Using Web GIS to Support Geospatial Thinking and Reasoning

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DR K-12 Award 1118677

Environmental Literacy and Inquiry Group

http://www.ei.lehigh.edu/eli

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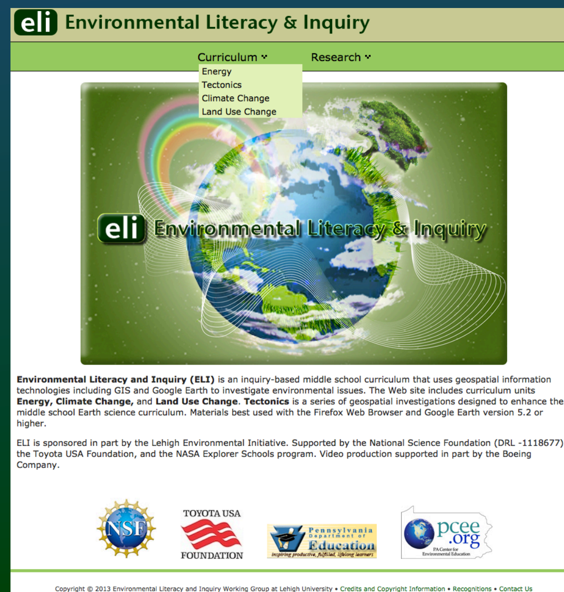
Violet Kulo – Instructional Design and Web Development
Laura Turner – Web Development
Farah Vallera– Data management
Middle school science teachers

ELI middle school curriculum

- Energy (40 days)
- Climate Change (21 days)
- Land Use Change (20 days)
- Tectonics (7 Web GIS investigations)



ELI middle school curriculum

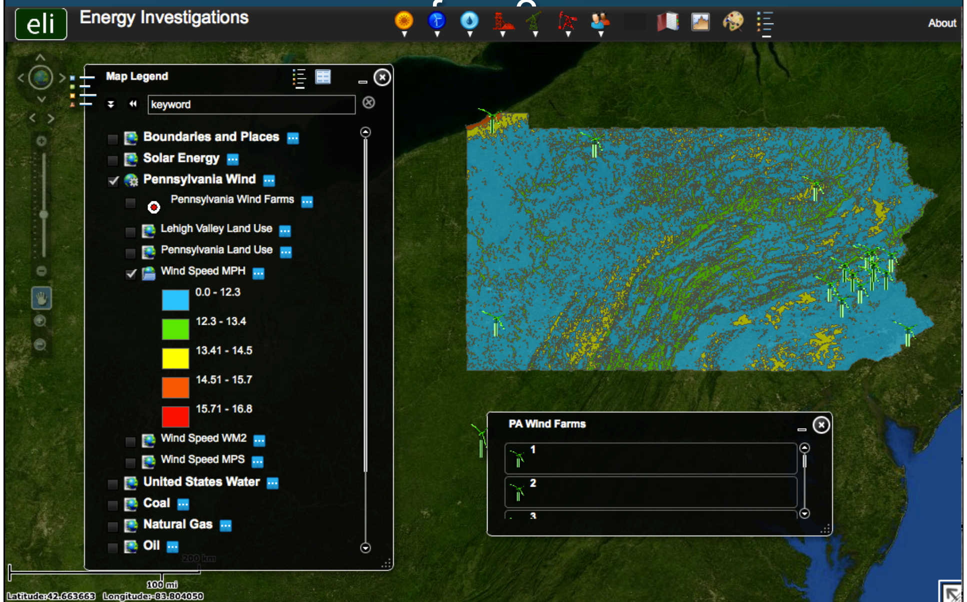
- **Geospatial curriculum approach:**
  - Curriculum framework
  - Design principles
  - Instructional model for the development of learning activities with GT
  - Educative materials to support teacher enactment
- **Align instructional materials and assessments with science and environmental literacy learning goals.**
- **Use geospatial technology as a tool for learners to explore and investigate problems.**
- **Iterative stages of development: Prototype, pilot test, and field test with diverse 8th grade urban classrooms.**

Design Principles

1. Design curriculum materials to align with the demand of classroom contexts.
2. Design activities to apply to diverse contexts.
3. Use motivating entry points to engage learners.
4. Provide personally relevant and meaningful examples.
5. Promote spatial thinking skills with easy to use geospatial learning technologies.
6. Design image representations that illustrate visual aspects of scientific knowledge.
7. Develop curriculum materials to better accommodate the learning needs of diverse students.
8. Scaffold students to explain their ideas.

