Rate of Plate Movement

Overview:

Hawai‘i volcanoes are born when magma rises from a hotspot through the Pacific Plate and is erupted as lava onto the ocean floor. A chain of volcanoes is formed as the Pacific Plate continually moves over the hotspot. The rate at which the Pacific Plate moves can be calculated if the age of a volcanic island and the distance from its hotspot source is known. In this activity, students calculate the rate at which the Pacific Plate moves.

Objectives:

The student will:

- calculate the individual rates of movement for four islands on the Pacific Plate;
- calculate the average rate of movement of the Pacific Plate;
- forecast how far the Pacific Plate will move in 100 years; and
- understand that the rate the Pacific Plate moves has increased over the past 65 million years.

Materials:

- Calculator
- Student Worksheet: “Rate of Plate Movement”

Answers to Student Worksheet:

Analysis of Data:

1. Moloka‘i—16.1 cm/yr
   Kaua‘i—10.4 cm/yr
   Midway—8.7 cm/yr
   Suiko—7.5 cm/yr
2. No
3. 10.675 to 10.7 cm/yr (answers should fall within range)

Conclusion: If the same hotspot formed Suiko, Midway, Kaua‘i and Moloka‘i, then the rate of Pacific Plate movement is increasing over time.
Other answers will vary

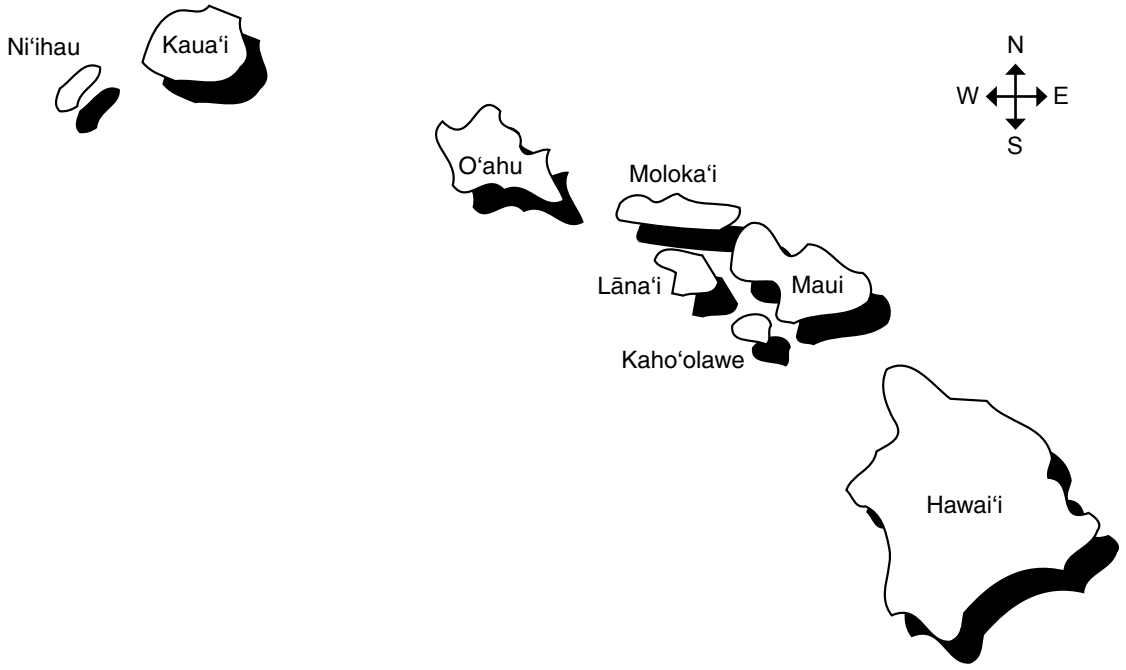
Further Questions:

1. (1067.5 cm to 1070 cm) or (10.675 to 10.7 meters)
2. Answers will vary
   12 years old—128.1 cm to 128.4 cm
   13 years old—138.8 cm to 139.1 cm
   14 years old—149.5 cm to 149.8 cm

Rate of Plate Movement

Activity Procedure:

1. Distribute the Student Worksheet: "Rate of Plate Movement." Explain that students will determine how the rate of Pacific Plate movement has changed over time.
2. Ask students to read the Background Information and look at the map, then use this information to write a hypothesis.
3. Explain that students will calculate the rate of movement of the Pacific Plate. Rate is calculated when distance is divided by time. To calculate how fast the Pacific Plate is moving, students will need to divide the distance the island is from the hotspot by the age of the island. This information is provided in the Data section of the worksheet. Make sure students recognize the abbreviation for million years (Ma).
4. Students must then convert the answer from kilometers per million years to centimeters per year. Explain that a conversion factor is needed to convert kilometers per million years (km/Ma) to centimeters per year (cm/yr). The conversion factor for km/Ma to cm/yr is 1/10. One kilometer per million years is the same as .1 centimeter per year.
5. Distribute calculators and ask students to perform calculations to complete the chart and questions on their worksheets.
6. After students have completed their worksheets, discuss Conclusions and Further Questions.



