

## How Does El Niño Affect Rainfall and Temperature?

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**Grade level:** 6-8

**Time:** 1-2 class periods, approximately 2 hours

### Overview:

During 1997, a major El Niño developed in the Pacific Ocean. This El Niño continued as of January 1998, and was expected to strongly affect global weather conditions during the December 1997 through February 1998 time period, and perhaps longer.

### Objectives:

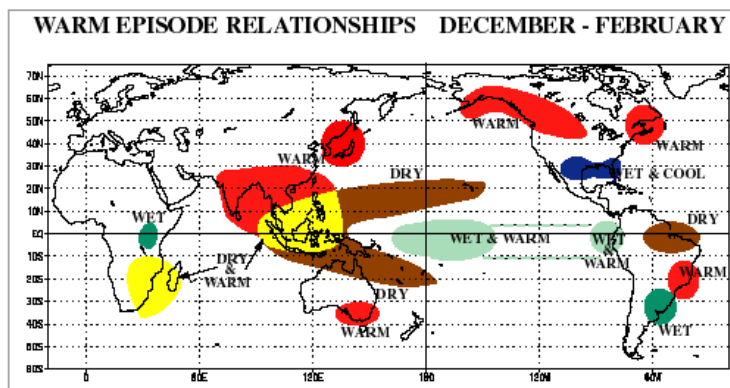
1. To develop a basic understanding of how El Niño works.
2. To learn about "normal" weather conditions in your area, and how they relate to conditions in other parts of the world.
3. To use GLOBE data to look for evidence of weather changes that might be related to El Niño.

**Prerequisites:** Read the document, "Background: What is El Niño?"

### Procedure:

#### Part I: Your School or Area

Here you will use GLOBE data from your school, and climatological data from other sources, to examine your local weather conditions and determine how they might be affected by El Niño. Note, if your school does not yet have a year of atmospheric data, you can use a nearby school, or skip to Part II (Global Conditions). Also, the instructions below specifically mention the December through February time period. However, feel free to use any months you may be interested in!



What are "normal" weather conditions for your area? Find the normal mean temperature and precipitation for December, January and February and record these values (you can use the table below). Where can you find this data? Some possible sources: a newspaper, local weather service office or University, weather or climate books, or the internet. (If you are not close to an "official" station, you can use a nearby station, but be sure to record the distance and any other important differences from your site - such as elevation)

Using the map shown above, make a prediction as to how weather conditions at your school should compare with "normal" for the period December 1997 through February 1998. Should the temperature be warmer than normal, colder than normal, or about the same as normal? What about precipitation: normal, wet, or dry? How does your prediction compare to predictions in the local media (newspaper and/or television)?

Use GLOBE data to test your prediction. This should be done two ways:

- Subjectively - Use the GLOBE Visualization system to plot a graph of your data covering at least the past year. The graph will allow you to examine daily temperatures and precipitation for the desired time period. Can you see evidence that current weather conditions are substantially different from a year ago? Two years ago?
- Objectively - Comparing graphs can be difficult, especially if the year-to-year changes are relatively small. Also, when you plot a graph, you are really comparing the current weather conditions to those of previous years. But the prediction you made based on the above map is relative to normal conditions. Therefore, if the weather conditions during last year were not "normal", you would not be able to assess the accuracy of your prediction simply by looking at a graph of your data. The best approach is to use your GLOBE data to compute the average temperature and total precipitation for each month, then tabulate and compare this to the long-term averages.

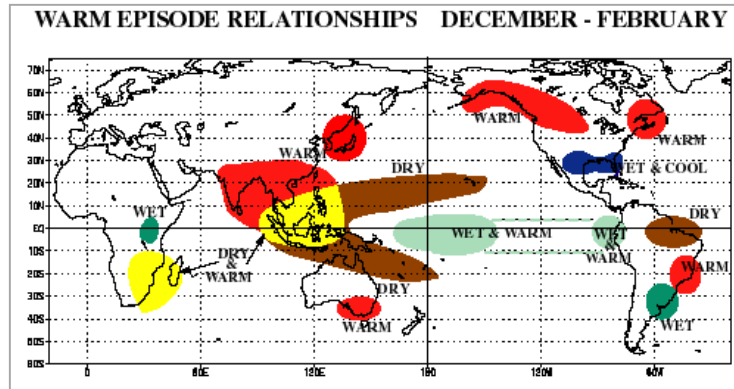
	1995-96		1996-97		1997-98		Normal	
Month	Temp	Precip	Temp	Precip	Temp	Precip	Temp	Precip
Dec								
Jan								
Feb								

### Additional Study Questions

- The period December 1996 through December 1997 was considered "normal" in that there was no El Niño occurring. If you have enough data, you should examine your GLOBE data for that period. Were your weather conditions "normal"? If not, how do you explain this observation?
- What criteria should you use to determine if a monthly average is abnormal? For instance, if the normal January temperature is 10 C, and you calculate the average for January 1998 to be 10.8 C, is that abnormal? Why or why not? What factors should you consider when making this decision? Can you think of situations when a monthly average is not really a useful measure of weather conditions?

