Investigating Factors that Influence Climate

Adapted from: My NASA Data Lesson Plans
http://mynasadata.larc.nasa.gov/preview_lesson.php?&passid=76

Focus on Inquiry

The students will focus on inquiry by collecting and analyzing climatic data on a specific location, constructing and using graphs to analyze the data, and then communicating their observations and conclusions to the class.

Lesson Overview

Students investigate how latitude and longitude (and distance from the oceans) impact climatic factors such as temperature range, average temperature, and precipitation. Students use the Internet to collect data on a specific location, and construct climatograms using Microsoft Excel.

Duration	Setting	Grouping	PTI Inquiry Subskills
4 50-min class periods	Classroom or Computer lab	Groups of 4	3.1, 3.7, 3.8, 4.2, 4.3, 5.2, 5.6, 5.7, 7.2, 7.3

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	30 minutes			2	Students use resources to research and answer questions regarding climate, precipitation, and climatogram. Students discuss factors that influence climate.
Explore	2 class periods	3.1, 3.7, 3.8, 4.2	Computer / Internet	3	Students use Internet to collect temperature and precipitation data on a specific location and construct a climatogram using this data.
Explain	1 class period	4.2, 4.3, 5.2, 5.6, 7.2, 7.3	Computer / Internet	3	Students analyze data and answer questions regarding their findings and present their conclusions to the class.
Expand	30 minutes	5.7	Computer / Internet	2	Students discuss and investigate other factors that influence climate not covered in the experiment.
Evaluate					Students can be assessed by using the answers to the questions, the climatograms, and their oral presentations.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

National Science Education Standards – Inquiry

Use appropriate tools and techniques to gather, analyze and interpret data
Develop descriptions, explanations, predictions, and models using evidence
Think critically and logically to make the relationships between evidence and explanations
Communicate scientific procedures and explanations

National Science Education Standards – Earth Science

Global patterns of atmospheric movement influence local weather. Oceans have a major effect of climate, because water in the oceans holds a large amount of heat.

Louisiana Grade Level Expectations – Inquiry

Gr. 8, Inquiry GLE#7. Record observations using methods that complement investigations (e.g. journals, tables, charts) (SI-M-A3)

Gr. 8, Inquiry GLE#9. Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3) Gr. 8, Inquiry GLE#6. Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3) Gr. 8, Inquiry GLE#11. Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4) Gr. 8, Inquiry GLE#12. Use data and information gathered to develop an explanation of experimental results (SI-M-A4) Gr. 8, Inquiry GLE#13. Identify patterns in data to explain natural events (SI-M-A4) Gr. 8, Inquiry GLE#19. Communicate ideas in a variety of ways (e.g. symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) Gr. 8, Inquiry GLE#22. Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
Louisiana Grade Level Expectations Earth Science Gr. 8, GLE#24 – Investigate and explain how given factors affect the rate of water movement in the water cycle (e.g., climate, type of rock, ground cover) (ESS-M-A10)

Materials List (per group)

- Computers with Internet access
- Microsoft Excel or other spreadsheet software
- Map of North America or Atlas
- Printed copies of the document: Using Excel to Construct Climatograms

Advance Preparation

1. Gather materials necessary to complete lab. It may be helpful to run through the document (http://mynasadata.larc.nasa.gov/docs/climatograms-excel-instr.doc) and construct a climatogram so you are prepared to answer questions if students run into problems.
2. Before implementing the lesson with students, it is strongly recommended that you check to see that the browser being used is compatible with the Live Access Server, and that the pop- up blockers are turned off.

Other Information

Learning Objectives

- 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.

Prior Knowledge Needed by the Students

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

Procedure

Engage

Part 1 – Background Information

1. Provide the students with the My NASA Data glossary (http://mynasadata.larc.nasa.gov/glossary.php), an Earth Science textbook, or library resources to answer the nine questions contained in Part 1 of their **Blackline Master 1**.
2. Form groups of 4 and have students discuss their answers and then discuss the answers as a class.
3. Explain to the class that 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.
4. Explain the activity to the students: In this activity, 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.

Explore

Part 2 – Download My NASA Data microsets and perform calculations

1. Assign a location (latitude and longitude) to each group of students, or let them choose a location, but be sure that the locations are evenly distributed from the entire North American continent along lines of latitude and longitude.
2. 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.)
3. 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.
4. Assign one data point per group. 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.
5. Have students work through Part 2 on their **Blackline Master 1**. Make sure computers are connected to the NASA Live Access Server (http://mynasadata.larc.nasa.gov/las15/servlets/dataset) and that pop-up blockers are turned off. Note that the Excel directions may vary based on the version of Excel you have on your computer.

