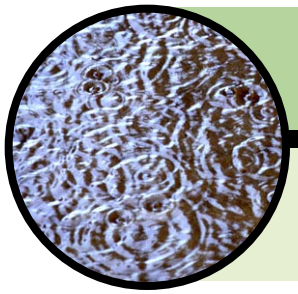


Differences between Climate and Weather

Unit: Little Ice Age
Lesson: 1

Materials & Preparation

Time:
- Introduction: 30 min
- Data collection: 10 minutes daily (for one or more weeks)
- Part 1 graphing/analysis: 45 min
- Part 2 graphing/analysis: 45 min

Materials for the Teacher:
- Thermometer
- A copy of the Weather Data Student Page for each day of data collection
- Overhead plot of average monthly temperature for your region (*see Advanced Preperation*)
- Overhead table of averaged climate data for region for period of data collection (average daily temperatures, minimums, maximums) (*see Advanced Preperation*)
- Internet access required

Materials for Students:
- Graph paper
- Pencils
- Colored pencils (recommended)
- Transparency (optional)

Source
Modified with permission from Project LEARN (http://www.ucar.edu/learn), a project of the University Corporation for Atmospheric Research (UCAR).

National Science Standards
Science as Inquiry: Content Standard A
Earth and Space Science: Content Standard D

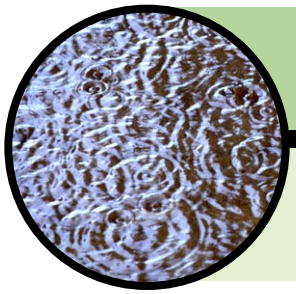
Colorado Science Standards
- Science: 1, 4.2, 6
- Math: 3

Learning Goals
Students will
- Learn to collect and graph local weather data
- Understand the general distinctions between weather and climate
- Understand that daily weather measurements are highly variable compared to long-term climate data

What Students Do in this Lesson
Understanding and interpreting local weather data and understanding the relationship between weather and climate are important first steps to understanding larger-scale global climate changes. In this activity, students will collect weather data over several days or weeks, graph temperature data, and compare the temperature data collected with averaged climate data where they live.

Key Concepts
Weather is the current atmospheric conditions, including temperature, rainfall, wind, and humidity, while climate is the general weather conditions. Comparing daily temperature with averaged climate data, students will understand that weather is highly variable, but climate is not.

Scientists need a lot of data to average and understand regional climates or the "usual" conditions. To detect a change in climate, scientists need large amounts of data. They look for evidence of climate that existed long before humans made weather measurements. These climate records, including ice cores, lake bottom sediments, and tree rings, are called proxies. They are discussed in several of the activities that follow in this unit of the *Climate Discovery Teacher Guide*.



Differences between Climate and Weather

Advanced Preparation

- Familiarize yourself with the procedure for using your thermometers to collect atmospheric temperature data.
- Determine how long you want students to collect weather data (a week, month, or even all year). Depending on your regional climate, one week of data collection can be sufficient to illustrate weather variation (and may be more appropriate for younger students).
- Print and copy the Weather Data Student Page for data collection.
- Find climate data for your region: Climate data may be obtained from regional climatologists or local news stations. NOAA resources for locating regional climate data can also be found at: http://www.cdc.noaa.gov/PublicData/data_faq.html. However, as of the printing of this teacher guide, the simplest way we have found to locate regional climate data for locations within the North America, Europe, and major cities around the world is by visiting www.weather.com. At the main page, type your city name to get local weather, and then click "Averages" at the bottom of the page. Print the graph of monthly averages to show to the class when introducing Part 2 of this lesson. Then choose "Daily Averages" from the pull down menu at the top and select the month in which you are doing the activity. Use the average high, average low, and mean temperature values when plotting climate data in Part 2 of this lesson.

Directions

Part 1: Collecting Temperature Data

- Explain to students that they will collect temperature data to see how the temperature varies from day to day.
- Ask students to brainstorm what other aspects or characteristics of the weather might influence temperature (such as cloudiness, precipitation, and wind). Students will collect data about these factors too.
- Introduce students to the thermometer. Explain that each day a different pair of students will take the temperature measurement, and that because different people will be collecting data, it is important to collect the data the same way each time to be consistent. As a group, determine the procedure that students will follow each day to take measurements. (Observations should include the time of day and location. Care should be taken to ensure that body or building heat doesn't influence temperature measurements. Other considerations might include distance off the ground, number of measurements, length of time outside before measuring, etc.). Post these methods in a prominent classroom location.
- Record data for three days on the Weather Data Student Page to acclimate students to the observation methods. Once students appear comfortable with the data collection process, you may wish to have student pairs collect and share the data daily with the class.
- Have students create a graph of their weather data, adding to it each day (Y/vertical axis=temperature, X/horizontal axis=time/days). Help students to choose an appropriate range of values for their temperature axis based on their measurements. Graphing data helps students to identify patterns and relationships.
- If data is collected over several weeks, ask students to identify any patterns they see between the temperature data and the other weather elements measured (cloudiness, wind, precipitation).

Part 2: Comparing Student Data to Climate Data

- In a class discussion, ask the students if they think that their data is "typical" or representative of the weather for the period of time they have been monitoring. (The goal is for students to begin to understand that daily variations in weather are normal. Climate data, which describes "typical" weather, includes averages

of decades of daily data.

