Comparing Temperature and Solar Radiation for Common Latitudes

Adapted from: My NASA Data Lesson Plans

http://mynasadata.larc.nasa.gov/preview_lesson.php?&passid=67

Focus on Inquiry

The student will focus on inquiry by using the Internet to collect solar radiation and surface temperature data of two locations that share the same latitude. The student will make predictions regarding these two locations, and then compare the data, look for patterns, and provide explanations for the findings.

Lesson Overview

Examine solar radiation at two different latitude locations using NASA satellite data and compare the surface temperature of each location.

Duration	Setting	Grouping	PTI Inquiry Subskills
2 50-minute class periods	Classroom or computer lab	Small groups of 2-3	**3.1, 3.3, 3.6, 3.8, 4.2, 4.3, 5.2, 5.3, 7.2, 7.3**

Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	10 minutes			1	Students interact in a class discussion on how solar radiation affects Earth's temperature.
Explore	20-30 minutes	3.1, 3.3, 3.6, 3.8, 4.2	Internet/ computer	2	Students gather surface radiation and surface temperature data on two locations that have the same latitude.
Explain	20-30 minutes	4.2, 4.3, 5.2, 5.3, 7.2	Internet/ computer	3	Students analyze the resulting graphs on surface radiation and surface temperature, make predictions, look for patterns, and develop explanations for the data.
Expand	10-50 minutes	7.2, 7.3		3	Students compare graphs with one another and give explanations for differences.
Evaluate					Student answers to questions can be used as assessment.

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#6 - Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (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#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#16 – Use evidence to make inferences and predict trends (SI-M-A5)
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) (SI-M-A7)
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#25 - Explain and give examples of how climatic conditions on Earth are affected by the proximity of water (ESS-M-A11)
Gr. 8, GLE#26 – Describe and illustrate the layers of Earth's atmosphere (ESS-M-A11)

Materials List (per group)

- Computer with Internet and printer access

Advance Preparation

1. Check to see that the browser being used is compatible with the Live Access Server (LAS) http://mynasadata.larc.nasa.gov/las/servlets/dataset.
2. Download Goggle Earth 4.3 (free) http://earth.google.com/download-earth.html. Note that it may take a few minutes to download Google Earth on each computer. If you do not have access to Google Earth, you may try the Lookup table (http://www.bcca.org/misc/qiblih/latlong_us.html). Note that it may take the students a bit longer to find two cities with the same latitude using the Lookup table.
3. Have Google Earth or the Lookup table website already open on each group's computer before the activity begins.
4. Make sure the pop-up blocker is turned off on the computer's browser.
5. Make sure the students will be able to print their graphs from each computer.

Other Information

Learning Objectives

- Students will analyze surface temperatures between locations to identify patterns.
- Students will analyze solar radiation downward flux between locations to identify patterns.
- Students will examine the patterns and determine variables that may be responsible for differences.

Prior Knowledge Needed by the Students

- Reading Graphs
- Understand latitude and longitude coordinates

Procedure

Engage

1. Generate a class discussion to determine student's prior knowledge on how solar radiation affects Earth's temperature. Solar radiation is energy emitted by the Sun. Surface temperature is characteristic of the temperature of the air above the Earth's surface. There are various local climates on the Earth's surface. While the overall climate of the earth is often the focus of research and discussion, individual local climates are important to consider when thinking of indigenous plants and animals. Local climate is determined by several factors. Primarily it is determined by latitude, elevation, distance from the sea, and prevailing winds. Additional factors that can play a role are cloud cover, cloud height, precipitation, etc.

Explore

1. Connect each computer to the previously downloaded Google (which should now be in your Programs on your computer or wherever you downloaded it to). If prompted, open Google Earth in "DirectX" mode.
2. Have the students select a minimum of 2 locations (i.e. cities) that have the same latitude. Try to have the students select two places with different climate zones. To see the latitude lines in Google Earth, go to the "View" tab at the top, and make sure "Grid" is selected. You can zoom in and out using the zooming tool on the upper right corner. If you do not have access to Google Earth, you may try the Lookup table (http://www.bcca.org/misc/qiblih/latlong_us.html). Have the students record the longitude and latitude of each location.
3. Have the students follow the rest of the directions on the **Blackline Master 1** provided. Be sure pop-up windows are allowed on the computer's browser or else students will run into issues with viewing their results.

