

# LESSON 3 How Did the Island Chain Form?

## Lesson at a Glance

Students view two video segments presented by the NOAA's Learning Center. In these short videos, students learn about the theory of plate tectonics and hot spots. Students then participate in a class discussion, and complete a diagram showing the different types of tectonic movements.

## Lesson Duration

One 60-minute period.

## Essential Question(s)

What is plate tectonics?

How does the Earth's crust move along plate boundaries?

What is a hot spot and where are they found?

How does plate tectonics help explain the characteristics of an island chain formed by a hot spot?

## Related HCPSIII Benchmark(s):

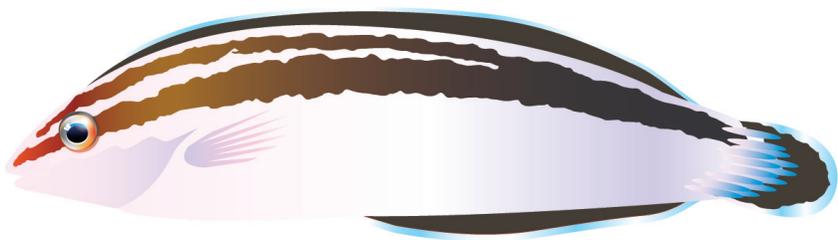
Science SC 4.8.1  
Describe how slow processes sometimes shape and reshape the surface of the Earth.

## Key Concepts

- Plate tectonics is a theory that explains that the Earth is covered by a series of plates that are continually moving, spreading from the center, sinking at the edges, and being remelted in the Earth's interior.
- The three types of plate boundaries are *convergent* (collision, subduction), *divergent* (seafloor spreading), and *transform* (slide side by side).
- Earthquakes and volcanoes occur along plate boundaries.
- The Hawaiian archipelago was formed by a stationary hot spot deep in the Earth's mantle, away from plate boundaries.

## Instructional Objectives

- I *can* describe the 3 types of plate boundaries, *convergent*, *divergent*, and *transform*.
- I *can* explain why Earthquakes and volcanoes occur along plate boundaries.
- I *can* define what a *hot spot* in the Earth's crust is, and describe how a hot spot relates to plate tectonics.
- I *can* describe the origin of the Hawaiian archipelago, and how it was formed by volcanoes over a hot spot in the Pacific tectonic plate.



## Assessment Tools

### Benchmark Rubric:

<b>Topic</b>		Forces that Shape the Earth	
<b>Benchmark</b> <a href="#">SC.4.8.1</a>		Describe how slow processes sometimes shape and reshape the surface of the Earth	
<b>Rubric</b>			
<b>Advanced</b>	<b>Proficient</b>	<b>Partially Proficient</b>	<b>Novice</b>
Use evidence to explain how slow processes have shaped and reshaped the surface of the Earth	Describe how the shaping and reshaping of the Earth's land surface is sometimes due to slow processes	Provide examples of the shaping and reshaping of the Earth's land surface due to slow processes	Recognize that the shaping and reshaping of the Earth's land surface is sometimes due to slow processes

### Assessment/Evidence Pieces

<p><b>Lesson</b></p> <ul style="list-style-type: none"> <li>• <i>Plate Tectonic Drawings</i></li> </ul> <p><b>Unit</b></p> <ul style="list-style-type: none"> <li>• <i>The Island Formations portfolio maybe used to monitor student progress throughout the unit.</i></li> </ul>
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### Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> <li>• Computer with Internet access</li> <li>• Method to project short videos</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