http://www.ei.lehigh.edu/eli/energy/

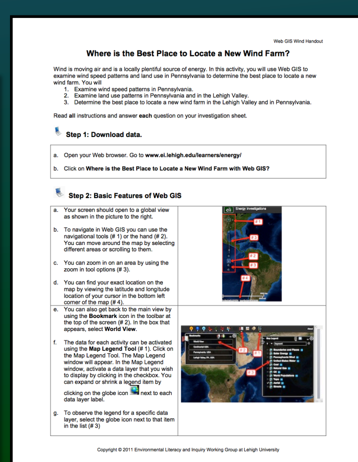
Where is the best place to locate a new wind farm?



http://gisweb.cc.lehigh.edu/energy/ ArcGIS viewer for Flex

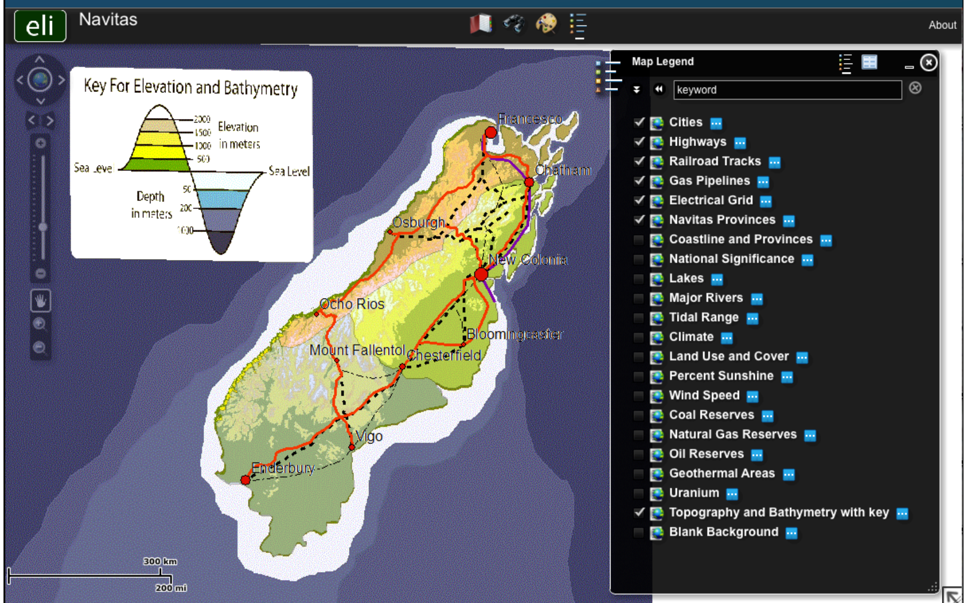
"Educative" Support Materials

- Pedagogical and content support for teachers
- Instructional Web GIS handouts: teacher guide, student handout, investigation sheet, assessment information
- WebGIS video tutorials

