

El Niño and the Channel Islands Kelp Forest

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Grade Levels:

This lesson can be used with students in grades 7-12.

Lesson Duration:

Preparation and computer lab time: 2 -3, 40 minute class periods.

Part A - 40 minutes

Part B – 40 minutes

Parts C and D – 40 minutes

Follow-up and extensions: 1 - 40 minute class period

Materials:

Computers with **My World GIS** software and El Niño and Kelp Project file.

Lesson handouts and answer sheets for students

Optional:

Lab materials

Globes or World Maps

Additional videos or articles about El Niño. See resources for ideas.

Lesson Overview:

The lesson, “El Niño and the kelp forest” introduces students to normal seasonal sea surface temperature (SST) variation as well as extreme variation, as in the case of El Niño. In part A of the activity students examine mean SST in February and August and then look at the anomalous year of the 1997 El Niño.

While the causes of an El Niño year are still a mystery, the impacts have been well documented. Students examine a global impacts graphic at the end of Part A to lead into the examination of El Niño’s impact on the kelp forest of the Pacific coast of the United States. Part A can be used as a stand-alone lesson on the El Niño phenomenon.

Part B of the activity engages student interest in a regional kelp forest around the Channel Islands. Also included in this part of the lesson are an introduction to surface currents and yearly variations in SST. Students use the statistical analysis tool included in the program to find the mean and max SST over the time period 1997 -2004.

In the final two sections of the activity, parts C and D, the focus is zoomed even more tightly into one exemplary kelp forest region, the kelp forest along the coast of Catalina Island. Catalina Island being the southern-most of the Channel Islands is particularly susceptible to El Niño induced fluctuations in SST.

After noting the years of major and minor El Niños in the first part of the activity, students can correlate decrease in the extent of the kelp forest around Catalina as a result of frequent El Niños in the period between 1997 and 2004. The kelp forest area and location varies significantly, due to a number of factors. By 2005 the forest had recovered and was very healthy. In 2006, there was a strong and extended period of summer warmth that nearly wiped out all of the kelp forest around the Catalina region.

Key Questions

- ✓ What is an El Niño?
- ✓ What is the impact of El Niño on the kelp forest?

Goals

GIS and Map Skills

Students who complete this project will be able to:

- Open a My World GIS project
- Turn layers on and off
- Create selections by clicking on the legend
- Use the Zoom tools
- Use the Identify tool
- Turn legends on and off
- View the statistics for a data layer
- Use the Link tool to view pictures

Content Knowledge

Students who complete this project will know:

- How Sea Surface Temperature varies seasonally and regionally.
- What an El Niño is and its impact on the kelp forest.

Prerequisite Background Skills and Knowledge

Students should have a basic understanding of seasonality.

Students should have a basic understanding of kelp and ocean plants. Reading materials and activities to achieve this understanding can be found in JASON XIV – From Shore to Sea, or on Web Sites, listed below.

While not essential, this lesson builds on the first in the series, Global Kelp Location.

Students should have a basic understanding of how to make simple selections.

California Standards

Subject : Science

Grade Level: Nine thru Twelve

Strand : Life Sciences

Substrand 6 : Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

Ecology

STAR California Standards Test

Standard:

6b

Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

Subject : Science

Grade : Nine thru Twelve

Strand : Earth Sciences

Substrand 5 : Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:

STAR California Standards Test

Standard:

5d

Students know properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.

Student Activity:

See separate student document. – El Niño and Kelp Student

Assessment:

Ask Students to predict how the kelp forests of the northern Channel Islands will respond to El Niño conditions.

Use the graph included in the project to discuss the cyclical nature of El Niño.

Have students define SST and anomaly.

Extensions:

Examine El Niño impacts elsewhere around the world

Discuss the impact of El Niño on other creatures in the kelp forest ecosystem.

Teacher Background and Supplemental Resources:

Books and Print Resources:

JASON XIV – From Shore to Sea: A complete unit on the Kelp Forest of the Channel Islands.

Video: Chasing El Niño - NOVA

Hands-On Activities:

Examine the decrease in dissolved oxygen and other nutrients as a factor of increased water temperature.

Complete a lesson / lab examining the specific heat of water and the impacts of increased temperature on convection patterns.

Web Links:

Kelp Forests:

Site with links http://www.pcds.org/share/sci8/usefullinks/kelp_forest.htm

El Niño:

Site with links http://www.pcds.org/share/sci8/usefullinks/el_nino.htm

Notes:

This project was created using data from a variety of sources, including student collected data from our class trip to Catalina Island. For this project, students worked in teams of 2-5 to collect data to support a research question of their own design. The following is an example of a project created by students. This project can be used as a tutorial illustrating how to work with student and scientist combined data sets, or as a stand-alone lesson.

Data Credits:

Catalina Island Data: Dr. Bill Bushing, Catalina Conservancy www.starthrower.org

Detailed Seafloor Data, Two Harbors region: Seafloor Mapping Lab at CSU, Monterey Bay <http://seafloor.csumb.edu/>

Channel Island Kelp Forest Data: Dr. Will McClintock - UCSB www.marinemap.org

Sea Surface Temperature: NOAA Coastwatch <http://coastwatch.pfel.noaa.gov/>

Source for additional data sets:

http://www.dfg.ca.gov/itbweb/gis/mr_nat_res.htm

Featured Student Data Set:

Kelp Forest Extent North and South of Howland's Landing, Catalina Island. The students created this data set by kayaking around the kelp beds with GPS units.