Name:_____ **Student Worksheet**

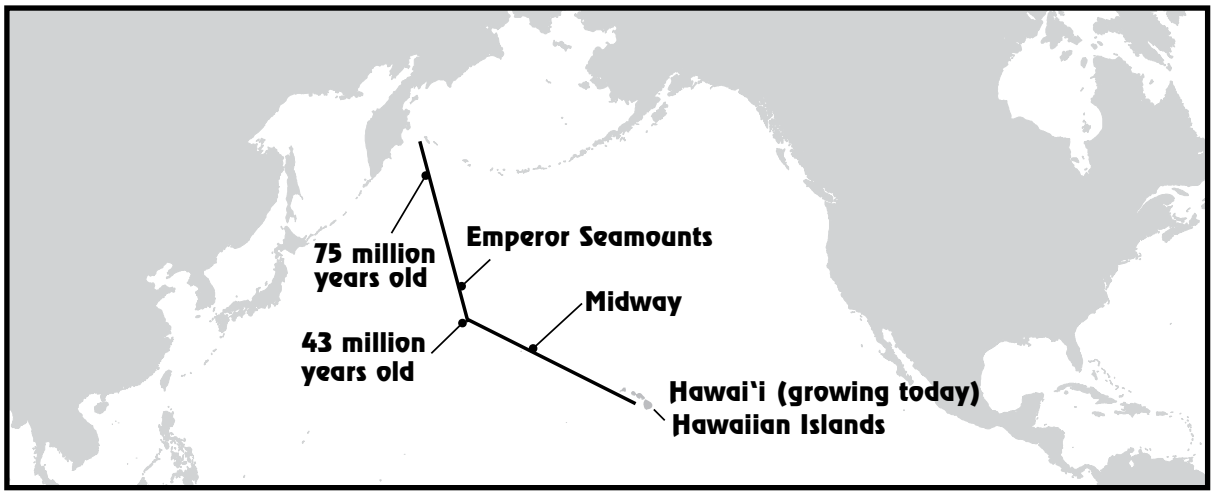
Rate of Plate Movement

Testable Question:

How has the rate of Pacific Plate movement changed over time?

Background Information:

In the early 1960s, J. Tuzo Wilson suggested that volcanic ocean island chains were created when Earth's plates move continuously over a stationary hotspot. The Emperor Seamounts and the Hawaiian Archipelago were formed in this way. Scientists have developed methods for determining the ages of these islands and seamounts. The map shows the Emperor Seamounts and Hawaiian Islands today.



Hypothesis:

During this activity, you will calculate the rate of Pacific Plate movement for different time periods. This will help you learn how the rate of Pacific Plate movement has changed over time. Complete the hypothesis below by writing the correct answer (increasing or decreasing) in the blank.

If the same hotspot formed Suiko, Midway, Kaua'i and Moloka'i, then the rate of Pacific Plate movement is _____ over time.

Data: Scientists have collected the following data regarding the age and distance from the hotspot of various islands and seamounts in this chain.

Island or Seamount	Distance from hotspot (km)	Age (Ma)
Moloka'i	290	1.8
Kaua'i	519	5
Midway	2432	28
Suiko	4860	65

Name:_____ **Student Worksheet**

Rate of Plate Movement

Analysis of Data:

1. Use the formula (island distance from hotspot ÷ island age) to calculate the rate of movement for each island in the chart, then multiply by .1 to convert from kilometers per million years to centimeters per year. Round your answers to the nearest tenth.

Island	Distance (km) ÷ Age (Ma)	x	Conversion factor	=	Rate (cm/yr)
Moloka‘i	290 ÷ 1.8	x	.1	=	
Kaua‘i	519 ÷ 5	x	.1	=	
Midway	2432 ÷ 28	x	.1	=	
Suiko	4860 ÷ 65	x	.1	=	

2. Is the rate of movement of the Pacific Plate constant? _____

3. Follow the directions in the box to calculate the average rate of movement of the Pacific Plate. Write the answer in the space below.

   Answer: _____ cm/yr

Fill in the rate of movement from the chart in question #1, above.

Island	**Rate**
Moloka‘i	_____ cm/yr
Kaua‘i	_____ cm/yr
Midway	_____ cm/yr
Suiko	_____ cm/yr
Total	_____ cm/yr

To find the average, add the rates of movement for the four islands and divide by the number of islands used in the calculation, in this case 4. Write the average rate of movement in the blank on question #3, above.

Name:_____ **Student Worksheet**

Rate of Plate Movement

Conclusion:

Write your conclusion as a complete sentence on the lines below.

_____

_____

_____

Was your hypothesis proved or disproved? Explain your answer.

_____

_____

_____

Further Questions:

1. Using the average rate of movement, how far will the plate move in 100 years? Show your work.

   The total distance the plate will move in 100 years = the Average Rate (from Analysis of Data section) X 100 years.

   Answer: _____ cm

2. Using the average rate of movement, how far has the plate moved in your lifetime? Show your work.

   Answer: _____ cm

