put a bead on the ruler on the table top. When the ruler is flat, the bead (air) doesn't move. When the ruler is tilted, then the air moves from "high pressure" (more air molecules - not elevation) to "low pressure" (fewer air molecules). The wind is blowing in the direction down the ruler.
- Have a third cup filled part way with crumpled paper. Mountains should be drawn on the outside of the cup to represent that it is not at sea level. Fill one of the "sea level" cups with enough beads to be above the height of the mountains. Add a few beads to the mountain cup so that the beads in both cups are at about the same level.
- The pressure of the air above mountains is much less than that at sea level (many fewer beads above the ground in the mountains), many more beads pushing down at sea level. But, if the stack of beads over the mountains is level with that over sea level, then there is no wind. There is no difference in pressure between the air over the mountains and over the coastal area.
- Reinforce that concept by putting a bead on the ruler across the top of the "sea level" and "mountain" cups. The ruler represents being at the same elevation above sea level. If the ruler is not tilted, then the marble doesn't move. There is no wind. Tilt the ruler, same concept as before as far as air moving from high pressure to low pressure.

Anemometer center:

- Students will create a simple anemometer
- Using the paper punch, punch one hole in each of four Dixie cups, about a half inch below the rim.
- Take the fifth cup and punch two holes in it, directly opposite from each other, about $\frac{1}{2}$ inch below the rim. Now punch two more holes in the cup, each $\frac{1}{4}$ inch below the rim that are equally-spaced between the first two holes.
- Using the push-pin and the scissors, make a hole in the center of the bottom of the cup with four holes in it. The hole should be large enough that the pencil can fit easily through it.



NATURAL HISTORY
MUSEUM OF UTAH

Rio Tinto Center | University of Utah

Understanding Elements of Weather

Anemometer center continued:

- Now slide one cup and straw assembly through two opposite holes in the cup with four holes. Push another one-hole cup onto the end of the straw just pushed through the four-hole cup. Bend the straw and staple it to the one-hole cup, making certain that the cup faces in the opposite direction from the first cup. Repeat this procedure using the other cup and straw assembly and the remaining one-hole cup.
- Align the four cups so that their open ends face in the same direction (clockwise or counterclockwise) around the center cup. Push the straight pin through the two straws where they intersect. Push the eraser end of the pencil through the bottom hole in the center cup. Push the pin into the end of the pencil eraser as far as it will go. Mark one of the four cups with an “X” or another color so you can count how many times it goes around in one minute.

Cloud poster center (optional):

- Students will use their knowledge to make an educational poster about a single type (or all three basic types) of cloud. They will need to form cotton balls into the typical shapes of the cloud type that they choose. (pull apart for cirrus clouds, small piles for cumulus, and/or layered/leveled for stratus). Then they should use their scientific vocabulary to describe their cloud type(s) and what type of weather they typically relate to.
- While making the posters I emphasize informational text features like titles, bullet points, and keywords and encourage my students to use such features to present their information.

Conclusion

- Once the rotations have ended and have been cleaned up, students will partner up with a peer to share their scientific notes and inferences using precise science vocabulary.

Optional ELA integration: students will write a paragraph describing what they learned about the elements of weather from this activity: air pressure, wind, air (as a substance), and clouds.



NATURAL HISTORY
MUSEUM OF UTAH

Rio Tinto Center | University of Utah