## Part II: Global Conditions

Here you will use GLOBE data from several schools to examine how weather conditions differ around the world, and to look for changes that may be caused by El Niño. Note, the instructions below specifically mention the December through February time period. However, feel free to use any months you may be interested in!



1. First, select some schools for study. These schools should have been submitting data since at least December 1996 (a longer period would be better). We have identified some schools with good records for this period. These schools have been separated by region. Clicking on the desired region below will take you to our "School Selection Interface", with the some of the schools already selected (also see the list of Regional Schools at the end of this lesson plan):

[Australia](#)

[Europe](#)

[Japan](#)

[United States \(northern\)](#)

[United States \(southern\)](#)

Note, there may be other schools that would be worth studying - you can find them by searching the GLOBE database.

2. Keep track of the schools you have chosen, along with the reason for each selection. You can use the table below. Some interesting comparisons might include:
  - Schools in your local area
  - Schools at the same latitude but different longitudes
  - Schools at the same longitude, but different latitudes
  - Schools in the southern hemisphere vs schools in the northern hemisphere
  - Schools near each other but on different sides of a mountain range or body of water

Name of School	Lat	Lon	Elev	Reason for Selection

3. Plot graphs of precipitation, air temperature, and any other quantities you may be interested in. You may also want to compute some monthly average temperatures and precipitation totals as was done in part I.

**Questions:**

1. How are the schools related in terms of latitude and/or longitude? Are they in the same or opposite hemispheres? Identify any other similarities or differences among the schools you have chosen. How do you expect these differences to affect weather conditions?
2. Examine the graphs carefully, using the same graph analysis techniques used in Part I. For each school, can you determine if the conditions for the current year (December 1997 through February 1998) are significantly different from 1 year ago? From 2 years ago? Consider both the general shape of the graphs (using the average line technique) as well as the presence, frequency and intensity of any extreme (outlier) values, such as very high or low temperatures, or heavy precipitation amounts.
3. For several schools, determine if the conditions during the current El Niño period agree with expectations based on the El Niño map. As in Part 1, you really should compare the student observations with long-term normals for each area. Are the predictions accurate? If not, can you see any pattern, i.e. are the predictions accurate for some areas but not others? Why might this be the case?

## **Additional Study Questions**

As you know, average weather conditions (or climate) vary around the world. For example, it is typically warmer near the equator than near the north or south pole because the sun heats the ground more strongly near the equator.

What other factors influence the climate locally? Examine the graphs from the schools you have selected. Do the patterns agree with what you would expect based on the location of each school? If not, how can you explain the differences? Note, the latest edition of the GLOBE Teachers Guide contains more information about this topic in the "Seasons Investigation". This might be a valuable reference for this activity.

### **Regional Schools**

#### Australia

Carine Senior High School, Carine, WA, AU; Hamilton North Primary School, Hamilton, VIC, AU.

#### Europe

Mittelschule Elsterberg, Elsterberg, DE; Enon kirkonkylan ala-aste, Eno, FI; Koninklijk Atheneum Tienen, Tienen, BE; 25. Zakladni Skola, Ekolog. Praktikum Uzel, Liberec, CZ; Bundeshandelsakademie und Bundeshandelsschule Bregenz, Bregenz, AT; Vannarodsskolan, Sosdala, SE.

#### Japan

Tenno-minami Junior High School, Akita, JP, JP; Chiyo Junior High School, Fukuoka, JP; Attached Fukuyama Junior High School, Hiroshima University, Hiroshima, JP; Musashino Junior High School, Saitama, JP.

#### United States (Northern)

Moreau Elementary School, South Glens Falls, NY, US; Huntingdon Area Middle School, Huntingdon, PA, US; Kodiak High School, Kodiak, AK, US; St. John Vianney School, Spokane, WA, US; Hartland Consolidated School, Hartland, ME, US; Saukville Elementary School, Saukville, WI, US.

#### United States (Southern)

Cobb Middle School, Tallahassee, FL, US; Hahira Middle School, Hahira, GA, US; Lincoln High School, Tallahassee, FL, US; Marlow Middle School, Marlow, OK, US.