Wet Weather-- Wet Climate?
Lesson Plan

Overview

Children will measure and graph the precipitation on the playground throughout the year using a rain gauge. Children will also observe satellite images of clouds and begin to investigate how clouds occur in patterns that sometimes result in precipitation. Children will also begin to learn the difference between weather and climate. This lesson is an extension of How Wet Did it Get?, an entry-level lesson.

Suggested Lesson Sequence	Please see the Seasonal Changes module description.
Lesson Level	Intermediate
Science Connections	· Students will measure **snowfall/rainfall** on school playgrounds. · Students investigate the concept of **density** by observing how the depth of snow in a **gauge** differs from the depth of the resulting melt water. · Students learn the difference between **weather** and **climate**.
Math Connections	· Children will measure rainfall and/or snowfall in **centimeters** and **millimeters** using a rain gauge. · Children will make a **bar graph** of the total precipitation each month. · Children will **extrapolate** measurements from a short (e.g. monthly) time period to a longer (e.g. annual) period.
Technology Connections	· Children will construct a **gauge** to **measure** rainfall and/or snowfall. · Children will access **current satellite images** to track weather changes.
Lesson Assessment Tools	Assessment and Summary Table (Word) Assessment Activity Description (below) Authentic Assessment (below)

Materials

Plastic Jar (e.g. peanut butter jar) with equal diameter from top to bottom

Indelible marker
Plastic ruler with millimeter scale
Rain Gauge activity sheet—one per student
Precipitation Bar Graph activity sheet
Wet Weather, Wet Climate? interactive slideshow (Powerpoint)
How Wet Did it Get? Clouds from the Ground and Space Activity Sheet

About the slideshow: this slideshow is not meant for students to read through on their own. It is intended to be viewed together, to outline and illustrate a discussion of the lesson's themes, led by the teacher. You might have a different student read each slide's text.

Vocabulary Words

Centimeter: a unit of length often used to measure small objects. Most pieces of chalk are about one centimeter across. 1 centimeter equals 10 millimeter, and 100 centimeters equals 1 meter.
Climate: the average annual or seasonal weather (usually temperature, precipitation, cloud cover, and windspeed) at an area, determined using many years of measurement.
Clouds: objects in the sky made out of ice crystals or water droplets.
Estimate: a measurement that is not exact.
Exact: a very high detail of measurement.
Gauge: an instrument used to measure something.
Liquid: a wet substance that can easily flow.
Millimeter: a unit of length used to measure very small objects. 10 millimeter equals one centimeter, and 1,000 millimeters equals one meter.
Precipitation: water that falls from the sky to the ground. Precipitation can be in the form of snow (solid water crystals), ice (solid water crystals), or rain (liquid water).
Rain: liquid water that falls from clouds.
Snow: solid water that falls from clouds. Snow is made of flakes, or water crystals, that each have 6 points.
Solid: a substance that does not flow easily and can stand alone in its form.
Weather: the temperature, precipitation, cloud cover, and windspeed that occurs at an area over a short time period.

Vocabulary Note: students may be unfamiliar with other vocabulary presented in this lesson. This is done intentionally, to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about unfamiliar words.

Procedure

I. Assessing Prior Knowledge

Begin a classroom discussion about the last time it rained or snowed outside. Sample starter questions could include: Can students remember the last time it rained or snowed? What special clothing did they wear the last time it rained or snowed, to keep dry? As the discussion progresses, have students begin to think about how often it rains or snows in your area. How many times has it rained or snowed in the past week? Two weeks? Month? Since the beginning of the school year? Depending on your climate, students will have different special memories about various rain or snow events, or no special recollections at all. After discussing how many times it has rained/snowed, ask students to think about *how much* it has rained or snowed. This is a more challenging question for students to ponder. How could they measure the amount of rain or snow water that falls?

