Teacher Resource Document

Activity Description:

In this activity students will compare El Nino / La Nina Anomaly data and compare these data to hurricane frequency in the Atlantic Basin. The ENSO Anomaly Data has been provided. It is suggested that the student collect their own data for the hurricane frequency using computer access. If computer labs are not available, then the hurricane frequency data has been provided in this in this document. The teacher can also print the hurricane track maps for student to use as an alternative to giving them the completed data set.

The activity starts with two short video clips that explain the ENSO process and include a weather report explaining that El Nino conditions create wind that generally shear hurricanes. The students will watch these videos. Then, students will graph the provided data set and the data set that they collect on hurricane frequency.

After both data sets are potted, students should see that there is a pattern between El Nino/La Nina conditions and the frequency of Atlantic Hurricanes. Both data sets will be plotted on the ENSO Graph worksheet. This graph has a Double-Y Axis so both series can be plotted together to determine patterns. Be sure you review the two axes and how to plot on each side during the guided practice (I Do/We Do component on the lesson plan).

There is also a series of data analysis questions and a summative writing prompt where students will be given information and need to synthesize a response based on what knowledge they have discovered plotting the data.

Background information on ENSO:

The following are a few resources if additional information on ENSO is needed:

http://www.elnino.noaa.gov/

http://kids.earth.nasa.gov/archive/nino/intro.html

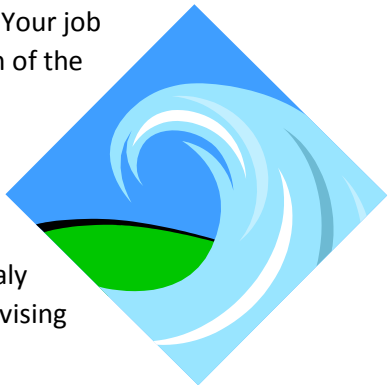
http://oceanservice.noaa.gov/facts/ninonina.html

http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html#recog

Suggested Pacing:

The graphing exercise should take 2-3 days (if using the computer lab). Students will also need time to prepare the summative prompt.

El Nino Southern Oscillation (ENSO) Data



Part 1: Below are the yearly averages of ESNO data from the Pacific Ocean Basin. Your job is to plot this data on the provided ENSO Graph Worksheet to measure the pattern of the ENSO anomalies that have occurred over a 30-year period.

You will need this data to complete your task; the second part of this lab will involve comparing your graph to that of hurricane frequency to determine if any patterns exist. You will then assume the role of the Governor of Florida and be sent an email from the State's Chief Meteorologist with the future breaking anomaly data. You will need to act and prepare a press briefing for the people in Florida advising them what time of weather we might expect.

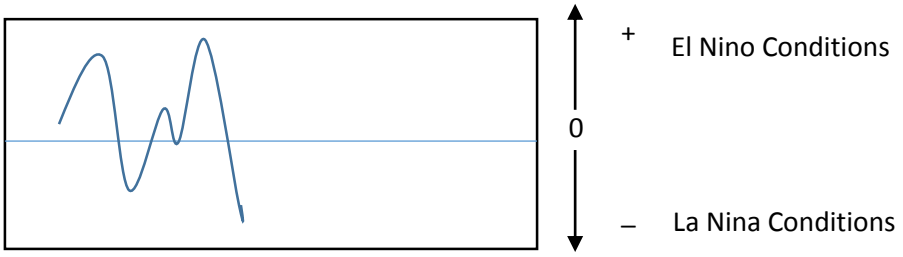
ENSO Anomaly Data Table*

Year	Anomaly (°C)	Year	Anomaly (°C)
1983	0.4	**1998**	0
1984	-0.5	**1999**	-1.2
1985	-0.6	**2000**	-0.9
1986	0.3	**2001**	-0.3
1987	1.3	**2002**	0.6
1988	-0.8	**2003**	0.3
1989	-0.6	**2004**	0.4
1990	0.3	**2005**	0.1
1991	0.7	**2006**	0.1
1992	0.6	**2007**	-0.5
1993	0.3	**2008**	-0.7
1994	0.5	**2009**	0.4
1995	-0.1	**2010**	-0.3
1996	-0.4	**2011**	-0.7
1997	1.1	**2012**	-0.1

*positive values indicate warmer the average temperatures; negative values represent lower than average temperatures

Step 1—This the temperature anomalies and the year in which they occurred. Take this data and graph it on your ENSO Graph Worksheet. **There are two Y-axes on this graph. One is for ENSO Anomaly data and the other axis will be used to plot the frequency of hurricane data**.

