# Earth's Climate Lab

**Objective**: To learn how the climates of various places are controlled by large scale weather patterns.

**Background**: The Earth's climate is generally defined as the average weather over a long period of time. A place or region's climate is determined by both natural and anthropogenic (human-made) factors. The natural elements include the atmosphere; geosphere; hydrosphere and biosphere; whilst the human factors can include land and resource uses. Changes in any of these factors can cause local, regional, or even global changes in the climate. Remember that weather is current atmospheric conditions, including temperature; rainfall; wind and humidity at a given place. If you stand outside, you can see that it's raining or windy, or sunny or cloudy. You can tell how hot it is by taking a temperature reading. Weather is what's happening right now or what is likely to happen tomorrow or in the very near future.

Climate, on the other hand, is the general weather conditions over a long period of time. For example, on any given day in January, we expect it to be rainy in Portland, Oregon and sunny and mild in Phoenix, Arizona; in Buffalo, New York, we're not surprised to see January newscasts about sub-zero temperatures and huge snow drifts. Some meteorologists say that "climate is what you expect and weather is what you get." In other words, "climate tells you what clothes to buy, but weather tells you what clothes to wear."

Climate is sometimes referred to as "average" weather for a given area. The National Weather Service uses data such as temperature highs and lows and precipitation rates for past years to compile an area's "average" weather. However, some atmospheric scientists think that you need more than "average" weather to accurately portray an area's climatic character - 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. The term also applies to large-scale weather patterns in time or space such as an 'Ice Age' climate or a 'tropical' climate.

Although an area's climate is always changing, the changes do not usually occur on a time scale that's immediately obvious to us. While we know how the weather changes from day to day, subtle climate changes are not as readily detectable. Weather patterns and climate types take similar elements into account, the most important of which are:

- temperature of the air
- humidity of the air
- type and amount of cloudiness
- type and amount of precipitation
- air pressure
- wind speed and direction

Although weather and climate are different, they are very much interrelated. A change in one weather element often produces changes in the others - and in the region's climate. For example, if the average temperature over a region increases significantly, it can affect the amount of cloudiness as well as the type and amount of precipitation that occurs. If these changes occur over long periods of time, the average climate values for these elements will also be affected.

## Paleoclimates (Ancient Climates)

Good weather records extend back only about 150 years. In that time, the Earth's global average temperature has increased by approximately 0.5° C or about 1° F. Scientists have studied the

Earth's past climate extending back millions of years. To examine these long time scales, known as geologic time, scientists have had to gather clues from geologic and plant fossil records.

Evidence in the fossil record indicates that the Earth's climate in the distant past was very different from todays. However, the climate has fluctuated substantially within the last several centuries - too recent to be reflected in the fossil record. Studying past climates and climate changes helps us to better understand our current climate and what may happen in the future.

The Earth's atmosphere has evolved over the course of its long history (approximately 4.5 billion years) resulting in significant changes to global, regional and local climates. Some of the fossil record suggests that these changes are somewhat cyclical, with periods of global warming followed by ice ages. The most recent global ice age ended about 18,000 years ago with a gradual warming since then despite some intermediate periods of cooling.

Several techniques are used for measuring past climates, including

- examining fossil and pollen records
- extracting deep ice cores from glaciers and the polar ice caps
- examining growth rings on tress

All of these methods provide clues to past temperature, precipitation and wind patterns as well as the chemical make-up of the atmosphere. Studying how the atmosphere has changed over the history of the Earth helps scientists understand how our current climate may change as human activity continues to alter the concentration of some key atmospheric gases. For example: the addition of $CO^2$ increases the atmosphere's ability to trap heat. By studying past atmospheric $CO^2$ concentrations and correlating it to past climate regimes, we get an idea of what types of changes to expect as a result of increasing $CO^2$ concentrations. Finally, remember that the Earth's climate has always changed and always will.