- Show students the graph of average daily temperature over a year for your region. (See Advanced Preparation section above for help finding a graph.) Ask students what conclusions they can draw about climate from the graph. (Temperature is colder in winter, or warmer in summer, average temperatures and the amount of searsonal variation). Explain that this graph might help someone who is visiting the region to plan what sort of clothes to bring with them. For instance, if they are visiting in July, what should they bring? Would it help them to plan for tomorrow specifically?
- Compare the data from the climate graph to student weather data for the same time of year. To do this, students should plot climate temperature data points on their graphs with a different color and connect points with a line. If possible, have students also plot average maximum temperature and average minimum temperature on their graph. (Consider having students plot the data on overhead transparency using the same scale axes as the Part 1 graph so that the two graphs can be easily overlayed.)
- Discuss the differences between weather and climate:
    - Which is more variable: the daily temperature values or the average temperature values? Why?
    - Is the temperature data that the class collected warmer, cooler, or about the same as the average?
    - If you were asked to predict the temperature for tomorrow, which data would you find the most useful: the previous day's temperature, or the average temperature for that day?
    - If a scientist reported that your state was warmer last month than the same month a year ago, would you consider this to be evidence for climate change? Why or why not? (See Background Information.)

Extensions

- Do this exercise in cooperation with another school in a different geographic location comparing weather data.
- Set up a weather station at your school, collect data each day, and compare how aspects of the weather vary over the course of a school year.
- Participate in the GLOBE Program (www.globe.gov) in which students at schools around the world collect and share data about the environment.

ASSESSMENT

- Create your own simulated weather datasets. Ask students to examine the datasets and discuss: Which line on the graph is more variable: the daily values or the average values? Why?

Science Background Information

- When atmospheric scientists describe the "weather" at a particular time and place or the "climate" of a particular region, they describe the same characteristics: air temperature, type and amount of cloudiness, type and amount of precipitation, air pressure, and wind speed and direction. Why are the same characteristics used to describe both weather and climate? And why do we eagerly listen to the local weather forecaster but pay far less attention to predictions from the state climatologist?

    - **Weather** is the current atmospheric conditions, including temperature, rainfall, wind, and humidity at any given place. Weather is what is happening right now or likely to happen tomorrow or in the very near future.

Differences between Climate and Weather

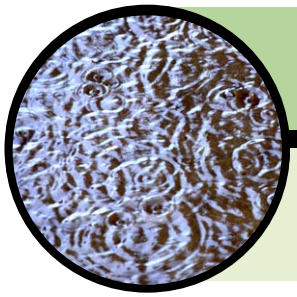
- **Climate** is sometimes referred to as "average" weather for a given area. The National Weather Service uses values such as temperature highs and lows and precipitation measures for the past thirty years to compile "average" weather for any given area. However, some atmospheric scientists consider "average" weather to be an inadequate definition. To more accurately portray the climatic character of an area, variations, patterns, and extremes must also be included. Thus, climate is the sum of all statistical weather information that helps describe a place or region.

Example of a climate temperature graph for Denver, CO showing change in average low and high temperature for each month (from weather.com)

- In the winter, we expect it to often be rainy in Portland, Oregon, sunny and mild in Phoenix, Arizona, and very cold and snowy in Buffalo, New York. But it would not be particularly startling to hear of an occasional January day with mild temperatures in Buffalo, rain in Phoenix, or snow in Portland. Meteorologists often point out that "climate is what you expect and weather is what you get." Or, as one middle school student put it, "Climate helps you decide what clothes to buy, weather helps you decide what clothes to wear."
- Scientists rely on large amounts of data over long timeframes to establish if the current weather patterns are usual. As weather measurements have only been made for 100-200 years, scientists look to records preserved in ice cores, tree rings, and sediment layers to identify how climate has varied in the past.
- Worldwide averages are used to describe global climate. Global climate is not easy to change. Regional averages may vary a bit, without causing a change in global climate. For instance, if the climate of Tunisia becomes warmer, and the climate of Mexico becomes cooler, the global average may not change. However, if regions warm more and are not balanced by other areas that cool, then global climate warms, as is the case over the past century.
- To investigate how climate may be changing due to human influences, scientists use weather data from as far back as the historical record goes (100-200 years). Detailed daily weather data are collected at surface weather stations throughout the world.
- Understanding and interpreting local weather data and understanding the relationship between weather and climate are important first steps to understanding larger-scale global climate changes.

Additional Resources

- Web Weather for Kids (http://www.ucar.edu/educ_outreach/webweather/)
- The Globe Program (http://www.globe.gov/)
- Project SkyMath (http://my.unidata.ucar.edu/content/staff/blynds/Skymath.html)
- National Weather Service (http://iwin.nws.noaa.gov/iwin/graphicsversion/main.html)
- United States Climate at a Glance (http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html)
- The Weather Channel (www.weather.com)



Differences between Climate and Weather

Name _____

Date _____ Class _____

WEATHER DATA

Date: _____ **Time:** _____ **Location:** _____

Data collected by (names): _____

The temperature is: _____ °C _____ °F

C= (**F**-32) / 1.8
F= (1.8 x **C**) +32

Other things we noticed about the weather that may affect temperature:

Cloudiness *(Circle one.)*

No clouds

Clear (clouds in less than 10%)

Isolated clouds (10-25% of sky covered)

Scattered clouds (25-50% of sky covered)

Broken clouds (50-90% of sky covered)

No blue sky showing (100% of sky covered)

Precipitation

- ☐ Heavy Rain
- ☐ Light Rain
- ☐ Light Snow falling
- ☐ Heavy Snow falling
- ☐ Hail
- ☐ Other _____

Wind

- ☐ Completely calm
- ☐ Light breeze (Wind felt on face. Leaves rustle.)
- ☐ Moderate breeze (Flags flap a little, Small branches and leaves move.)
- ☐ Strong breeze (Wind whistles, umbrellas turn inside out, bushes sway.)
- ☐ Gale (It's difficult to walk in the wind, tree twigs breaking)