II. Contextual Preparation

In this lesson, students will take measurements of precipitation on their own playground, learn that the clouds which dropped this precipitation can be seen by a satellite orbiting overhead, and then repeat their measurements daily over a long time period to determine how much precipitation falls at the school. To introduce the concept that clouds can be seen using satellites orbiting around the Earth, you might play the Meet Pixel the Satellite Quicktime animated movie for your students. This movie is best appreciated if shown with sound, but if no sound is available, you may the transcript along with the movie, as written below:

> "1. Hi kids, I'm Pixel the Satellite. 2. I spend my days and nights orbiting the Earth, gathering photos and other information about our planet's many interesting places and living things. 3. From up here, I can see that the Earth is one connected system: 4. see how the Earth looks from hundreds of miles high in the sky? (shows the Earth, in close up view, scans around it for a moment, with Pixel narrating the scene, 5. "Here's the Land of North America, the Atlantic Ocean, and some clouds here and there") 6. Together with your teacher, I'll be your guide as we look closer at the Earth and its many related parts. 7. As for now, I'm off to snap some pictures of some lakes, a few mountains, and maybe even your home town! (short pause) 8. See you soo-oon!" (fades off into orbit around Earth)

"Pixel" makes specific mention of clouds that can be seen from the vantage point of outer space. After completing this movie, display the Wet Weather, Wet Climate? interactive slide show. This slide show motivates students to make measurements of rainfall/snowfall on their own playground. During the discussion, you may also wish to introduce and discuss the vocabulary words with your students.

III. Student Activities

1. To measure rainfall or snowfall, the children should first construct a rain gauge. This may be done as a class or the teacher may choose to have children make their own gauges. First, children will need a clean, empty plastic jar (e.g. peanut butter jar). Make sure the diameter of the jar opening is the same size as the base of the jar.

2. Using the template on the Rain Gauge activity sheet, cut out the template for the metric

ruler. This template will be used to mark the jar in centimeters with an indelible marker. This template will also be used in conjunction with a mm-scale ruler to help children read and graph the rain or snowfall water amount (see step #8).

3. Place the plastic jar in an open location on the school playground or outside the classroom window that will not be disturbed or blown over by the wind. For example, the jar may be placed in a garden and supported by rocks or bricks.

Part A: The First Storm

4. Distribute the How Wet Did it Get? Activity Sheet. As the first rain or snow storm passes, encourage students to draw pictures of the clouds overhead on this Activity Sheet. After the rain/snowstorm, children can observe the amount of rain/snow collected through the clear jar and observe which mark the water level is nearest. The teacher should help the children estimate the amount of rainfall to the nearest centimeter (cm) using the marked scale. At this point, utilize a millimeter-scale ruler next to the cm-scale ruler marked on the activity sheet to determine the water amount to the nearest millimeter.

5. To help children learn to estimate and read the rain/snow fall measurements, the teacher should use the paper centimeter ruler template (see Rain Gauge activity sheet). While observing the amount of water in the gauge, children can make a bar graph by coloring the amount of rain on the paper centimeter ruler. The teacher can then assist students in estimating the amount of water that fell. In the case of snow measurement, try to measure the snow depth before, during, and after melt. *Although the water measurement will be ultimately used for graphing the seasonal trend, taking these multiple measurements as snow melts will help students to make the connection between snow and the water it contains.* Point out that the moisture is becoming more compact, or *dense*, as it melts from snow to water.

6. On the day that it storms, children may check the National Oceanic and Atmospheric Administration's GOES website (http://www.goes.noaa.gov) to observe satellite images of the clouds and storm systems near your school's location. Choose the area that best corresponds to your location. For the continental United States (CONUS) images, short movies can be viewed by clicking on the icons below the images to show the clouds "in motion." This will allow children to observe on the computer how the weather system moves across time and location. For these movies, it is best to choose the "infrared" option so that the image does not go dark at night. The teacher (or children) can also go to other weather forecasting sites (such as the National Weather Service site at www.nws.noaa.gov) to read the forecast and find out how long the rain or snow will last.

7. Using the How Wet Did it Get? activity sheet, children can now draw a picture of the cloud images they observe, showing the storm system and clouds as viewed from space.

8. Using the Precipitation Bar Graph activity sheet, children can record the water measurement in centimeters and millimeters by coloring in the amount of precipitation on the bar graph chart. To assist in graphing, use a metric ruler with a millimeter scale. Locate the appropriate month column (beginning with "S" for September) for recording the measurement.

