

## DATA IN THE CLASSROOM: LEVEL 2

# Graphing Sea Surface Temperature

1. At the equator, how does the surface temperature of the Pacific Ocean vary from west to east?

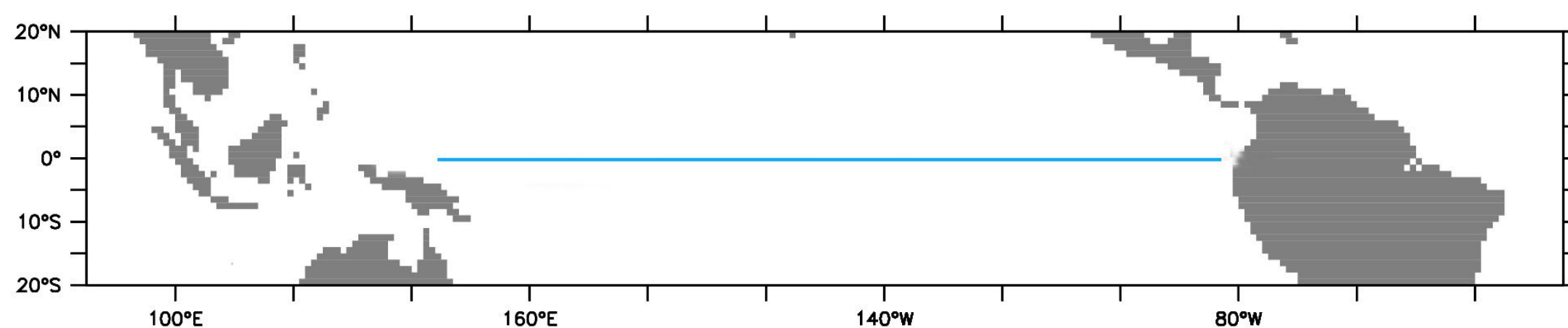
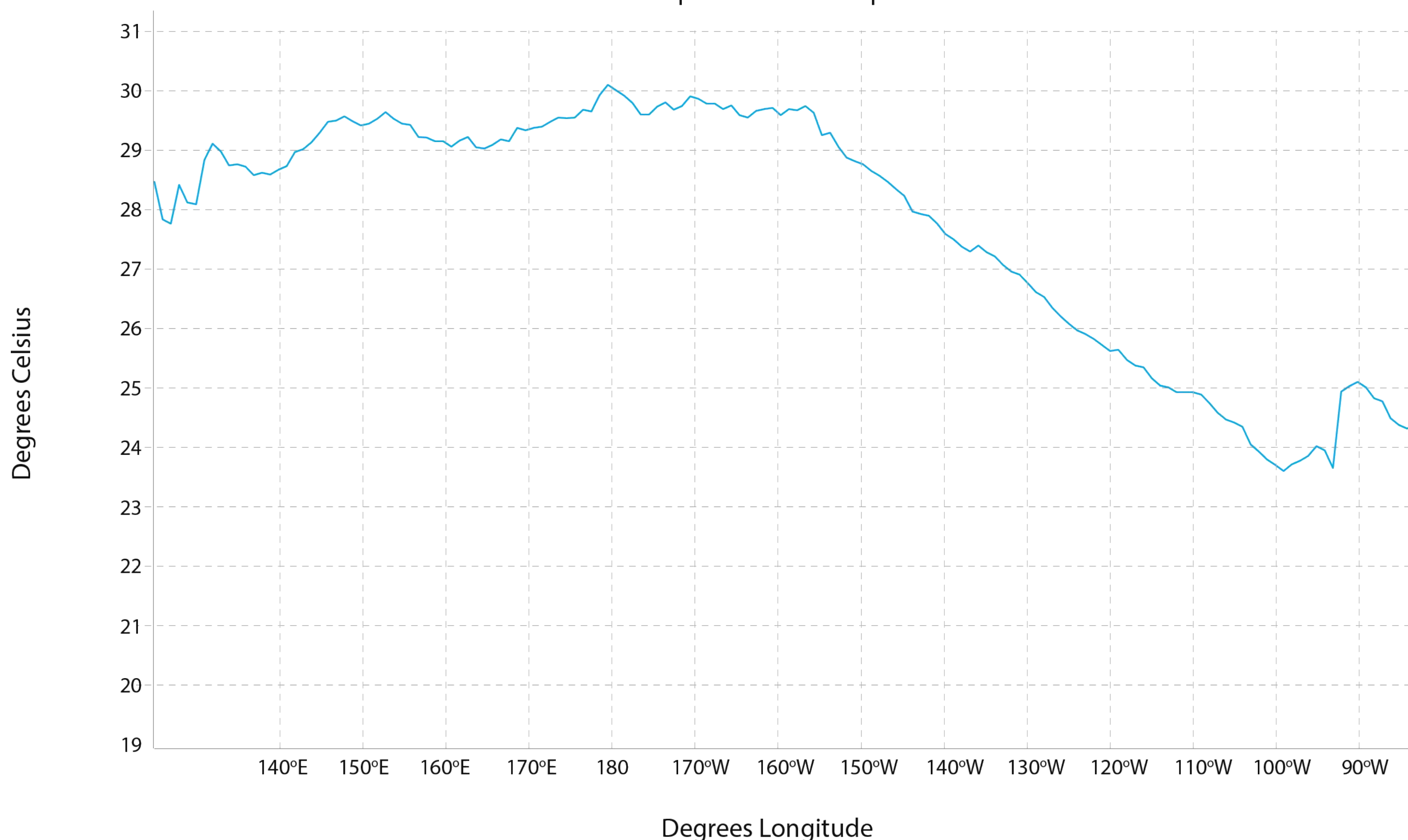
- Observe the line graph of sea surface temperature data below. Notice how temperature changes along one line of latitude, in this case along the equator, during December 2015.
- What were the monthly average sea surface temperatures along  $0^\circ$  latitude at  $140^\circ$  E? To find out, find  $140^\circ$  E on the x-axis. Then, find the corresponding temperature on the y-axis. **Record this temperature in the table below.**
- What were the monthly average sea surface temperatures along  $0^\circ$  latitude at  $180^\circ$ ,  $140^\circ$  W and  $100^\circ$  W?

