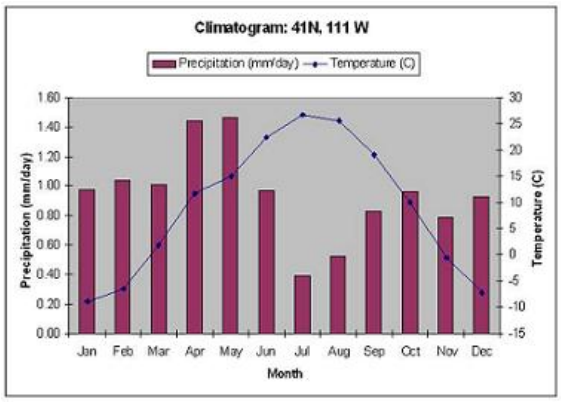
MY NASA DATA Lesson:

See notes at the end of the lesson for data updates with the new Earth System Data Explorer

Investigating Factors that Influence Climate



Purpose:
To employ inquiry methods to investigate how latitude and longitude (and distance from oceans) impact climatic factors such as temperature range, average temperature, and precipitation.

Grade Level: 9 – 12

Estimated Time for Completing Activity:
6-10 days based on a 50 minute period

Prerequisite

- An Introduction to the Live Access Server
- Familiarity with Excel or other spreadsheet program

Tools

- Computers with Internet access
- Excel or other spreadsheet software
- Map or Atlas

AP Environmental Science Topics

- Climate shifts
- Latitude
- Major terrestrial and aquatic biomes

Vocabulary:

- Celsius

- climate
- climatic diagram
- dependent variable
- GPCP
- independent variable
- ISCCP
- Kelvin
- precipitation
- solar radiation
- temperature
- weather

Lesson Links:

- Live Access Server Introduction
- MY NASA DATA Glossary
- Live Access Server (Earth System Data Explorer)
- Using Excel to Construct Climatograms
- Importing Data into Excel
- Sample Climatogram

Background:

There are several factors that influence the climate or prevailing weather conditions for any given location on Earth. The most important factor is the latitude of the location because that affects the amount of solar radiation received throughout the year. For example, at the Equator, the amount of solar radiation is fairly constant year-round, but as you head toward the poles, the amount of solar radiation varies by season. Other factors include its distance from a body of water (its moisture source), elevation and local topography.

In this unit plan, you will create climatic diagrams called climatograms that allow you to display monthly average weather conditions such as temperature and precipitation at a particular location. You will then use the data to design an investigation about the factors that influence climate.

Procedure:

Day 1 – Background Introduction

1. Use the MND glossary, an Earth Science textbook or library resources to answer the following questions. Record your responses as a Lab Report introduction or background.
a. What is the difference between climate and weather?
b. Describe what an average temperature, temperature range and precipitation are.
c. List at least three possible forms of precipitation.
d. Sketch an example of a climatogram
e. What information can be found on a climatogram?
f. What information cannot be found on a climatogram?
g. What variables are plotted on each axis of a climatogram? (remember the units)
h. Why are there two y (vertical) axes in a climatogram?
i. What information do you need in order to make your own climatogram?
j. Use words to describe the climate illustrated by your climatogram.

2. Discuss answers with a partner or study group or discuss them as a class.

Day 2 – Download MND microsets and perform calculations

1. Choose (or be assigned) a location (latitude and longitude) to research. For the purpose of this investigation, the locations should be evenly distributed from the entire continent along lines of latitude and longitude.
a. To determine an even distribution, use a large map of North America. (An overhead transparency or a plain labeled grid could substitute for the map.)
b. Using a black marker, draw 10 degree by 10-degree grids on the map (130W to 70W and 30N to 60N). This will give you 30 data points.
c. Assign one data point per student. This can be done by assigning each student a specific latitude and longitude, or by allowing students to choose their own point using a post-it adhered to the map. If there are more than 24 students, then additional points can be added to the grid.

2. Download MND microsets for your assigned location. You should finish with two files of data (one of precipitation and one of temperature).
a. Open the Earth System Data Explorer version of the Live Access Server (LAS) from the lesson links above.
b. Click the Atmosphere Investigation Protocols link, click Precipitation, then Monthly Precipitation (GPCP) for the first data microset.
c. Make sure the following selections are set to the left of the color plot.
Maps: Latitude Longitude
Line Plots: Time Series
Type in the specific latitude and longitude in the compass to the right of the map.
Select time range 15 Jan 1994 through 15 Jan 2005
All of the other values should remain on default

d. click on update plot at the top.
e. At the top of the plot click on the save as option, change Select Format to ASCII, make sure you are ok with the date range and click ok.
f. You will then have a new window appear. Make sure to go in to your browsers file menu and select Save as from the menu options to save the text file to import into Excel at a later time.
g. When data opens in a new window, save your data as a text file to the desktop for ease of use.
h. Repeat for the second data set. Click the Atmosphere Investigation Protocols link, click Surface Temperature, then the Monthly Surface Clear-Sky Temperature (ISCCP) for the second data set. Save as a text file just as you did in the steps above (e-f).

