Be a Weather and Climate Watcher

MRCC Midwestern Regional Climate Center

Sea Grant Illinois - Indiana

ILLINOIS STATE WATER SURVEY
PRAIRIE RESEARCH INSTITUTE

This education resource was developed through support from the Midwestern Regional Climate Center, Illinois-Indiana Sea Grant, and the Illinois State Water Survey.

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Be a Weather and Climate Watcher

Overview

This activity will inspire a student's interest in the day-to-day weather as well as climate by giving them the opportunity to measure and observe the weather on a daily basis. For older students, a comparison between current weather and climate normals will help them gain a more comprehensive understanding of how meteorologists and climatologists use climate to interpret current weather conditions.

Objectives

- Students will observe and describe weather.
- Students will present data about weather through graphs, discussions, and observation summaries.
- Students will compare the observed weather to climate normals (additional option).

Materials

- Weather station with thermometer and rain gauge
- Computer with Internet connection
- Weather Observation Table (provided)*
- Weather Graph (provided)*
- Information sheet (provided)
  Use this information sheet to introduce the activity to students: this sheet discusses background information on weather observations and the importance of weather observations.
- Student information sheet (provided)*
  This information sheet for students explains the difference between weather and climate and provides a glossary for terms used in the activity.

*These materials are provided as loose sheets in the packet so that copies can be made for students

Activity Instructions—Part 1

1. **Obtain your classes weather station** (see *Building your Own Weather Station* for how to do this)
2. **Determine the length of time for students to take daily weather observations.**

- Option 1: Two weeks
- Option 2: One month
- Option 3: Multiple months

  The best option is one month or longer. This allows students to observe monthly or seasonal trends in the weather and is the best approach best for comparing with climate normals.

3. **Determine the time(s) of day your students will take observations.**

- The time(s) of day you choose to observe should be consistent from day to day.
- If you choose a maximum/minimum digital thermometer to measure temperature: measure once a day
- If you choose a basic thermometer: measure twice a day (morning and afternoon)

4. **Assign students to take observations.**

   Rotate assignment either by day or by week.

5. **Have students use the *Weather Observation Table* to record their daily observations.**

   Use Web-based Resource #1 for days missed (see page 6).

6. **After your selected observation period is over, have students use the *Weather Graph* to plot the high temperature, low temperature, and precipitation.**

- For the temperature graphs, instruct them to use a line graph with markers on each day's value.
- For the precipitation graph, instruct them to use a bar graph.

7. **Have students write a summary of their observations and experience based on the following:**

- Describe the weather during the observation period.
- Calculate the average high and low temperature during the observation period.
- Calculate the range of temperature and precipitation during the observation period.
- Were there any major weather events during the observation period?
- Were any records broken during the observation period? (using Web-based Resource #2)
- What was the experience like taking weather observations?
- Why do you think it is important to take weather observations every day?
- Why do you think it is important to take observations at the same time each day?
- Did you learn anything you did not know before about weather by taking daily observations?

Activity Instructions—Part 2

More advanced – making comparisons to climate normals

8. **Obtain daily climate normals from Web-based Resource #2 (see page 6).**
9. **Have students plot the normals on the same *Weather Graph* they used to plot the current weather.**
10. **Have students write the same type of summary described in part 1 above, but also respond to the following questions** (Web-based Resource #3 on page 6 provides example summaries)**:**

- How do the high temperatures during your observation period compare to normal?
- How do the low temperatures during your observation period compare to normal?
- Did you receive more or less precipitation than normal during this observation period?
- Why do you think it is important to compare the current weather with climate normals?

Activity Follow-up

After students have written their weather and climate summary, below are some creative and fun ideas to expand upon the information that has been collected:

- Type the summaries and display them in your classroom or in the hallway for other students to see.
- Publish student summaries in your school's newsletter (print or electronic).
- If students enjoy observing the weather, start a mini-monthly newsletter or hallway display with a weather summary for the previous week and/or month.
- Have students summarize their findings by presenting them as if they were a television meteorologist (record each student if video access is available).

Building your Own Weather Station

Access to a real weather station is ideal for this activity, however not realistic for your classroom. Therefore, we have put together some ideas on how you can inexpensively build a weather station or purchase instruments at a reasonable price for your students to observe temperature and precipitation on a daily basis.

For this activity, you will need a thermometer to measure temperature and a rain gauge to measure precipitation. Check your school's science supplies to determine if rain gauges or thermometers are available. If you decide to only make or buy one instrument, you can use Web-based Resource #1 (see page 6) to obtain observations for the other variable (either temperature or precipitation).