### Instructional Resources

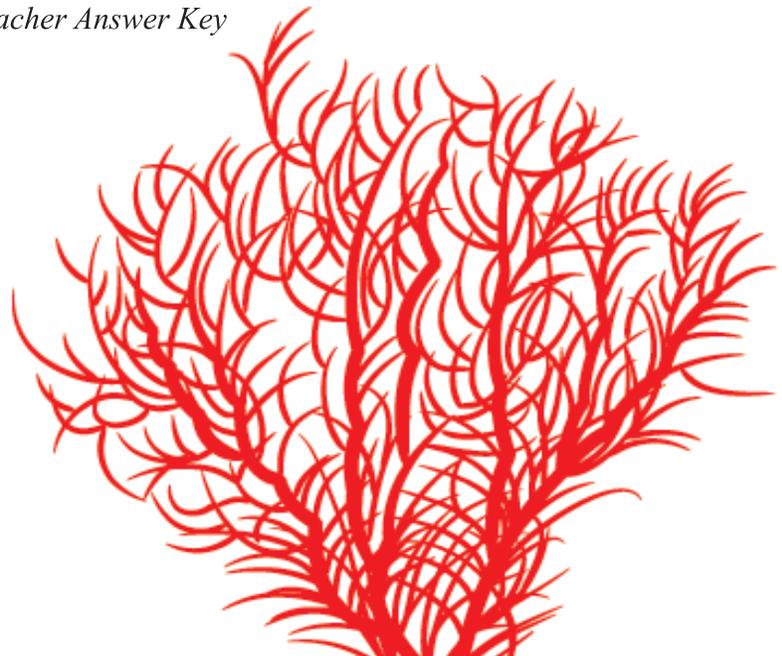
Student Reading: *Plate Tectonics Diagrams*

Student Worksheet: *Plate Tectonic Drawings*

PowerPoint Presentation: *World's Tectonic Plate Boundaries*

Teacher Worksheet: *Plate Tectonic Drawings-Teacher Answer Key*

Video: *Tectonic Plates and Volcanoes*



## Student Vocabulary Words

**absolute location:** the exact location on the planet where something resides, or the latitude and longitude of a place.

**archipelago:** a group of islands in an expanse of water, with many scattered islands.

**atoll:** a ring-shaped coral reef or string of closely spaced small coral islands that enclose or nearly enclose a shallow lagoon.

**convergent boundary:** two tectonic plates collide and one is pushed under the other plate.

**divergent boundary:** two tectonic plates that are moving away from each other.

**fringing reefs:** a reef that runs parallel to and is in close proximity or is directly adjacent to the shoreline.

**guyot:** a submerged seamount that at one time was above or in close proximity to the sea surface.

**hotspot:** generally localized plumes of magma that originate in the Earth's mantle and move outward through the crust; magma movement may result in volcanic eruptions.

**high islands:** islands that are composed of volcanic rock whose landmass is above the sea surface.

**low islands:** islands that are composed of coral and/or sand whose landmass is above the sea surface.

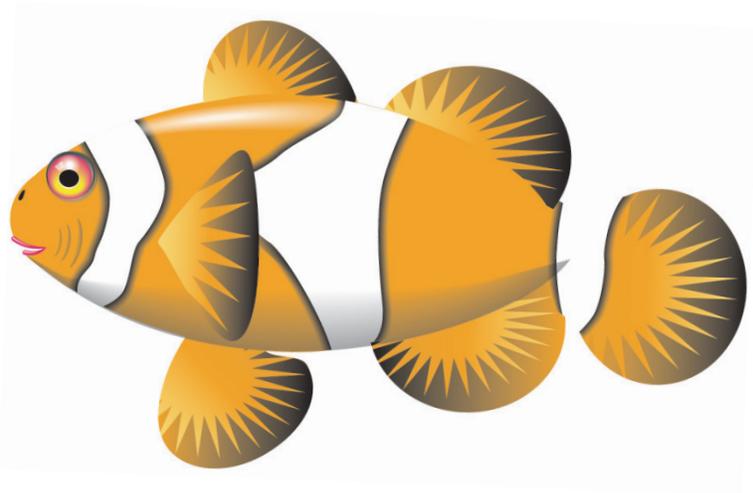
**lines of latitude:** numerical system of imaginary circles on Earth's surface that lie parallel to the Equator and are used to describe position north and south of the Equator; measured in increasing degrees north and south away from the Equator.

**lines of longitude:** numerical system of imaginary half circles on Earth's surface that lie perpendicular to the Equator and end at the poles, used to describe position east and west, measured in degrees with 0° at the Prime Meridian.

**plate tectonics:** geologic theory that combines the concepts of sea floor spreading and continental drift to explain the large-scale movement of the Earth's crust.

