Lesson 1-Clouds

GRADE 3-5

BACKGROUND

Certain conditions must exist for clouds to form - water vapor in the air, temperature change, and particles in the air for the water vapor to condense on. As warm, moist air rises, it begins to cool and condense on dust particles forming water droplets. These water droplets form clouds. They will not fall to Earth because they are too small.

Clouds take different shapes depending on the amount of water vapor available and the speed and direction of the moving air. Clouds are classified according to how they are formed. Below are the main types and their descriptions.

- Stratus clouds are low, flat, gray clouds that look like sheets covering the sky. They are the closest clouds to the ground. They form as low as surface level (fog) to about 6,500 feet above the ground. They can produce rain, drizzle, snow, or mist.
- Cumulus clouds are puffy and white-like cotton balls. They form from 2,000 to 20,000 feet above the ground. They usually indicate fair weather. Sometimes they grow very large and become thunderheads. As these clouds gather, they create thunder and lightning and produce precipitation in the form of rain and hail.
- Cirrus clouds are thin, curly, wispy clouds. They are sometimes referred to as mares' tails. They form between 25,000 to 40,000 feet above the ground. They are so high in the atmosphere that the water droplets freeze into ice crystals. They often indicate an incoming storm or weather change.

There are cloud charts in the kit to show what these clouds look like. However, most cloud charts will have more than these basic clouds. They use the prefixes "alto" and "nimbo"(nimbus) to tell more about these three basic clouds. If the prefix "alto" is used, it means middle, referring to the position of the clouds in their respective areas. If the prefix "nimbo" is used, it means water and these clouds will often bring rain.

BASIC LESSON

Objective(s)

Students will be able to... observe and record different types of clouds.

State Science Content Standard(s)

4. Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

4.4 Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured.

A. Record temperature
B. Display data on a graph.

C. Interpret trends and patterns of data.
D. Identify and explain the use of a barometer, weathervane, and anemometer.
E. Collect, record and chart data from each weather instrument.
F. Identify the patterns.
G. Discuss trends within the patterns.

		Safety
From the Kit	**Provided by Teacher**	• None
• 2 Cloud Charts • Student Cloud Data Sheet found in binder or website	• One-fourth sheet blue construction paper (6”x9”) • White crayon • Lined paper • Pictures of clouds from magazines, the library, Internet, or digital camera • Blue construction paper - 12”x18” • Glue • Cotton balls • Black markers to color the underside of the stratus clouds. • Glitter for rain and lightning	

Key Vocabulary	**Mastery Questions**
• Clouds • Nimbo • Alto • Stratus • Cumulus • Cirrus	• See Lesson

Detailed Plan

Engage

Pass to the students the prescribed sheet of blue paper. Ask the students to draw a cloud they have seen in the sky. Have several students show pictures of their clouds to the class. Have some draw their clouds on the board. Discuss how their drawings are alike and different. Tell students they may have all drawn different looking clouds because clouds come in all different shapes and sizes. Tell them there are three main categories that scientists use to classify clouds. With the use of a cloud chart, point out the three basic cloud types, and see if students can identify the clouds they drew.

Explanation/Exploration

For Activity 1 and 2, use the website for images of the different cloud types: Online Cloud Guide

Activity 1 - Looking at Clouds.

1. Present information about the basic cloud types (found in background information) - stratus, cumulus, and cirrus. Be sure to discuss the kind of weather that is associated with each type of

cloud. You may want them to record this information in their journals/notebooks. Use the cloud charts found in the kit to help illustrate the various cloud types.

2. Tell the students that meteorologists look to see how much of the sky is covered by clouds. A website for local current weather conditions is http://www.wunderground.com/weather-forecast/US/MT/Helena.html

- 100% would be that the sky is completely covered by clouds.
- 75% would be that most of the sky is covered by clouds.
- 50% would be that half the sky is covered by clouds.
- 25% would be that some of the sky is covered by clouds
- 0% would be a clear sky.

3. Give the students the **What Types of Clouds are found in the Sky?** Activity sheet found on the website or binder. Tell the students they will be looking at the sky for several days and doing the following observations/predications:
    - Tell the types of clouds that are in the sky. Limit it to the **three basic** types.
    - Estimate the percentage of sky that is covered by the clouds.
    - Tell what the weather is like today.
    - Make a prediction of what the upcoming weather will be.
    - Take the students outside to record the cloud cover for this day and repeat every day for several days. Each day the students should check the forecast they made the previous day and compare it with the current weather conditions.

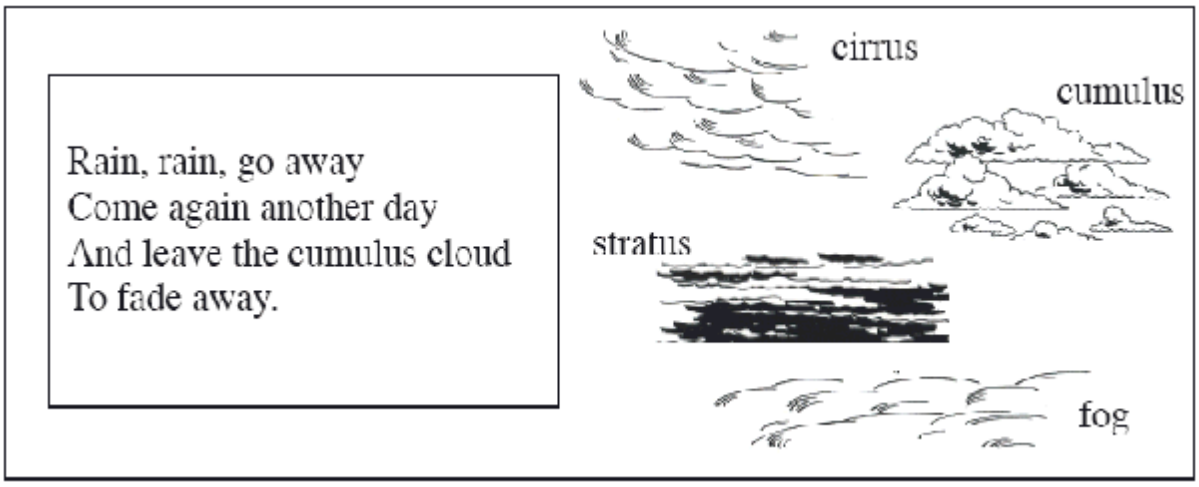
Activity 2 - Constructing Clouds

Review with the students what they learned about clouds. Have them look at pictures from magazines, the library, an Internet site (www.askjeeves.com), or pictures you have taken with a digital camera of the three types of clouds. There are many poetry books that have been written about weather that include poems about clouds. Read a cloud poem to them as they are looking at the pictures.
https://www.brainpickings.org/2015/07/07/the-invention-of-clouds-luke-howard-hamblyn/

- one Example.

1. Give students the prescribed blue construction paper, some cotton balls, and glue. Have black markers available for them to color the underside of the stratus clouds and glitter for rain.
2. Divide the construction paper up into three parts as a trifold.
3. Name the cloud in each trifold.
4. Make each of the clouds with cotton balls, glue, markers, and glitter. Glitter is used for rain and lightning in cumulus clouds.
5. In the center of each trifold, have the students describe each cloud type and what type of weather is associated with each cloud.
    a. Cirrus clouds are thin and wispy; precede a storm.
    b. Cumulus clouds are white and puffy; indicates fair weather.
    c. Stratus clouds are low, flat, gray; often bring rain.
6. At the bottom of each trifold have the students write poems about each type of cloud. The poems should contain one or two facts about each cloud. The poems can be written in any form you wish. Give students enough time to work or allow them to finish later.