**Record these temperatures in the table below.**

Longitude	$140^\circ$ E	$180^\circ$	$140^\circ$ W	$100^\circ$ W
Sea Surface Temperature ( $^\circ$ C)	<b><math>28.6^\circ</math> C</b>	<b><math>30.0^\circ</math> C</b>	<b><math>27.6^\circ</math> C</b>	<b><math>23.6^\circ</math> C</b>

- Use the data in the table to complete the sentence: The data show that surface temperature **increased** [increased or decreased] by **approximately 6** degrees Celsius from east to west along the equator..

Sea Surface Temperature at the Equator, December 2015



## DATA IN THE CLASSROOM: LEVEL 3

# Answering a Question With Data

1. **Your Mission:** It's the winter of 2015. The waters along the coast of California are unusually warm. Huge numbers of pelagic red crabs that are typically common in the warmer waters off the coast of Mexico are now washing up along beaches of California (shown in images below). Have the warmer surface waters in California brought this sub-tropical species northward? Could these observations be the result of an El Niño? Your mission is to find out - using data.



2. **Answer a Question With Data:** What data would you need to find out whether the presence or absence of an El Niño during the winter of 2015 could have caused this event? Make a list below of the specific TEMPERATURE data you might need to answer the question.

*Hint: can you answer the question by looking at data from only one year? Will you need maps, graphs or both?*

Data set	Date	Map or Graph?
Example: Sea surface temperature	December 2001	Map
<b>Sea Surface Temperature</b>	<b>December 2014</b>	<b>Line graph</b>
<b>Sea Surface Temperature</b>	<b>December 2015</b>	<b>Line graph</b>
<b>Sea Surface Temperature</b>	<b>December 2016</b>	<b>Line graph</b>
<b>Sea Surface Temperature</b>	<b>December 2014, 2015, 2016</b>	<b>Map</b>