Explain

1. Have students answer the questions on the **Blackline Master 1** provided.

Expand

1. Have students compare their graphs and conclusions with students in other groups. Have them discuss how their findings are similar or different from the others.
2. Have the students use Google Earth to identify locations with similar elevations, proximity to oceans, etc. as well as the same latitude. In their same groups, have students create graphs of solar radiation and surface temperature to see if there are still other variables that need exploration.
3. Explore the LAS and locate other parameters that may provide you with information responsible for temperature differences between your locations

Evaluate

1. Student responses on the **Blackline Master 1** can be used as assessment.

Blackline Master

1. Comparing Temperature and Solar Radiation

Supplementary Resources

See website for additional information

Credits

Lesson plan contributed by Ken Mattingly, Mount Vernon, Kentucky

Name: _____ Date: _____

Comparing Temperature and Solar Radiation

Procedure:

1. Using Google Earth (http://earth.google.com/download-earth.html) or the Look-up table website (http://www.bcca.org/misc/qiblih/latlong_us.html), select 2 locations (i.e. cities) that have the same latitude. To see the latitude lines in Google Earth, go to the "View" tab at the top, and make sure "Grid" is selected. You can zoom in and out using the zooming tool on the upper right corner.
2. Record the longitude and latitude of each location.

Location 1: _____ Latitude: _____ Longitude: _____
Location 2: _____ Latitude: _____ Longitude: _____

3. Connect to the MY NASA DATA Live Access Server (LAS) http://mynasadata.larc.nasa.gov/las/servlets/dataset.
4. Select Land Surface and then Surface Radiation.
5. Check the box beside Monthly Surface Clear-sky SW Downward Flux (SRB) and click the Next link.
6. Click the Compare Two Variables tab located on the left side of the page.
7. From the Select View drop down menu select Time Series.
8. From the Select Output drop down menu select Overlay Plot.
9. Input the latitude and longitude for your first location for var 1 on the right side of the picture, and input latitude and longitude for the second location for var 2.
10. Select the time range underneath the picture as July 2000 – Dec 2004. Click the Next link.
11. Look at the graph that appears in the pop-up window, taking note that the axis values may differ. Print this graph. This will be your **Solar Radiation** graph.
12. Answer questions 1-4 below.
13. Back on the LAS website, click on the Data Access button at the top, and then click the Live Access Server (Advanced Edition) link (or just use this link again: http://mynasadata.larc.nasa.gov/las/servlets/dataset).
14. Select Land Surface and then Surface Conditions.
15. Check the box beside Monthly Surface Clear-sky Temperature (ISCCP) and click the Next link.
16. Click the Compare Two Variables tab located on the left side of the page.
17. From the Select View drop down menu select Time Series.
18. From the Select Output drop down menu select Difference Plot.
19. The locations should still be the ones you used in your first graph. If not, repeat step 9.
20. The time range should also be the same. If not, change it to the range used in step 10. Click Next.
21. Look at the graph that appears in the pop-up window, taking note that the axis values may differ. Print this graph. This will be your **Surface Temperature** graph.
22. Answer questions 5-8 below.

Questions:

1. Examine your **Solar Radiation** graph. How does the amount of solar radiation at each location compare?

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2. What is the detectable pattern in the **Solar Radiation** graph?

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3. What explanation can you give for this pattern?

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4. Your **Surface Temperature** graph compares the monthly average surface temperature at each location. Based on your **Solar Radiation** graph, what would you expect the **Surface Temperature** graph to say?

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5. Examine your **Surface Temperature** Graph. How do the temperatures compare between the two locations?

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6. How is this similar to or different from your prediction in Question 4?

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7. You should have found that both locations receive nearly identical amounts of solar radiation; however their temperatures differ (sometimes dramatically). What explanation can you give for this data?

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8. What other variables, besides solar radiation, can you identify as possibly having an effect on surface temperature?

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