Part 3 – Construct a Climatogram

1. Have students work through Part 3 on their **Blackline Master 1**.
2. Hand out printed copies of the document: http://mynasadata.larc.nasa.gov/docs/climatograms-excel-instr.doc. *Note: These directions may vary based on the version of Excel you have.*

Explain

Part 4 – Questions and Oral Presentations

1. Have students present their findings orally to the class.
2. Ask each group or the class as a whole: What factors in this investigation influence climate and how is climate affected by each?
3. Discuss answers to questions and activity conclusions found under Part 4 of the **Blackline Master 1.**

Expand

1. As a class, discuss each of the factors that influence climate and lead into topics such as solar intensity, seasons, wind belts, elevation, topography and ocean currents which were not addressed by this investigation. How would these factors have altered the experiment? Would any of these factors cause you to revise your interpretation or conclusion?

Evaluate

1. Students can be assessed by using the answers to the questions on the Blackline Master 1, the resulting climatograms, and their oral presentations.

Blackline Masters

1. Identifying Factors that Influence Climate (pages 1-5)

Supplementary Resources

Credits

Lesson plan contributed by Denise Thompson, Orting, Washington

Investigating Factors that Influence Climate

Name: _____ Date: _____

Investigating Factors that Influence Climate

Procedure

Part 1 – Background Information

Using the resources provided to you, answer the following 9 questions:

1. What is the difference between climate and weather?
   _____
   _____
   _____
   _____
2. Describe what an average temperature, temperature range and precipitation are.
   _____
   _____
   _____
   _____
3. List at least three possible forms of precipitation.
   1. _____
   2. _____
   3. _____
4. Sketch an example of a climatogram.

5. What information can be found on a climatogram?
   _____
   _____
   _____
   _____
6. What information cannot be found on a climatogram?
   _____
   _____
   _____
   _____
7. What variables are plotted on each axis of a climatogram? (remember the units)
   _____
   _____
   _____
8. Why are there two y (vertical) axes in a climatogram?
   _____
   _____
   _____
   _____

9. What information do you need in order to make your own climatogram?

_____
_____
_____
_____

Part 2 – Download My NASA Data microsets and perform calculations

1. You should have been given or chosen a specific location (latitude and longitude) in North America. Record the latitude and longitude here:

   Latitude: _____ Longitude: _____

2. Your computer should be connected to the NASA Live Access Server (LAS): http://mynasadata.larc.nasa.gov/las15/servlets/dataset.
3. Click the Water link, and then check the box next to Monthly Precipitation (CMAP). Click Next.
4. Enter the following parameters:
   Select view: Time series (t)
   Select output: Table of Values (text)
   Select region: North America
5. Type in your specific latitude and longitude in the boxes to the right of the map.
6. Select time range Jan 1994 through Jan 2005. Click the Next link.
7. The data should be displayed in a new window. Save this data by printing it or clicking File → Save As. Enter "Your Location Name + Precipitation" (for example, "Southern California Precipitation") as your file name and save it to your desktop or another specified location. This will be your **Precipitation** dataset. Close this pop-up window only.
8. Go back to the main page: http://mynasadata.larc.nasa.gov/las15/servlets/dataset.
9. Click the Land link, and then check the box next to Monthly Surface Clear-Sky Temperature (ISCCP). Click Next.
10. Repeat steps 4-6, entering the same data as above.
11. The data should be displayed in a new window. Save this data by printing it or clicking File → Save As. Enter "Your Location Name + Temperature" (for example, "Southern California Temperature") as your file name and save it to your desktop or another specified location. This will be your **Temperature** dataset. Close this pop-up window only.
12. Open Microsoft Excel and import your two datasets. *Note: These directions may vary based on the version of Excel you have.*
    a. Go to the Data tab, and click the "From Text" option.
    b. For Files of Type, navigate to the Desktop or to the folder where you saved your data. Select All Files from the drop down list and find your **Precipitation** file. Click Import.
    c. For Start import at Row, enter 59. Click Next.
    d. Under Delimiters, make sure Space is selected. Click Next.
    e. Click Next. Click Finish.
    f. If Column A is full of blank data, highlight the column, right click, and click delete. Do the same for Column B (full of 0's) and Column C (full of backslashes). All you need is the time column (i.e. 1-Jan-94) and the Precipitation column (i.e. 1.34). All other columns can be deleted. So you should only have data in Columns A and B after formatting.
    g. Calculate a precipitation average for each month for the entire data spread. Note: It may be easier to calculate if you first line up each year's data side by side instead of in one long column. So you can rename Column A "January" through "December" and then copy each year's data next to it. In the last column, calculate the average.
    h. Now go to Sheet 2 of the worksheet.
    i. Repeat steps a and b except this type find your **Temperature** file.
    j. For Start import at Row, enter 57. Click Next.
    k. Under Delimiters, make sure Space is selected. Click Next.
    l. Click Next. Click Finish.
    m. If Column A is full of blank data, highlight the column, right click, and click delete. Do the same for Column B (full of 0's) and Column C (full of backslashes). All you need is the time column (i.e. 1-Jan-94) and the Temperature column (i.e. 287.8). All other columns can be deleted. So you should only have data in Columns A and B after formatting.
    n. Calculate a temperature average for each month for the entire data spread. Note: It may be easier to calculate if you first line up each year's data side by side instead of in one

long column. So you can rename Column A "January" through "December" and then copy each year's data next to it. In the last column, calculate the average.

o. Now, go to Sheet 3 of the worksheet.
p. On Row 1, Enter "Time" in Column A, "Avg Precipitation" in Column B, and "Avg Temperature" in Column C.
q. Copy the Avg Precipitation and Avg Temperature columns from Sheets 1 and 2 into these two columns in Sheet 3. You may have to right click and choose "Paste Special" and select "Values and other formats" to paste successfully. Format these columns so the data has two decimal points.
r. Save this file as "Your Location Name + Climatogram" (for example, "Southern California Climatogram").
s. Temperature data may be converted from Kelvin to degrees Celsius or Fahrenheit, if desired.

