

Climate and Latitude: A GLOBE Data Exploration

Purpose

Students match GLOBE air temperature data with location given what they know about the relationship between latitude and seasonal temperature variations.

Overview

Students investigate GLOBE air temperature data from five locations and deduce which location each dataset comes from after learning the relationship between distance from the equator and temperature.

Student Outcomes

Students will be able to:

- Match graphs of temperature data with locations given the latitude.
- Explain why they matched each graph to a particular location using knowledge that seasonal differences are larger further from the equator and temperatures are warmer near the equator.

Science Concepts

- *Earth Systems Science*
- *Weather and Climate*
- *Seasons*
- *Geography*
- *Weather can be described with quantitative measurements*
- *Weather changes day to day and over seasons.*

Science Practices

- *Analyzing and interpreting data*
- *Constructing explanations*
- *Obtaining, evaluating, and communicating information*

Time

One class period (50 minutes) for less advanced learners, or a quick (10-minute) warm-up activity for more advanced learners.

Level

Middle school (grades 6-8)

Materials and Tools

- *Data Cards* (pages 5-8)
- *Student Activity Sheet*
- A globe or image of Earth from space
- Scissors

Preparation

- Copy a set of the *Data Cards* for each pair or group of students and cut them apart.
- Copy the *Student Activity Sheet* for each student.

Prerequisites

Students should have a basic understanding of latitude and Earth's tilt (see *About Prerequisites* below).

Consider doing the *Make a Climograph GLOBE Data Exploration* before this activity to familiarize students with the types of graphs they will explore.

About Prerequisites

Students should have a basic understanding of latitude - that the Equator is 0°, the Poles are 90°N and 90°S, and other locations are in-between), that more solar energy reaches the equator than the Poles, and that locations

that are not at the Equator receive less sunlight during the winter than during the summer.

You may wish to review this information and that Earth's tilt is the reason for seasonal variations in temperature. The idea that seasonal variations in temperature are due to



Earth's distance from the Sun is a common misconception. Survey students' prior understanding of the reason for seasonal variations. If you find that students have this misconception, have students communicate their ideas, provide learning opportunities to help students evaluate their ideas (such as a reading), and plan a sense-making experience that helps students understand the scientific concept. Consider having students compare GLOBE air temperature data from the Southern Hemisphere and the Northern Hemisphere using the Visualization Tool (viz.globe.gov).

Background

In this activity, students explore how temperature patterns relate to latitude (or distance from the Equator). Locations at or near the Equator are warmer overall than places that are a greater distance from the Equator, which receive less sunlight per unit of area. Additionally, because Earth's axis is tilted, a location that is not at the equator receives more sunlight at times of year when its hemisphere is tilted towards the Sun and less sunlight at times of year when its hemisphere is tilted away from the Sun. This means that locations far from the Equator have strong seasonal differences in temperature and locations at or near the Equator have little or no seasonal differences in temperature (aside from that caused by storms or other weather phenomena).

About the data: Students interpret graphs of maximum daily air temperature from five GLOBE locations. Measurements were collected according to the GLOBE Atmosphere Protocol. Data were selected from GLOBE locations that have a multiyear record of observations without gaps, that are north of the Equator, and that are located at various latitudes and longitudes.

- Juuan Lukio/Poikolan Koulu, Finland
- WANAKA Field Station, Vermont, USA
- Many Farms High School, Arizona, USA
- Hamzah Bin Abdulmutalib Secondary School at Jeddah, Saudi Arabia
- Wp/Minu/D S Senanayake College, Sri Lanka

What To Do and How To Do It

Step 1. Orient students to the graphs of maximum daily temperature.

- Show students a globe or an image of the Earth from space. Ask students to describe general differences in temperature between Earth's poles and the equator.
- Discuss as a class: What is the climate like in the Arctic and Antarctic? At the Equator? In-between? Record student ideas on the board and revisit these at the end of class.
- Pass out the five graphs of maximum daily air temperature. Tell students that GLOBE students in five locations around the world take measurements of maximum daily temperature (the warmest temperature each day).
- Ask students what they notice about the graphs. Students may notice that the x-axis is time and that the data were collected over several years. Students may notice that the data in different places were not collected over exactly the same time period. Students may notice that some graphs have strong shifts in temperature over time and some locations have little variation over time.

