Incorporating Geographic Information Systems into Regents Earth Science Laboratory Curriculum

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Geographic Information Systems (GIS)

A GIS is an information system that recognizes location and can be utilized by every discipline.[1] The acronym GIS is used for Geographic Information Systems and broadly refers to any system that integrates, stores, edits, analyzes, shares, and displays geographic information.[2] GIS uses location to compare, relate, analyze unrelated data. Locations can be recorded as dates/times of occurrence, and x, y, z coordinates representing, longitude, latitude, and elevations. These systems allow us to visualize spatial data, thereby developing a deeper understanding of spatial relationships, patterns, and trends.

GIS is layercentric. Map projects are built with layers of data. In this way, a GIS combines the visual benefit of a map with the power of a database.[1]

Data can include:

- Basemaps
- Roads/Infrastructure
- Land use/Land cover
- Environment *f* Weather information
- Vehicle locations

GIS Summer Camp at UB

BPS teachers and students participated together in the 2017 GIS Summer Camp. The goal of the Camp was to provide teachers and students with guided instruction and hands-on practice with GIS concepts, software, mobile applications, and analysis.

The lessons included:

- Collecting field data using the Collector App.
- Using smartphones and Collector App to gather data, take geo-located photos
- Navigating Google Earth to visualize geographic phenomena
- Creating 3-D buildings using Sketch Up
- Designing Story Maps using Google Earth & ArcGIS Online
- Using real project data to perform geospatial analysis (mapping “hot spots”) of contamination

BPS students participate in an “Introduction to Ddrone Fligh” facilitated by UB Professors Dr. Cerne and Dr. Wang.

Content and Rational

PS #156 Frederick Law Olmsted is a public magnet 5-12 school focused on creativity and critical thinking. All 9th-grade students at Olmsted are enrolled in Regents Earth Science. This unit is designed to help strengthen scientific inquiry and analysis of geoscience data while simultaneously strengthening reading, writing, and informational skills for the gifted students, allowing collaboration between both groups and permitting modifications for simplifying lessons or adding enrichment as needed.

Unit Overview

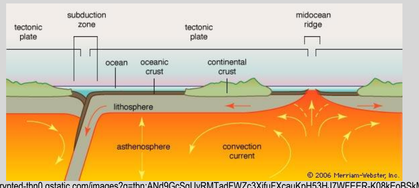
This Tectonics unit is a series of Geospatial investigations designed by Environmental Literacy & Inquiry (ELI), to augment existing middle school Earth science Curriculum, and has been enhanced to appropriately challenge 9th grade Olmsted students.

It will allow students to explore scientific principles related to plate tectonic motion and resulting geologic hazards. They will utilize conduct a series of experiments and simulations to understand and explain scientific and mathematical concepts and vocabulary, and ultimately design a model to express their understanding in a creative way.

Students will need to utilize critical and creative thinking, including collaborative problem-solving and 21st-century skills; science and math prior content knowledge, applied in new ways; and literacy skills, including following multi-step directions, explaining thinking verbally and in writing, and using metacognition to analyze their results.

Key Ideas

- The outer portion of the Earth is made up of about 20 distinct “plates”, which move relative to each other.
- The movement of thermal energy contributes to the movement of tectonic plates
- The location of geologic hazards (Earthquakes, volcanoes) is correlated with plate tectonic boundaries.
- Plate boundary types are determined by plate motion and interaction.
- Boundary conditions result in specific geologic features.



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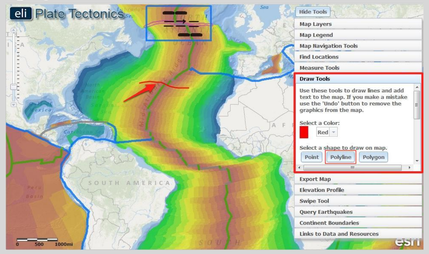
Teaching Implementation, Student Learning, & Terminology

Lesson 1: In this investigation, students research how geologic hazards are distributed around the globe and infer how this is related to plate tectonics.

Lesson 2: 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 movement of the surrounding plates to determine plate boundary types (divergent, convergent, or transform).

Lesson 3: Students locate different divergent boundaries and study their history. They investigate how tectonic strains 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 joins oceanic crust.

Lesson 4: They investigate an oceanic transform fault within the Charlie-Gibbs Fracture zone, using seismic 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.



Lesson 5: By analyzing the distribution of earthquakes and volcanoes, students learn about plate collision at an ocean-ocean subduction zone. They determine the inclination of subducted plates along convergent plate boundaries, and discover the relationship between the Aleutian Islands, volcanoes, and subduction zone types.

Standards

Next Generation Science Standards

- HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- HS-ESS2-3 - Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- HS-ESS3-6 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

NYS Common Core Learning Standards

ELA

- 9-10.L.1 - Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- 9-10.L.1.b - Conventions of Standard English: Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
- 9-10.L.6 - Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression

Science

- 1.SI.1 - The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.
- 6.MS.3 - The grouping of magnitudes of size, time, frequency, and pressures or other units of measurement into a series of relative order provides a useful way to deal with the immense range and the changes in scale that affect the behavior and design of systems.

Math

- A.SSE.1 - Interpret expressions that represent a quantity in terms of its context.
- 1.SI.1 - The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Resources & References

1. NAPSG Foundation, A Quick Guide to Building a GIS, n.p. Esri, 2014. Print.
2. Clarke, K. C., 1986. Advances in geographic information systems, computers, environment and urban systems, Vol. 10, pp. 175–184.
3. Environmental Literacy and Inquiry (ELI), 2017. An inquiry-based middle school curriculum that uses geospatial information technologies including GIS and Google Earth to investigate environmental issues. The Web site includes curriculum units on Energy, Climate Change, and Land Use Change. http://www.ei.lehigh.edu/eli/tectonics/index.html

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