Step 2—After plotting connect your data points. Use Blue Colored Pencil/Pen to connect the data points.



Step 3—Now, write a brief analysis of your data before moving on to the second part of the activity. Be sure to address the following questions in your data summary:

I. Describe any patterns observed in the data set after you graphed it.
II. What years had the longest period of average El Nino conditions before changing to average period of La Nina conditions?
III. What years had the longest period of average La Nina conditions before changing to average period of El Nino conditions?

Answers

i. Student answers should indicate that there is a cyclical pattern to the data. Students should also recognize that not all peaks are of the same duration and that some (1990-1995 and 2000-2006) seem to have multiple peaks or a attenuation of the cyclical data.
ii. 1990-1994 AND 2002-2006 (both runs are of equal length and should be addressed if a student does not see both sets.
iii. 2007-2012

Hurricane Data Hunt

Part 2: Now it is time for you to collect some data. For the second part of this activity, you will be researching the frequency of hurricanes in the Atlantic Basin (the number of named storms for each year that graphed in the previous exercise.

After completing your data hunt, you will graph the hurricane frequency on the ENSO Graph Worksheet (Graph #2 – Hurricane Frequency). You will need this information as you assume the role of the Governor in the writing challenge at the end of the activity.

Step 1—The National Hurricane Center (NHC) has a tremendous amount of data regarding tropical storms that occur almost every year.

Log onto a computer and visit the following URL: http://www.nhc.noaa.gov/data/. Look through the website to see the vast amount of data that the NHC collects. After exploring, find the section titled, **Past Track Seasonal Maps**. This section will have two menus: Atlantic Basin and Pacific Basin. Click on the most recent data for the Atlantic Basin. When you click on this drop down menu, a map of all of the named storms will appear for that year.

Step 2—Open each map for the years of ENSO Data that you plotted in the last activity (years 1983-2012). Count the number of named storms for each of the years and included them on a data table.

Year	# of Storms	Year	# of Storms	Year	# of Storms
1983	4	**1993**	8	**2003**	16
1984	12	**1994**	7	**2004**	15
1985	11	**1995**	19	**2005**	13
1986	6	**1996**	13	**2006**	10
1987	7	**1997**	8	**2007**	15
1988	12	**1998**	14	**2008**	16
1989	11	**1999**	12	**2009**	9
1990	14	**2000**	14	**2010**	19
1991	8	**2001**	15	**2011**	19
1992	7	**2002**	12	**2012**	19

Step 3—Plot the data that you have collected on the ENSO Graph. You will plot hurricane frequency on the same graph as the ENSO Anomaly Data. BE SURE TO USE THE PROPER SCALE (double Y-Axis).

Step 4—connect the hurricane frequency data points with RED PEN and answer the following questions.

Data Analysis Section

Compare your two graphs on ENSO Anomaly Data and the Hurricane Frequency Data to answer the following questions. Time periods of El Nino Periods are categorized by positive values on Graph #1 and La Nina Periods are categorized by negative values.

a. When comparing the two graphs do you see any patterns between the frequency of storms and EL Nino or La Nina Conditions? (i.e when ENSO Anomaly data goes up, what happens to hurricane frequency?

Students should respond that as condition are in El Nino there are fewer hurricanes and when conditions are La Nina there are more hurricanes.

b. Look at your data for 1990 to 1995; is what relationship do you see in these data?

There is a strong inverse relationship and the curves mirror each other in a very tight relationship.