**relative location:** the location of a place in relation to another place (*Kauai* is WNW of Oahu).

**transform boundary:** tectonic plates slide and grind against each other.



## Lesson Plan

### Lesson Preparation

- Review the Science Background provided in the Unit Overview.
- Review and make copies of Student Reading *Plate Tectonics Diagrams* and Student Worksheet *Plate Tectonic Drawings*, one per student.
- Preview PowerPoint *Tectonic Plate Boundaries* and make arrangements to project it.
- Preview video clips from the College of Exploration on Plate Tectonics and Hawaiian Hot Spots at: <http://mm.coexploration.org/video/tcoe/vtw06/bbflv/index.html>
- View NOAA's Learning Objectives video on plate tectonics <http://www.learningdemo.com/noaa/>

### I. Activating Prior Knowledge

- A. Have students brainstorm a list of natural disasters that have occurred over the past several years (or historically) that they remember. (i.e: *The Indonesian Tsunami, Hurricane Katrina, and Earthquakes recently felt in Hawai'i will probably be some of the main responses.*)
- B. Tell students that you will be looking at geological events such as Earthquakes and volcanoes. Note that tornadoes and hurricanes are not geological events, but meteorological events (*disasters caused by weather*). Circle the geological events the students thought of, and tell them that today, they will be learning how those geological events helped to shape the Hawaiian Islands.
- C. Write the term *plate tectonics* on the board, and ask whether students are familiar with the term. Allow students to briefly share what they know about plate tectonics.
- D. Explain that shifts in plates on the Earth's surface are responsible for much of the incredible landforms we know, such as mountain ranges, valleys, and volcanoes.



## II. *Plate Tectonics*

- A. Show students the Plate Tectonics video from NOAA’s learning center, *Plate tectonics*. Hand out Student Reading *Plate Tectonics Diagrams* and have the class take notes on it and keep them in their *Island Formation* portfolio. <http://www.learningdemo.com/noaa/>
- B. View the short video clip from College of Exploration on *Hawaiian Hot Spots* and have students continue to take notes to add to the portfolio. As students watch, have them look for information explaining the difference between volcanoes caused by shifts in the Earth’s plates, and those caused by hot spots. <http://mm.coexploration.org/video/tcoe/vtw06/bbflv/index.html>
- C. Show students short PowerPoint “*Tectonic Plate Boundaries*”. Notes at the bottom of the slides will direct discussion.
- D. After viewing the video segments and PowerPoint, ask students to come up with a definition of *hot spot* and write it on the board. (*An area where a plume of magma forms and comes to the surface forming a volcano.*)
- E. Discuss the following questions:
  - 1) How do volcanoes form?  
(*They can form when one plate sinks under another plate. As the sinking plate moves deeper into the mantle it is heated and water in the plate turns to steam and helps to melt the rock on the overlying plate. The newly formed melt (now magma) rises through the crust, breaking rocks along the way, and erupts as a volcano. They can also form when magma rises to the surface where a mantle plume, or **hot spot**, reaches the surface of a plate.*)
  - 2) What effect do plates have on volcanoes?  
(*Volcanoes are sometimes caused by shifting of plates and, therefore, can be found where plates meet, like the Pacific Rim of Fire. Volcano locations may also trace the movement of a plate, as in the Hawaiian archipelago which is the surface expression of the hotspot beneath the Pacific Plate.*)
  - 3) How are the Hawaiian volcanoes different than those in the *Ring of Fire*?  
(*Hawaiian volcanoes are caused by hot spots rather than shifting and sinking of the Earth’s plates.*)
- F. Check for understanding by having the class complete Student Worksheet *Plate Tectonic Drawings*. Go over the directions at the top of the worksheet with the class. If students have trouble completing the worksheet the teacher may allow them to use the notes from the video clips to assist them. This worksheet will be placed in the *Island Formations portfolio* as evidence of student progress and meeting benchmark standards.