Here is an example of a sample table:

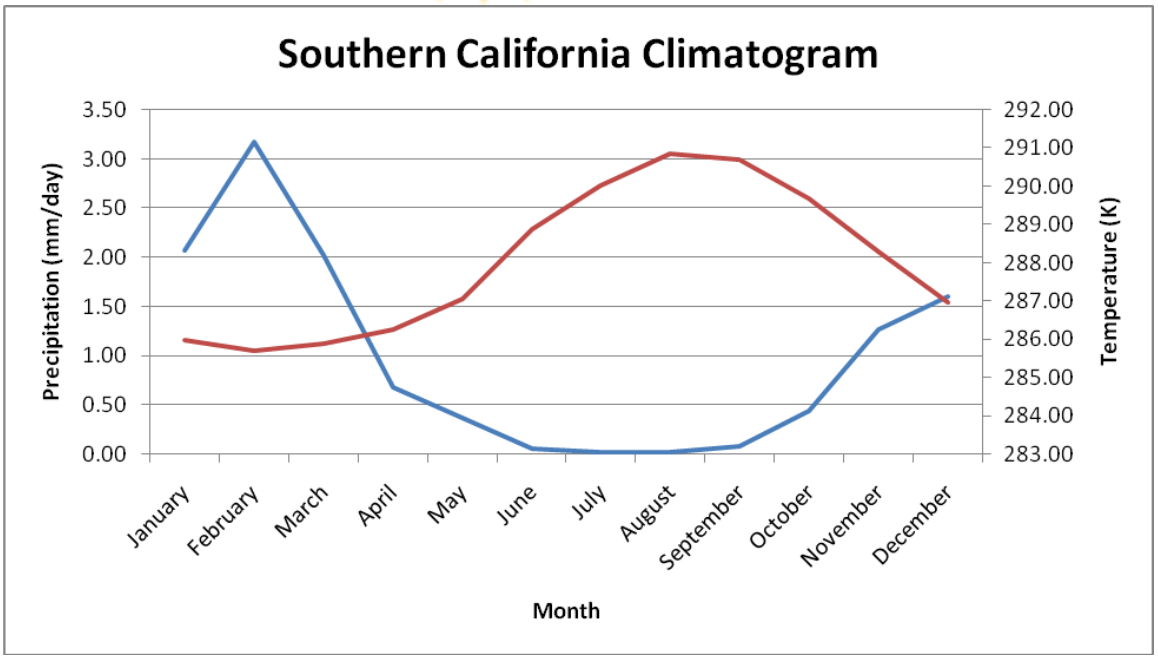
	A	B	C	D
1	Time	Precipitation	Temperature	
2	January	2.07	285.99	
3	February	3.17	285.71	
4	March	2.02	285.89	
5	April	0.68	286.27	
6	May	0.37	287.06	
7	June	0.06	288.88	
8	July	0.02	290.03	
9	August	0.03	290.85	
10	September	0.08	290.68	
11	October	0.44	289.67	
12	November	1.26	288.29	
13	December	1.61	286.98	

Part 3 - Construct a Climatogram

1. After you have completed your calculations, you are ready to construct the climatogram using the standard climatogram axes.
2. Refer to the document "Using Excel to construct Climatograms" (found here: http://mynasadata.larc.nasa.gov/docs/climatograms-excel-instr.doc).
3. Follow the directions on this document to construct your climatogram. Do not forget to label the title, axes and units! Save your climatogram, and if possible, print your climatogram to share with the class.

   Note: These directions may vary based on the version of Excel you have. If you can't find the options listed in the document, highlight the data you want to graph, go to the Insert menu, and select the "Line" option in the Charts area. Then, manually add the labels by using the options on the Layout menu. To create a secondary axis, in the chart, click the data series that you want to plot on a secondary vertical axis. On the Format tab, in the Current Selection group, click Format Selection. On the Series Options tab, under Plot Series On, click Secondary Axis and then click Close.

   Here is an example of a sample climatogram:



4. 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.

Part 4 – Questions and Oral Presentations

1. As a group, answer the questions 1-4 below.
2. Then, using the information collected including your resulting climatogram, write a paragraph conclusion or final summary for the activity in the space provided below.
3. Present your findings orally to the class.

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?

_____

_____

Conclusion:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____