El Niño and Global Warming

- El Niño
- Climate
- Trade winds
- Barometric pressure
- Southern oscillation

WHAT YOU WILL LEARN

- 1. You will identify the cause of El Niño events.
- 2. You will describe climatic variations caused by El Niño events.
- 3. You will recognize the relationship between El Niño events and global warming patterns.
- You will discover current views held by scientists concerning the El Niño – global warming relationship

Engage Your Thinking

Climate can be affected by many factors. On the west coast of South America in Peru, many Peruvians depend upon the fishing industry. Fishermen find a wealth of fish in the cool nutrient-rich Pacific waters. Occasionally, these same nutrient-rich waters warm up, and the fish disappear. When this has happened, the fishermen would be temporarily out of work, but this warming did not last, and then the waters would return to normal with abundant schools of fish. This ocean warming phenomenon would often occur near Christmas, so the fishermen started referring to these warming events as El Niño. In Spanish, El Niño is short for "El Niño Jesus" meaning "the child Jesus." Scientists have continued to use the term El Niño for this change in ocean temperature. El Niño has been part of life for Peruvian fisherman for hundreds of years, but the global atmospheric affects of El Niño events have only recently come to the attention of atmospheric scientists. In the past twenty years, the "no fish" periods off the coast of Peru began to last longer, causing a serious disruption in the fishing industry of Peru. Scientists began to take note of this problem, and since then research seems to be indicating that a correlation seems to exist between El Niño events and global warming. Scientists began to wonder whether the El Niño events were the cause of global warming, or, whether global warming was the cause of the longer El Niño events. In the following activity you will explore the data and have a chance to consider the nature and the effects of El Niño events.

- 1. What causes an El Niño event?
- 2. What are some changes in weather cause by an El Niño?
- 3. Are El Niño events responsible for global warming?

Explore and Explain



Figure 1. The Impact of El Niño on Ocean Temperature. Source: NASA

Above (Figure 1) are illustrations of the difference in Pacific Ocean temperatures during an El Niño as compared to a normal situation. In the first figure, you can see the El Niño's high surface temperatures in the Pacific Ocean (red area). The second illustration shows a normal situation with trade winds keeping the warm surface temperatures away from the South American coastline.

4. During an El Niño event, what are the Pacific Ocean surface temperatures like near the South American Pacific coast?



Figure 2. Normal Ocean Conditions. Source: NASA

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Figure 2 shows a normal ocean condition, where the **trade winds** blow from east to west along the equator. The warm Pacific surface waters are pushed westward by the strong trade winds. The movement of surface waters toward the west draws cool, nutrient-rich water up from the bottom of the Pacific Ocean along the eastern shores. This creates a perfect living environment for many types of fish and results in a flourishing fishing industry along the Pacific coast of South America.

5. What factor forces the warm Pacific waters westward?



Figure 3. El Niño Conditions. Source: NASA

Although scientists have yet to fully understand why, the strong trade winds occasionally weaken. In Figure 3 above, the warm Pacific surface water begins to flow back toward the east. The cool, nutrient-rich fishing waters disappear along the Pacific coast of South America, and the waters are without fish to catch. This El Niño situation has always been well-known in Peru. Since the 1500's records show that the people of Peru knew that this situation resulted in bad fishing and torrential rain. But most people had no idea how this event might effect the rest of the world.

6. What conditions are usually seen in Peru during an El Niño event?

Today scientists know that El Niño events not only affect the Peruvian coast of South America, but they also produce consequences all around the globe. In the 1920's a scientist by the name of Sir Gilbert Walker was in India trying to discover the causes of monsoon seasons. He was collecting weather data from all over the world when he discovered a difference in **barometric pressure** in the Pacific Ocean. He found **high pressure** in the east near South America and **low pressure** in the west near Indonesia. This explains the strong trade winds across the Pacific Ocean. He discovered that the intensity of the pressure would decrease occasionally causing weak trade winds. This back and forth change in pressure is now known as the **Southern Oscillation**. The El Niño events were found to correspond to the Southern Oscillation.

Even though scientists really don't understand how an El Niño forms, they now have a better understanding of the effects caused by an El Niño. These effects are varied and global and include large changes in rainfall in the tropical Pacific, interruption of monsoons in India, flooding in some areas of North and South America, drought and fires in other areas, changes in the frequency and locations of hurricanes, mild winters, warm summers, and many more climate and weather changes in various places around the globe. The effects of an El Niño are very complex and difficult to predict and continue to be the subject of much scientific research.

7. How did the study of monsoons in India lead to an understanding of El Niño?

One of the main reasons that scientists started to pay attention to El Niño events is that the time periods in which the fishing in Peru was suspended due to El Niño were growing longer and longer, causing serious problems for the fishing industry of Peru. Scientists were quick to notice that these longer warming periods were corresponding to other warming phenomenon occurring elsewhere in the Earth's atmosphere.

The chart below (Figure 4) shows temperature changes in the Pacific Ocean waters off of the coast of Peru from 1950 to 2015. The red areas of the chart are above the normal line (0) record El Niño events.



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8. According to Figure 4, in about what year do the El Niño events become more frequent and longer lasting?

The chart below (Figure 5) shows global temperatures from 1950 to 2006. Compare the two charts to see if you can see any relationship between global temperature and El Niño events.



Figure 5. Global Temperatures. Source: US National Climate Data Center

9. According to the chart in Figure 5, in about what year do the global temperatures begin to show significant increase?

10. Considering the above information, do you think El Niño events contribute to global warming? Or does global warming cause more El Niño events? Explain your thinking on this issue.

Extend Your Thinking

Which came first, global warming or more frequent El Niño events? Sounds like the "chicken or the egg" question! Yet, scientists consider this an important question. What do scientists actually think? Do they all agree? To find out, go to the internet and learn what scientists are thinking about the relationship between global warming and El Niño events. This is a current topic, so make sure you check the dates of articles and their opinions. If you find something that was written eight or ten years ago, note whether or not it still applies today. Also, try to find two different opinions on the same question. Keep accurate records of the authors, web site addresses, and dates.

More frequent El Niño events cause	Global warming cause more frequent El Niño events
Author:	Author:
Date:	Date:
Web address:	Web address:
Summary of reasons:	Summary of reasons:

Apply What You Have Learned

After you have gathered your information, meet with your group to discuss your findings. As a group, try to decide which idea to support. Be ready to present and defend your findings to the class.

Reflect on What You Have Learned

11. What causes an El Niño event?

12. What are some changes in weather cause by an El Niño?

13. Are El Niño events responsible for global warming?