Contributing Students:

Alex, Heath, Chris, Wyatt, Kevin, Cezanne, Devika, Kathryn, Harry, Austin, Ryan and Cole.

Learn More:

To learn more about this project and / or to read other student reports visit <http://www.pcds.org/share/sci8/projects/catalinaproj.htm>

Student Answer Sheet *with answers*

1. How does Sea Surface Temperature (SST) vary across the global ocean from the Equator North and South toward the Poles?

The temperatures cool as you go towards the poles. Students may also notice regional variations.

2. What is the mean temperature of the ocean in August? February?

August: 12.916°C or 54.8462 °F

February: 11.5279 °C or 52.3549°F

3. Give a generalization describing the regions of the Earth and water temperature that appear to be the most suitable to kelp.

The regions are generally near the coasts and in cool water.

More information here -

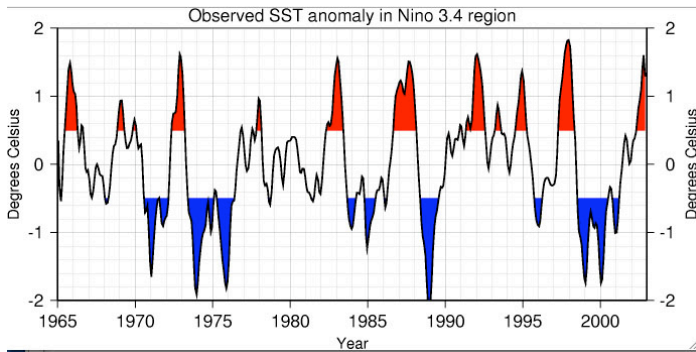
http://aquarium.ucsd.edu/Education/Learning_Resources/Voyager_for_Kids/kelpvoyager/forests1.html

4. Using the data on the linked graph, determine what year had the strongest El Niño. Discuss how you made your choice. See graph below.

72-73, 82-83, 87-88, 97-98

5. List the all the El Niño years that occurred between 1980 and 2003.

There are quite a few in a row. 82-83, 87-88, 92-95, 97-98 all had El Niño's



Graphic source:
http://iri.columbia.edu/climate/ENSO/background_monitoring.html

<http://iri.columbia.edu/climate/ENSO/currentinfo/figure4.html>

6. After watching the linked movie and reading the text above, explain anomaly in your own words.

Students should mention above and below normal variations

7. After reviewing the linked El Niño impacts graphic, list 3 impacts of El Niño.

a. drought

b. flood

c. fisheries disruption

8. What type of **Surface Current** runs along the Western United States, warm or cold?
Generally, it is a surface cold current.

9. Generalize how the mean **sea surface** temperature in this area changes between February and August. (this number can be an estimate)
The students can toggle the February layer on and off to more easily see this. Generally the SST around the region changes dramatically between the seasons.

10. List the states of the lower 48 United States that have an adjacent kelp forest.
(Note: Alaska also has a kelp forest, but it was not drawn for this project)

Oregon, Washington, Alaska, California

Fill in this table with data from the Channel Islands SST October data:

Year	Mean SST degrees C	Maximum SST degrees C
1997	18.29	25.5
1998	17.17	20.4
1999	17.17	20.4
2000	16.8	19.6
2001	16.7	20.0
2002	17.0	19.45
2003	16.8	19.95
2004	<u>16.8</u>	19.95

11. Compare the 2004 Kelp forests of Catalina and Santa Cruz. Describe where you think the kelp forests seem to be the greatest.
(Note: In the Channel Islands layer, the students can make selections, by clicking on the island name in the legend of islands and then click back and forth between them)

The Santa Cruz kelp is south of the island, the Catalina Island kelp surrounds the whole island.

12. Make other observations about the location and extents of the kelp forests and the Channel Islands. Do some islands have larger kelp forests than others? What other information would you like to know about these habitats?
Students might want to add Bathymetry and Wind Data to this view to make some more observations about this area.

Fill in this table with information about Catalina: *Answers will vary.*

Points of Interest	Description of scene
Arrow Point	
Bird Rock	
Emerald Bay	
Howland's Landing	
Isthmus Cove	
Toyon Bay	

13. Does the kelp forest ring the all of Catalina Island equally?
Yes, although there are sections that are more dense.

14. Where does kelp seem to be more or less prevalent, and how might you explain these variations? What other information would you like to add to your map?
Students may want to look at wave action (sea swell) or bathymetry.

15. Compare the **kelp 1980 Catalina** and **kelp 2004 Catalina** layers, which one appears to cover a greater area?
They are pretty similar, the 1980 forest was before all the El Niño activity.

16. How does the 1999 Catalina Kelp Forest compare to the 2004 kelp forest? Return to your Sea Surface temperature and El Niño anomaly information. How frequent and intense were the El Niño cycles during this time period?

Year	Mean SST <i>Use the Channel Islands October SST (from Part B)</i>	Kelp Forest Extent <i>Use the Kelp Forest Layers</i>	Other Information <i>Description of general location of Kelp forest</i>
1999			
2004			
<i>choice</i>			

The kelp forest area and location varies significantly, due to a number of factors. By 2005 the forest had recovered and was very healthy. In 2006, there was a strong and extended period of summer warmth that nearly wiped out all of the kelp forest around the Catalina region.

Source for additional data sets:
http://www.dfg.ca.gov/itbweb/gis/mr_nat_res.htm