

# Make Your Own El Niño

<http://sealevel.jpl.nasa.gov/education/make-your-own-el-nino.html>

**Focus on Inquiry**

The student will collect and analyze data while demonstrating the effects of El Niño, trade winds, and upwelling.

**Lesson Overview**

Students will create an ocean using oil and water and use a fan/hair dryer to create trade winds and other effects on the surface water.

<b>Duration</b> 2 days	<b>Setting</b> Classroom or Computer lab	<b>Grouping</b> Cooperative groups of 3-5 students	<b>PTI Inquiry Subskills</b> <b>3.7, 5.2, 5.3, 5.4, 5.8</b>
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
<i>Engage</i>	5 to 10 min	None	None	2	Students are engaged in a discussion on El Niño.
<i>Explore</i>	20 min	3.7, 5.8	None	3	Students will create El Niño, trade winds, and upwelling and discuss how this effects the surface water.
<i>Explain</i>	20 min	5.2, 5.3, 5.4	None	3	Students answer questions while they explore the effects of El Niño on surface water
<i>Expand</i>	25 min	5.3	Internet	3	Students can further their understanding of the effects of El Niño by experimenting with “chads” and doing follow-up research.
<i>Evaluate</i>	Varies	None	None	N/A	Teacher can use class discussion and answers to discussion questions as an informal evaluation.

**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

<p><b>National Science Education Standards – Inquiry</b></p> <p>Use appropriate tools and techniques to gather, analyze, and interpret data. Think critically and logically to make the relationships between evidence and explanations.</p>	
<p><b>National Science Education Standards – Earth Science</b></p> <p>Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.</p>	
<p><b>Louisiana Grade Level Expectations – Inquiry</b></p> <p>Gr. 8, Inquiry GLE#7 - Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3) Gr. 8, Inquiry GLE#12 - Use data and information gathered to develop an explanation of experimental results (SI-M-A4) Gr. 8, Inquiry GLE#14 - Develop models to illustrate or explain conclusions reached through investigation (SI-M-A5) Gr. 8, Inquiry GLE #16 - Use evidence to make inferences and predict trends (SI-M-A5)</p>	
<p><b>Louisiana Grade Level Expectations Earth Science</b></p> <p>Gr. 8, GLE#27 - Identify different air masses, jet streams, global wind patterns, and other atmospheric phenomena and describe how they relate to weather events, such as El Niño and La Niña (ESS-M-A12)</p>	

**Materials List (per group)**

- Clear plastic oblong container (approximately 18"x4"x4") (food storage containers are ideal; the container must be transparent or translucent to work properly)
- Water for the container



- Mineral oil
- Blue food coloring
- Battery operated hand-held fan is highly recommended for safety reasons, but a hair dryer can also be used if extreme caution is used
- Red oil-based paint (optional)
- Old newspapers
- Marker (optional)
- Ruler
- Paper sheet map showing the Pacific Ocean
- Straws
- Paper towels for clean-up and spills

### **Advance Preparation**

1. Obtain materials listed in the materials list.
2. If desired, pour mineral oil in a bowl and mix in some red oil-based paint until the oil is evenly colored. If you do not have oil-based paint, it does not affect the outcome - we don't use it in our demos here.

### **Other Information**

#### **Objective**

The learner will:

- conduct an experiment to explore the effects of trade winds, upwelling, and El Niño's effects on surface water.

#### **Prior Knowledge Needed by the Students**

- None

#### **Procedure**

##### ***Engage***

1. Begin discussing what students know in general about the ocean. Ask them, "What does the term "sea level" mean?" Does "sea level" mean that the ocean is at the same level no matter what shore it touches? Or, do you think it is possible to "pile up" the water in the ocean on one side? Can anyone think of a way to "pile up" the water on one side of the ocean? If we were able to do such a thing, what would happen to the ocean level on the other side?

##### ***Explore and Explain (sections are combined in this activity)***

1. Have each group fill the container with water to within 1" of the top. Put the container on the old newspaper.
2. Add several drops of blue food coloring to the water until students have a nice "ocean blue". Some of the food coloring will settle to the bottom which is fine because this will show the upwelling.
3. Gently pour the oil over the surface of the water. You will only need enough oil to create a ½" layer. It is okay if the oil mixes a bit because it will separate out again.
4. Using a marker or pen, write "West" (Indonesia) on the left side of the newspaper beside the container. Similarly, write "East" (South America) on the right side – See the diagram below. Ask students if they can figure out what the components in this model represents (container, blue water, red mineral oil; fan). Students should explain that they are creating a model of the Pacific Ocean, with Indonesia to the west and South America to the east. The blue water represents the colder, denser water at the bottom of the Pacific Ocean. The (red) mineral oil layer represents the warmer, less dense water at the surface of the Pacific Ocean.

