



Webcams: A Window of Weather

Mount Rainier National Park



About this Lesson...

Grade Level(s):	3 rd -10 th grade
Location:	Classroom
Applicable Subject(s):	Climate, Ecology, Geography, Landscapes, Environment, Science and Technology
Duration:	10-15 minutes daily for at least one month
Group Size:	Entire class
Education Standard(s):	ESS2D, Weather & Climate

Overview:

A speed bump for incoming weather from the Pacific Ocean, Mount Rainier experiences dynamic weather changes by throughout the year, and by month, day, hour, and even minute. Not only can these changes be observed from distant cities of Seattle, Tacoma, and Olympia, people from around the world can see the changes in Mount Rainier's weather on the park's website. This activity is a great addition to morning station work.

Connection to Mount Rainier National Park:

Mount Rainier affects the weather far beyond the reaches of the national park's boundaries.

Objectives:

Students will:

- Observe, collect, and analyze weather data at via weather stations and webcams at Mount Rainier National Park.
- Represent data in tables and graphical displays to describe weather conditions at Mount Rainier National Park.
- Summarize the data collected.
- Compare and contrast weather data collected to climate data at Paradise at Mount Rainier National Park.
- Compare and contrast weather data collected at Mount Rainier National Park and data collected in their hometown.

Background Information:

Weather comes in from the Pacific Ocean travelling eastward. Mount Rainier lies within 100 miles from the Pacific Ocean. As air comes in off the ocean it is filled with large amounts of moisture. When the air hits the mountain it is forced to rise higher and higher in order to make it over the mountain. As the air rises, it also begins to cool. Cooler air cannot hold as much moisture, so there is an increase in precipitation, either rain or snow depending on elevation. Once the air makes it over the mountain it moves down the slope and warms, which allows the air to hold more moisture and cause less precipitation. This is why the eastern part of Washington is so much drier. This process is called a rain shadow or the orographic effect.

The climate is generally cool and rainy, with summer highs in the 60s and 70s. While July and August are the sunniest months of the year, rain is possible any day, and very likely in spring, fall, and winter.

Wet, cold weather can occur anytime of the year. Although late-July and August are generally the driest and warmest time of the year, summer can also be wet and cool. Snow will remain at the 5,000 to 8,000 feet elevation well into mid-July. Paradise is the second snowiest place on Earth where snowfall is measured.

Approximately 94 feet of snow fell during the winter of 1971-72. On average, Mount Rainier receives approximately 54 feet of snow a year.

MesoWest is an ongoing cooperative project, started in 1996, to provide access to current and archive weather observations across the United States. Weather observations include but are not limited to: temperature, humidity, wind speed, wind direction, and precipitation. Data are collected from a variety of organizations. Some stations participate in voluntary weather observing networks such as the Citizen Weather Observer Program. Others are managed by private firms or federal/state/local agencies. These data are available for a multitude of uses. Over 20,000 weather stations actively report to the MesoWest database.

From: <http://en.wikipedia.org/wiki/Mesowest>

The MesoWest (<http://mesowest.utah.edu/>) station identification for Paradise is PVC55.

Materials:

You will need:

- A computer
- Internet connection
- A projector or smart board for showing tutorial
- Electronic copy of tutorial PowerPoint (available on the web)
- Tutorial PowerPoint notes page printout (optional)
- Electronic copy of Mount Rainier Weather PowerPoint slideshow (available on the web)
- One printout of the data sheet
- One printout of the weather station reference sheet

Procedure:

Step 1: Set up

- Load the electronic copy of the Mount Rainier Weather PowerPoint to the computer that the students will be using to record data and observations. This file will open directly into the slideshow mode. Students will not be able to edit the slideshow.
- Load the weather tutorial PowerPoint to project for the entire class to see.

Step 2: Prepare the Class for Recording Observations

- Using the notes for reference, guide the students through the process of recording observations.
- With the class, go through the steps as if you were recording observations for that day.
- Print a copy of the reference sheet to post near the observation computer.