3. **Get the Data:** Locate the data tool in last section of [Level 3](#) titled 'Answering a Question with Data.' Follow the instructions on the web page to access the data you'll need. *Not sure how to create line graphs? Watch the video in Level 3. Or use the sea surface temperature graphs from December 2014, December 2015 and December 2016 on the following pages.*

## DATA IN THE CLASSROOM: LEVEL 3

# Answering a Question With Data

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4. Construct an Explanation: Did an El Niño event occur during the winter of 2015? Answer the question using the claim, evidence, reasoning table below.

Did an El Niño event occur during the winter of 2015? Could an El Niño have caused these crabs to appear along the beaches of California?	My Claim (a simple statement that answers the question):  <b><i>Example: An El Niño event occurred during the winter of 2015 that caused water to become warmer than normal along the coast of California.</i></b>
Include specific data and observations from the graphs & maps you collected.	My Evidence:  <b><i>Example: The line graphs show that along the equator, the surface ocean temperature near the Americas was approximately 26°C during December of 2014 and 2016. However the surface temperature during December of 2015 was 27°C (1°C warmer). The data maps show that surface ocean temperature along the coast of Mexico and California were also warmer in December 2015 (compared with 2014 and 2016).</i></b>
Connect the evidence to your claim	My Reasoning:  <b><i>Example: During December of 2015, the temperature difference from west to east was smaller &amp; coastal SST temperatures near the Americas were warmer. Both of these changes are characteristic of an El Niño year. When SST warmed off the coast of Mexico, this may have affected the red crabs.</i></b>

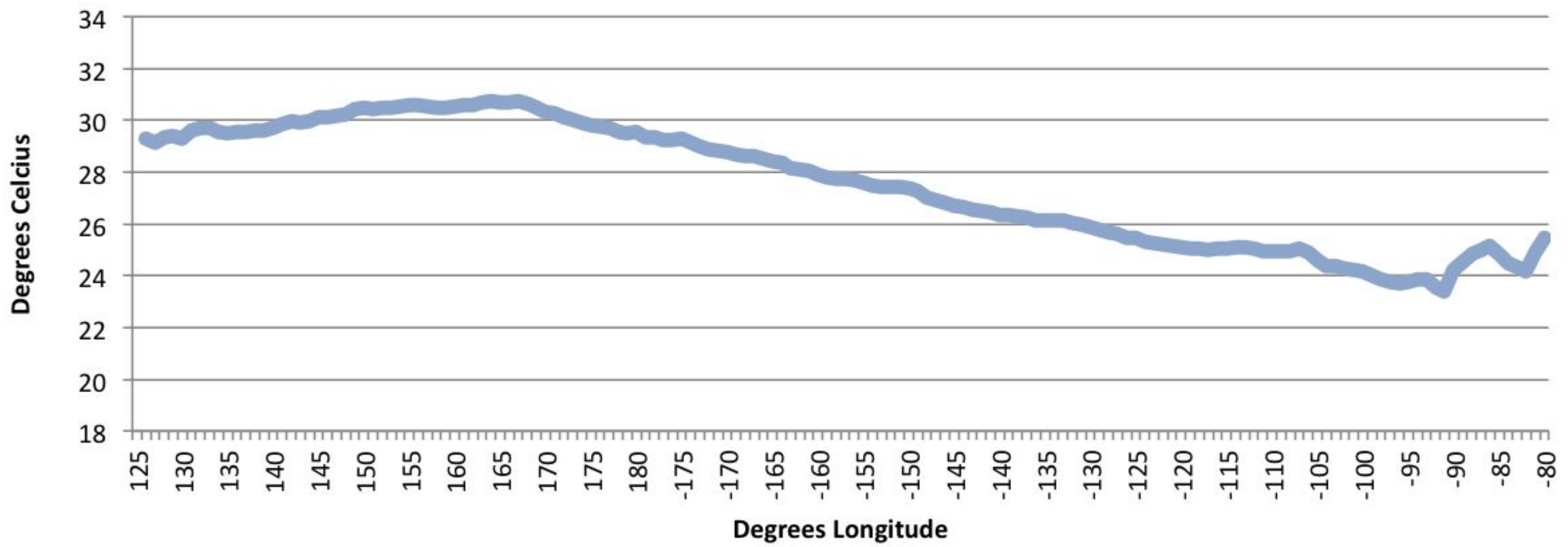
5. Drawing Conclusions: Could the presence or absence of an El Niño event during the winter of 2015 have caused huge numbers of pelagic red crabs, typically common in the warm waters of Mexico, to wash up along beaches of California? Use your explanation in #4 above to help draw your conclusions.

