

Activity	Explore patterns and characteristics of El Niño and effects on global climate.
Science Standards	APES: I. Earth Systems and Resources (The atmosphere; weather and climate, atmosphere-ocean interactions, ENSO). NGSS: HS-ESS2-2. Analyze geoscience data to make the claim that one change to the earth's surface can create feedback that causes changes to other earth systems.
Learning Outcomes	<ul style="list-style-type: none">• Students will describe the potential impact of El Niño at various scales.• Students will be able to compare and contrast characteristics of El Niño and La Niña.

Map URL: <http://esriurl.com/enviroGeoInquiry8>

Engage

Is the weather the same from year to year?

- ? What has snowfall in your area been like in past years? Are there some years when you have experienced more snow? Less snow? *[Answers will vary.]*
- Open the map by clicking the URL link above.
- Observe the map with data layer, Snow Cover: January 2016.
- ? What parts of the world experienced snow cover? What about your current location? *[Answers will vary.]*
- ? Is there always the same amount of snow at your location? At various locations around the world? *[Answers will vary.]*

Explore

How are sea surface temperatures different around the globe?

- The year range 2015-2016 was considered a moderate El Niño event.
- From the Details pane, click the button, Show Contents Of Map.
- Click the checkbox to the left of the layer name, Sea Surface Temperature Anomaly: January 2016.
- ? What patterns in SST anomaly are in the Pacific Ocean? *[Above average temperatures]*
- ? What are some possible factors that may influence ocean temperatures throughout a given year? *[Rainfall, ocean circulation, air temperature, season, global wind patterns, and so on.]*

Explain

What is some possible feedback of warmer sea surface temperatures?

- Click the checkbox to the left of the layer name, Global Temperature Anomaly: January 2016.
- January 2016 was considered the peak heating of the Pacific Ocean.
- ? What patterns in global temperature anomalies do you notice in the United States? *[Cooler temperatures in the Southwest, and warmer temperatures in the East and Northeast.]*
- ? Do the sea surface temperature patterns that you previously observed correspond to the observed land surface temperature anomaly layer currently visible? Explain your reasoning. *[Answers will vary.]*

Elaborate

How would warmer ocean temperatures affect precipitation?

- Click the checkbox to the left of the layer name, Water Equivalent Anomaly: September 2009.
- ? What generalizations can be made about precipitation in California during an El Niño event? [*El Niño events tend to bring cooler, wetter conditions to California.*]

Evaluate

Is there an opposite event to El Niño?

- La Nina is the opposite event to El Niño, generally observed as unusually cold ocean temperatures in the Equatorial Pacific.
- ? From your observations of the 2015-2016 El Niño event, what sea surface temperature conditions may be present during a La Niña event? [*Sea surface temperatures will be below average.*]
- Click the checkbox to the left of the layer name, Sea Surface Temperature Anomaly: January 2008.
- Record your observations.

TURNING DATA LAYERS ON/OFF

- Make sure the Details pane is turned on by pressing the button, Details.
- Show the table of contents for the map by pressing the button, Show Map Contents.
- To show a map layer, check the box next to layer name.
- If a map layer name is light gray, zoom in or out of the map until the layer name is black. The layer can now be turned on.

ADD MAP NOTES

- Click the button, Add. Choose Add Map Note.
- Type a name, select a template from the drop-down list, and click Create.
- In the Add Features pane, choose a symbol and click in the map to place it.
- In the pop-up window, add your desired information.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://www.esri.com/schools>.

THEN TRY THIS...

- Use an ArcGIS Online organization subscription for schools to load this activity's map and create a hot spot analysis of climate events.
- Explore the website and story map from Stanford, *Mapping the Impacts of Global Climate Change*, at www.mappingglobalchange.org.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these texts.

- *Environment: The Science Behind the Stories (3rd)* by Pearson — Chapter 18
- *Living in the Environment (15th)* by Miller - Chapter 20