Step 3: Recording Data

- It is recommended, but not necessary, to start this activity at the beginning of the month.
- As part of a morning or afternoon routine or the start of class, assign students to record observations for each day. If possible, assign students to make observations at home on the weekends.
- After at least two weeks (a month is recommended), make copies of the observation form and continue onto Step 4: Synthesizing the Data

Note about Snow Depth

If your class is recording data in late July, August, September, and/or October, you may notice that there is a reading for snow depth, but snow cannot be seen on the webcams. This is due to the technology that is used for measuring snow depth. The sensor used to measure snow depth is a Judd Depth sensor that works by measuring the time required for an ultrasonic pulse to travel to and from a target surface. It is generally zeroed to the ground. It measures the distance to the ground and inputs that distance into the program. When snow

starts to fall, the ultrasonic beam starts to pick up the snow surface which helps calculate the accumulated snow depth.

In the summer, the ultrasonic beam is reflecting off of vegetation. When park scientists summarize the data, they determine the last day of snow on the ground through a variety of means (comparing to the Cooperative Observer Program, soil moisture and temperature) and then zero out the data.

With students, this provides an example for how scientists use different ways to collect data. This discussion may be driven by the students, as they observe a snow-free Paradise, but the weather station is reading 14 inches of snow depth. As a student-driven discussion, explain to the students how the sensor works and ask the students how they would solve the challenge of collecting this data. Share how the scientists at Mount Rainier National Park use data from other scientists to solve this issue.

Step 4: Synthesizing Data

Describing Data

Students can create charts by hand or by computer. Describing data will help them with assessment and extension activities.

Students can develop the following calculations or descriptions and create tables:

- Minimum temperature, maximum temperature, “right now” temperature, precipitation in 24 hours, and total snow depth
 - Range
 - Mean
- Number of days weather phenomena occurred
 - Fog
 - Snow
 - Rain
 - High Winds
 - Other occurrences mentioned in the webcam observations
- Total precipitation for the month
- Day certain weather phenomena occurred
 - When did the highest temperature occur? The lowest?

Compare

The Western Regional Climate Center has a [monthly climate summary](http://bit.ly/ZEdDc5) (<http://bit.ly/ZEdDc5>). Students can compare their monthly results to the WRCC’s results. Please note that the Western Regional Climate Center separates 24 hr. precipitation into snowfall and rainfall.

- How do your observations compare with the total average of (factor) for this month?

Graphing

Students can create the following graphs and charts individually or in groups by hand or by computer:

- Line graph or bar graphs representing the following by day or week
 - Minimum temperature, maximum temperature, “right now” temperature, precipitation in 24 hours, and total snow depth
- Bar graph comparing:
 - “Right now” temperatures observed in the morning vs “Right now” temperatures observed in the afternoon
 - Number of days fog, snow, rain, high winds, and other occurrences happen
 - Total precipitation for the month vs. average total precipitation (from the climate summary)
 - Mean snow depth for the month vs. average total snow depth (from the climate summary)
 - Mean max. temperature for the month vs. average max. temperature (from the climate summary)
 - Mean minimum temperature for the month vs. average min. temperature (from the climate summary)
- Pie chart

- Depicting days with rain, snow, or no precipitation during entire observation period

Assessment:

Preparing for a Mount Rainier Field Trip

You will need: Paper, crayons or markers, scissors, old magazines, and glue

- After synthesizing data, have students create a collage of clothing that they would wear and supplies that they would bring if they were going to visit Mount Rainier National Park for a field trip.
- Extension: Bring in clothing items (some appropriate for the weather and some not) and have students “dress up” another student for a field trip. Students could also create a “What Not to Wear” example.