7. Have students read their poems to the class or display them on a bulletin board.



Extensions

Fine Arts/Visual Arts-

- Have students look at outdoor pictures in magazines. Cut them out and glue them on paper. Have them write what type of clouds they are.
- By putting your class into groups, have the students make a collage of cirrus, cumulus, and/or stratus clouds.
- Have students create a cloud animal using art paper and chalk or cotton. Be sure they use only the three types of clouds. Give them pictures of animals to look at to create their animals. They can get into groups and share their animals and tell the types of clouds they used for the different body parts.

Fine Arts/Music-

- Create a rhyming sentence to a beat about clouds. Example: To the tune of "We will, we will rock you." "Rain clouds, thick clouds - stratus." "High clouds, wispy - cirrus." "Puffy, cotton balls - cumulus."

Technology-

- Look on the Internet to observe clouds as a class and individually at www.askjeeves.com. Ask for the types of clouds you want to observe. If you want all types, ask for clouds.

Language Arts-

- Have students make some analogies about clouds. Examples: "High is to cirrus as low is to stratus." "Puffy is to cumulus as thin is to cirrus."
- Make a matching game with pictures of clouds with the definitions. Example: high, wispy clouds - cirrus.

Additional Resources for Class

Videos:

- Check district media centers for videos about clouds.
- There are also commercial weather videos available.

Assessment

- Response Questions
    1. What are differences between how cirrus, cumulus, and stratus clouds look?
    2. Which clouds are located high in the sky, in the middle of the sky, and low in the sky?
    3. Which clouds relate to what type of weather?
- Check the student journals for accuracy of recorded information.
- Observe their cloud charts when completed. Listen as students recite their poems to make sure their information is correct.

Resources

Adapted from:

- National Severe Storms Laboratory
- Online Cloud Guide
  You will find a collection of images which illustrate the different cloud types.

Lesson 2--Temperature
GRADE 3-5

BACKGROUND

A thermometer is a delicate instrument used for measuring temperature. It needs to be handled carefully so that it does not break. The liquid inside the glass tube expands as it is heated and rises in degrees Fahrenheit or Celsius that can be read on the scale. Soil generally absorbs heat from the sun faster than water, so it is usually warmer. Shiny or light-colored surfaces reflect more of the sun's energy than dark colors, so they are cooler. Heat rises in a room, so temperatures taken at the ceiling level are generally warmer than at floor level. Communicate with necessary school personnel to let them know that students will be measuring temperatures around the building. Students would be asked not to measure the temperature of certain areas such as fish aquariums and toilets. They should also let the thermometer rest on a surface for at least two minutes before reading the temperature.

Fahrenheit is a temperature scale named after the German-Dutch physicist Daniel Gabriel Fahrenheit (1686–1736), who proposed it in 1724. In this scale, the freezing point of water is 32 degrees Fahrenheit (written “32 °F”), and the boiling point is 212 degrees, placing the boiling and freezing points of water exactly 180 degrees apart.

Celsius is, or relates to, the Celsius temperature scale (previously known as the **centigrade scale**). The **degree Celsius** (symbol: **°C**) can refer to a specific temperature on the **Celsius scale** as well as serve as unit increment to indicate a temperature *interval* (a difference between two temperatures or an uncertainty). “Celsius” is named after the Swedish astronomer Anders Celsius (1701-1744), who developed a similar temperature scale two years before his death.

Until 1954, 0 °C on the Celsius scale was defined as the melting point of ice and 100 °C was defined as the boiling point of water under a pressure of one standard atmosphere; this close equivalence is taught in schools today.

On the Celsius scale, the freezing and boiling points (*just reaching full boil, at which point it is about to turn to steam or the gaseous form*) of water are exactly 100 degrees apart, thus the unit of the Fahrenheit scale, a degree Fahrenheit, is 5/9 of a degree Celsius. The Fahrenheit scale coincides with the Celsius scale at -40 °F, which is the same temperature as -40 °C.

Differences in Usage
In the United States the Fahrenheit system continues to be the accepted standard for non-scientific use. All other countries have adopted Celsius as the primary scale in use. Fahrenheit is sometimes used by older generations in English speaking countries, especially for measurement of higher temperatures. The United Kingdom has almost exclusively used the Celsius scale since the 1970s, with the notable exception that some broadcasters and publications still quote Fahrenheit air temperatures occasionally in weather forecasts, for the benefit of generations born before about 1950, and air-temperature thermometers sold still show both scales for the same reason.

The Fahrenheit scale was the primary temperature standard for climatic, industrial, and medical purposes in most English-speaking countries until the 1960s. In the late 1960s and 1970s, the Celsius

(formerly Centigrade) scale was phased in by governments as part of the standardizing process of metrication.

Fahrenheit supporters assert its previous popularity was due to Fahrenheit's user-friendliness. The unit of measure, being only 5⁄9 the size of the Celsius degree, permits more precise communication of measurements without resorting to fractional degrees. Also, the ambient air temperature in most inhabited regions of the world tends not to go far beyond the range of 0 °F to 100 °F: therefore, the Fahrenheit scale would reflect the perceived ambient temperatures, following 10-degree bands that emerge in the Fahrenheit system. Also, coincidentally, the smallest sensible temperature change averages one Fahrenheit degree; that is, the average person can just detect a temperature difference of a single degree.

But some Celsius supporters argue that their system can be just as natural; for example, they might say that 0–10 °C indicates cold, 10–20 °C mild, 20–30 °C warm and 30–40 °C hot.

http://www.diffen.com/difference/Celsius_vs_Fahrenheit

BASIC LESSON

Objective(s)

Students will be able to…

- understand how temperature is measured and how temperatures taken at different locations can be explained.
- use temperature readings to help predict weather

State Science Content Standard(s)

Standard 4 Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

4.4 Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured.

H. Record temperature
I. Display data on a graph.
J. Interpret trends and patterns of data.
K. Identify and explain the use of a barometer, weathervane, and anemometer.
L. Collect, record and chart data from each weather instrument.
M. Identify the patterns.
N. Discuss trends within the patterns.

Materials		Safety
From the Kit	Provided by Teacher	
• 20 Student Thermometers • Large class thermometer • Water bottle with lid and hollow stick (homemade thermometer)	• Ice • Zip-lock Baggie • Recording sheet for temperature readings • Food coloring • Graph paper	• Students need to treat the thermometers carefully/respectfully to prevent breakage.

	• Markers, pencils, crayons • Paper plate • Index card	

Key Vocabulary	Mastery Questions
• Temperature • Fahrenheit • Celsius • Centigrade •	• See Lesson

Detailed Plan

Engage

Tell the students that each one of them or each group will be given a small student thermometer and a baggie with ice cubes. Ask them to see if they can make the temperature rise and fall without leaving their seats. After a few minutes, ask them how they were able to make the temperature of their thermometers rise and fall.

Explanation/Exploration

All recordings should be in Celsius.

Activity 1 - Hot Hands-on Science

1. Assess the students' understanding of the use and care of a thermometer.
2. Review how to read a thermometer and the different units used to measure temperature – Fahrenheit versus Celsius.
3. Assign them to take a recording sheet, a thermometer, and their pencil outside or somewhere in the school. Tell them to take five minutes to measure the temperature of any area and write down the location and the temperature on their recording sheet. Having areas designated ahead of time will ensure a variety of temperatures and locations. Assign groups/individuals to specific locations. Then they are to return to the classroom. (This can be done in groups if you do not have enough thermometers for each student.)
4. Ask them upon their arrival to share their findings. At this point, the data (temperature and location) can be written on the board or on a weather chart in their journals.
5. As a class, have them graph results of their findings – bar graph of location versus temperature.
6. Have the students write why the thermometer readings are different throughout the room, school, or playground. Read them in class and discuss the differences.

