“Rotation”

Resource Summary:
Students will be presented with data showing the age of the main Hawaiian island chain. Students will label the ages of the Hawaiian Islands on a map and generalize the direction and average speed of the Pacific Plate. Using this information, students will predict how far the Channel Islands have rotated in the same amount of time. Students will then be presented with data that shows the different pieces of evidence of the theory of plate tectonics. Students will examine fossils in the Pleistocene epoch to make predictions about how the plates and climate have changed.

Subject Areas: Science

Grade Level Range: 9^{th}-12^{th}

Standards:
Common Core English Language Arts

RST.9-10.1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

RST.11-12.1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

Next Generation Science Standards

HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

Resource Provided By: Cody Foster, Biology, Marine Biology, and Earth Science, Buena High School, Ventura Unified School District

Resource Details:
1. Students watch “Island Rotation” segment from *West of the West*. While watching the video, direct the students to pay close attention to the timeline that the Channel Islands broke off from mainland California.
2. Students are independently or in pairs. Each student is given a set of web resources and questions. In part I, students will explore the major pieces of evidence that support the plate tectonic theory.
3. In part II, students will use the pieces of evidence to construct an explanation as to how the Channel Islands would have broken from the mainland. Students will also calculate how fast the plate rotates, and how long it would have taken the Channel Islands to move to their current location.

4. The data that they calculate (rate of plate movement and timeline of movement) are rough and estimated. Using the data presented in the video, have a class discussion as to why their estimations and the estimations of the video differ.

Part I—Examining Evidence of Plate Tectonics
Use the following website and directions to complete the following prompts.

- Go to: https://www.geolsoc.org.uk/Plate-Tectonics
- Click on "Pioneers of Plate Tectonics"
- Click on "Alfred Wegener"

1. Alfred Wegener produced many pieces of evidence to support his theory of "Continental Drift," but what was his theory missing?

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2. Fill out the following chart by clicking on each piece of evidence for Continental Drift.

Piece of Evidence	**How it supports Continental Drift**
Jigsaw Fit	
Geological Fit	
Tectonic Fit	
Glacial Deposits	
Fossil Evidence	

- Click on "Pioneers of Plate Tectonics"
- Click on "Dan McKenzie"

3. Dan McKenzie provided the missing link that Alfred Wegener was unable to explain before his death. Explain how Dan McKenzie transformed the theory of Continental Drift into Plate Tectonics.

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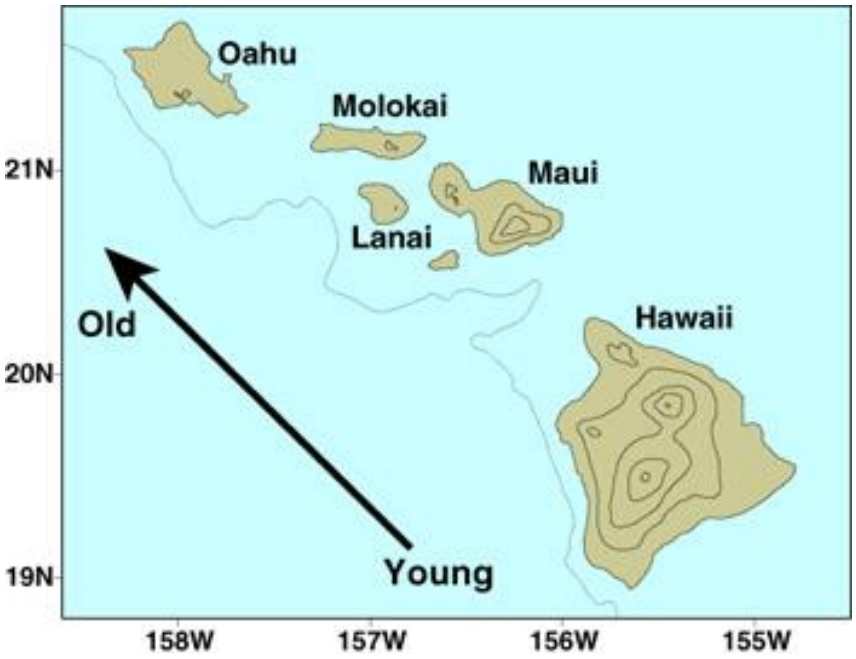
Part II—Movement of the Pacific Plate

Part of Dan McKenzie's work in plate tectonics has to do with modeling of hot spots. In this section, you will analyze the Hawaiian hot spot to calculate the direction and movement of the Pacific Plate. You will then use these calculations and information to predict how the Channel Islands in California have moved over time.

- Go to: http://www.punaridge.org/doc/factoids/hawaii/

1. Label the following diagram with the estimated ages of each island:



2. The difference in age between **Oahu** and **Hawaii** is _____ million years. This is approximately the time it took the island of **Oahu** to move to its current location.

3. The approximate distance between **Oahu** and **Hawaii** is 335 km. Calculate the estimated **rate of Pacific Plate movement** by dividing the distance **Oahu** has migrated by the time it took the island to migrate. Use the following equation to help you convert your answer to **cm/yr.**

$$\frac{distance\ Oahu\ has\ moved\ (km)}{time\ (million\ years)} \times \frac{10{,}000\ (cm)}{1\ km} = \_\_\_\_\_\ \frac{cm}{yr}$$

4. The distance between Anacapa Island and San Diego is approximately 250 km. Use the rate of Pacific Plate movement calculated in question #3 to approximate how long ago the main chain of the Channel Islands broke from the mainland.

$$\frac{distance\ Oahu\ has\ moved\ (km)}{rate\ of\ plate\ movement\ (\frac{cm}{yr})} \times \frac{10{,}000\ (cm)}{1\ km} = \_\_\_\_\_\ yr$$

Image source: http://www.punaridge.org/doc/factoids/hawaii/

5. Now that we know how long it took the Channel Islands to migrate to their current location, use the evidence from the previous page to synthesize an explanation for how this would have occurred.

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Additional Resources:

1. Animated Life: Pangea, Wegener, and Continental Drift: https://www.youtube.com/watch?v=RgJZ0ySEKYg

2. Plate Tectonics Interactive from University of CO, Boulder: https://phet.colorado.edu/en/simulation/plate-tectonics

3. There are several activities and videos associated with PBS Learning Media's website: http://ca.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp_platetectonics/plate-tectonics/