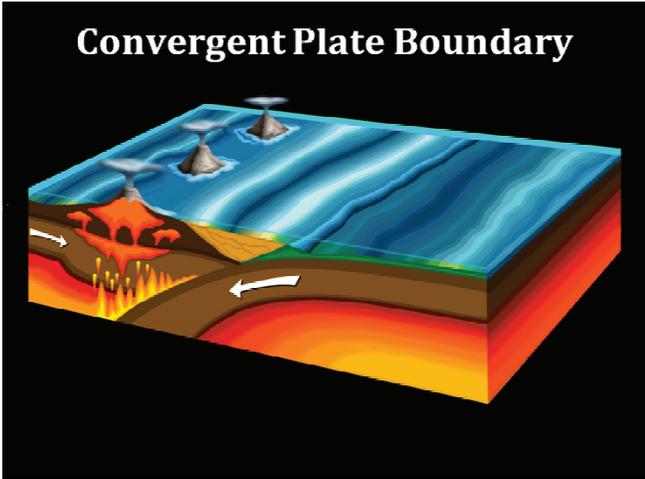
### Extended Activities

- A. Students can build their own volcanoes by following the instructions presented on the National Geographic’s [Forces of Nature](http://www.nationalgeographic.com/forcesofnature) Website. (Click on *build your own volcano*.)  
<http://www.nationalgeographic.com/forcesofnature>
- B. In groups, start a simple inquiry about movements and create a model that shows what happens when plates converge or diverge.