My conclusions:	<b><i>Example: During the El Niño event of December 2015, the coastal waters of Mexico and California warmed. The warmer waters brought southern marine species not normally found off the coast of California northward. Other reports from NOAA have indicated that a number of warm temperate and sub-tropical species (including the red crabs) have been observed beyond their normal geographic range during El Niño events.</i></b>
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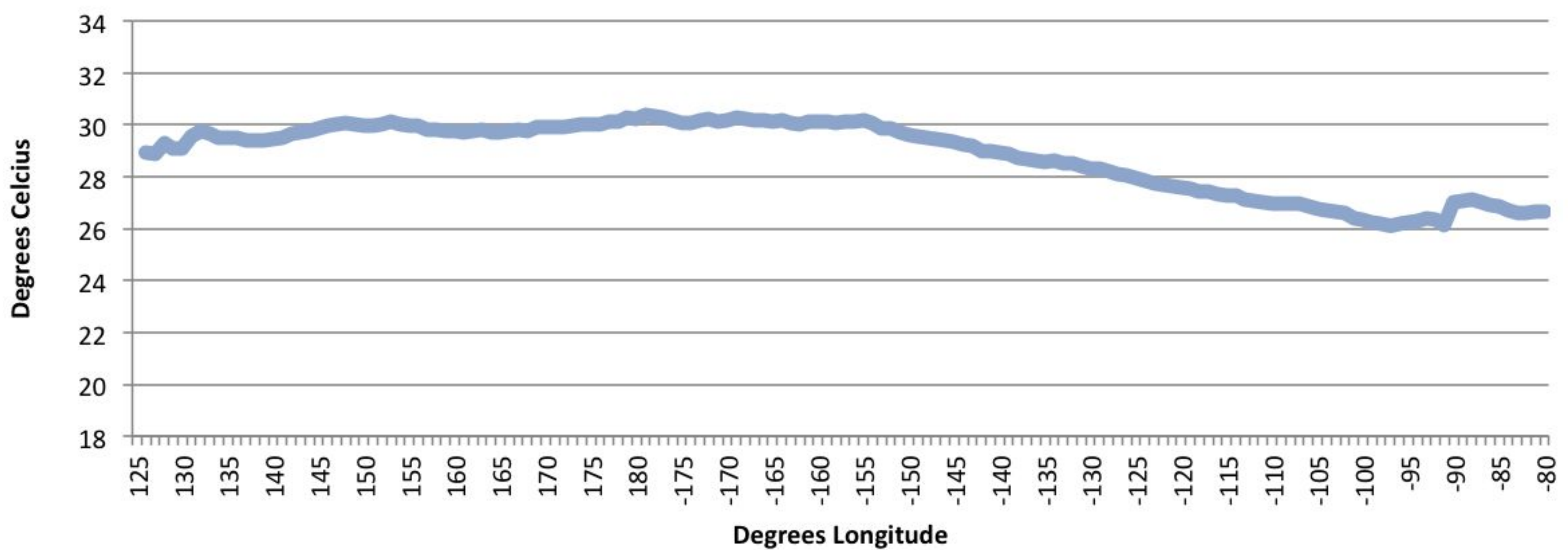
## DATA IN THE CLASSROOM: LEVEL 3