Measuring Temperature

A thermometer that automatically records the maximum and minimum temperature is ideal so your students can take observations once a day and know what the highest and lowest temperature reading was for the 24-hour period (resetting the digital thermometer after each recording). Some digital thermometers have this option with an outdoor sensor, which can be ordered on sites such as Amazon.com (search maximum/minimum digital thermometer).

Another option is to mount a basic thermometer (not containing silver-colored mercury) outside and have students take temperature readings twice a day, once in the morning and once in the afternoon. Confirm your observations with a nearby station using Web-based Resource #1. Most likely students will not record the actual high and low temperature for that day. To buy a basic non-mercury thermometer, search outdoor thermometer on sites such as Amazon.com.

Measuring Precipitation

You can purchase a rain gauge, mount it outside, and have students take a precipitation observation at the same time once a day (emptying the rain gauge if needed after each recording). You can buy these on sites such as Amazon.com (search magnifying rain gauge).

Your students can also build their own rain gauge using the following link, which provides a printable handout with step-by step instructions to make your own rain gauge using a recycled 2-liter bottle, ruler, and a couple other items:
http://mrcc.isws.illinois.edu/resources_links/links_k12_howtoguides.htm

Observing Snowfall

Observing in the winter is a little more difficult since snow may play a role as well. Snowfall is reported in three ways: as amount of new snow, snow depth, and as precipitation (the amount of water snow produces when melted). Some options for dealing with snow include the following:

1. Do this activity in non-snow months.
2. Obtain and confirm snow observations from Web-based Resource #1.
3. When snow occurs:

- Follow the instructions at the provided link on how to measure the amount of new snow and snow depth: http://mrcc.isws.illinois.edu/resources_links/downloads/howto_precip_instruments.pdf
- Reporting the amount of precipitation associated with snow is somewhat difficult (i.e. the amount of water snow produces when melted). Therefore, it would be best to get this observation from Web-based Resource #1.

Ideal Conditions for your Weather Station

The ideal location for your instruments is a place where they cannot be tampered with such as a locked fence or on the outskirts of school property. The following guidelines should also be followed when possible:

- The ideal location for your thermometer would be somewhere out of direct sunlight and a few feet off the ground.
- Find a location for your rain gauge where there is nothing overhead (such as trees or a building roof) that could direct water into or away from your gauge. The edge of a fence away from buildings is often a good location.

Alternative: Can't create a weather station?

Use the National Weather Service's Daily Climate Report (Web-based Resource #1) to look at weather data for the preceding month. Use this data for your weather observations, then complete the rest of the activity as described.

Web-based Resources

1. **Daily weather observations**

   If your class misses a day of observations (such as during the weekend) or you need to get the official reading for your data, use the National Weather Service's Daily Climate Report for the station closest to your school (generally available the following morning). Website: http://www.nws.noaa.gov/climate/

2. **Daily climate normals**

   Use the Midwestern Regional Climate Calendars to obtain daily climate normals for high temperature, low temperature, and precipitation at the station closest to you. The calendar also provides the records for each day, so your students can determine if any records were broken during their observation time.
   Website: http://mrcc.isws.illinois.edu/INTERACT/mwclimate_data_calendars_1.jsp

3. **Climate summary examples**

   As your students begin to write their weather and climate summary for part 2 of the activity, it may be helpful to have some examples on how climatologists compare current weather to the long-term normal. The Midwest Climate Watch produces a weekly summary that has a similar format. Website: http://mcc.sws.uiuc.edu/cliwatch/1202/week2.htm

Learning Assessment

For purposes of reflection, it is critical to question students about why they are collecting the data and what they are observing during data collection during the exercise. If they are conducting data for a month, you may need to remind students of the goals of the exercise throughout the activity.

Activity – Part 1 Assessment

- Did the student accurately describe the weather during the observation period?

  e.g., "The week started out really hot, but by the end of the week, temperatures were much cooler."
- Did the student calculate the average temperatures and range of temperature and precipitation?
- Did the student mention major weather events that occurred during the observation period and connect it to their observations?

  e.g., "A large thunderstorm moved through overnight on the 11th, producing 1 inch of rainfall."
- Did the student provide their thoughts on why it is important to take weather observations every day and at the same time each day?
- Was the student effective at communicating the weather?

  In other words, would someone not living in your location be able to imagine what it was like living there during that period in terms of weather?