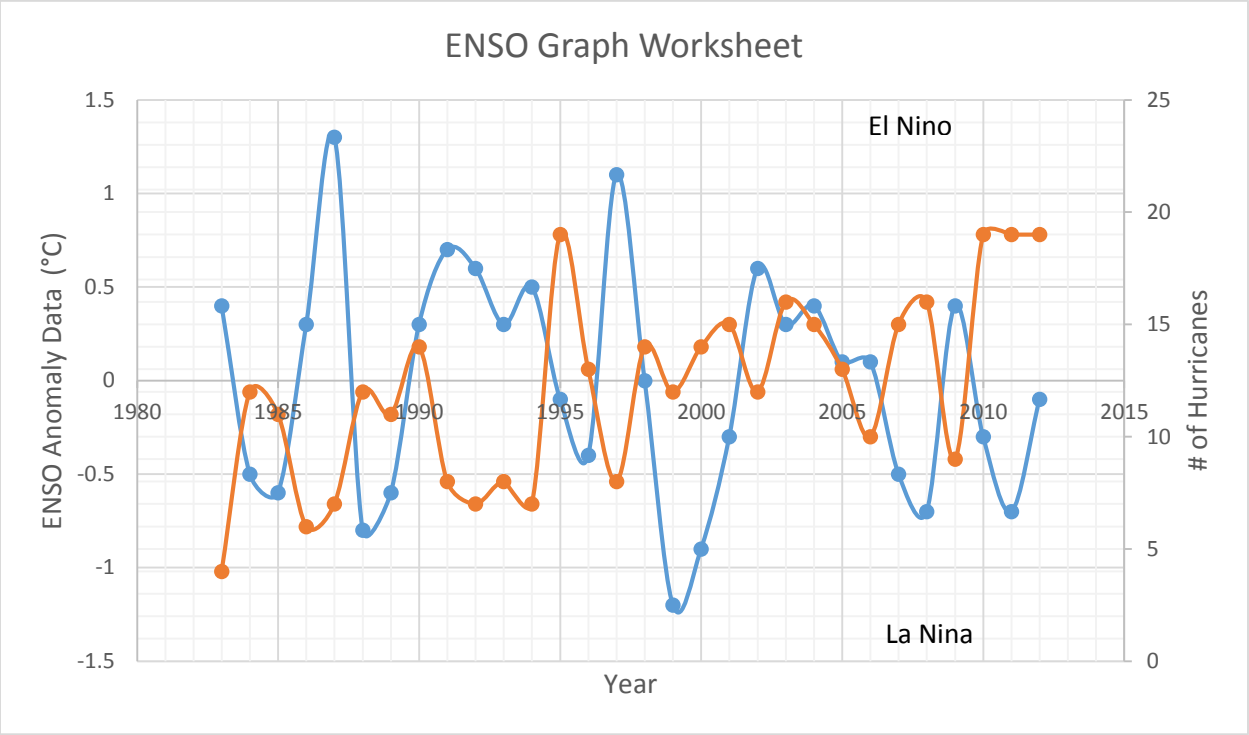
c. Are there any areas on the graph that do not follow the pattern of El Nino Conditions with fewer hurricanes?

Years 2001 to 2005 is where the data does not follow the general pattern.

d. What are some of the limitations of making generalizations/predictions based on this data set?

Student responses should indicate that predictions are not perfect. The data set here only represents 30-years. No computer models were used, so if we want to extrapolate data we must understand that there are limitations. For example, in years 2001 to 2005 there was a point where ENSO variability did not correlate like it did for the other data in the series.

Graph Key



For the Writing Prompt:

Students should answer the email/letter to the Meteorologist and identifying that the conditions in the Pacific as an El Nino cycle. Students should address the limitations of predictions with such a small data set and include data from the graph when ENSO and hurricane frequency are not clear (years 2002-2006)

A rubric is included below:

Rubric for writing:

ENSO writing rubric		
Score	**Description**	**Criteria**
4 (A)	Exceeds expectations	• Commanding use of key terms with very few or no errors • Connections between concepts are well developed • Concepts presented demonstrate understanding at the analysis, synthesis, or evaluation levels; reflect transformation of content beyond that provided in the activity by the student • Further examples and extensions are provided and illustrate excellent comprehension Student correctly identifies El Nino Condition and uses multiple data to support their writing
3 (B)	Meets expectations	• Sufficient use of key terms to illustrate comprehension; majority of key terms used accurately • Connections between concepts are beginning, although they may be limited to the applications provided in the activity Student correctly identifies El Nino Condition and uses data to support their writing
2 (C)	Not yet within expectations	• Relatively few key terms present; or a majority of the key terms present are used inaccurately • Connections between concepts not present; or generally incorrect Student somewhat identifies El Nino Condition and uses data to support their writing
1 (D)	Below expectations	• No examples from activity present (activities not referenced) • However, paper cannot be scored
NC (F)	Can Not Score	• Unrelated, unintelligible, or does not answer the email sufficiently