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**
- 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

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**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.
- 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.]

Evaluate

Is there an opposite event to El Niño?

- La Niña 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.

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