# Reference Data

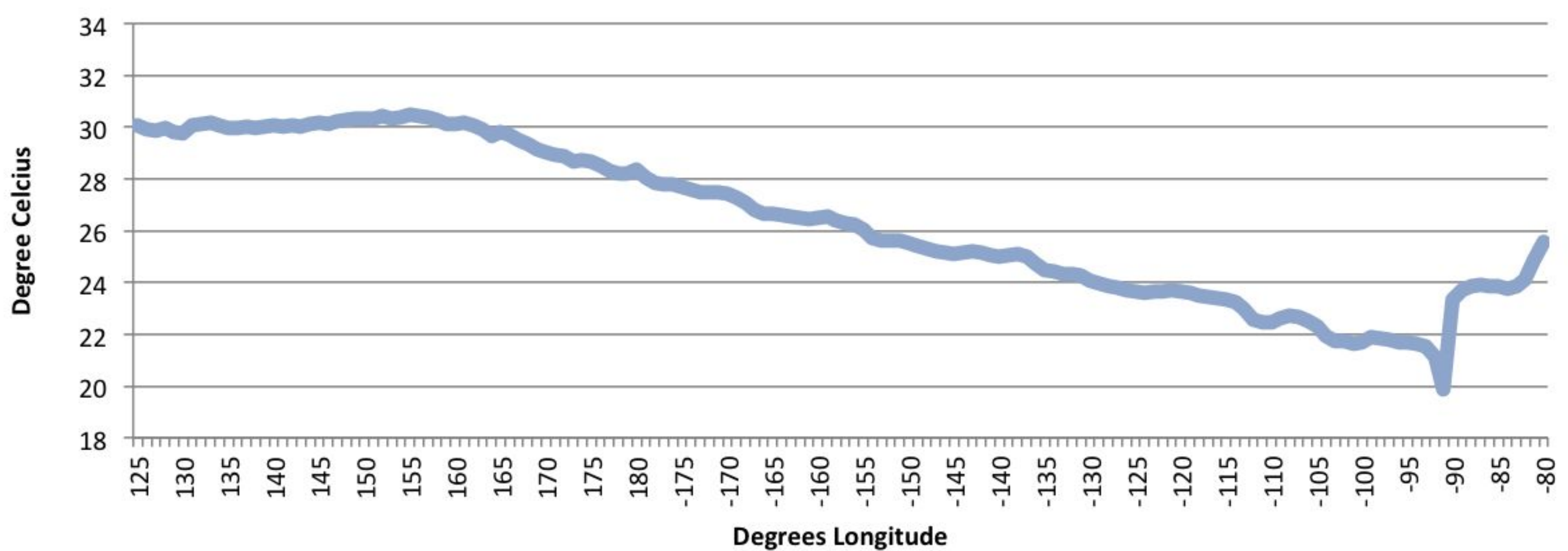
Sea Surface Temperature at the Equator, December 2014



Sea Surface Temperature at the Equator, December 2015



Sea Surface Temperature at the Equator, December 2016



## DATA IN THE CLASSROOM: LEVEL 4

# Exploring El Niño and Chlorophyll Data

Your Mission: You have joined a team of scientists who are studying the effects of El Niño on biological systems in the ocean. Specifically, you are interested in the relationship between sea surface temperature (SST) and productivity, as measured by the amount of chlorophyll. Your task is to determine if there is a relationship between sea surface temperature and the distribution of phytoplankton, and, if so, how this relationship is impacted during El Niño. The team has decided that you will compare two time periods: December 2009 and December 2010.