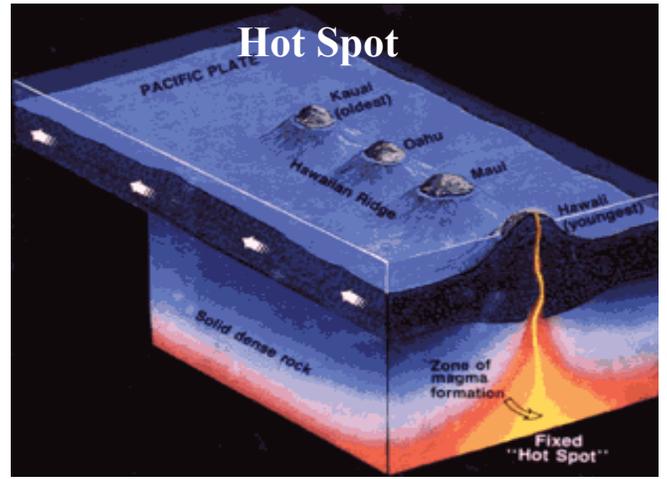
# LESSON 3 Plate Tectonics Diagrams



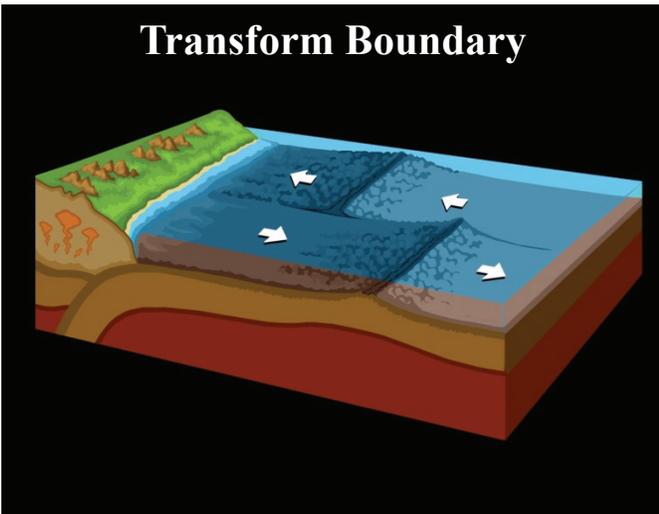
### Convergent Plate Boundary



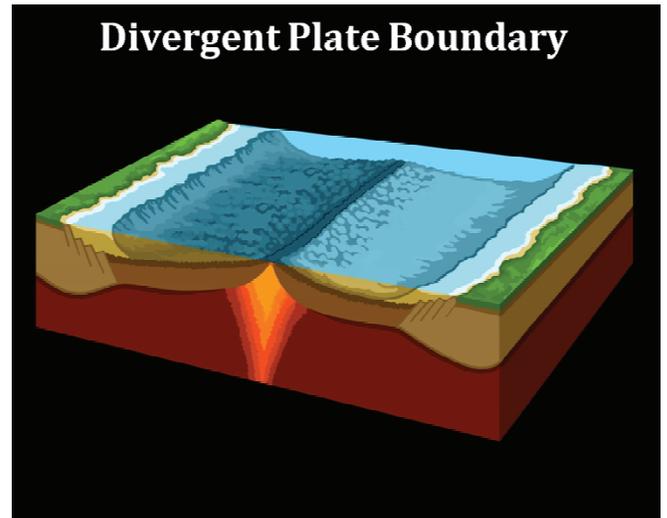
### Hot Spot



### Transform Boundary



### Divergent Plate Boundary



# LESSON 3 Plate Tectonic Drawings

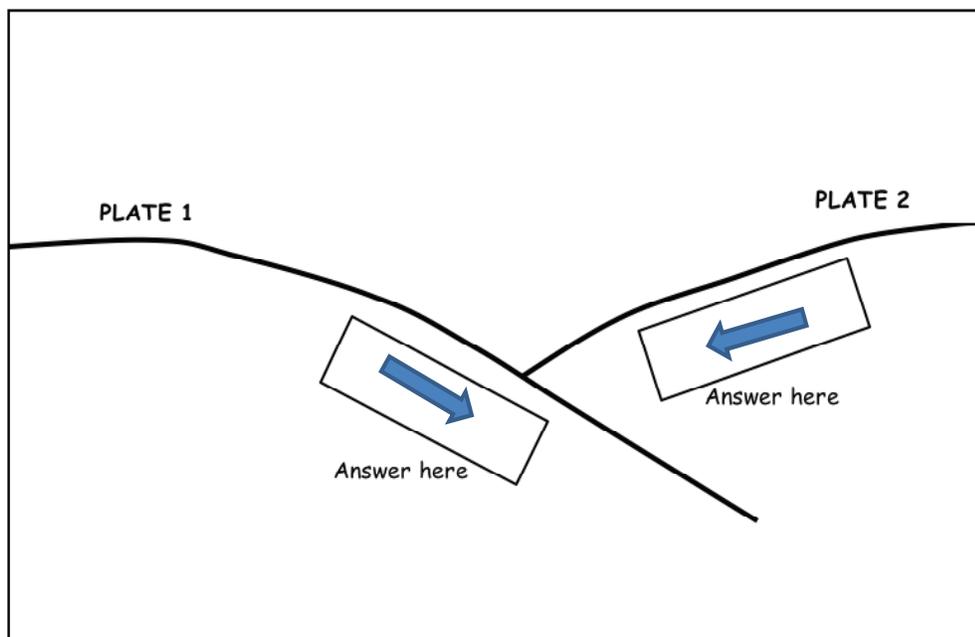
## Teacher Answer Key

Name: \_\_\_\_\_ Date: \_\_\_\_\_

(BENCHMARK:SC 4.8.1. Describe how slow processes sometime shape and reshape the surface of the Earth.)

### Directions:

In the top left hand corner of each diagram label the different tectonic plate movements you learned about. Use arrows inside the boxes to show the direction in which the Earth's crust is moving. In the space under each diagram box explain what is happening with each type of plate movement. Complete the short answer questions on the last page of the worksheet.