Activity 2 - Making a Class Thermometer (Teacher Demonstration)

Review what the students learned about the thermometers and the uses of thermometers. Show them the classroom thermometer and have them explain how they think it works to measure temperature. Explain to them that when the liquid (red alcohol) in the bulb begins to heat up it expands and goes up the tube. The warmer it gets the higher it goes. Tell them that they are going to make thermometers today to see how they work on a larger scale or you may want to do this as a demonstration. Obtain the water bottle with the lid and hollow stick from the kit. (See ExPlore More if you would like the students to

make their own thermometers.)

1. Fill the container ¼ full of ice cold water. Add 3-4 drops of food coloring to **darkly** color the water.
2. Place the lid tightly on the bottle making sure the bottom of the hollow stick is immersed in the water.
3. Have the bottles stand for a day for the water to adjust to the temperature of the room. Tape an index card behind the water bottle to be able to mark the level of colored water in the bottle. As the water in the containers get warmer, the water will rise in the stick.
4. After the water has adjusted to the temperature of the room, mark the height of the column of water on the card. Use a thermometer to find the current room temperature and write it next to the mark you made.
5. Place the container on a plate (in case of spills) in different places throughout the classroom, school, and/or outside where the air temperature can be measured.
6. Check regularly to see if the liquid in the hollow sticks change over the next few days. Have the students record any changes in their journals.

Activity 3 - Observing and Recording Temperature Data

Tell the students they will observe the temperature each day with a thermometer just like a meteorologist. They will record the temperature each day for a few days.

1. Go outside and observe the temperature (same time each day) for five days. Have the students enter the data in their journals. This can be done individually or different students or groups, using the same thermometer, will record the temperature.
2. Have them also record the weather: nice, cold, hot, cloudy.
3. Have them graph their temperatures and see if there is a pattern between temperature and weather type.
4. Discuss the observations. Is five days enough time to see a pattern

Extensions

Science-

- Explain to students that people in other parts of the world use the Celsius scale. Ask them to make comparisons to temperature on the Fahrenheit scale. *(See Background)*
- The sun is responsible for the weather on planet Earth. One kind of energy we get from the sun is heat. The sun does not directly heat up the air. Air is heated by the land or water beneath the air. Land and water heat up and cool down at different rates, the air, therefore, heats unevenly. This uneven heating of the air causes wind and changes the weather. Try the following experiment to see the difference between the cooling of soil and water.
    1. Get two cups and fill one cup half full of water and one cup half full of soil.
    2. Let the cups sit in a room for a couple of hours without sunlight on them to get them to room temperature.
    3. Place the thermometers deep into each cup. After three to five minutes record the beginning temperatures of the water and soil.
    4. Place both cups in the direct sun or under a bright lamp.
    5. After 15 minutes, record the temperatures of both thermometers.

6. Now place both cups in a refrigerator.
7. After 15 minutes, record the temperatures of the thermometers.
8. Explain your findings.

Assessment

Observe students for accuracy as they make measurements of temperature. Evaluate their success at making a homemade thermometer if you have them construct one. Check their journals, graphs, and tables for accuracy.

Fine Arts/Visual Arts-

- Have pictures of different places from around the world that have different climates that show different temperatures. Have students tell what effects the temperature has on plants, animals, and people. Can they predict what type of activities people will be doing or the clothes they would be wearing at certain outside temperatures? Can they make observations about where people may choose to live because of the temperature? Do they notice changes in the temperature outside as it becomes windy, cloudy, or starts to rain or snow?

Resources

Adapted from Utah Lesson Plans –online.

Other Resources

- UEN Internet Weather Links
- Brain Pop (requires subscription): https://www.brainpop.com/science/energy/temperature/

Newspapers: Students can bring in newspapers with daily weather maps and forecasts.

Videos: Check district media centers for these videos:

  - Restless Atmosphere
  - What Makes Weather?
  - Meteorology
  - Weather Class with Dr. Neil Frank
  - Weather Express
  - Weather Station Backyard Science
  - Any other videos that will enhance the students learning.
- There are also commercial weather videos available.

- For local weather: http://www.wunderground.com/weather-forecast/US/MT/Helena.htm]

EXPLORE MORE

Directions for making student thermometers.

1. Fill the containers with cold water. Add two drops of red food coloring to the water.
2. Punch holes in the center of the lids with a nail and hammer.
3. Place the lids on the containers and slide the balloon sticks through the hole.
4. Place white glue around the balloon sticks to seal them in place and make them airtight.
5. Have students write their names on the back of their index cards. Carefully tape the cards vertically to the balloon sticks.

Materials:
Water bottle with lid
Hollow balloon stick (party store)
Food coloring
White glue
4 x 6 Cards

Hammer
Nail
Tape
Marker

Lesson 3--Wind
GRADE 3-5

BACKGROUND

Wind is one of the elements of weather. It is the movement of air that can be felt against our face and body. 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.

If you are unable to immediately detect the wind's direction, throw a small piece of grass into the air and watch its descent. Easterly winds, which blow from the east, can indicate good weather; westerly winds can mean an approaching storm front. Strong winds indicate high pressure differences, which can be a sign of advancing storm fronts. Winds can funnel over mountain passes indicating a change in weather.

Wind-chill or **windchill**, (popularly **wind chill factor**) is the perceived decrease in air temperature felt by the body on exposed skin due to the flow of air. This is another effect of wind. In Montana, we always need to be aware of the wind chill factor! The following is a link to a wind chill chart from NOAA: https://www.weather.gov/safety/cold-wind-chill-chart

BASIC LESSON

Objective(s)

Students will be able to…

- measure the direction and speed of wind.
- predict changes in weather using wind information.

State Science Content Standard(s)

Standard 4 Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

4.4 Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured.

A. Record temperature
B. Display data on a graph.
C. Interpret trends and patterns of data.
D. Identify and explain the use of a barometer, weathervane, and anemometer
E. Collect, record and chart data from each weather instrument.
F. Identify the patterns.
G. Discuss trends within the patterns.

Materials		Safety
From the Kit	**Provided by Teacher**	• None
• Directional Compass • 24 Ping-Pong balls • Commercial Wind Speedometer	• 4 x 6-inch index card • Ruler • Straight pin	

(Anemometer) • Upright Weather Station • Anemometer Device	• Plastic drinking straw • Unsharpened pencils • Clay - round about the diameter of a quarter • Marker • Fastening device (stapler, tape, or glue) • Paper clips • 5 x 8 Cardboard • Glue • Scissors • Light-weight string or thread • Tape	

Key Vocabulary	**Mastery Questions**
• Wind • Air • Weathervane • Anemometer (Wind Speedometer) • Meteorologists	• See Lessons

Detailed Plan

<u>Engage</u>

Read this to your class:

"Bill crouched low, peering through the willows at the grazing antelope. It tugged gently on the tips of the young grass shoots, pawed loose from an earlier digging. Dad had instructed him to always stay downwind of animals when tracking and trying to get closer to them. The antelope's head rose at the sound of a snapping twig underfoot as Bill cautiously ventured closer. He noticed tumbling dark clouds over head. The distant thunder momentarily broke his concentration. He recalled his mother's caution that a calm peaceful evening could quickly change with little warning with an approaching storm.