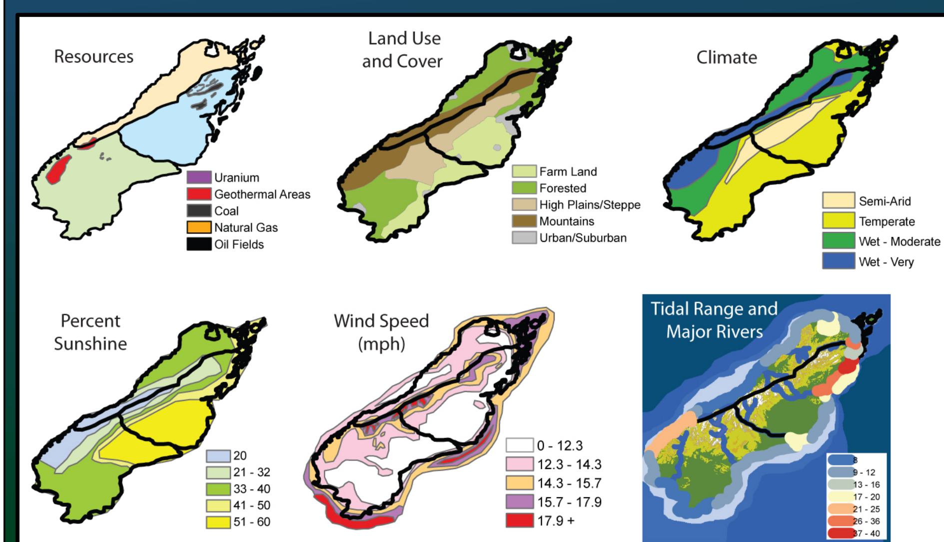


http://www.ei.lehigh.edu/eli/energy/support

Energy Culminating Investigation: Island of Navitas



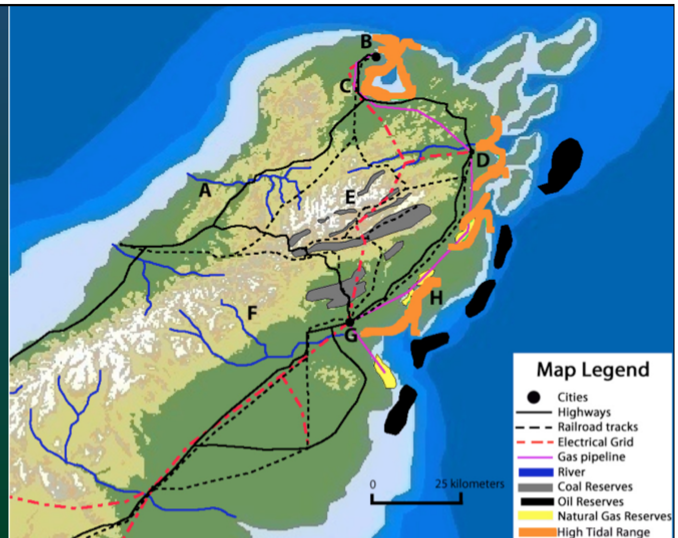
http://gisweb.cc.lehigh.edu/navitas/ ArcGIS viewer for Flex



http://gisweb.cc.lehigh.edu/navitas/

Where would be the best location to build both a coal and petroleum (crude oil) power plant?

A. Location A
B. Location C
C. Location E
D. Location F



What is a **disadvantage** to building a hydroelectric power plant at Location A?

A. A dam at this location could provide recreation opportunities.
B. Hydroelectric power generation does not create water pollution.
C. This location could not be used to build a tidal power plant.
D. Infrastructure is needed to connect to the electrical grid.

Findings

Geospatial technology integrated curriculum increased student's knowledge of Energy concepts and spatial thinking and reasoning skills.

Energy achievement and achievement by subscale for pre/post test.

	Pre-test Mean (SD)	Post-test Mean (SD)	Gain (SD)	Standard Effect
Entire Assessment (n=38)	15.16 (5.10)	22.10 (7.18)	6.94 (6.04	1.36***
Content Subscale (n=27)	10.80 (3.83)	16.09 (5.48)	5.29 (4.81)	1.38***
Spatial Subscale (n=11)	4.36 (1.97)	6.01 (2.28)	1.65 (2.38)	.84***

******p<0.001***
N=928

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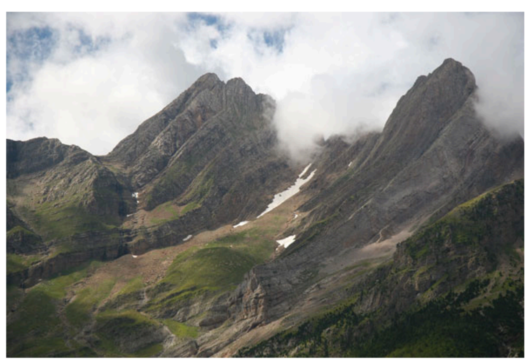
Tectonics Project Features

- Tectonics investigations for curriculum enhancement
- Javascript Web GIS to be platform independent (i.e. tablets, laptops, cellphones)
- Interface design and customized data display
- Visualizations and tool features designed to enable spatial thinking
- Content and pedagogical supports for teachers to implement geospatial learning investigations

eli Environmental Literacy & Inquiry

- Tectonics Home
- Overview
- Instructional Framework
- Instructional Sequence
- Student Resources
- Assessments
- Instructional Resources
- Support Materials