*EXPLANATION: The liquids in the plastic container represent a slice across the Pacific Ocean in the vicinity of the equator. The oil (possibly colored red) represents the warm layer of surface water that has been heated by the sun. The blue water represents the colder water below the surface warm layer (Where the two layers meet is the thermocline). The fan/hair dryer is about to represent the trade winds.*

- Hold the battery operated hand-held fan over the side of the container marked “East”. Turn the fan on low and direct the “wind” across the surface of the oil-topped water from the East to the West. Ask students what the fan represents. They should respond that it is the wind blowing from East to West. Explain that scientists call this a “trade wind.” In the Pacific Ocean south of the equator, trade winds blow from east to west. This is the “normal” condition. (CAUTION. We strongly encourage teachers to use a battery-operated fan. Electric hairdryers are extremely dangerous in this setting.)

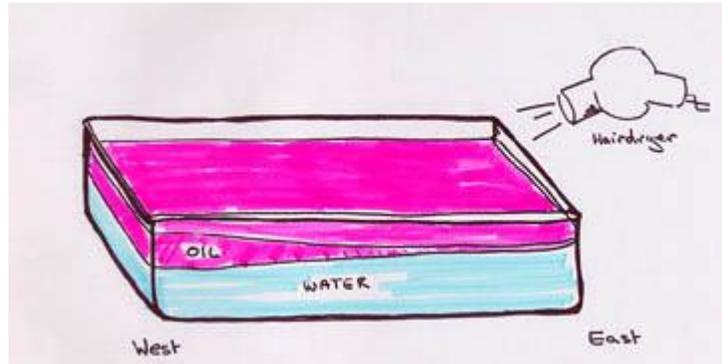


Image is from the source of this lesson:

<http://sealevel.jpl.nasa.gov/education/make-your-own-el-nino.html>

- Have students make observations about what happens to the water on their worksheet (**Blackline Master 1**). Using the ruler, have students measure the relative thickness of each layer in both the East and the West. Have students write observations down in terms of “cause” and “effects” of their trade winds on the movement of their “ocean.”
- Have students describe the effect that the trade wind has on their “warm” and “cold” water layers. *EXPLANATION: Note that the “warm” water piles up in the West as it is blown by the “trade winds” (hair dryer). This is the normal condition for the equatorial Pacific Ocean. Discuss the location of the warm water on the globe. Discuss what will happen to the air above the warm water in terms of how much moisture the air can hold. (Optional: Have them design an experiment to test the relative moisture holding capabilities of warm and cold air). You may notice that the sediment of the blue food dye moves upwards towards the surface at the east end (this will only happen if there is sediment). This is called “upwelling,” which brings nutrient-rich bottom waters to the surface. Plankton feed on the nutrients, and in turn fish feed on the plankton, so these areas tend to be rich in fish and other sea life.*
- Now have the students turn off the “trade wind” and observe what happens to the layers of the ocean. Have students describe what happened when the trade winds stopped. What happened to the “upwelling” in the east when the fan was turned off? *EXPLANATION: You may need to have the students do this several times to observe the motion. The “warm” water pulses across the “ocean” from West to East, this pulse of water is the warm water that is the oceans part of the El Niño condition. In the real ocean, the water also deflects up and down the coastline of South and North America. Check out the El Niño poster: <http://sealevel.jpl.nasa.gov/education/el-nino-poster.html> for the full series of measurements.*

### Expand

- Go to the **University Corporation for Atmospheric Research** website to view a visualization of the 1995-97 El Niño Event [[http://www.vets.ucar.edu/vg/ELNINO/movies/el\\_sst\\_ag98.mpg](http://www.vets.ucar.edu/vg/ELNINO/movies/el_sst_ag98.mpg)]. In this animation, the sea surface temperature anomalies represent the departure from normal sea surface temperatures. Red shows regions where the water is warmer than normal and blue shows regions where the water is cooler. Begin by letting students watch the entire visualization (it will progress very rapidly). Ask students to note where the areas of red are in the visualization and in what month they appear (in the east near South America or in the west near Indonesia).

