Investigating Tectonics with Web GIS

Lori Cirruci[1], Alec Bodzin[2], Allison Teletzke[2], David Anastasio[2], Dork Sahagian[2], Scott Rutzmoser[2], Denise Bressler[2], and Jill Burrows[2]

[1]Broughal Middle School and [2]Lehigh University, Bethlehem, PA

Session presented at the 2013 NSTA National Conference on Science Education in San Antonio, TX., April 11-14

Abstract

Educators have recognized that geographic information systems (GIS) have the capacity to promote spatial thinking by: a) enabling powerful, multidisciplinary visualization, analysis, and synthesis of data, b) expanding student understandings of Earth science, and c) enhancing inquiry in natural and social sciences. We developed six new Web GIS tectonics learning activities using a spatial learning design model that incorporates a related set of frameworks and design principles to provide guidance in the development of the geospatial technologies-supported curriculum materials. The Web GIS interface uses JavaScript for simplicity, intuition, and convenience for implementation on a variety of platforms, making it much easier for diverse middle school learners and their teachers to conduct Earth science investigations than would be possible using a desktop GIS. The Web GIS is designed with an intuitive interface to enable diverse learners to develop geospatial thinking skills that are important for understanding Earth's structures and processes and to investigate a range of Earth science issues. Students are able to perform advanced desktop GIS functions including spatial analysis, map visualization and query, and the manipulation of geospatial information. The Web GIS interface integrates graphics, multimedia, and animation in addition to some newly developed features allowing users to explore and discover geospatial patterns that would not be easily visible using typical classroom instructional materials. We discuss how teachers have successfully implemented the learning activities with just one-computer in the classroom without student laptops, modified instructional handouts to assist English language learners with science language acquisition, and provided important scaffolds to ensure that all classroom learners understand spatial relationships in the tectonics data. Implications for curriculum enactment including instructional adaptations for students who are English language learners, have disabilities, or are reluctant readers are discussed.

The ASTE Experiential Session:

The Web GIS investigations are freely available at:
http://www.ei.lehigh.edu/learners/tectonics/

To access the assessments, use login: **eliteacher**; password: **87dja92**.

Below are brief descriptions of the six investigations and open-ended investigations Web GIS. The Web address listed above contains additional information about each learning activity including teacher guides, student guides, assessments, and teacher support materials.

Investigation 1: Geohazards and Me: What geologic hazards exist near me? Which plate boundary is closest to me?

http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation1.html

In this investigation students locate geologic hazards created by tectonic forces near their geographic location. They discover where the most recent earthquake occurred near their geographic location and where the nearest volcano is located. They also investigate how geologic hazards are distributed around the globe and infer how this is related to plate tectonics.

Investigation 2: How do we recognize plate boundaries?
http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation2.html
In this investigation students use tectonics data to identify the eastern and western boundaries of the North American plate. They analyze earthquake epicenter and volcano data to determine the boundaries of the North American Plate and analyze the movement of the surrounding plates to determine plate boundary types (divergent, convergent, or transform).

Investigation 3: How does thermal energy move around the Earth?
http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation3.html
In this investigation, students locate areas where heat escapes from the Earth's interior and provide evidence for a hot mantle. They investigate how surface heat flow (loss) is distributed around the Earth and its relationship to plate boundaries. They also explore geologic features on the Earth's surface that are associated with heat loss.

Investigation 4: What happens when plates diverge?
http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation4.html
In this investigation, students locate different divergent boundaries and study their history. They investigate how tectonic stresses are accommodated at the plate boundary by examining earthquake and fault data and calculating the half-spreading rate of a plate boundary. They also investigate features of passive margins, areas along divergent boundaries where continental crust becomes oceanic crust.

Investigation 5: What happens when plate move sideways past each other?
http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation5.html
In this investigation, students locate oceanic and continental transform boundaries and study their history. They investigate an oceanic transform boundary, the Charlie-Gibbs Fracture zone, using earthquake and age of the ocean floor data. They also investigate a continental transform boundary, the San Andreas Fault zone, and the seismic hazards associated with living in this area using earthquake data and historical photographs.

Investigation 6: What happens when plates collide?
http://www.ei.lehigh.edu/eli/tectonics/sequence/investigation6.html
In this activity, students analyze the distribution of earthquakes and volcanoes to learn about plate collision at an ocean-ocean subduction zone. They analyze volcanoes and earthquakes near an ocean-ocean subduction zone, determine the slope of subduction along a convergent plate boundary, and discover the relationship between the Aleutian Islands, volcanoes, and the ocean-ocean subduction zone.

Open-Ended Investigations
http://www.ei.lehigh.edu/eli/tectonics/sequence/open.html
This Web GIS is a compilation of all the spatial data layers used in the ELI Tectonics investigations. Teachers can use this Web GIS for students to investigate their own questions about tectonics or can provide them with guiding questions to further explore spatial relationships and patterns in tectonics data.