Tectonics Home

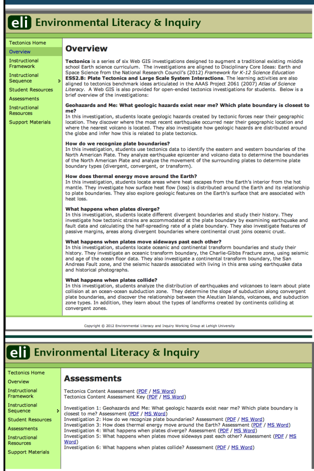


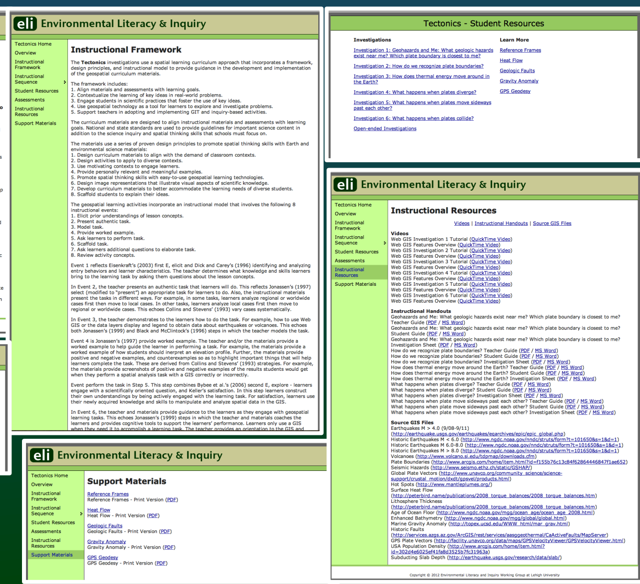
Tectonics is a series of geospatial investigations designed to augment existing middle school Earth science curriculum. Students use Web GIS to investigate important tectonics concepts. The investigations include scientific practices, crosscutting concepts, and core ideas from the National Research Council (2012) *Framework for K-12 Science Education*.

The materials are best used with the Firefox or Google Chrome Web browser. This material is based upon work supported by the National Science Foundation (DRL -1118677).