Step 2. Describe the challenge and provide the clues.

- Tell students that in this activity they will determine where the data was collected for each graph with the help of two clues about how the Earth works. (Note: With more advanced students, you may wish to omit the clues and have students make the hypotheses at the end of the activity, during the class discussion (Step 5).
 - Clue 1: Seasonal differences are stronger at higher latitude (further from the Equator). At or near the Equator there is usually no seasonal difference in temperature.
 - Clue 2: Temperatures are warmer at low latitude (close to the Equator) than at high latitude (far from the Equator).
- Have students use this information to write two hypotheses by filling in the

blanks of the following with either the word “increase” or the word “decrease”:

- As the latitude of the Earth _____ , the temperature will _____.
- As the latitude of the Earth _____ , the differences in seasonal variations _____.

Step 3. Students match graphs with locations.

- Pass out the location cards and worksheets. Instruct students to work in groups to find the maximum seasonal difference in temperature for each location and then match the locations with the graphs.
- (Optional) If students need assistance with graph reading. Have them match the low/high temperature cards with graphs and then find the maximum seasonal difference in temperature for each location before matching with the location cards.

Step 4. Students explain their matches.

- Have students complete the *Student Activity Sheet*. Remind students to note which letters match, and to explain why they made the match. Worksheet answers can be used to assess student learning (see *Assessment* below).

Step 5. Class discussion

- Review the matches and rationale for each match as a class. Discuss which matches were easy and which were more challenging. Remind students that other factors affect the temperature besides location with respect to the Equator. For example, if a location is prone to storms or clouds in one season, less solar radiation makes it to the Earth’s surface.
- Return to the student ideas about climate at the Equator, Poles, and in-between. Ask students whether their thinking has changed. Is there anything else that they would add to their list.
- Have students review their hypotheses and consider whether their hypotheses were supported or refuted by the data.

Assessment

The answers on the worksheet will indicate whether students made correct matches and whether they relied on their knowledge of the impact of latitude on temperature to do this.

Students should make the following matches:

Location	Graph	High/Low
Finland	B	I
Vermont	E	J
Arizona	A	H
Saudi Arabia	C	F
Sri Lanka	G	D

Ensure that students cite that seasonal differences are stronger at higher latitude and that temperatures are warmer at low latitude as their rationale for each match they make.

Note that students might have difficulty matching the Saudi Arabia graph and Sri Lanka graph because the maximum temperature in Saudi Arabia is higher even though it is further from the Equator. Remind students that there will be little or no seasonal fluctuation in temperature near the Equator.

Extensions:

Delve Deeper into GLOBE Data

Have students explore their seasonal pattern of temperature by collecting air temperature data following the GLOBE Atmosphere Protocols or get your school participating in the GLOBE Surface Temperature Campaign.

Explore how proximity to a coast moderates temperature through the seasons with the *Comparing Croatia Climates* activity.

Have students use the GLOBE Advanced Data Access Tool or Visualization Tool to explore the seasonal temperature pattern in the Southern Hemisphere and compare it to the pattern in the Northern Hemisphere.

Credits

This activity is part of *GLOBE Data Explorations*, a collection of activities developed by the UCAR Center for Science Education (scied.ucar.edu), a GLOBE partner. Activities were reviewed by science educators and staff at GIO and field tested by teachers.



I think Finland matches with...

- _____ Graph (letter)
- _____ Lowest maximum temperature
- _____ Highest maximum temperature
- _____ Difference in temperature
(highest minus lowest)

This is why I think Finland matches this graph:

I think Saudi Arabia matches with...

- _____ Graph (letter)
- _____ Lowest maximum temperature
- _____ Highest maximum temperature
- _____ Difference in temperature
(highest minus lowest)

This is why I think Saudi Arabia matches this graph:

I think Arizona, US, matches with...

- _____ Graph (letter)
- _____ Lowest maximum temperature
- _____ Highest maximum temperature
- _____ Difference in temperature
(highest minus lowest)

This is why I think Arizona, US, matches this graph:

I think Vermont, US, matches with...