Bill could feel the wind pick up around him. How strange it seemed to stand so close and not be seen by the antelope. The large drops of rain splattered on his coat as he tried to get closer. A sudden boom of thunder echoed in the canyon, startling the unsuspecting antelope. Bill watched as it leaped out of sight. With great excitement, Bill returned to camp having successfully tracked and gotten close to the antelope."

- What carried the sound of a snapping twig?
- How could thunder be heard so far away?
- What brought in the storm so quickly?
- How was Bill able to get so close to the antelope?

If you said air and wind, you are correct. Earth is surrounded by a protective blanket of air that is constantly moving. Moving air is called wind. You might feel a calm, gentle breeze on your face on a lazy

summer evening or experience the ravaging fury of a thunderstorm. Wind can cool you off when you are hot, or fuel forest fires caused by summer lightning.

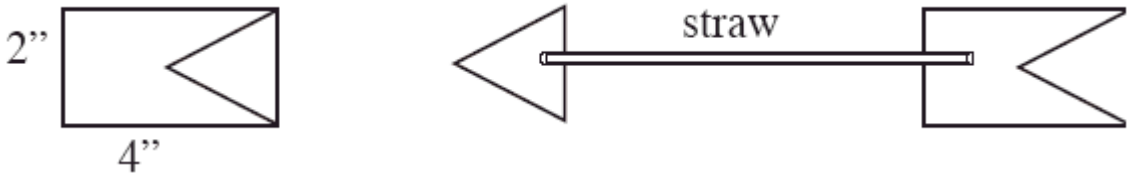
Exploration/Explanation

Activity 1 - Make a Wind Vane

How do you observe the direction of the wind? Do you notice leaves as they are blown in the fall season? How important is knowing the wind direction when flying a kite? Wind vanes have decorated barns, houses, and other public buildings for centuries. They turn with the wind, showing the direction the wind is coming from. You may have seen windsocks at airports or used as colorful decorations on people's homes. By observing wind vanes, meteorologists know a wind's direction and can predict how this moving air will change the weather conditions in an area. Wind is what brings us storms. By knowing the direction and speed of wind, we can forecast the weather. (Show them the weathervane found in the Upright Weather Station box. It will have to be assemble but is easy to do.) Right now, we are going to make a wind vane.

(This can be done individually or as groups.)

1. On the 4 x 6 index card, draw a vertical line that divides the card into a 4 x 4-inch piece and a 4 x 2 inch piece.
2. Cut the card into the two pieces. The smaller piece will be the front and back of the wind vane and the larger piece will be the base.
3. Make an arrow in the smaller piece as illustrated below, and then cut the arrow out. The leftover card is the back fin.



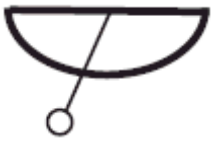
4. Tape, staple, or glue the arrow and the fin on the ends of a straw as shown on the previous page.
5. Stick the straight pin through the straw near the back fin so the arrow is balanced.
6. Stick the same pin into the eraser head of an unsharpened pencil so the arrow will spin.
7. Paper clips may be added near the arrowhead of your vane to balance your straw.
8. With the 4 x 4 card, draw two straight lines to opposite corners. Where they meet is the center of the card.
9. Label the corners on your card - N for North, S for South, E for East, and W for West.
10. Place your clay in the center of the 4 x 4 card.
11. Place the unsharpened end of the pencil in the clay so the wind vane will stand up.
12. Find a spot outside away from any building. Hopefully the wind is blowing.
13. Place a directional compass on top of your 4 x 4 direction card. Locate magnetic north and turn your paper so the North lines on the card lines up with the compass arrow.
14. The arrow will turn toward the blowing wind telling where the wind is coming from.

Activity 2 - Make a Wind Speedometer (Anemometer)

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 helps meteorologists forecast the upcoming weather, or how long the same weather will remain in an area. Right now we are going to make a wind speedometer that will tell us approximately how fast the wind is blowing.

(This can be done individually or as groups)

1. Copy the Paper protractor and Wind Speedometer Converter (See binder or website) for each student in the class and pass them out. Have the students cut them out.
2. Glue the paper protractor to a 5 x 8 piece of cardboard (Straight edge at top of card).
3. Cut a piece of string or thread ten inches long and tape one end to the Ping-Pong ball and the other end tape to the center of the straight edge at the top of the card.
4. Glue the wind speed converter to the back of the cardboard, making sure it is upright.
5. Go outside and determine with your wind speedometer how fast the wind is blowing.
6. With your left (or right) shoulder to the wind, hold the wind speedometer in front of your round edge of the protractor closest to the ground.
7. Check the angle of the ball and thread.



8. Look at the converter chart on the back of the cardboard. Find the angle on the left side of the chart. Look at the next column to the right on the same row and record what the wind speed is.
9. Compare the wind speed of the home made speedometer with the commercial speedometer (anemometer).
10. This is an opportunity for students to compare and discuss their results with each other and their results compared to the commercial wind speedometer. There is also a wind speedometer included on the Upright Weather Station. This reading could also be included in the discussion.

An Alternate Way to Measure Wind Speed – Anemometer Device (Demonstration)

Assemble the device prior to class using the directions found in the box. The unit consists of four cups – three of them black and one is red. Make sure that each cup is pointed in the same direction with its face perpendicular to the ground. Set the unit outside on a table or chair away from buildings and other obstacles at least 3-4 feet off the ground. Start your stopwatch and have the students count the revolutions of the cups using the red cup as the counting indicator. Continue counting for one minute. Write an agreed upon number down and do these three more times. Ask students why it is important to do this more than once. Find the average revolutions per minute. You can calibrate your anemometer by comparing the revolutions per minute to the miles per hour found on the commercial anemometer. This instrument may also be used to measure the daily wind speed in Activity 3.

Activity 3 - Observing and Recording Wind Data

Meteorologists are weather scientists that observe and forecast weather. Wind is one of the important

weather conditions they study. Knowing wind direction and wind speed can help them predict how and when the weather will change. We will observe the wind each day with our instruments just like a meteorologist. We will record the wind direction and wind speed for a few days.

1. Review the use of the wind vane and wind speedometer, explain to them how they work before they go outside. Possibly you can demonstrate them with a hair blower or a fan.
2. In their journal have the students construct a data table for as many days as you would like for them to observe wind speed and direction. Use the following headings: Day, Wind Direction (student constructed and/or vane in kit), Wind Speed (student constructed speedometer), Wind Speed (commercial speedometer), and Weather. Have students take turns reading the commercial speedometer.
3. Go outside and observe the readings of the wind direction and wind speed. Have the students enter it into their journals.
4. Discuss the observations.
5. Keep a daily chart of the wind direction and speed for several days. Five to ten days is a good amount of data to collect.
6. Share with students the Beaufort Wind Speed Scale (See binder or website) and discuss the various measurements collected and what the winds speed tells them about the weather using the chart. See background for help.
7. If Wind Chill is a factor during your lesson, this would be a great time to include it in your discussion.

Assessment

- Research and report on the effects of severe windstorms on people and property. Many incidences are found in past newspapers, magazines, and http://www.wunderground.com/weather-forecast/US/MT/Helena.htm.*)*
- Listen to student discussion and monitor the wind data tables students have written in their journals or logs.
- Participation in making the wind vanes and speedometers.