http:www.ei.lehigh.edu/eli/tectonics

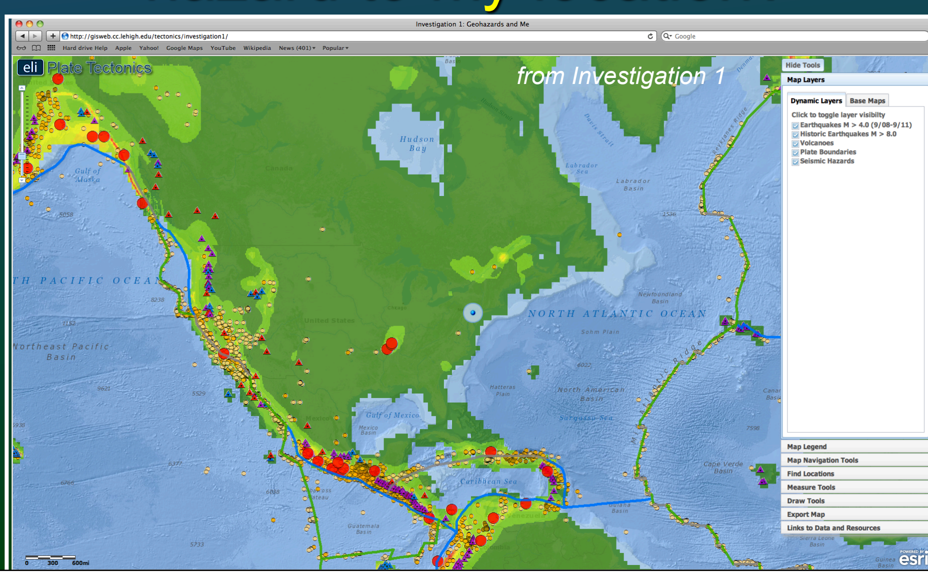
Menus



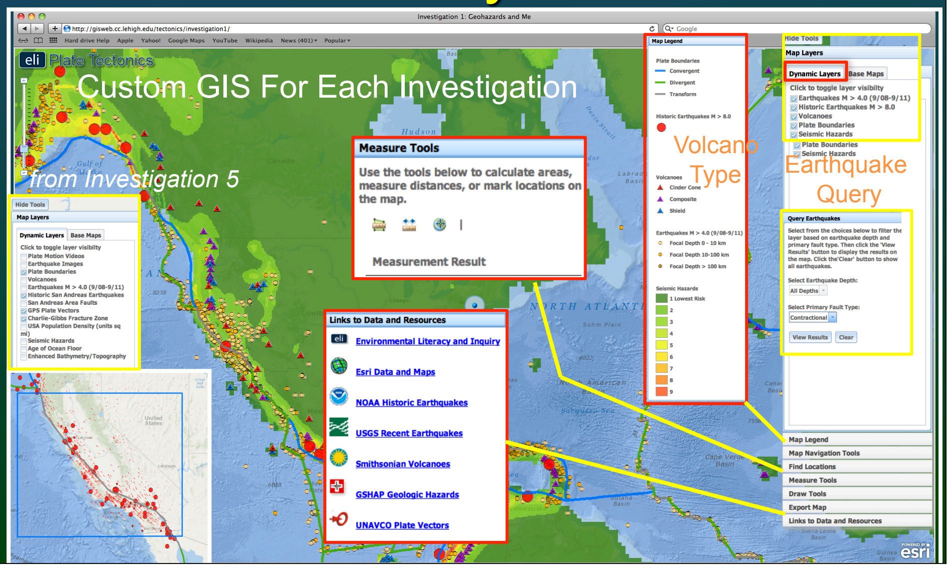


To access assessments:
Login: eliteacher
Password: 87dja92

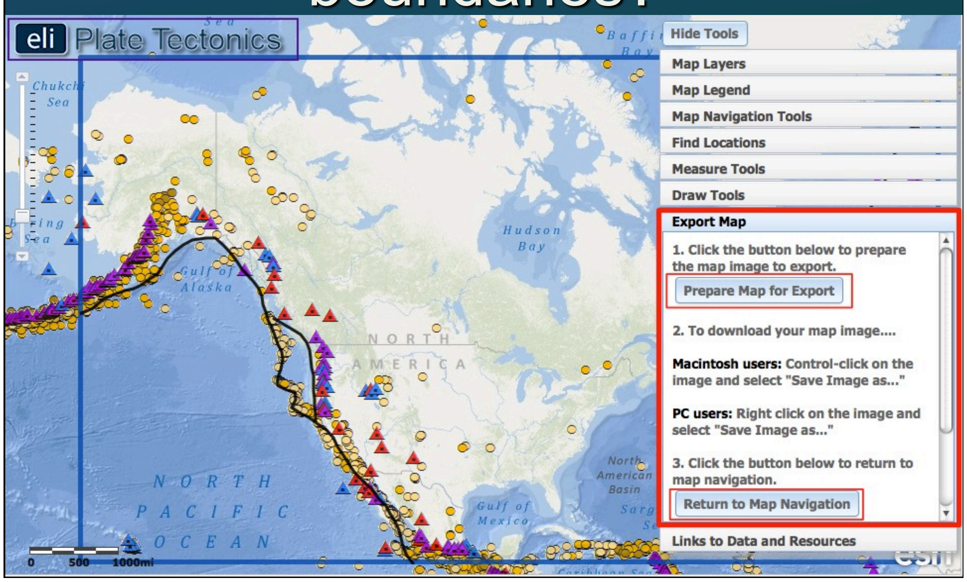
Where's the nearest hazard to my location?



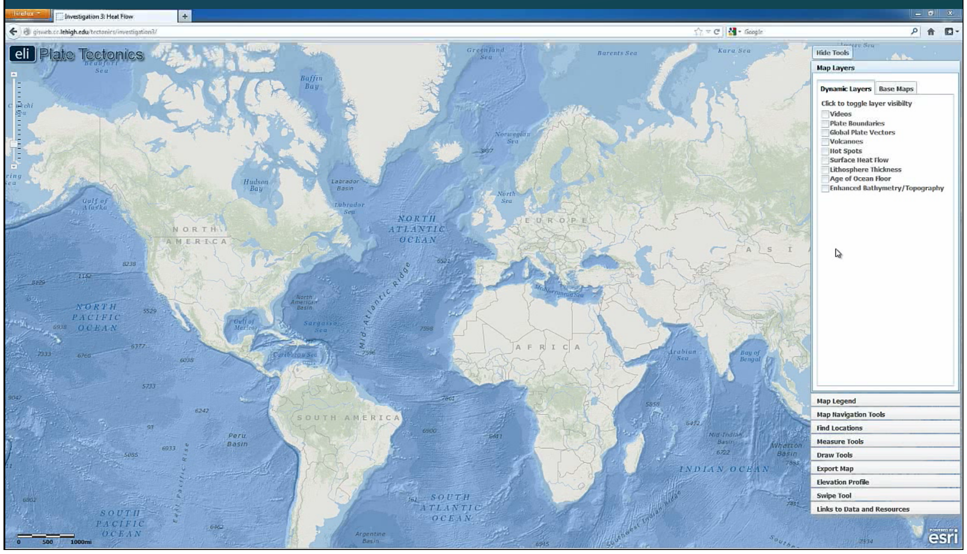
Where's the nearest hazard to my location?