- _____ Graph (letter)
- _____ Lowest maximum temperature
- _____ Highest maximum temperature
- _____ Difference in temperature
(highest minus lowest)

This is why I think Vermont, US, matches this graph:

I think Sri Lanka matches with...

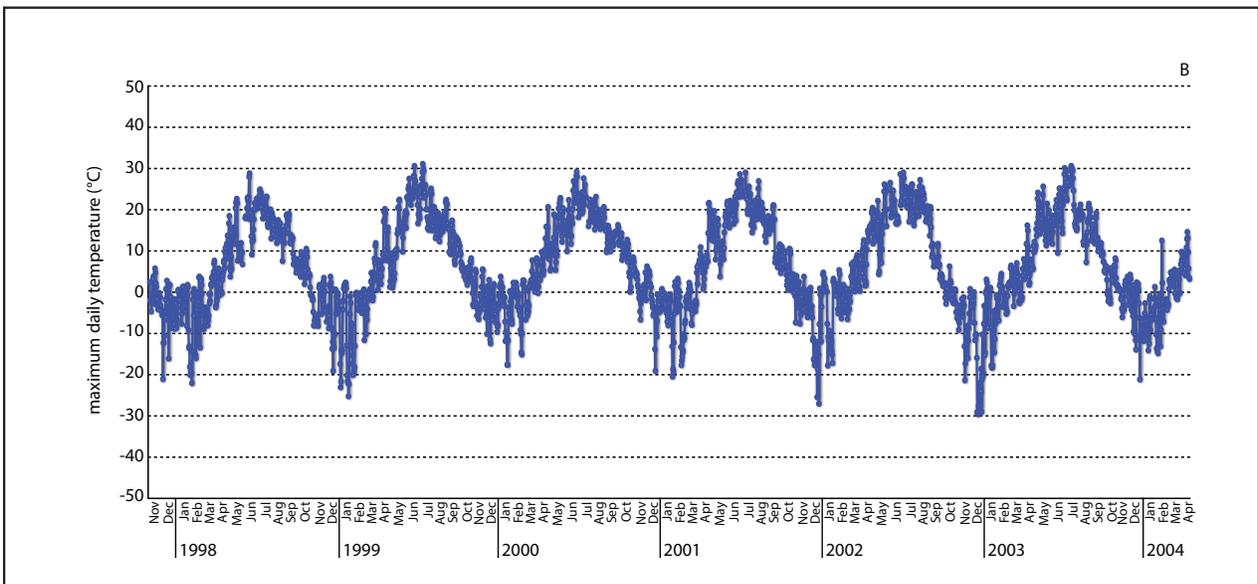
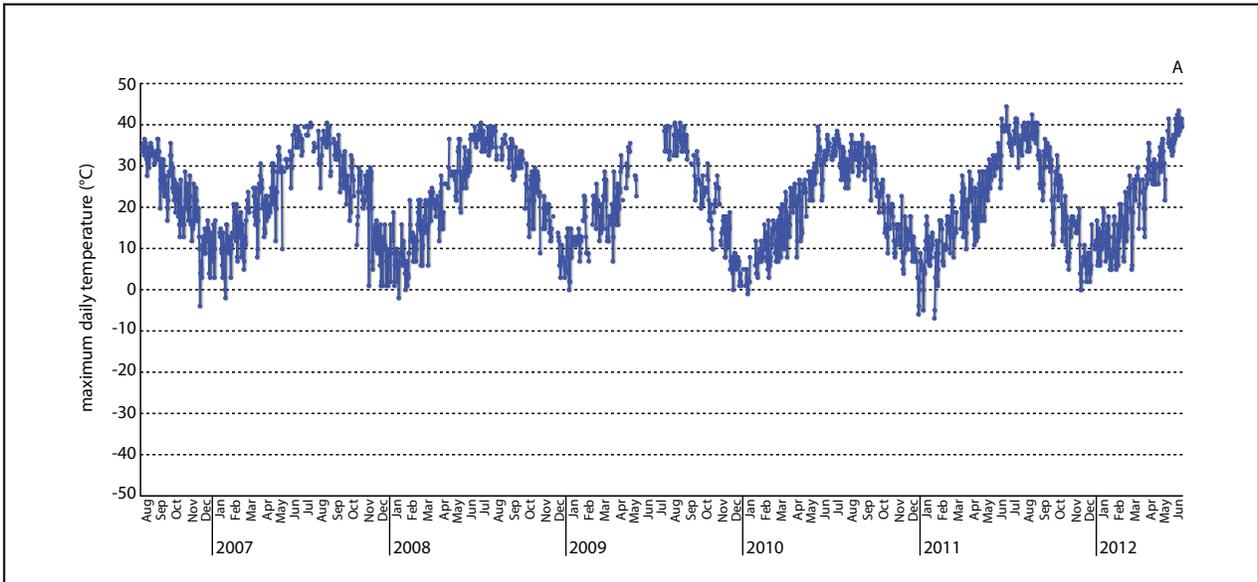
- _____ Graph (letter)
- _____ Lowest maximum temperature
- _____ Highest maximum temperature
- _____ Difference in temperature
(highest minus lowest)