1. Form a Hypothesis: What is the relationship between sea surface temperature and phytoplankton concentrations? State your hypothesis by completing the sentence below.

<b>My hypothesis</b>	<b>Write the word(s) that completes the hypothesis. Word choices: increases, decreases</b>
During an El Niño event, when sea surface temperatures in the eastern Pacific Ocean increase, the amount of phytoplankton, as measured using chlorophyll-a .....	<b>decreases</b>

2. Test Your Hypothesis with Data:

- a. Click on the 2009 and 2010 data maps and graphs presented in the Level 4 online activity. Make some initial observations by answering the questions below.

Which year shows warmer sea surface temperatures in the eastern Pacific (near the equator)? 2009 or 2010?	<b>2009</b>
Which year shows higher chlorophyll concentrations in the eastern Pacific (near Mexico City)? 2009 or 2010?	<b>2010</b>

- b. Analyze the data shown in the 2009 and 2010 data maps and graphs by completing the table below.

		Date: 2009		Date: 2010	
Latitude	Longitude	SST (°C)	Chlorophyll (mg/m <sup>3</sup> )	SST (°C)	Chlorophyll (mg/m <sup>3</sup> )
0°	140° E	<b>28.7</b>	<b>0.14</b>	<b>30.0</b>	<b>0.10</b>
0°	180°	<b>30.1</b>	<b>0.09</b>	<b>27.1</b>	<b>0.20</b>
0°	140° W	<b>27.7</b>	<b>0.19</b>	<b>25.5</b>	<b>0.23</b>
0°	100° W	<b>23.7</b>	<b>0.19</b>	<b>22.7</b>	<b>0.23</b>

## DATA IN THE CLASSROOM: LEVEL 4

# Exploring El Niño and Chlorophyll Data

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3. Construct an Explanation: Do the data in the maps and graphs support your hypothesis? Use the claim, evidence, reasoning table below to explain the relationship between El Niño, ocean temperature and phytoplankton.

What is the relationship between sea surface temperature and phytoplankton concentrations?	My Claim (or hypothesis):  <b><i>Example: When sea surface temperature in the eastern Pacific Ocean increases, the concentration of phytoplankton decreases.</i></b>
Include specific data and observations from the graphs & maps you observed.	My Evidence:  <b><i>Example: In 2009, sea surface temperatures were 1°C warmer in the eastern Pacific compared to 2010. In 2009, chlorophyll concentrations were 0.04 mg/m<sup>3</sup> lower in the eastern Pacific compared to 2010.</i></b>
Connect the evidence to your claim	My Reasoning:  <b><i>Example: During an El Niño, sea surface temperatures in the eastern Pacific gets warmer and upwelling is disrupted. This prevents the normal transport of cold, nutrient-rich water from the depths from reaching the surface waters. Without these nutrients, phytoplankton growth decreases. There is a decrease in chlorophyll in these areas due to a decline in phytoplankton productivity.</i></b>

## DATA IN THE CLASSROOM: LEVEL 5

# Design an Investigation

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**1. Develop Your Question:** Ask a question that can be answered using the data available in the module.

Some sample questions are below.

- Are El Niño events becoming stronger over time?
- Are El Niño events becoming more frequent?

<b>Identify a question of interest about El Niño.</b>	
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**2. Collect and Analyze Data:** Identify the data that you need to answer your question. If possible, paste or attach your data maps or charts to this document.

Data	Date	Map or Graph
<i>Example: Sea surface temperature</i>	<i>Dec 2015</i>	<i>map</i>

**3. Construct an Explanation:** Does the data support or refute your claim? Use the claim, evidence, reasoning format to help develop your own explanation based on evidence.

Claim: Record a simple statement that answers your question.	
Evidence: Include specific data from the the data maps, graphs or charts you have analyzed.	
Reasoning: Connect the evidence to your claim.	