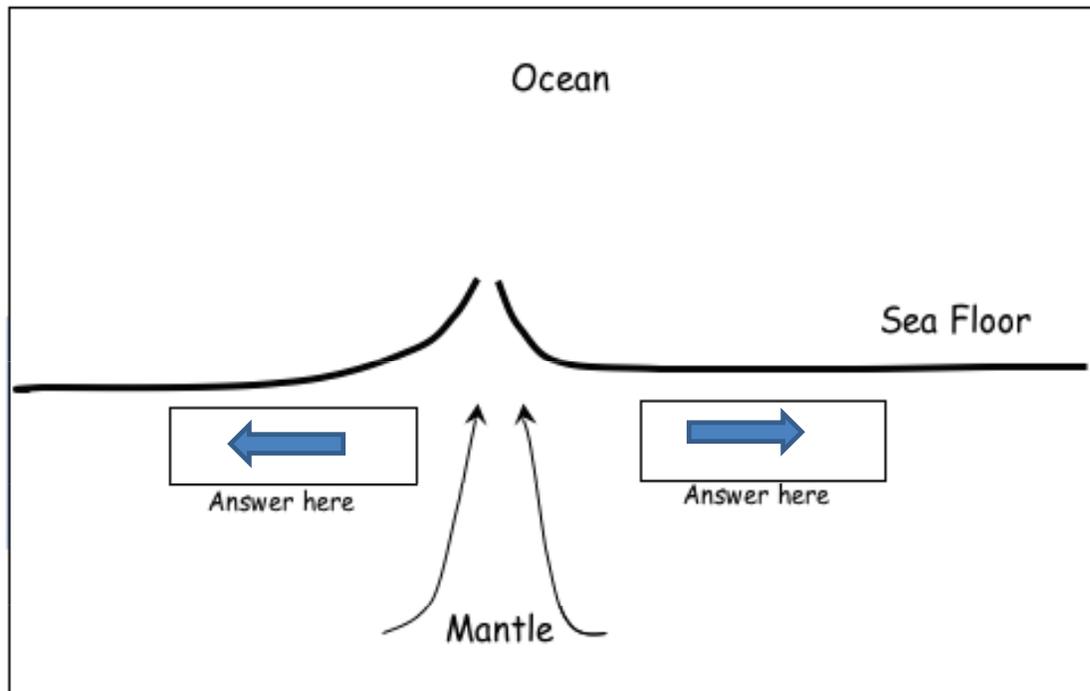
**Convergent boundary** occurs when two tectonic plates collide and one is pushed under the other plate.

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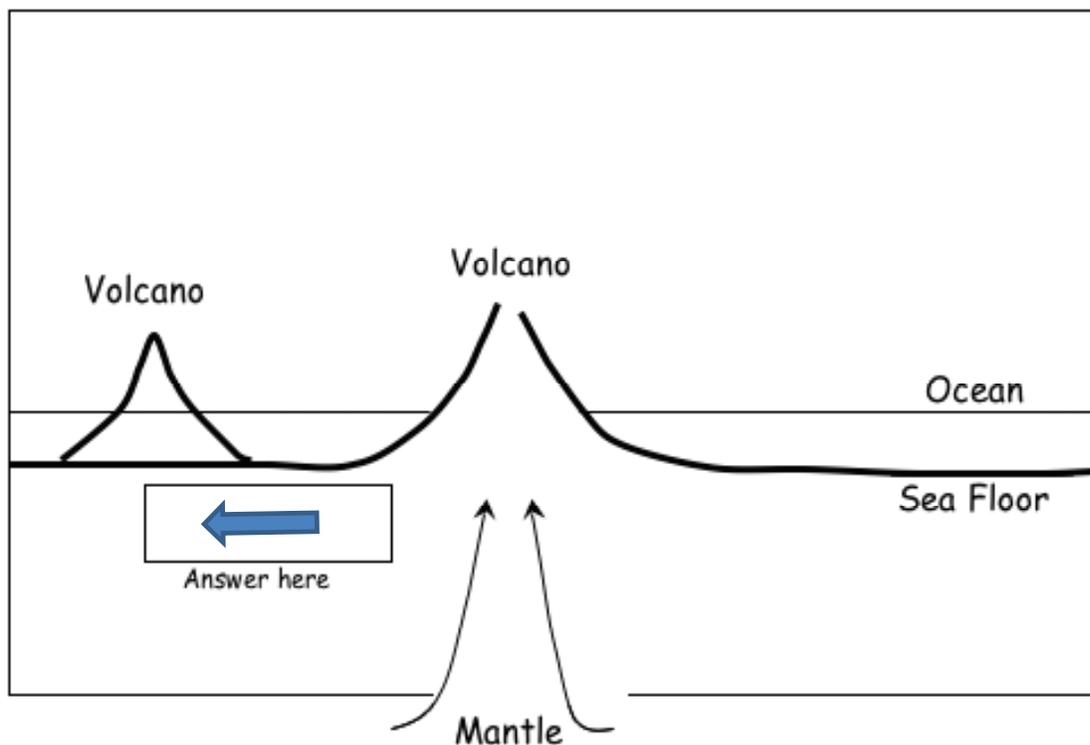