Resources

EXPLORE MORE

Website that demonstrates tornado action through computer simulation.
http://classwww.gsfc.nasa.gov/CAGESite/pages/demo1.htm

Lesson 4--Air Pressure and Barometers
GRADE 3-5

BASIC LESSON

Objective(s)

Students will be able to…

- Understand air or barometric pressure.
- Measure air pressure using a barometer.
- Understand what the air pressure may indicate about weather.

Air Pressure:
Adapted from Utah Lesson Plans—online.

For local weather: https://www.wunderground.com/forecast/us/mt/helena.htm/59601

The Weather Report is an online project that encourages classrooms to set up a weather station, measure, and record weather data.
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.
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 30 or higher, it means that we will have fair weather for a while with increasing temperature. If the needle of the barometer drops below 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.

State Science Content Standard(s)

Standard 4 Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

B. 4.4 Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured.

H. Record temperature
I. Display data on a graph.
J. Interpret trends and patterns of data.
K. Identify and explain the use of a barometer, weathervane, and anemometer.
L. Collect, record and chart data from each weather instrument.

M. Identify the patterns.
N. Discuss trends within the patterns.

Materials		Safety
From the Kit	**Provided by Teacher**	
• Open wide mouth jar • Nitrile glove • Plastic bottle for "Leaky Bottle Demonstration" • Box with milk bottle for pressure demonstration • Pressure Pullers • Water barometer • Barometer – gold metallic • Test tube and coverslip	• Straw • Toothpicks • Rubber band • 8-9 oz. plastic cup • Plastic wrap • Pie plate or tray to catch water. • Mailing tape – wide • Plastic water or pop bottle with lid • Ice or refrigerator • Food coloring	• Do not use a balloon to stretch across the mouth of the jar because of latex allergies. • Be careful that students do not pull too hard and go flying as they attempt to pull the cups apart.

Key Vocabulary	Mastery Questions
• Pressure • Air pressure • Barometric pressure • barometer	• See Lesson

Detailed Plan

Engage

Air pressure in Montana changes constantly. On some days it is a high pressure. On other days it is lower pressure. We usually can't feel it when it changes. But, when the air pressure changes, the weather changes too. Do one or more of the following demonstrations to help show the students the effects of air pressure. (Be sure to practice ahead of time.) ☺

Ask students "What is pressure?" (The force exerted on an area) Examples – feet on floor, high heel of a boot, hand pushing on tabletop. Ask "What exerts more pressure – walking in snow with snowshoes or walking on snow with boots?" (Boots – all your weight is exerted over a smaller area)

Water Glass Experiment

This is one of the best experiments to observe air pressure. Take a glass or test tube and fill one-third of it with water. Place a cardboard cover over the mouth of the glass or coverslip over the test tube. The cardboard should be bit bigger than the glass' mouth. Now apply some pressure on the cardboard from the left hand and invert the glass with the right hand. Slowly remove the hand and see what happens. The water does not fall from the glass, retaining the cardboard and the water in the same place as before. This takes place because the air pressure outside, i.e., 14.7 psi (pounds per square inch), is greater than the combined weight of water and air inside the glass.

Leaky Water Bottle

Before class, take the liter plastic bottle labeled leaky bottle and fill completely with water. Place the cap securely on the bottle. During class, explain there is a small hole created by a push pin on the side of the bottle, unscrew the cap and have a container to catch the leaking water (a pie plate or tray works well).

Ask students if they can explain why the bottle is “leaking”. Remind them of the water glass experiment and what they learned.

Explanation

The water seems to defy logic when it does not leak out of the holes with the cap on! This happens because the air pressure outside the bottle is pushing against it at 14.7 pounds per square inch. However, when the cap is removed air now able to flow inside the top of the bottle and starts pushing down on the surface of the water inside the bottle at 14.7 pounds per square inch. This added weight of the air pressure now acting inside the bottle is enough to force the water through the holes we poked! Gravity also is acting on the water and pulling it down toward the ground.

Egg in a Milk Bottle Demonstration

Take a hard-boiled egg and remove its shell. Wet the egg. Take the milk bottle found in the kit whose mouth is large enough to squeeze the egg inside it without squashing it but should also not easily allow the egg to enter the bottle. Now light a matchstick(s), put it inside the bottle and immediately close its mouth with the egg. The match stick will utilize the oxygen inside the bottle and will create low air pressure. High pressure outside the bottle will push the egg inside. This experiment with the air pressure shows how strong it can be. (See directions in the box for other ideas)

Crush a Plastic Water Bottle with Air Pressure

This demonstration helps to show students the power of air pressure by using temperature change to change the density of air. This is a very easy air pressure experiment and only requires a few common supplies to get started.

Materials Needed

- *clear water bottle* with cap
- *Cold water*
- *Hot water*
- *Refrigerator or small cooler filled with ice.*

1. Peel the label off the water bottle so students can see what is happening inside the bottles during the experiment.
2. Fill the water bottle with hot water. Use hot pads, if needed, to avoid burning hands. Hot tap water works fine.
3. Put the lid on the bottle and shake until the temperature of the plastic is consistent with the water inside the bottle.
4. Remove the bottle cap and pour the water down the drain.
5. Quickly screw the bottle cap back on the water bottle.
6. Place the bottle inside of the refrigerator or small cooler filled with ice.
7. Wait about 5 minutes and open the refrigerator door and remove the bottles. Look at the shape of the bottles now.

The air inside the bottle which was heated with hot water expanded from the higher temperature. The expanded air was then sealed inside the bottle when the cap was tightened on the bottle. As soon as the air inside the hot bottle began to cool, lower air pressure was created as the air inside the bottle began to

cool and contract. Placing the bottle inside the refrigerator amplified this result even greater. The air pressure difference between the air outside the bottle and inside the bottle was great enough to push in the sides of the plastic bottle, crushing the bottle.

Pressure Pullers

Although the directions refer to the term suction, in science there is truly no suction but for ease of explanation we will use this term. Please read the directions found in the "Pressure Puller" box for further explanation.

One of the handles is in the fixed position and the other can be moved back and forth. When they are 90° to each other they are in a relaxed position. When they are both pointed the same way they are in the "suction" position. In the relaxed position have two students line the bottom of the pullers together. Help them move the handles into the "sucking" position. The two suction cups should now be holding firmly together.

By placing the two cups together and squeezing their handles, you are simply reducing the air pressure in the space between the two cups resulting in a higher pressure on the outside surface of the cups. This makes it difficult (impossible) to separate the two cups from each other. It is the pushing force of the air pressure that makes the cups stay together.

Warning: Be careful that students do not pull too hard and go flying as they attempt to pull the cups apart.

****

Show and tell the students that there is an instrument called a barometer (see kit) that measures air pressure. Show them the numbers on a barometer - 28, 29, 30, and 31. When the needle on the barometer points to 30 and above, it tells us that we will have fair weather for a while with increasing temperature. When the needle on the barometer points to the numbers below 30, it tells us that there will be a change in the weather. The change could be increasing clouds, strong winds, temperature change and/or precipitation. Watching the barometer closely from day to day helps us predict what the weather will be like in the next day or two.

Tell the students that they will be making a barometer today. They will also be keeping a record of the changes of a barometer for the next two weeks. When the air pressure is high, there will be fair weather. When the barometer is low, there is a change in the weather with increasing clouds, strong winds, temperature change, and/or precipitation. If you want to know about the first barometer--
go to https://www.thoughtco.com/how-barometers-measure-air-pressure-3444416

It will explain barometers and how we barometers today.