Activity – Part 2 Assessment

- Did the student discuss how the high and low temperatures compared to normal during the observation period?

  e.g., "High temperatures were above normal every day of the month except for two."
- Did the student discuss how precipitation compared to normal during the observation period?

  e.g., "There was only 0.5 inches of precipitation during the month of August, which is 3.5 inches below normal."
- Did the student provide their thoughts on why it is important to compare the current weather to climate normals?
- Does it seem as though the student comprehends the difference between weather and climate?
- Was the student effective at communicating how the current weather compared to normal?

Extension

1. Invite a meteorologist to describe the profession and what he or she does on a daily basis. Have your students do research on this profession and prepare questions prior to the visit.
2. Arrange a classroom visit to your closest cooperative weather station to look at weather instruments up close and for students to learn how weather observers record observations for the National Climatic Data Center. Contact your State Climatologist to find the closest cooperative station (www.stateclimate.org).

Be a Weather and Climate Watcher

Information Sheet

Weather versus climate

Weather refers to the day-to-day changes in the atmosphere. Every day, weather is described using variables like temperature, precipitation, dew point, wind speed, wind direction, pressure, and cloud cover.

*Statement about **weather**: "The high temperature on Monday was 72° F."*

Climate, on the other hand, is the average weather conditions of a specific location over many years. The type, frequency, and magnitude of extreme events (like flooding, heat waves, drought, cold waves, and blizzards) also describe the climate of a location.

*Statement about **climate**: "The average high temperature in July is 89° F."*

What is a weather station?

A weather station houses the instruments that measure atmospheric variables like temperature, humidity, precipitation, pressure, and wind. These instruments include the maximum and minimum thermometers, psychrometer, rain gauge, barometer, and anemometer. The picture on the right shows a typical cooperative weather station. A "cooperative weather station" is an official weather station with the National Weather Service.

Credit: Jim Angel

Credit: Jim Angel

Weather stations should be in a place where the instruments cannot be tampered with, like a locked fence. The ideal location for instruments like the thermometer, barometer, and psychrometer is somewhere out of direct sunlight and a few feet off of the ground (cooperative weather stations house these instruments in a covered white shelter like the picture to the left). Rain gauges should be located where there is nothing overhead, like trees or a building roof, that could direct precipitation away from your gauge.

Background on weather observations

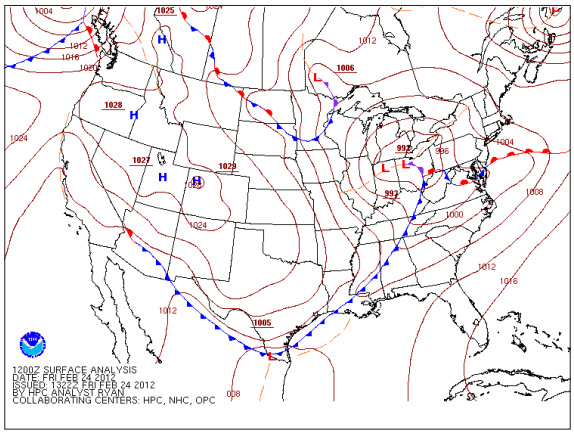
Historical weather observations, called climate data, go back to the early 1800's in the United States. The first weather observers were part of the Army's Signal Service Corps. Since the late 1800's, a network of over 10,000 cooperative weather stations has been established across the country as part of the National Weather Service. In addition to cooperative weather stations, modern weather observations are also routinely taken at airports (provide hourly weather observations), at mesonet stations throughout the country, and through other volunteer networks across the United States, like CoCoRaHS (Community Collaborative Rain, Hail, and Snow Network).

Credit: NOAA

Importance of weather observations

How did scientists discover that weather systems move from west to east in the United States?

By taking daily weather observations and distributing these observations using a daily telegraphic weather report, meteorologists in the 1800's discovered that weather systems move from west to east across the United States. Using current and historical weather observations, scientists have answered this question and many more about our atmosphere. With climate data dating back to the early 1800's, modern-day scientists have an extensive record of weather observations, which is useful for many reasons, including studying climate change. In addition, the weather observations taken today are adding even more information to the extensive climate database.



Credit: NOAA

How do meteorologists forecast the weather for tomorrow?

Every day, weather observations are used to get a snapshot of our atmosphere. Meteorologists and computer models then use this data to forecast the weather for the coming days. Atmospheric scientists use weather observations and climate data to improve forecasting and advance the field of atmospheric science.