This is why I think Sri Lanka matches this graph:



Climate and Latitude Data Cards, page 1

Note to teacher: Cut apart the graphs, maps, and high/low temperature data on the following four pages for each student group.



highest max temperature	49°C	lowest max temperature	24°C
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highest max temperature	41°C	lowest max temperature	27°C
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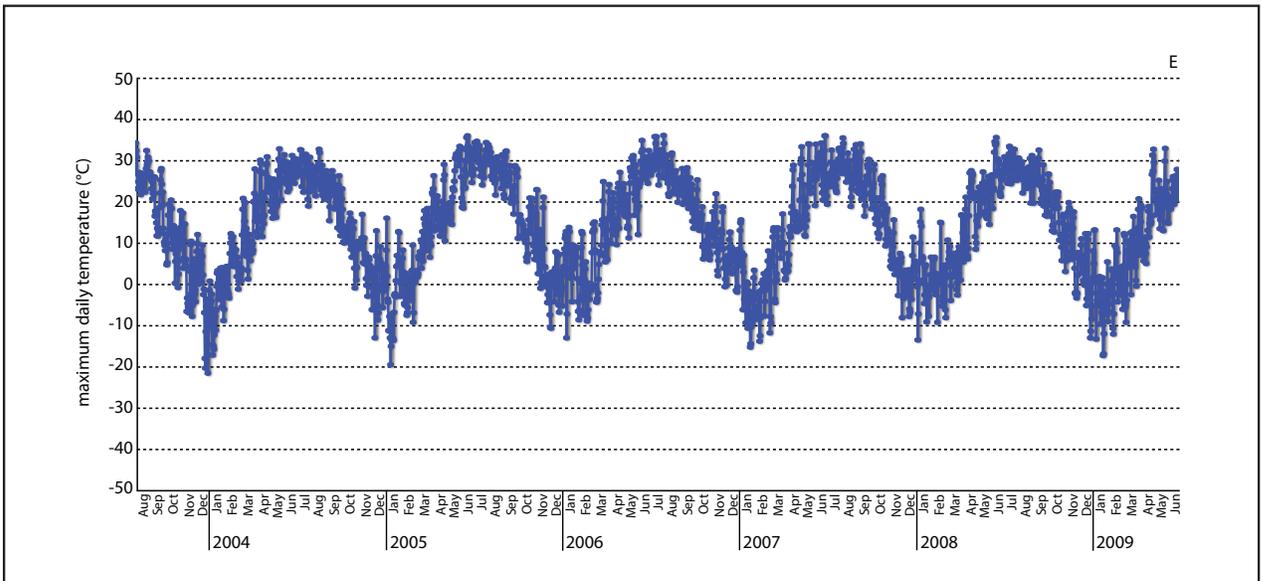