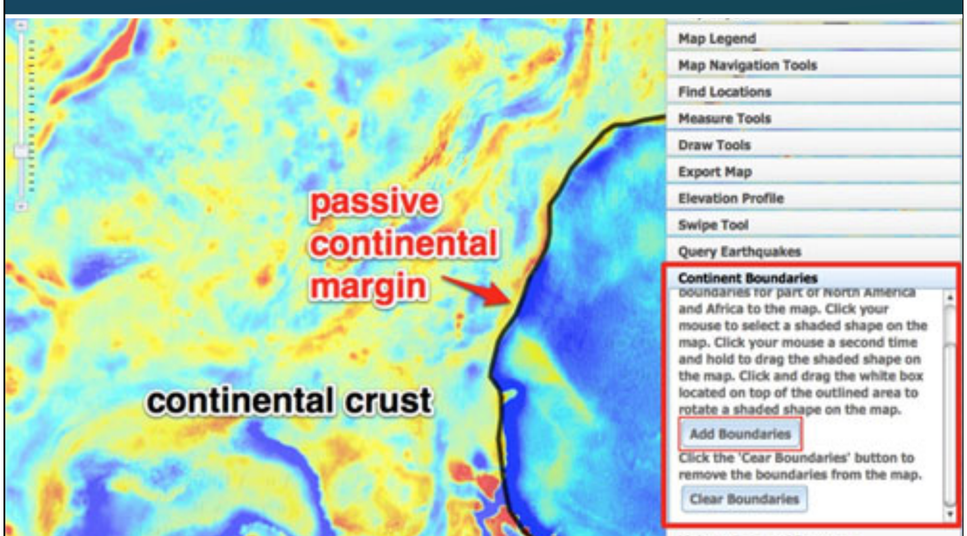
How do we recognize plate boundaries?



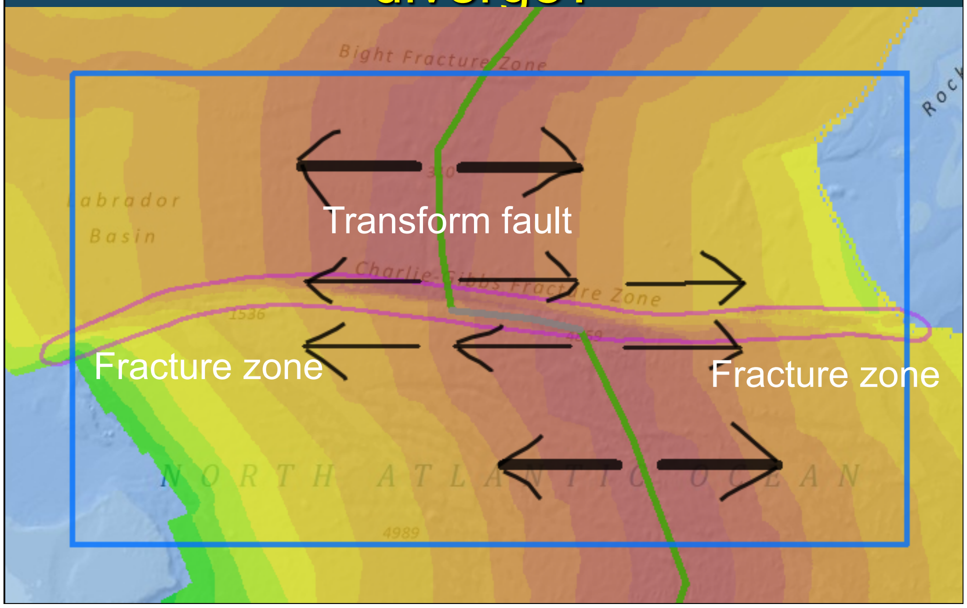
How does thermal energy move around in the Earth?