<u>Explanation/Exploration</u>

Tell the students that today we are going to make a barometer. Then for the next few days we are going to see if the air pressure rises or falls or stays the same. (This can be done as a whole class, groups, or individually.) These barometers are not very sensitive so results will vary but this is a good demonstration

of how a barometer works.

1. Use the pre-cut nitrile glove to stretch over the mouth of the jar.
2. Stretch it over a jam jar (or any wide mouth bottle).
3. Put a rubber band around the bottle to hold the balloon on and keep the air out.
4. With a type of cement glue (Liquid Nails), glue a straw on the top of the balloon with the end in the middle.
5. Glue a toothpick in the opening of the outstretched straw.
6. Behind the bottle with the straw tape a piece of paper so the middle of the paper is about where the toothpick is pointing.
7. Draw a line on the paper to indicate where the toothpick is pointing.
8. Write the existing barometric pressure on the paper. (Check on local barometric pressure. http://www.wunderground.com/weather-forecast/US/MT/Helena.htm
9. Check the barometer each day. If the toothpick points above the initial position, there is an increase in air pressure. Air pressure is pushing on the balloon. If the toothpick points below the initial position, there is a decrease in air pressure. Air pressure is less, letting pressure inside the bottle push it up. When there is a change in the air pressure, watch to see if there is a change in the weather in one or two days.
10. Observe and record air pressure for a few days.
11. Compare results of student made barometer, commercial instrument, and local barometric pressure from the above website.
12. Discuss differences between the values of each barometer. Which won is more accurate? Why? Which one appears to be more sensitive to daily changes in pressure? Why do you think that is true?

Show the students the water barometer found in the kit. Have the barometer already prepared before showing the students. Explain to them how you set up the barometer. (See instructions in box) Place the barometer in a spot next to a piece of paper and mark where the water level is. Compare the movement of the water barometer to the jar barometer and commercial barometer.

Extensions

Math-Graph the results of the daily barometric readings over a period of two weeks.

Science-Write about how accurate the barometer readings have been in predicting the change of weather.

Language Arts-Find a trade book about air pressure and read it to the students. Have them take notes about the facts they hear as you read it. Discuss the facts. Make a journal with facts and draw pictures with labeled parts.

Assessment

- Performance Test- The Cup and the Plastic Wrap
    1. Get a 8-9 oz. plastic cup.
    2. Cut off a piece of plastic wrap big enough so it lines the inside of the cup. Have it big enough so some of it hangs down around the outside of the cup evenly.
    3. Tape the plastic down that is hanging out around the outside of the cup so it is airtight. Wide mailing tape works best.
    4. Have the students write on a piece of paper.

a. Title - The Cup and the Plastic Wrap.
b. Purpose - To pull out the plastic wrap.
c. Prediction - (Have the students write a prediction.)
d. Observations - (Have the students write their observations.)
e. Conclusion - (Have the students write their conclusion.)

5. Tell the students that in a moment they will reach into the cup and pull out the plastic wrap. Have them predict what is going to happen.
6. Have each student reach down inside the cup and try to pull the plastic out. Tell them to be careful not to poke a hole into the plastic.
7. Have the students write what they observed about the experiment. (Should be difficult to lift the plastic out of the cup.)
8. Have the students explain why they could not pull the plastic out of the cup. (Air pressure pushing down on the plastic.)
9. Have them draw pictures of the experiment of the different steps writing captions under each picture of what is happening.
10. Have them write their conclusions explaining why it happened.
11. Put hole in cup. See and discuss what happens.

Resources

- Check your district or school media center for videos about weather and pressure. There are also commercial weather videos available.
- Check your local school libraries for books about air pressure and weather.
- For local weather: http://www.wunderground.com/weather-forecast/US/MT/Helena.htm

Adapted from:
Utah Lesson Plans—online

Read more at Buzzle: http://www.buzzle.com/articles/air-pressure-experiments.html

Check out: Matter Experiments

Lesson 5--Severe Weather
GRADE 3-5

BACKGROUND

Montana weather is, to say the least, diverse. The combination of its northern latitude, its location in the Great Plains, the dramatic elevation changes and the numerous tall mountain ranges in the state all combine to produce some wild, wacky, and generally unpredictable weather. As the saying goes "If you don't like the weather in Montana – wait five minutes!" For anyone who is venturing in Montana, knowing what kind of weather to expect is very important. This is more so if you plan to do outdoor activities in the mountains.

General Montana Weather

These are just general rules, and change at the whims of nature, of course. But, overall, eastern Montana (which is defined as that portion east of the Continental Divide) is drier than western Montana (which is defined as that part of Montana that is west of the Continental Divide).

During the summer, eastern Montana generally has warmer weather than the western half – frequently much warmer. During the winter months, though, western Montana usually has warmer temperatures than does the eastern half of the state – often with remarkably substantial differences.

An additional Montana weather trait relates to clouds. The area of Montana that is west of the Continental Divide has much more cloud cover than eastern Montana. This is especially true during the winter months when inversions set in. During the winter, inversions often keep the western valleys of Montana under clouds for weeks at a time, while over in eastern Montana the sun shines continuously.

The reason for these general traits in Montana weather is due to the Continental Divide. The Continental Divide essentially divides Montana into two distinct big geographical zones that vastly influence the weather in Montana. The Continental Divide are towering mountain peaks that meander through the entire width of Montana. More than anything else, the Continental Divide shapes the weather in Montana, causing the often dramatic differences in temperature and precipitation.

The Continental Divide has a dramatic effect on weather in Montana for two reasons. The first reason is that the divide hinders the flow of the often very cold air that invades eastern Montana from making its way over into the western part of the state. This occurs because that very cold air (you know, the stuff that is like -20 degrees) is usually just a "shallow pool" of air, often not more than 2000 feet in height. Consequently, this cold air is frequently unable to make it over the mountains to invade the western half of the state. Because of this, during the winter months or during cold snaps that happen to occur during the rest of the year, it is not uncommon at all to have Great Falls shivering in 20 below weather (and windy) while Kalispell basks in 25 degrees above zero weather.

Yet, the Continental Divide does not always prevent the cold air from invading western Montana. From time to time, these pools of cold air are "deep enough" (or are thick enough) to penetrate through the mountain passes along the Continental Divide. When this happens, conditions along the Continental Divide and near these passes, become less than pleasant as this very cold air blows through, resulting in

cold, very windy conditions.

The second dramatic effect of the Continental Divide relates to moisture and sunshine in Montana. The Continental Divide is a wonderful rain and snow-gathering machine. The high peaks of the divide force moisture out of the weather systems that cross Montana, leaving very little for eastern and central Montana (or those areas that lie to the east of the Continental Divide). As such, most areas in western Montana receive decent amounts of moisture, while areas to the east have significantly less – particularly the vast swath of prairie in Montana. That said, it needs to be noted that the many mountain ranges that lie to the east of the Continental Divide are high enough to force significant amounts of moisture out of weather systems. This is why many central and southern Montana mountain ranges receive so much snow – their huge vertical rise (measured from base to summit, which can exceed 7000 feet in places) is able to force abundant moisture out of weather systems that leave the surrounding area completely dry.

Thunderstorms in Montana can and occasionally will produce tornados, damaging winds, large hail, and flash floods, threatening lives, and causing significant property damage. In 2012 alone, Montana had three tornados confirmed, 138 high wind and damaging wind events, 151 large hail reports, and two flash floods: causing hundreds of thousands of dollars in damage and resulting in several injuries.

Source: https://www.bigskyfishing.com/Montana-Info/montana_weather.shtm

BASIC LESSON

Objective(s)

Students will be able to…

- Learn about severe weather in Montana.

