How Can We Observe, Represent, Analyze, and Compare Climate Patterns?

Introduction
Most people want to know only, “Hot? Cold? Wet? Dry?” So patterns of temperature and precipitation often provide the best ‘snapshot’ of an area’s climate. Monthly averages contain a 30-year record. This is long enough to provide expected patterns, even if there are years when unusual events occurred.

In Part 1 of this activity, you’ll use data found online to create graphs that will allow you to describe the climate of your chosen locations. You’ll look at data for average (mean) monthly temperatures, average maximum monthly temperatures, and average minimum monthly temperatures. Since temperature forms a continue pattern, you’ll show these using line graphs.

You’ll also represent average monthly precipitation. Unlike temperature, precipitation (rainfall) is not continuous, so you’ll use bar graphs to show these records.

In addition to tables and graphs, climate can be shown in color-coded maps. In part 2, you’ll example and interpret some of these.

Climate scientists often use anomalies to highlight patterns. An anomaly means how much some value is above or below the expected value. In part 3, you’ll learn much more about the benefit of studying anomalies for understanding climate.

Part 1: Temperature and Precipitation (Rainfall) Patterns
There are many online resources you can use to find climate data. Here are two starting links:

NOAA National Climatic Data Center (NCDC) US Climate Normals: http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl?directive=prod_select2&prodtype=CLIM20&subrnum=

NYS Climate Data: http://www.usclimatedata.com/climate/new-york/united-states/3202

1) Select one of these and follow the links to obtain average (mean), maximum, and minimum temperature data for a city of your choice: ________________________________.

2) A. Open an Excel spreadsheet and create one set of columns for “Month,” “Average High °F,” and “Average Low °F.” Below that, create a second set with “Month” and “Avg. precip. In.”

B. Input the data for average monthly temperatures and plot these as line graphs.
   Explain why these should be line graphs:

C. Input and plot the monthly precipitation data as a bar graph.
   Explain why these data should be shown as a bar graph:

3) Now select another location of special interest to you. You can use the links below to find climate data for locations in the US and around the world.
   Location: __________________________________________________________________

   http://www.usclimatedata.com/climate/united-states/us

   http://www.worldweatheronline.com/

   Make similar line and bar charts for these data.

Do you need to convert?
   Temperatures provided in deg C → need to be converted into deg F for chart
   Precipitation provided in mm → need to convert 25 mm = 1 in. for chart
WRITE A 2-3 PARAGRAPH COMPARISON OF THE CLIMATE IN THESE LOCATIONS. TRY TO PROVIDE A BRIEF EXPLANATION OF WHAT CAUSES THE DIFFERENCES.
REMINDER: ALWAYS WRITE YOUR IDEAS IN COMPLETE SENTENCES AND PARAGRAPHS
Part 2: Color-Coded Climate Data

Most people are ‘visual,’ so color-coded maps effectively show climate patterns.

4. Become familiar with these, examine some of the images available at http://www.ncdc.noaa.gov/cag/mapping

Use the selection boxes to open and examine various maps. Describe at least five examples of what you view and what you have learned from this format.

5. Next, go to http://www.ospo.noaa.gov/Products/ocean/sst/contour/

The images show the sea surface temperatures over various time periods. Global and local weather are strongly influenced by heat patterns in the oceans, which cover about ¾ of our Planet. These data are measured using sensitive instruments aboard environmental satellites.

Write 2 – 3 paragraphs describing the patterns you observe. Compare latitude patterns from the equator to the poles in each hemisphere. Also, identify regions where seawaters are warmest.
Part 3 Using Anomalies to Understand Patterns

6. “**Anomalies**” means variations from the expected. Scientists often use anomaly maps to learn more about processes. For example, it means one thing of a temperature measurement is 20 °C, but much more if this is 2 °C above normal or 3 °C below normal.

Here is a link to an animation that shows sea surface temperature anomalies over the past few months: [http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/anim.html](http://www.ospo.noaa.gov/Products/ocean/sst/anomaly/anim.html). You can see where the ocean is unusually warm or cold. Since the ocean is *coupled* with the atmospheric circulation, these patterns play a major role in create weather and climate worldwide.

Explore some of the other resources available through this website.

One area to pay special attention to is the west coast of South America. Normally, waters are cool, but over the time period shown, you may see that the area closest to the coast of Chile becomes unusually warmer or cooler. A warmer-than-normal event is called an **El Nino**, and a cooler-than-normal event is a La Nina. Both can produce unusual weather and climate patterns across the globe that you will study in another activity.

Discuss what you have learned with these. (At least 2 -3 paragraphs.)
7. The TRMM (Tropical Rainfall Measuring Mission) satellite monitors precipitation and other variables, primarily between 35°N and 35°S. Go to http://trmm.gsfc.nasa.gov/affinity/affinity_3hrly_rain.html and study the images. Then click on the animations and study them.

Now look at the monthly data and anomaly images at https://trmm.gsfc.nasa.gov/trmm_rain/Events/thirty_day.html.

Explore some of the other types of information and imagery available through the TRMM website https://trmm.gsfc.nasa.gov/overview_dir/background.html.

**Summary**

Explain at least three advantages and three disadvantages of “current data,” “anomalies,” and “animations” for understanding current and past climate patterns.
Enrichment and Extension Activities:

Attach your responses on additional sheets to these cover sheet.

1) Go to: http://sealevel.jpl.nasa.gov/science/elnino/pdo/learnmoreninonina/
   This site provides more information about El Nino and La Nina observations made by NASA satellites.
   Read about and describe some of the concepts you have learned.

2) Sustainable water resources are among the major problems facing the world in this century.
   Drought (unusually high dryness in a region) is another climate variable that can best be shown using color-coded maps.
   Go to http://droughtmonitor.unl.edu/. Explore the website.
   Also explore the resources at: http://www.climate.gov/news-features/decision-makers-toolbox/monitoring-drought.
   Then write 2-3 paragraphs about what you have learned.

3) The American Meteorological Society provides a teacher enhancement course, DataStreme Earth’s Climate System.
   Explore some of the resources on the home page, http://www.ametsoc.org/amsedu/ecs/home.html, and describe what you learn.

4) Identify other suitable resources to understand climate patterns, and present a report about them to your teacher and class.