



The Exploratorium Teacher Institute and Institute for Inquiry Present

NGSS STEM Conference 2020

All Systems Go!

Investigating Earth Systems Science in All Science Classrooms

Plate Tectonics and Its Driving Force

Saturday, March 7, 2020

This document can be found at: <https://tinyurl.com/driving-force-2020>

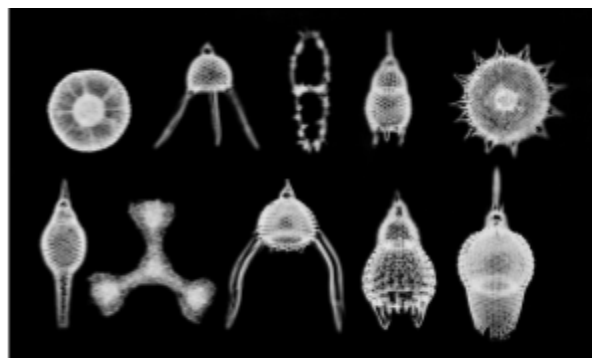
Don't get stuck between a rock and a hard place when it comes to sea-floor spreading and continental drift. Join us and be part of the upper crust as we investigate the driving force of plate tectonics. We'll gather evidence and find out how the cooling of the earth's interior is driving its exterior plate motion.

Anchoring question:

How did our local rocks get here, and why should you care?

About the rock you have:

- Rock type: Chert
- 200-100 mya
- Made of radiolaria - Plankton (tiny sea creatures = zooplankton)
- Found in deep-ocean sediments more than 4 km deep
- Found in more equatorial latitudes, southern Mexico or further south
- But now on top of [Twin Peaks!](#)



Radiolarians (10 Species), source: USGS.gov



Our rocks

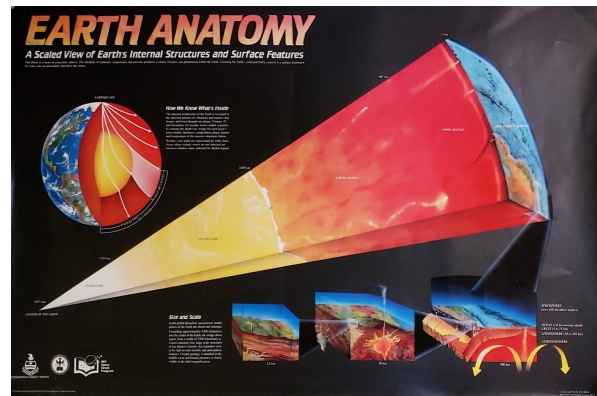
- Local geology: [interactive map](#)
You get this map/poster!

Other resources:

- U.S. Geologic Survey: [Geology of USA](#)
- National Park Service: [Golden Gate NPS](#)
- UC Berkeley Museum of Paleontology: [Radiolaria](#)

Given: The earth is made of tectonic plates

- Earth Anatomy poster:
Tectonic plates are thinner in comparison than an egg shell is to an egg!



Activity sequence:

- [Inverted Bottles](#)
- [Pie-Pan Convection](#)

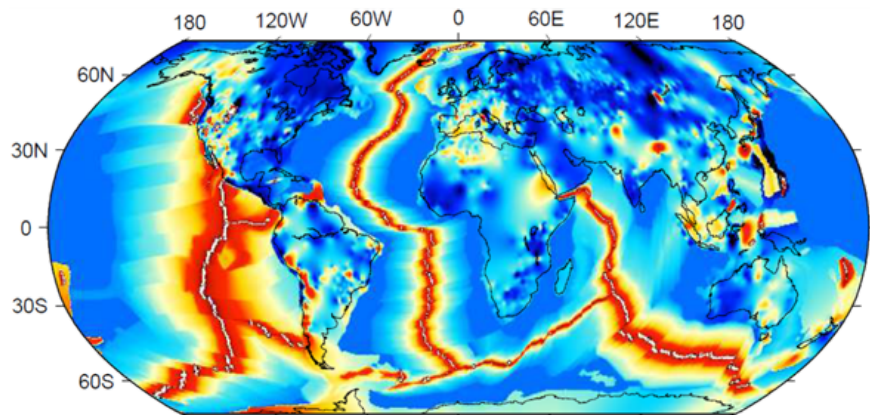
What are the dark lines?
Can you model what's going on in setup #2?



Maps and data:

Heat flow studies and data:

- [American Geophysical Union](#)
- [International Heat Flow Commission](#)



Animations of [plate tectonics from UCSB, by Tanya Atwater](#)

Other plate tectonics and convection resources:

- Hands-on activity: [Slab Pull](#)
- [Tectonics Overview, by the University of Texas](#)
- [Dynamic Earth, by the USGS](#)

Other evidence for sea-floor spreading and plate tectonics:

- Seismic data
- Magnetic striping
- Paleomagnetism
- Topography/Bathymetry
- Symmetry
- Density
- Gravity
- Age
- Fossils
- Fitting of the continents
- Modeling

Mini field trips around the museum:

- Cafe wall convection (art piece on wall of Seaglass)
- Convection current
- [Gas Model](#)
- [Turbulent Orb](#)

NGSS resources:

PEs

- 4-ESS2-2.
Analyze and interpret data from maps to describe patterns of Earth's features.
- 4-PS3-2.
- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- MS - ESS2-1
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- MS - ESS2-2
Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- MS-ESS2-3
Analyze and interpret data to provide evidence for phenomena on the distribution



of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

- MS-PS1-4.
Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- MS-PS3-4.
Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- HS-ESS2-3
Develop a model based on Earth's interior to describe the cycling of matter by thermal convection.

SEPs

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Developing and Using Models
- Constructing Explanations and Designing Solutions

DCIs

- ESS1.C: The History of Planet Earth
- ESS2.B: Plate Tectonics and Large-Scale System Interactions
- PS3.A: Definitions of Energy
- PS3.B: Conservation of Energy and Energy Transfer
- PS1.A: Structure and Properties of Matter

CCCs

- Patterns
- Cause and Effect
- Energy and Matter Systems and System Models
- Stability and Change

Image credits:

Radiolaria: <https://www.usgs.gov/media/images/radiolarians-10-species-0>

Heat flow:

<http://ihfc-iugg.org/products/global-heat-flow-database/mapping-studies>