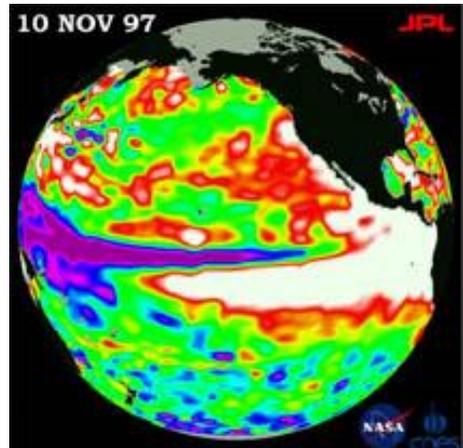


Image and content source from the original lesson found at

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- Next, using the slider bar on the visualization, slowly move through the visualization. When do the students think the El Niño is readily apparent? [El Niño shows up as the large red area off the



West coast of South America beginning in October of 1996 (you'll start to see red zones appearing adjacent to South America).] When does the El Niño begin to fade? [As the El Niño event begins to fade, a La Niña event begins to emerge in the early part of 1998. This is difficult to pick out from this animation since we are only looking at sea surface temperature anomalies. You can explain to students that scientists are looking a much larger sets of data than just this single data set.]

### **Evaluate**

1. Teacher can use class discussion of the answers to the questions in the Explain section as an informal assessment of student knowledge and can also assess the answers to the questions posed throughout the Explore/Explain section.
2. Teachers can also use the answers to the Blackline Master #1 worksheet as an assessment.

### **Blackline Master**

1. **Make Your Own El Niño**

### **Supplementary Resources**

#### **Visit to an Ocean Planet**

<http://sealevel.jpl.nasa.gov/education/cdrom.html>

*This website offers an educational CD-ROM that contains a unit on El Niño.*

#### **NOAA: What is La Niña?**

<http://www.pmel.noaa.gov/tao/elnino/la-nina-story.html>

*This website can be used for research on La Niña. It contains a wealth of information not only on La Niña, but also on El Niño, including 3-D animations of both, as well as current conditions of El Niño and La Niña in the Pacific Ocean.*

#### **Biological El Niño Effects**

<http://www.atmos.washington.edu/gcg/RTN/Figures/RTN7.html>

*This website compares and contrasts El Niño's effects on upwellings at Ecuador and Peru.*

#### **COAPS Library: El Niño and La Niña Resources on the Internet**

[http://www.coaps.fsu.edu/lib/elninolinks/current\\_news.html](http://www.coaps.fsu.edu/lib/elninolinks/current_news.html)

*This website contains current news on La Niña and El Niño.*

#### **Reports to the Nation on Our Changing Planet: El Niño and Climate Prediction**

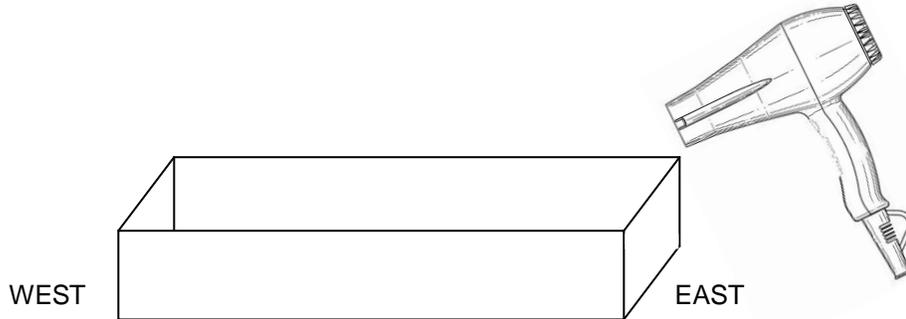
<http://www.atmos.washington.edu/gcg/RTN/rtnt.html>

*This website contains everything you need to know on El Niño.*

Date \_\_\_\_\_

Investigator \_\_\_\_\_

# Make Your Own El Niño



- Describe what happens to the water in your “ocean” when you turn on your hair dryer (the trade wind).
- Draw the relative thickness of the ocean layers in the illustration above.
- Using your ruler, record the relative thickness of each layer in both the East and the West.  
WEST ocean thickness = \_\_\_\_\_ inches      EAST ocean thickness = \_\_\_\_\_ inches
- Based on your observations of your trade wind - ocean system, complete this sentence:  
The trade winds that blow across the southern Pacific Ocean during a normal period causes  
(a)  
(b)
- Describe the effect that the trade wind has on your “warm” and “cold” ocean water layers.

In your own words, define what is meant by “upwelling”?

- Describe what happens when the trade wind was stopped.

What happened to the “upwelling” in the east when the fan was turned off?