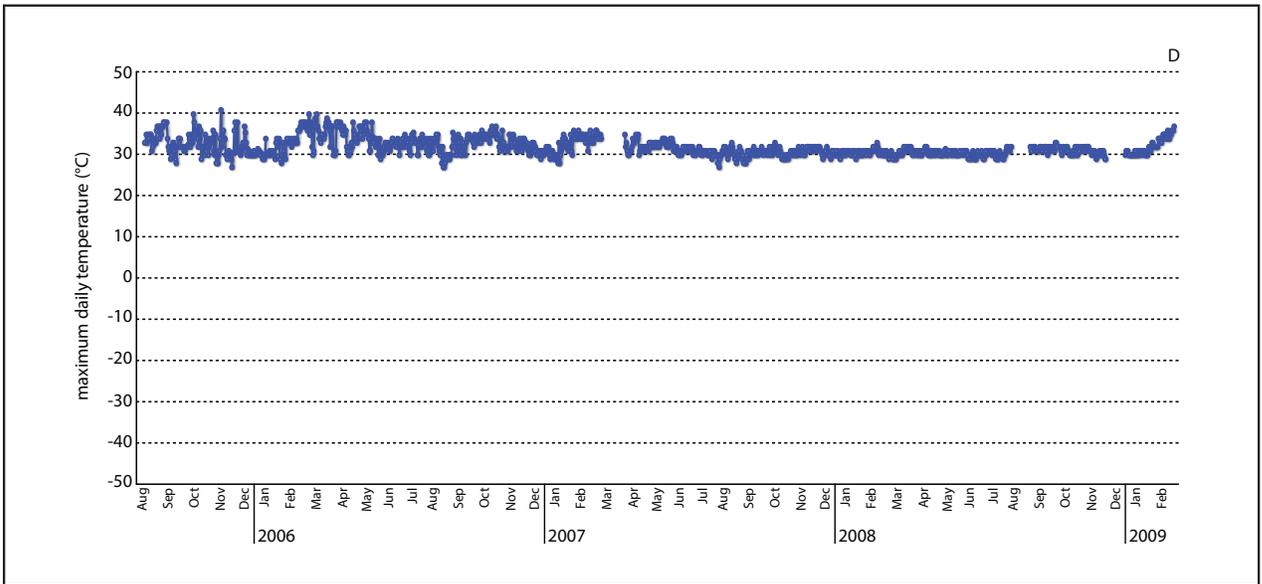
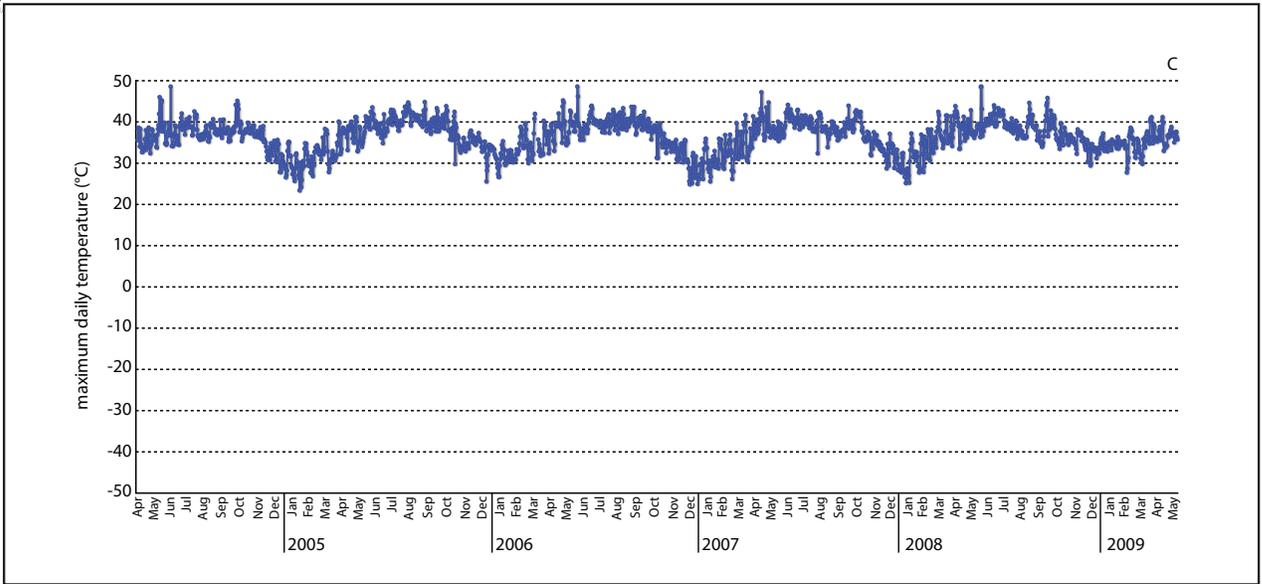
highest max temperature	44°C	lowest max temperature	-7°C
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highest max temperature	30°C	lowest max temperature	-30°C
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highest max temperature	35°C	lowest max temperature	-22°C
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Climate and Latitude Data Cards, page 2