Writing a District Ranger Report

You will need: Copies of the District Ranger report (or use a computer and projector), computers (optional)

- Pass out copies of the District Ranger report or, using a computer, project the report for the class to see.
- Rangers have been recording the weather and reporting on it at Mount Rainier for over 100 years. This is a monthly report from November of 1956.
- Read the first paragraph of the weather conditions section aloud:

“In the Paradise area the month of November was warmer and drier than normal. The maximum temperature of 61 degrees occurred on the 25th and again on the 29th; the minimum of 12 degrees occurred on the 19th. The mean temperature of the month was 37.7 degrees compared to an average of 32.9 degrees. The precipitation for the month totaled 6.68 inches which is half the mean of 13.39 inches. Snow occurred on 7 days with a total of 40.1 inches. The snow depth at the end of the month was 32 inches. There were 11 cloudy, 5 partly cloudy, and 14 clear days.”

- (Optional) If the students recorded observations from November, compare and contrast their observations to the observations from 1956.
- Hang student-created charts and graphs so that students can gather information from other students work. Students could write their own reports, or they could fill in the blank:

In the Paradise area the month of _____ was _____ compared to previous years. The maximum temperature of _____ occurred on the _____. The minimum temperature of _____ occurred on the _____. The mean temperature of the month was _____ degrees, compared to an average of _____. The precipitation for the month totaled _____ inches. Precipitation in the form of _____ occurred on _____ days. The snow depth averaged _____ inches. There were _____ cloudy and _____ clear days.

Extensions:

Comparing Mount Rainier Weather to Local Weather

Find a local weather station near your school (<http://mesowest.utah.edu/>) and a webcam <http://www.earthcam.com/>. Students can record data of both weather stations and webcams and compare and contrast the data. Monthly climate summaries can be found through regional climate centers (<http://www.ncdc.noaa.gov/customer-support/partnerships/regional-climate-centers>).

Build a Classroom Weather Station

The National Oceanic and Atmospheric Association has created instructions on how students can build their own weather station here: http://oceanservice.noaa.gov/education/for_fun/BuildyourownWeatherStation.pdf.

In groups, have students build a different instrument. While the class is recording Mount Rainier data, or after the class has finished, record data from the class weather station.

Demonstrating the Orographic Effect through Climate Summaries

Using the Western Regional Climate Center's map of Washington

(<http://www.wrcc.dri.edu/summary/Climsmwa.html>), encourage students to click on different weather stations and note the Annual Average Total Precipitation for locations on the west side of Mount Rainier and on the east side of Mount Rainier. Students should also compare these numbers to the Paradise weather station. Students could create a chart or map to illustrate their observations.

Demonstrating the Orographic Effect through Webcams

"The mountain is out" is a common phrase used by people that live within view of Mount Rainier. Using webcams from surrounding communities, students can view whether the mountain is "out." What is the weather like where the webcam is? Can the students see the mountain? Why or why not?

Webcam Location	Link
UW Seattle (50 mi away)	http://www.atmos.washington.edu/images/webcam2/
Seattle (50 mi away)	http://www.kirotv.com/s/weather/queen-anne-cam/
Vashon Island (50 mi away)	http://www.rcsx.com/Webcam/tabid/58/Default.aspx
Pierce County Airport (30 mi away)	http://www.wsdot.wa.gov/aviation/WebCam/PierceCoThunField.htm

Additional Resources:

Mountain Weather Interactive Graphic by PBS: <http://www.pbs.org/wgbh/nova/kilimanjaro/weather.html>

Connecting to other National Parks: http://www.nps.gov/teachers	
Related Parks*:	Big Bend National Park, Canyonlands National Park, Denali National Park, Everglades National Park, Grand Canyon National Park, Lava Beds National Monument, Mesa Verde National Park, Rocky Mountain National Park, Sequoia & Kings Canyon National Park, Statue of Liberty National Monument, Yellowstone National Park, Yosemite National Park
Related NPS Programs:	Air Quality in Parks, Inventory and Monitoring
Keywords:	Weather, climate, observation, data collection, webcam, distance learning, mountain, orographic effect, rain shadow, snow, rain, precipitation, temperature

*National Parks with webcams