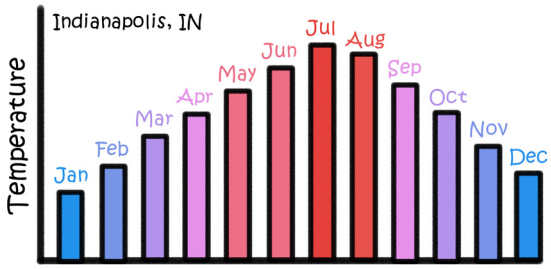
Climate normals

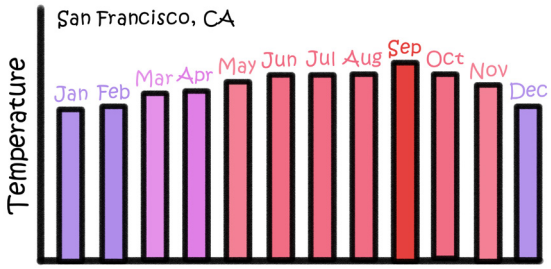
Climatologists also use weather observations to classify the climate of a location. Classifying the climate of a location involves identifying the *climate normals*, or 30-year averages, for variables like temperature, precipitation, and snowfall. Climate normals help us answer questions like:

- What is the average high temperature here in July?
- Does it usually snow here in the winter?
- Which month does your city receive the most precipitation?

"Weather is to climate as a page is to a book. A few days of weather does not give the entire story of climate, just like a single page does not tell the entire story of a book."

Therefore, to get the entire story of a location's climate, climate normals need to be calculated using several years of weather observations.





Glossary

Thermometer: an instrument that measures temperature

Psychrometer: an instrument that measures relative humidity

Rain gauge: an instrument that measures the amount of precipitation (in liquid form)

Barometer: an instrument that measures atmospheric pressure

Anemometer: an instrument that measures wind speed

Climate data: historical weather observations

National Weather Service: a NOAA agency providing weather forecasts and warnings for the United States

Climate normal: a 30-year average of a climate element such as temperature

Weather Observation Table for _____ **(month)** **Time of Observations** _____

Date	Maximum Temperature (° F)	Minimum Temperature (° F)	Precipitation (inches)	Snowfall (inches)	Notes on weather over the past 24-hours (Records broken? Large storm?)

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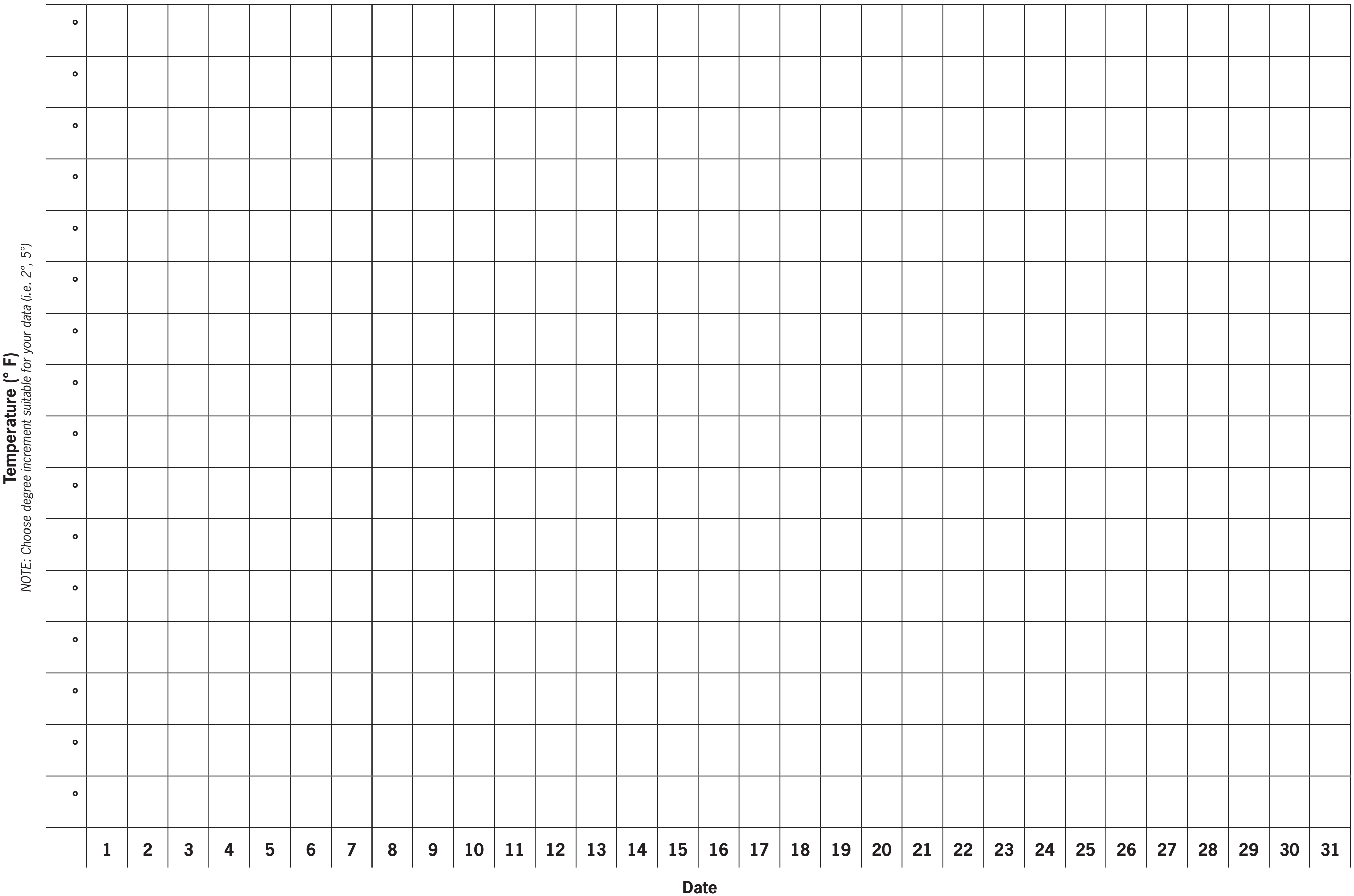
Daily Weather Observations of High Temperature for ____________________ (month) **Name ____________________**



