Promoting Spatial Thinking with Web-based Geospatial Technologies

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DR K-12 Award 1118677

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Research Questions

1. To what extent does learning Earth and environmental sciences with curriculum materials that use a spatial learning design model and Web GIS mapping and analysis tools improve urban middle school learners' understandings of Earth science concepts and processes?

2. In what ways do learning Earth and environmental sciences with curriculum materials that use a spatial learning design model and Web GIS mapping and analysis tools enable spatial and geographical thinking with urban middle school learners?

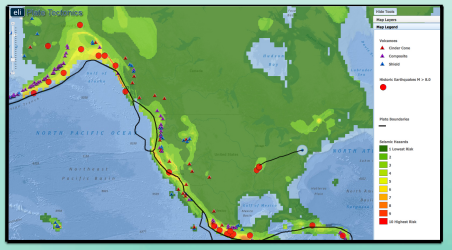
3. How can GIT-embedded curriculum materials be effectively designed to support teachers' adoption and pedagogical use of Web GIS to help teachers overcome existing implementation challenges in urban schools (e.g. differentiating instruction and modifying materials for diverse learners)?

Spatial Learning Design Model

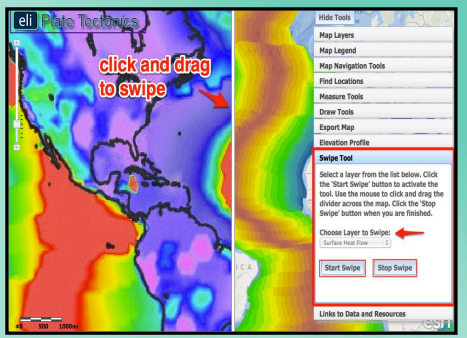
1. Elicit prior understandings of lesson concepts.
2. Present authentic task.
3. Model task.
4. Provide worked example.
5. Ask learners to perform task.
6. Scaffold task.
7. Ask learners additional questions to elaborate task.
8. Review activity concepts.

Key Features

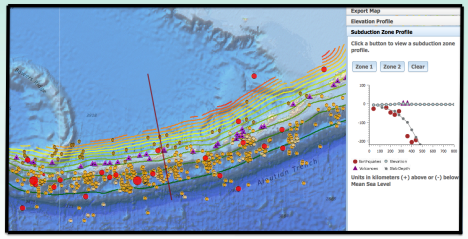
- Curriculum enhancement activities with javascript Web GIS to be platform independent (i.e. tablets, laptops, cellphones)
- Interface design for middle school learners
- Inquiry-based, geospatial learning investigations
- Visualizations and tool features designed to enable spatial thinking
- Content and pedagogical supports for teachers

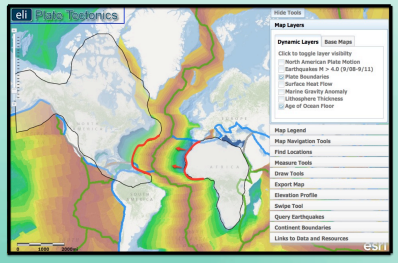


Investigation 1: Geohazards and Me: What geologic hazards exist near me? Which plate boundary is closest to me?
Analyzing relationships between locations, seismic hazards, plate boundaries, earthquakes, and volcanoes.

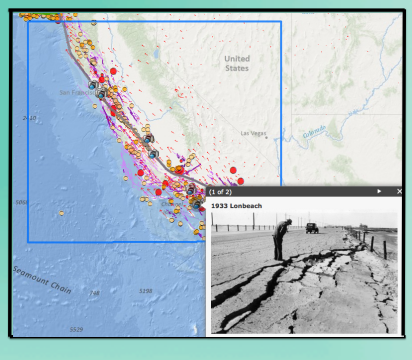


Investigation 3: How does thermal energy move around the Earth?
Swipe tool to analyze relationship between the age of the ocean floor and surface heat flow.





Investigation 4: What happens when plates diverge?
Dynamically move continental boundaries to examine plate motion.



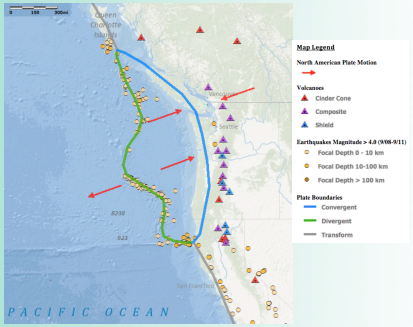
Investigation 5: What happens when plates move sideways past each other?
Locating a continental transform boundary in the San Andreas Fault zone. Analyzing plate motion vectors, faults, earthquakes, and historical imagery.

Investigation 6: What happens when plates collide?
Analyzing a subduction zone profile in the Aleutian Trench to understand spatial relationships among slab depth, earthquake foci, and volcanoes at a convergent boundary.

Research Methods

- Pilot-testing and field testing in an urban school district
- Tectonics content knowledge measures
- Spatial thinking and reasoning measures as applied to tectonics concepts
- Teacher Implementation practice to assess fidelity of implementation and curriculum enactment – adherence to geospatial learning design model
- Classroom observations
- Post-implementation survey items that address the pedagogical effectiveness of the educative curriculum materials

Sample Items



What pattern exists between volcano locations and plate boundaries?
A. Volcanoes occur on plate boundaries.
B. Volcanoes occur near plate boundaries.
C. Volcanoes occur only on the subducting plate.
D. Volcanoes occur only near divergent plate boundaries.

The image above includes…
A. two tectonic plates with two different types of plate boundaries.
B. two tectonic plates with three different types of plate boundaries.
C. three tectonic plates with two different types of plate boundaries.
D. three tectonic plates with three different types of plate boundaries.

Acknowledgements:
Development Team: Scott Rutzmoser, Allison Teletzke, Denise Bressler, Lori Cirruci, Jill Burrows
Data Management: Joan Fu, Farah Vallera
Program Evaluator - Jean Russo
Pilot testing middle school teachers