**Materials**:

- graph paper
- pencil
- paper

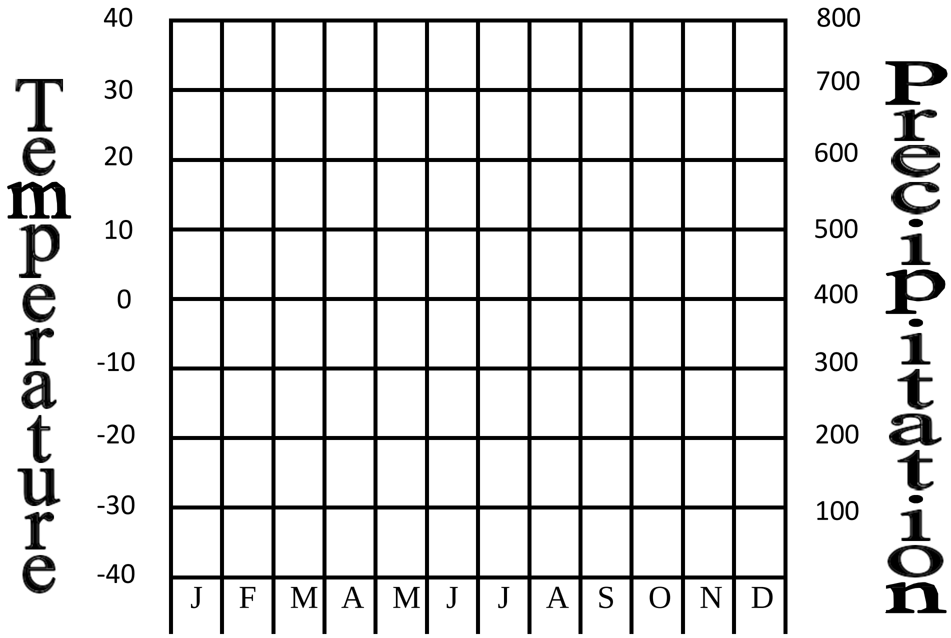
**Procedure**:

1. Using the graph layout on the next page, plot the data for the following six (6) weather stations.
2. Place temperature and precipitation values “on the line” rather than “in” the boxes.
3. Use your plotted graphs to answer the analysis questions.

**Note**: you are plotting both temperature and precipitation along the Y-Axis with the months along the along the X-Axis. You may find it easier to make the temperature plot a “line graph” and the precipitation graph a “bar graph.” This will assist in viewing the plotted data.

******When doing the lab report write-up, be sure to follow the guidelines.******

Name of Weather Station




**Data**:

| Temperature and Precipitation Data for Selected Weather Stations | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weather Station | | Month | | | | | | | | | | | |
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| Acapulco, Mexico | Temperture (°C) | 25 | 26 | 27 | 28 | 28 | 28 | 30 | 28 | 28 | 27 | 27 | 26 |
| | Precipitation (mm) | 10 | 0 | 0 | 0 | 30 | 430 | 220 | 250 | 360 | 170 | 30 | 10 |
| Churchill, Manitoba | Temperture (°C) | -28 | -27 | -21 | -10 | -1 | 6 | 12 | 11 | 6 | -3 | -14 | -24 |
| | Precipitation (mm) | 10 | 20 | 20 | 30 | 20 | 50 | 60 | 70 | 50 | 40 | 30 | 20 |
| Andagoya, Colombia | Temperture (°C) | 24 | 25 | 25 | 26 | 24 | 25 | 25 | 26 | 26 | 24 | 25 | 26 |
| | Precipitation (mm) | 640 | 550 | 490 | 650 | 640 | 650 | 590 | 650 | 625 | 590 | 590 | 500 |
| Yuma, Arizona | Temperture (°C) | 10 | 13 | 18 | 20 | 22 | 30 | 33 | 31 | 30 | 25 | 20 | 11 |
| | Precipitation (mm) | 25 | 30 | 25 | 10 | 30 | 30 | 50 | 50 | 30 | 20 | 10 | 10 |
| Omaha, Nebraska | Temperture (°C) | -8 | -5 | 0 | 10 | 12 | 20 | 23 | 22 | 20 | 15 | 10 | 0 |
| | Precipitation (mm) | 25 | 25 | 40 | 50 | 90 | 110 | 100 | 90 | 100 | 50 | 25 | 25 |
| Isachsen, Canada | Temperture (°C) | -40 | -40 | -35 | -28 | -12 | -2 | 2 | 1 | 8 | -20 | -30 | -34 |
| | Precipitation (mm) | 0 | 0 | 0 | 0 | 0 | 15 | 25 | 20 | 10 | 0 | 0 | 0 |

**Analysis Questions**:

1. Which of the six (6) stations has the most precipitation? Which has the least?
2. Which station has the hottest July temperature? Why is it not the station closest to the equator?
3. Which stations are most influenced by high pressure? How does this show in their plotted data?
4. Which station has weather most like that of New York City?