State Science Content Standard(s)

Standard 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

1.2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations.

1.3. Use data to describe and communicate the results of scientific investigations.

Materials		Safety
From the Kit	**Provided by Teacher**	• None
• Finding out about Montana's Weather – handout found in binder or website • Lightning poster	• Internet access	

Key Vocabulary	Mastery Questions
• Continental Divide • Inversion • Lightning • Thunderstorm • Blizzard • Flash Flood	• [What questions could a teacher ask his/her students throughout and after the lesson to assess mastery?]

Detailed Plan	

Engage

Ask the students these questions: (Have them write the answers in their journals.)

- Have you ever planned an activity and had it ruined by bad weather? What was it?
- What is considered "bad weather"?
- What type of weather have you seen or heard of in Montana that can be destructive? (Introduce severe weather here.)
- What are things that can be destroyed by severe weather?
- Explain that here in Montana we don't have it as bad as some people who live elsewhere in the country. What severe weather do other states usually encounter that we don't see much at all? (tornadoes, ice storms, hurricanes, etc.)
- Explain that in Montana our most dangerous weather usually occurs when we have thunder and lightning. Why are thunder and lightning storms dangerous in Montana? (Lightning strikes can hurt people and livestock. Also start fires in remote areas.) See the Lightning poster for explanation of lightning.
- (If possible, show some pictures from the Internet of severe weather and its destruction.)

Rainstorms in class: (Simulation)

1. Turn off the lights and have everyone tap **one** finger on their desks as it starts to rain.
2. Tap all fingers on the desk so it rains harder.
3. Have someone switch the lights on and off quickly for lightning.
4. Add snapping fingers, clapping hands, and stomping feet, as the storm gets worse.
5. Finally, do the sounds more quietly in reverse, as the storm moves away.

Questions to ask after the storm simulation:

1. Why are thunderstorms dangerous?
2. What can happen if you are out in a thunderstorm?
3. What are precautions that you must take in a thunderstorm?

Answers to these questions can be found on the Internet.

Explanation/Exploration

Today we will be exploring some wild weather information on the Internet. Each student should be given a list of addresses to enter into the computer.

1. Help the students access the Internet sites.
2. If you have access to a projector and an Internet connection, you may do this with the whole class.
3. This activity lends itself to a great discussion about weather, severe weather, and the consequences of severe weather to everyone. How does is impact our lives?
4. Looking at the 2-month forecast provided by question 10, have the students take note of the

information and then see if it turns out correct.

Extensions:
Language Arts-Have the students write about an incident they have been through where the weather was severe enough for them to remember.

Math-Students can do some graphing and comparisons around the state or country of temperatures, precipitation, climates, etc.

Assessment

Response questions students may write about based on what they have learned in the kit.

1. Why is technology important to us when we want to gather information about weather?
2. What types of severe weather are there in Montana?
3. What makes severe weather "bad" weather?
4. Compare normal weather with severe weather. (rain to flooding; lightning to catching things on fire; wind to blowing roofs off of buildings; etc.)

Resources

Adapted from:
Utah Lesson Plans-online

Videos: Check district media centers for these videos.

- Restless Atmosphere
- What Makes Weather?
- Meteorology
- Weather Class with Dr. Neil Frank
- Weather Express
- Weather Station Backyard Science

(There are also commercial weather videos available.)

Web Sites

- ✓ National Weather Service Forecast Office
- ✓ http://www.accuweather.com/en/us/national/severe-weather-maps
- ✓ National Severe Storms Laboratory

Lesson 6--Weather: Collecting Data
GRADE 3-5

BACKGROUND

Meteorologists collect weather data daily to make forecasts. With the aid of high-altitude weather balloons, weather equipment and gauges, satellites, and computers, accurate daily forecasts can be made. Collecting weather data in just one location and making a forecast requires a great deal of skill. Since air travels from one location to another, it is helpful to know what the approaching weather will be.

In this investigation, the students will collect data for two weeks. At this time, they will start seeing patterns in each of the areas. They can predict what the weather will be like the next day and for the next few days. They will also write if their predictions were correct from the previous day.

Collecting the data for this lesson can be done instead of collecting the data separately in lesson 1-4.

BASIC LESSON

Objective(s)

Students will be able to...

- Collect data for two weeks and use the information to detect patterns and predict weather around their location.

State Science Content Standard(s)

Standard 4. Students through the inquiry process, demonstrate knowledge of the composition, structures, processes and interactions of Earth's systems and other objects in space.

4.4 Observe and describe the water cycle and the local weather and demonstrate how weather conditions are measured.

O. Record temperature
P. Display data on a graph.
Q. Interpret trends and patterns of data.
R. Identify and explain the use of a barometer, weathervane, and anemometer.
S. Collect, record and chart data from each weather instrument.
T. Identify the patterns.
U. Discuss trends within the patterns.

Standard 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

1.2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations.
1.3. Use data to describe and communicate the results of scientific investigations.

Materials		Safety
From the Kit	**Provided by Teacher**	• None
• Rain gauge in Upright Weather Box • Thermometer • Barometer • Wind Meter (Anemometer) • Weathervane • Cloud chart • Weather Forecasting Data Table (Keep for Lesson 7and 8) see binder or website. •	•	

Key Vocabulary	Mastery Questions
• Weather • Barometer • Rain gauge • Thermometer • Wind vane • Anemometer • pressure	• See lesson.

Detailed Plan

Engage

Tell the students they will be completing a two-week unit predicting weather daily using a variety of instruments. Hold an instrument up and ask the students what the name of the instrument is and what it is used to measure and how meteorologists use it to help predict the weather.

1. Anemometer (Wind Meter) - Meteorologists use anemometers to measure wind speed in one area. With this data, they can determine how quickly a storm, or weather system, will travel to other areas.
2. Wind Vane - Wind vane is a tool for measuring wind direction. Knowing the direction of the wind helps meteorologists determine in which direction a storm or weather system will travel.
3. Barometer - To measure air pressure, weather forecasters use a barometer. When the air pressure is rising, good weather is on the way. When air pressure is falling, the weather will get stormier.
4. Rain Gauge - A rain gauge is a tool for measuring the amount of rain that falls in each: day(s); week(s); month(s); year(s).
5. Thermometer - A thermometer is a tool for measuring temperature.

Explanation/Exploration

Tell the students that for the next two weeks they will be using these instruments to see what the current weather conditions are. They will then record them on a sheet that will be given to them. They will also be making predictions of what is going to happen the next day, compare it with a professional forecast. The next day they will see how close they were to their prediction.

Instructional Procedure:

1. Pass out student sheet.
2. Discuss where the instruments are going to be placed or taken outside to be read.
3. Decide the time(s) of the day that will be observed for data collection. You may do it once, twice, or three times a day. (Measurements need to be taken at a distance from any building that might block wind or alter temperature. The thermometers should be read in the shade of a tree or students can use an object to provide the shade.)
4. Each day when it is time for the instruments to be read, send out a few students to read them. Each time the instruments need to be read, send out a new group of students to do it. Over time all students should have the opportunity to measure with all the instruments.
5. When the students bring the information back to the classroom, have a chart available for them to write on.
6. Designate a time to discuss each of the readings.
7. Make a prediction as to what the weather is going to be like tomorrow with the present day's data.
8. Compare the information with the actual meteorologist information by going to the website http://www.wunderground.com/weather-forecast/US/MT/Helena.html. Write in the space if the prediction you made yesterday is accurate with today's weather.
9. At the end of the two-week recording session, discuss results of predictions and actual weather observed. Discuss accuracy, how easy or difficult it was to predict the weather, and why different people make different predictions compared to other students.