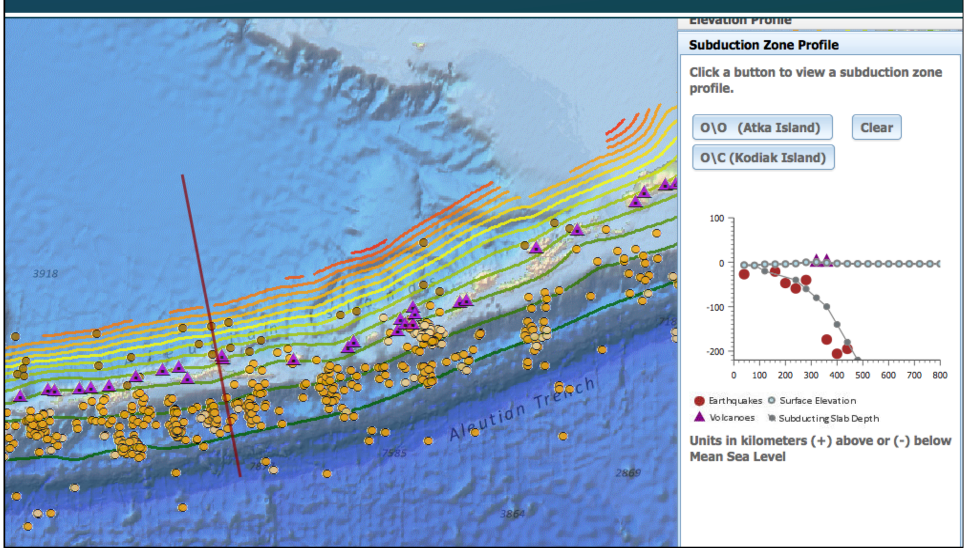
Continental Boundaries

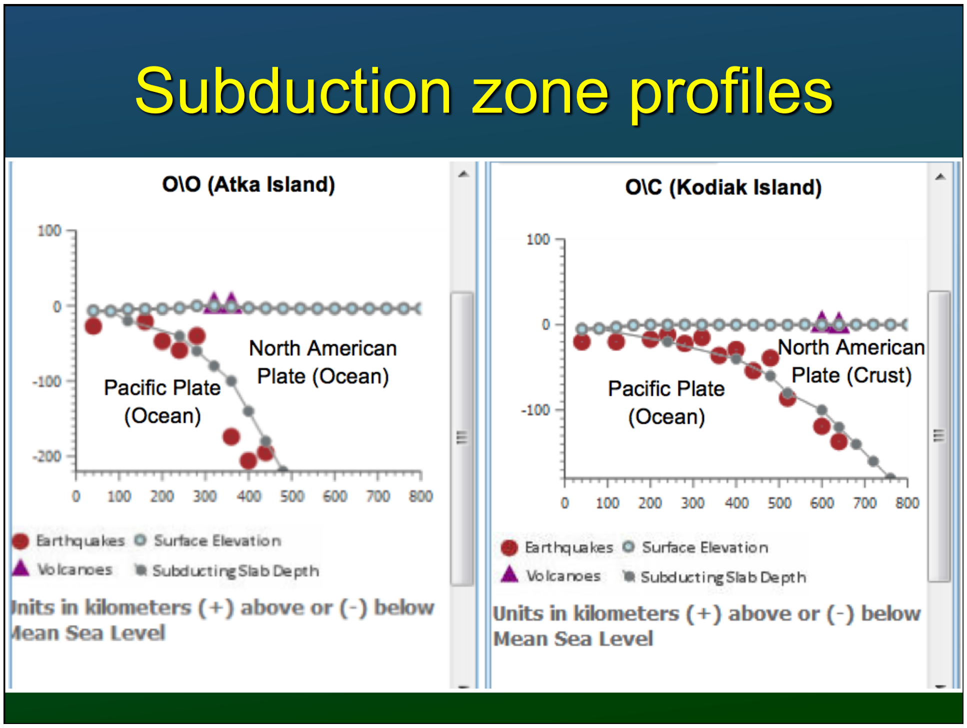


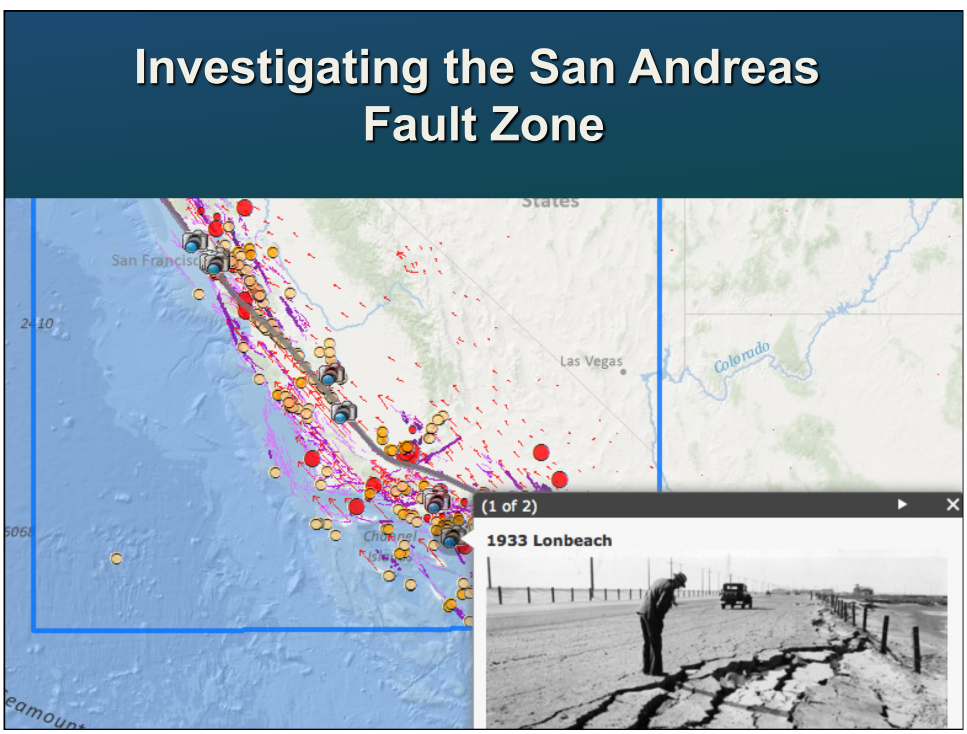
What happens when plates diverge?



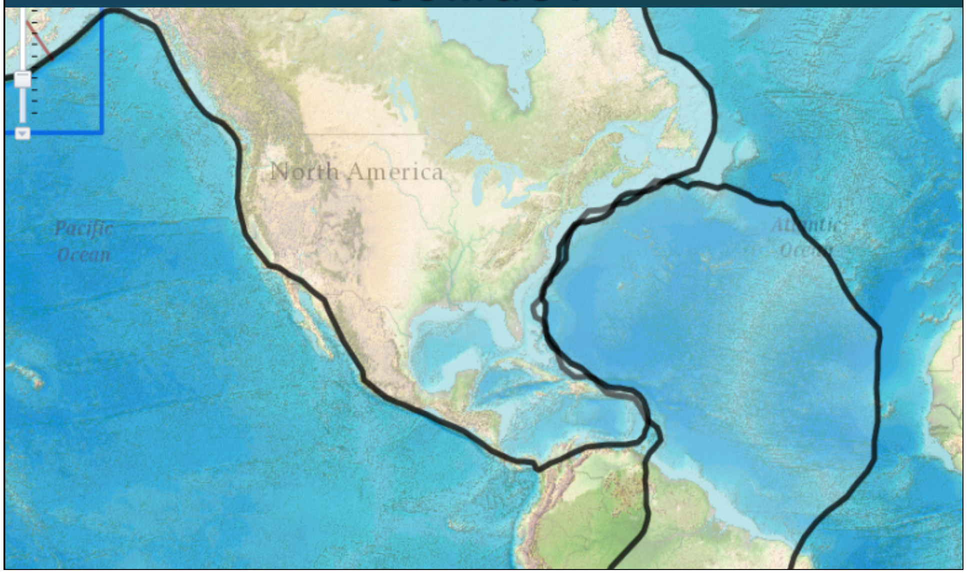
What happened when plates converge?




Subduction zone profiles
O\O (Atka Island)
North American Plate (Ocean)
Pacific Plate (Ocean)
Earthquakes
Surface Elevation
Volcanoes
Subducting Slab Depth
Units in kilometers (+) above or (-) below Mean Sea Level
O\C (Kodiak Island)
North American Plate (Crust)
Pacific Plate (Ocean)
Earthquakes
Surface Elevation
Volcanoes
Subducting Slab Depth
Units in kilometers (+) above or (-) below Mean Sea Level


Investigating the San Andreas Fault Zone
Las Vegas
Colorado
(1 of 2)
1933 Lonbeach

What happens when plates collide?



Findings

Web GIS investigations increased student's knowledge of tectonics concepts and spatial thinking and reasoning skills.

Overall achievement and achievement by subscale for pre/post test.

	Pre-test Mean (SD)	Post-test Mean (SD)	*t*	Effect Size
Entire Assessment (n=34)	17.57 (5.67)	24.79 (6.03)	49.45***	1.23
Geospatial Subscale (n=19)	9.61 (3.73)	13.71 (3.84)	39.50***	1.08
Tectonics Content Subscale (n=15)	7.96 (2.57)	11.09 (2.65)	40.12***	1.20

****p<0.001*
N=1025

Questions or Comments

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Presentation available at:
http://www.ei.lehigh.edu/eli/research/pubs.html

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