Part B. Continued Measures

9. Repeat the snow/rain water measurements described above for an extended period, dumping the water collected between measurement. Continue plotting on the bar graphs. In wet climates, the bar graph may need to be extended by cutting and pasting, and then re-labeling the precipitation axis (e.g. so that it reads 16-30 cm rather than 1-15 cm) Children should be sure to check the rain gauge on Mondays to record any precipitation that may have fallen over the weekend.

10. As measurements are repeatedly taken and graphed, begin to explore with your students the numbers they collect. Which month has had the most precipitation? Which has had the least? What is the total amount of precipitation measured after a given amount of time? As you lengthen your measurement time, you will begin to "average out" the high precipitation storms (or extended dry periods) and get a more seasonal measurement.

11. On a monthly basis, work with your students to extrapolate your measurements to an entire year. In other words, after one month, take your measurements and multiply by 12 (or, add 11 more numbers just like the first). After two months, multiply by 6 (or, add 5 more numbers just like the first). For example, if your class measures 11.5 cm of precipitation for the month of October, this number would extrapolate to an annual precipitation of: 11.5 x 12 = 138cm. For each extrapolation, compare to the annual climate precipitation amount for your area, which can be found at: http://www.wrcc.dri.edu/precip.html. You may need to help your students convert from metric to English units (1 cm = 0.39 inches) to make the comparisons.

12. As you continue to compute annually extrapolated results, it is likely that your extrapolations will become closer to the annual mean precipitation amount for your area. Note that climate means are computed from many years of data, but that you only have a fraction of one year to compare. Discuss the monthly trends with your students to explore seasonality in the precipitation of your own local area. Explore the notion of weather vs. climate by discussing with your students the fact that longer time periods provide a "smoother" precipitation trend through time than do shorter time periods (when one large storm can make a huge difference in the amount of water received at a location).

Questions for Class Discussion

1. Which month did you get the most rain? Least?

   Answers will vary.

2. From your graph, can you identify a dry season? Wet season?

   Children should usually be able to identify spring as a wet season. Fall is usually a dry season.

3. How do you think rainfall (or snowfall) amounts are related to plant growth on your playground?

   Plants need moisture for optimal plant growth. Wintertime moisture can be captured by the soils and provide important water for plant growth in the springtime and summer, particularly in climates with low summer precipitation.

4. How do satellite images from space show weather patterns that produce precipitation?

   Children should note frontal systems and cloud formations as seen from space.

IV. Assessment

Children should be able to record rainfall (or snowfall) in centimeters and millimeters, and graph the monthly precipitation. Children should make inferences about precipitation affects plant growth in a particular area. Students should also be able to describe the difference between weather (a daily event) and climate (an average of many many weather events over the course of seasons and years).

Lesson Extensions for Authentic Assessment

- To account for the variability of rain or snow measurements due to shadowing effects of buildings or trees, place several rain gauges around the playground. Then, using concepts of averaging developed in the Finding the Balance lesson, find the average precipitation that fell for a particular storm or over a particular season.

- Have students write their own report about the seasonal precipitation that fell in your locality, using all of the vocabulary words presented in this lesson.

- Explore the concept of measurement *bias* with your students. If the gauge had a flaw in it, such as a large bump in its bottom, that made all measurements come out higher than they should be, then the gauge would be biased towards overestimating the actual amount of water. Biases like these can make for large errors when taking any repeated measures and extrapolating them.

- Research average rainfall and snowfall amounts with your students for your locality. Then, using weather statistics found on the Internet (such as at http://www.worldclimate.com), choose other locations around the world for comparison. How does your home compare with other sites around the world, in terms of precipitation? With a little additional research on the plant life of your chosen area(s), students will begin to learn how climate and vegetation is linked across wide ranges.

- Students used a container for a rain gauge that had the same width from top to bottom. What would happen if a rain gauge was larger at the top than at the bottom? Or vice-versa? How would the measurement scale need to be changed? Conduct an experiment with your children to show how different gauge designs will affect the readouts of equal amounts of precipitation, and change the scale bars appropriately. The process of comparing measurements from a known instrument to measurements from an unknown instrument is called *calibration*. Calibration is a critical step to ensure the accuracy of measurements taken using many types of scientific instrumentation.