3. Import the MND microsets in Excel (see lesson link). Note: If Excel is not available or for additional math practice, students can print data instead and then perform average and conversion calculations using pencil and paper or a calculator.
a. The data should appear in 3 columns. The time (first column) and parameter value (third column) are what you will be using to construct a climatogram.
b. Calculate an average for each month for the entire data spread. Note: It may be easier to calculate and convert if you first line up each year's data side by side instead of in one long column.
c. Record averages in a new column. Repeat this process for each data file.
d. Temperature data may be converted from Kelvin to degrees Celsius or Fahrenheit, and precipitation data may be converted from mm per day to cm per month.

Day 3 – Construct a Climatogram

1. After you have completed your calculations, you are ready to construct the climatogram using the standard climatogram axes (see Sample Climatogram in lesson links).
a. Open the Lesson Link on Using Excel to Construct Climatograms.
b. Alternative: Hand graph on graph paper or a copy of a prepared and labeled graph.
c. Do not forget to label the title, axes and units!

2. Summarize your data using words and numbers
a. Use the maximum temperature and the minimum temperature to calculate the temperature range. Record on your climatogram.
b. Calculate the average temperature for your climatogram. Record.
c. Calculate the average total yearly precipitation for your climatogram. Record.
d. Use words to describe the trends that you observe in your climatogram. Be sure to describe any seasonal differences and the months that they occur.

3. Post your climatogram with summary somewhere in the room. Note: It would be best to do this on a wall in the same configuration as the map.

Day 4 – Design an Investigation

1. Assemble into groups of 4.

2. Each group should plan an investigation using the climatogram data. This information may be recorded in a lab report or lab book.
a. Begin with an investigative question.
b. Predict a hypothesis with a reason.
c. Design procedures remembering to use logical, numbered steps, change only one variable and keep all other variables the same, use at least 3 trials. (The independent variable is limited to latitude or longitude, however, dependent variables could be maximum temperature, minimum temperature, total rainfall, average rainfall, temperature range, etc.)
d. Note: have each group sign up or pick variables so that the class as a whole has them all covered.
e. Note: collect and sign off on each group's plan before giving them data. In the real world research projects must be approved before NASA allows scientists to initiate an experiment.

Day 5 – Collect and Analyze Data

1. Data can be collected from the climatograms on the wall or copies of the climatograms from the wall.

2. Analyze the data by:
a. Graphing the dependent vs. independent variable on a graph (see glossary)
b. Drawing a trendline
c. Advanced students can calculate the slope of the trendline
d. Describing the trend of the graph

3. After analyzing your graph, prepare to share your findings with the rest of the class. This can be facilitated in a number of methods however, such as a poster presentation. Note: Each group could construct a poster to accurately and clearly communicate what they did and what their results were. A poster should contain:
a. Title and authors
b. Investigative question
c. Hypothesis
d. List of the data used (i.e. Climatograms for latitudes 30, 60, 70, and 80 N)
e. Colored and clearly labeled copy of their graph
f. Summary of the graphs trend.

Day 6 – Oral presentations

1. Present your findings orally to the class.

2. Write a paragraph conclusion or final summary for the activity.
a. What factors in this investigation influence climate and how is climate affected by

each?

3. Discuss each of the factors and lead into topics such as solar intensity, seasons, wind belts, elevation, topography and ocean currents which were not addressed by this investigation.

Questions:

1. Why did you have to download 11 years of data from the LAS? Wouldn't one year of data have worked just as well?

2. Are the averages that you calculated considered weather or climate data? Explain your answer.

3. Discuss the accuracy of your climatogram.

4. What are the strengths and weaknesses of using a climatogram to model climate?

Extensions:

1. Continue this activity by using the LAS to further research the factors that impact temperature or precipitation such as clouds, vegetation, ocean temperatures, solar radiation, etc.

2. Use the CERES climate types LAS parameter to look up the climate type for your climatogram.

3. Predict the type of flora and fauna for your climate type. Research to see if you were correct.

4. Use all of the climatograms for the class to map North Americas climate types. (Discuss resolution or pixels)

5. Pick a place in North America that you think has the best climate and write a paragraph to explain why.

Lesson plan contributed by Denise Thompson, Orting, Washington

Click here for Teachers Notes

View lesson without Standards

Teacher Feedback

Data Notes from Dr. Brad (12/2018):

Up-to-date precipitation data on the Earth System Data Explorer can be found at Hydrosphere->All Data->Precipitation->Monthly Precipitation. Temperature data can be found at Atmosphere->All Data->Temperatures->Monthly Surface Air Temperature.