Data Visualization Activity Description

*Adapted from Earth Science By Design Handbook for Professional Developers (2006), available at: http://www.esbd.org/resources/ESBDBOOK.pdf*

In this activity, you will be shown examples of scientific visualizations and be introduced to a working definition of a scientific visualization. You will be led on a virtual tour of visualization websites. You will discuss the value of using visualizations to support Earth science teaching. You will review guidelines for evaluating the visualizations.

Activity Goals

This activity will help you to:

* Understand what is meant by scientific visualization.
* Know where to find scientific visualizations.
* Recognize the power of scientific visualizations to support learning.
* Use scientific visualizations to teach Earth science concepts.
* Select appropriate scientific visualizations for incorporation into an Earth system science unit by evaluating their suitability.

One of the goals of this summer program is for teachers to use scientific visualizations to build students’ understanding of water science. There are several types of data used and processes on Earth that can be studied with the data in visualizations.

Earth scientists routinely use satellite data to create images, maps, animations, and other representations to help them better understand and visualize processes that affect and shape our planet. They monitor earthquakes, track storms, measure sea surface temperatures and atmospheric temperatures, analyzing both short-term and long-term changes occurring on Earth.

By animating a decade’s worth of sea surface temperature data, Earth scientists can pick out periodic fluctuations, such as El Nino and La Nina events. They can study the movement of ocean currents and predict weather patterns. In particular, processes that occur over long periods of time can be animated and analyzed to help students understand the dynamic nature of planet Earth.

But let’s take a step back and define what we are talking about.

**Scientific visualization** – an image, photograph, map, graph, chart, drawing, illustration, animation, or simulation whose purpose is to promote understanding of a scientific concept or process.

Why should we use scientific visualizations in teaching Earth Science?

* Computer visualizations are central to the practice of Earth scientists
* Computer visualizations are dynamic and engaging
* Computer visualizations enable Earth science processes to be viewed over space and time in ways not possible with other media
* Computer visualizations can promote deep and enduring understanding

Links to scientific visualizations

* NASA’s Visible Earth, a catalog of NASA images and animations of our home planet
  + http://visibleearth.nasa.gov/
* NASA’s Earth Observatory, http://earthobservatory.nasa.gov/
* National Geographic Maps, http://maps.nationalgeographic.com/maps
* NOAA National Climatic Data Center: http://www.ncdc.noaa.gov/crn/visualizations.html
* Climate Central Gallery, http://www.climatecentral.org/gallery
* United States Drought Monitor/National Drought Mitigation Center: http://droughtmonitor.unl.edu/
* USGS California Drought Data Visualization website: http://cida.usgs.gov/ca\_drought/

Other visual tools to explore

* GeoMapApp: http://www.geomapapp.org/
* American Museum of Natural History (AMNH) Science Bulletins Earth Visualizations: http://www.amnh.org/explore/science-bulletins/%28subcategory%29/24950
* World Resources Institute Data Visualizations: http://www.wri.org/resources/data\_visualizations
* NOAA Ocean Today videos: http://oceantoday.noaa.gov/
* NASA/JPL Earth videos: http://www.jpl.nasa.gov/video/index.php?video\_destinations=Earth
* Earth Science World Image Bank, http://www.earthscienceworld.org/imagebank/
* Earth Science Picture of the Day, http://epod.usra.edu/

Standard Assessed:

* **PA Science Standards:** 
  + 3.3.6.A1. Recognize and interpret various mapping representations of Earth’s common features.
  + 3.3.6.A4. Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere.
* **NGSS Standards:**
  + MS-ESS2.C: Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.

**Evaluating Visualizations: An Example**

When evaluating the effectiveness of a visualization, consider both its basic design and your intended instructional use. Use these questions to guide your evaluation.

NOTE: the visualizations you will evaluated here are presented at the end of this handout and are from the 2007 GLOBE Earth System Poster

(color images available at: <http://www.globe.gov/do-globe/for-teachers/resources/additional-teaching-resources/earth-system-science-posters>)

**Grade level:**

For what grade level is this visualization appropriate?

**Instructional role:**

What big and subsidiary ideas in Earth science will this visualization help students understand?

Possible concepts this visualization may help uncover include:

**Accuracy:**

Is this visualization scientifically accurate? Which person or agency created this visualization? What is the underlying data, and how was it collected and processed to create this visualization?

**Background knowledge:**

What content knowledge is needed to understand this visualization? Are preparatory activities or scaffolding needed to use this visualization effectively? If so, how can these be provided to students?

**Embedded conventions:**

What visual conventions does this visualization use that students might not understand or that might lead to confusion?

* ***Scale:*** Is the scale clearly indicated? Is there any exaggeration of scale? For example, is the vertical dimension exaggerated with respect to the horizontal dimension?
* ***Legend and labels*:** Are they present, clear, and adequate?
* ***Projection*:** Are there aspects of the projection (such as distortion of area) that need to be explained?
* ***Color*:** Is it clear what the colors in the visualization represent? Are the colors misleading or confusing?
* ***Time and date*:** Is the time and date information provided adequate to understand the visualization?

**Misconceptions:**

Might this visualization inadvertently introduce misconceptions or misunderstandings? If so, how can you provide additional information to guard against this misunderstanding?

**Evaluating Visualizations: A Template**

When evaluating the effectiveness of a visualization, consider both its basic design and your intended instructional use. Use these questions to guide your evaluation.

As a group, let’s review NOAA Ocean Today’s video on The Water Cycle: http://oceantoday.noaa.gov/watercycle/

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