Collect the students' data tables for use in Lesson 7 and 8.

Extensions:

Language Arts-

- After you have discussed each of the weather instruments, have the students find out more information about them. Tell them that they can look the information up in encyclopedias, books, magazines, or the Internet. Have them write this information down by taking notes as they read.
- Have the students organize their notes about the weather instrument they researched. Have them write it in report form. Have them share it in class or put the reports in a binder to share with the class.
- Have the students read about other ways meteorologists gather data. Have them look them up in encyclopedias, books, the Internet and magazines. Have them draw a picture of it. Present it in class or put it in a binder.
- Have the students write riddles about the weather instruments. Have them write words they need to know for weather. Let the class guess which weather instruments they are talking about. (Ex. I spin around and around. Sometimes I spin fast and sometimes I spin slowly. Sometimes I don't spin at all. I don't stop until I am out of air. Even you can make me spin.)

Homework & Family Connections

- Students with Internet connections at home can be asked to visit weather websites.
- Students can be assigned to watch the evening forecast on one of the TV news channels.
- Have the students set up a weather station at home to continue their investigations about

weather.

Assessment

Response questions to the data they gathered:

1. Which day had the highest temperature? Lowest?
2. Which day(s) had the biggest change in the weather?
3. Which day(s) had the highest cloud cover percentage?
4. Which weather component(s) helped you to predict the weather for next day?
5. Describe the weather components on a day you enjoy.

Response questions about Montana weather:

1. How does the weather in Montana vary from the high Rocky Mountains in west to the plateaus and plains of eastern Montana?
2. On a hot August day, what direction would the wind be coming from if a storm were coming? (west)
3. List three ways weather affects our outdoor activities.
4. What temperature would precipitation turn into snow?

List different types of precipitation.

Resources

- Adapted from Utah Lesson Plans

Additional Resources:

Newspapers-Students can bring in newspapers with daily weather maps and forecasts.

Videos--Check district media centers for these videos:

- Restless Atmosphere
- What Makes Weather?
- Meteorology
- Weather Class with Dr. Neil Frank
- Weather Express
- Weather Station Backyard Science

There are also commercial weather videos available.

EXPLORE MORE

- Many websites have a variety of online activities to give the students an opportunity to explore, predict, and research weather forecasting.

Lesson 7--Weather: Interpreting Weather Data
GRADE 3-5

BACKGROUND

This investigation is based on the weather data gathered in Lesson 6. Once weather data is gathered, meteorologists want to interpret the data, looking for patterns. Their interpretations can be very complex. But we are going to be looking for simple patterns. To make the analysis easier, the data needs to be graphed and comparisons made.

When we compare graphs we begin to see the relationship one weather factor has with the others. When we see freezing temperatures, the precipitation will be in the form of snow. Often when a storm is approaching from the north, the barometer will drop, there will be a strong south wind, many clouds will begin to form, and the temperature will rise. After a storm, the barometer will rise, the winds will be gentle, most of the clouds will be gone, and the temperature will be colder.

However, the weather patterns in the summer are different from those of winter. When summer data is recorded, the data can be compared with the winter data. In the summer, there are still strong winds preceding a storm, but the storms blow in from the south. The barometer doesn't change much. After a summer storm the temperature may drop a few degrees but not drastically like it does in the winter. We see more cumulus clouds in the summer, and we see thunder, lightning, and hail during all seasons but winter. Understanding patterns helps make predictions.

BASIC LESSON

Objective(s)

Students will be able to…

- interpret the weather data they gathered in Lesson 6 looking for simple patterns.

State Science Content Standard(s)

Standard 1. Students, through the inquiry process, demonstrate the ability to design, conduct, evaluate, and communicate results and reasonable conclusions of scientific investigations.

1.2. Select and use appropriate tools including technology to make measurements (including metric units) and represent results of basic scientific investigations.

1.3. Use data to describe and communicate the results of scientific investigations.

Standard 5. Students, through the inquiry process, understand how scientific knowledge and technological developments impact communities, cultures, and societies.

5.1. Describe and discuss examples of how people use science and technology

Materials		Safety
From the Kit	**Provided by Teacher**	• None
• Weather Chart	• Pictures of graphs • Computer • Internet • Graph paper • Completed Weather Forecasting Data Table from Lesson 6	

	• Journals or notebooks for recording observations	

Engage

Review with the students about graphs and their purposes. Tell them that it is a fast way to analyze information. With temperature data we are going to graph the information to show how to make it. Make the graph on the board while they make it on graph paper. Use the Weather Chart provided on the website or binder or use regular graph paper.

Exploration/Explanation

1. Have the students (depending on how much time you have), individually or by groups, graph each of the areas data was gathered. Have the students keep the graphs in a safe place so they can be used for the next couple of days. The students will analyze the graphs to interpret them and look for patterns. They will also compare the graphs with each other to look for relationships.
2. Observe the air temperature graph with the precipitation graph. Observe and record in your journals the effects air temperature has on precipitation.
3. Observe the wind directional graph with the results of the next day's weather. Record in your journals what happened when an east wind, west wind, north wind, or south wind was present.
4. Observe the cloud graph with the results of the next day's weather. Record in your journals what happened after cirrus, cumulus, or stratus clouds were seen.
5. Observe the barometer graph with the wind force graph. Record in your journals what you observe about wind when the barometer is either high or low.
6. Observe the barometer graph with the next day's precipitation graph. Record in your journals what you observe about precipitation depth when the barometer is either high or low.
7. Observe the wind force graph with the next day's precipitation graph. Record in your journals what you observe about wind and the precipitation depth.
8. Observe the thermometer graph with the results of the next day's weather after a storm. Record in your journals what the temperature is after a storm.

Extensions:

Language Arts-

- Research different areas in the United States or in the world to see what the data is using the different weather components. Compare it to your data that you have from your specific area. After you have compared the data, tell why the data is the same or different.
- There are a few days during a season where the weather components are far from the average, either hotter or colder. Pick three weather components in a particular season and tell what could make them outliers during that season.

Math- With the data that you have, take an average of each component in each season. Compare the same components of each season. Write the differences you see between the seasons. Write down why there are differences in the weather components from season to season.

Homework & Family Connections--Students with Internet connections at home can be asked to visit weather websites and/or be assigned to watch the evening weather forecast on one of the TV news

channels.

Assessment

- Explain why sometimes it snows and sometimes it rains.
- What would the normal temperature be in the winter during the day?
- What would the normal temperature be in the summer during the day?
- What is going to happen when the barometer is low? High?
- Tell what the weather might be like before a storm.
- Tell what the weather might be like on a sunny day.
- Name three occasions that are considered severe weather.
- Why is severe weather dangerous?
- Name two seasons. Besides temperature, what else changes from one season to another?
- How do types of clouds help us find patterns in the weather?

Resources

Adapted from:
Utah Lesson Plans--online

Additional Resources

Newspapers: Students can bring in newspapers with daily weather maps and forecasts.

Videos: Check district media centers for these videos:

  - Restless Atmosphere
  - What Makes Weather?
  - Meteorology
  - Weather Class with Dr. Neil Frank
  - Weather Express
  - Weather Station Backyard Science
  - Other videos that may enrich the students experience.
- There are also commercial weather videos available.

Web Sites—Encourage students to follow weather developments and further their learning using the many online resources available.

- For local weather: http://www.wunderground.com/weather-forecast/US/MT/Helena.htm