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Daily Weather Observations of Low Temperature for ______________________ (month) **Name ________________________**

Temperature (° F)

NOTE: Choose degree increment suitable for your data (i.e. 2°, 5°)

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Date

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Daily Weather Observations of Precipitation for ______________________ (month) Name ________________________

Precipitation (inches)

NOTE: Choose inch increment suitable for your data (i.e. 0.2", 0.5")

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Date

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Be a Weather and Climate Watcher

Student Information

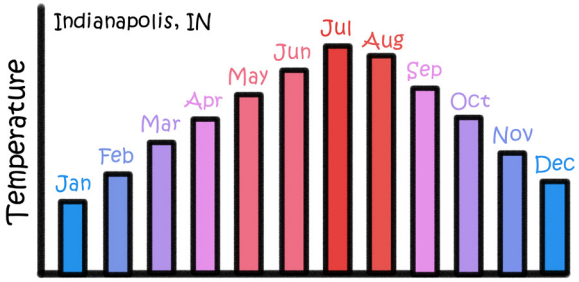
What is Weather?

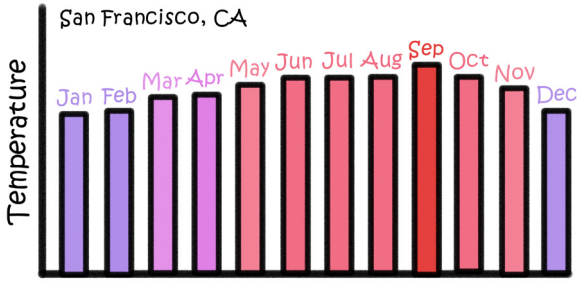
Weather is what's currently going on in our atmosphere. Weather is the temperature outside, the precipitation falling from the sky, the winds blowing all around, and the clouds above us!

In the "Be a Weather and Climate Watcher" activity, you will be observing the weather outside on a daily basis. You will measure temperature and precipitation.

What is Climate?

Climate is the typical weather in a place over many years. The climate is different in different places on Earth!





Weather and Climate Analogy

Weather is to climate as a page is to a book. A few days of weather does not give the entire story of climate, just as a single page does not tell the entire story of a book.

"Be a Weather and Climate Watcher" Glossary

Meteorologist: someone who studies the weather

Climatologist: someone who studies the climate

Weather station: houses instruments that measure the weather outside

Temperature: a measure of how warm or cold it is outside

Thermometer: an instrument used to measure temperature

Precipitation: water particles falling from the atmosphere, including rain, snow, sleet, freezing rain, and hail

Rain gauge: measures the amount of precipitation (in liquid form)

Amount of new snow: how much snow falls in a 24-hour observation period

Snow depth: the measure of total snow on the ground (old and new)

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