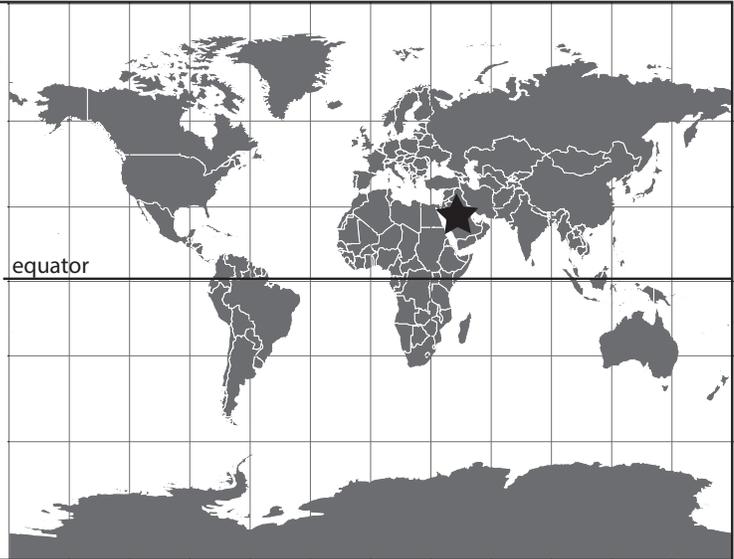


Location: Saudi Arabia

Latitude: 21.3725

Distance from
the equator:
2,372 km

N

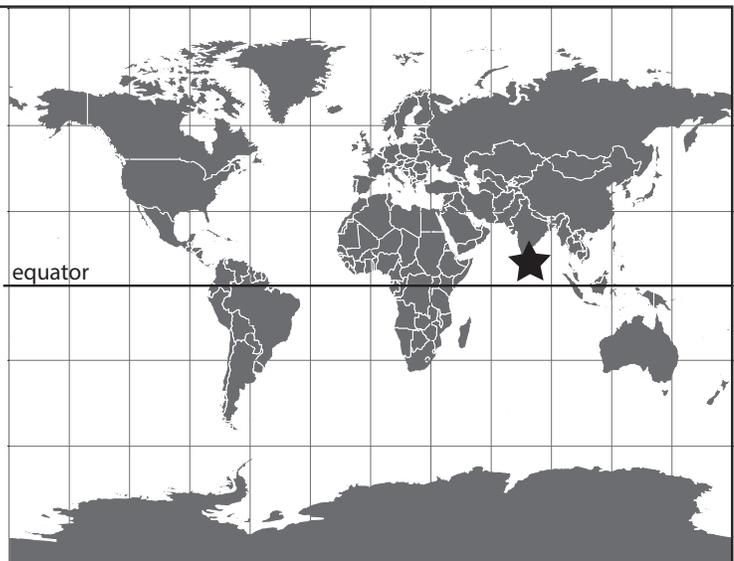


Location: Sri Lanka

Latitude: 7.1438

Distance from
the equator:
793 km

O





Location: Finland

Latitude: 63.2377

Distance from
the equator:
7,020 km

K

Location: Vermont, US

Latitude: 44.675

Distance from
the equator:
4,959 km

L

Location: Arizona, US

Latitude: 36.4493

Distance from
the equator:
4,046 km

M