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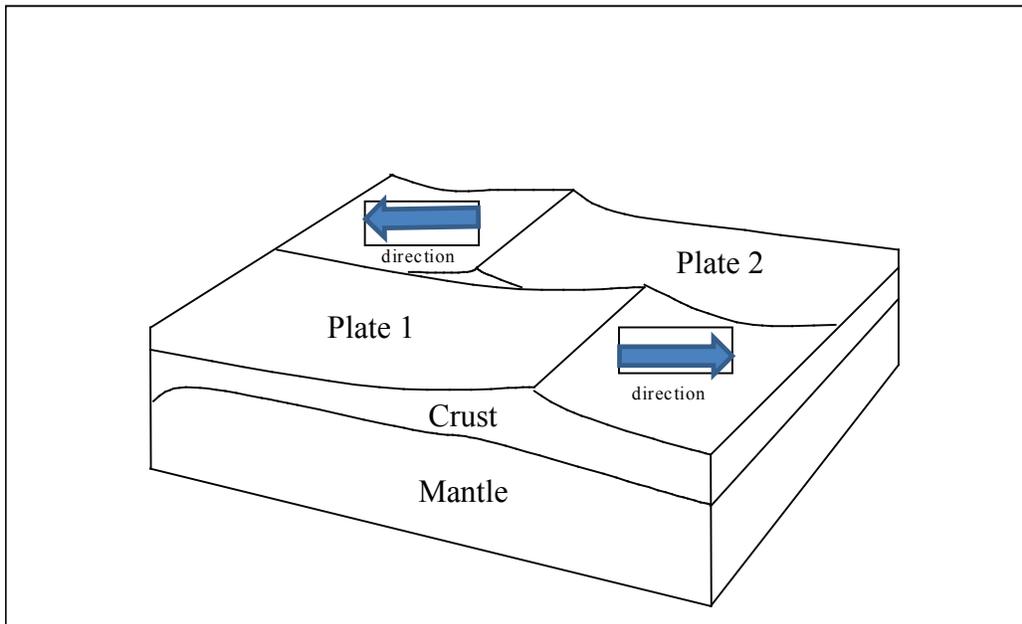




**Divergent plate boundaries** are defined as two plates that are moving away from each other due to new material being pushed upwards from the mantle asthenosphere between them; these are the sites of spreading centers and mid-ocean ridges.



**Hotspots** are generally localized plumes of magma that originate in the Earth's mantle and move outward through the crust; magma movement may result in volcanic eruptions.



**Transform plate boundaries** occur where two plates are sliding next to each other. Due to the friction between the two plates the sliding is more similar to grinding. As a result, large faults are formed along these boundaries which is where earthquakes occur.

Explain why earthquakes and volcanoes occur along plate boundaries.

Earthquakes occur along plate boundaries when two plates slip or grind past one another. Volcanoes are sometimes caused by shifting of plates and, therefore, can be found where plates meet. Volcano locations may also trace the movement of a plate, as in the Hawaiian archipelago which is the surface expression of the hotspot beneath the Pacific Plate.

Define what a *hot spot* in the Earth's crust is, and describe how a hot spot relates to plate tectonics.

Hotspots are plumes of magma that originate in the earth's mantle and move outward through the crust. As a crustal tectonic plates move over hot spots mantle material upwells and erupts on the surface of the plate to form a volcano, seamount or volcanic island.

Describe how the formation of the islands in the Hawaiian archipelago took place.

The islands and seamounts of the Hawaiian Archipelago were created by a hot spot under the Pacific Plate that has been active for the past 41 million years. The tectonic plate where the Hawaiian islands are located has been shifting or moving over the hot spot for a long period of time, which is how the different islands were formed.

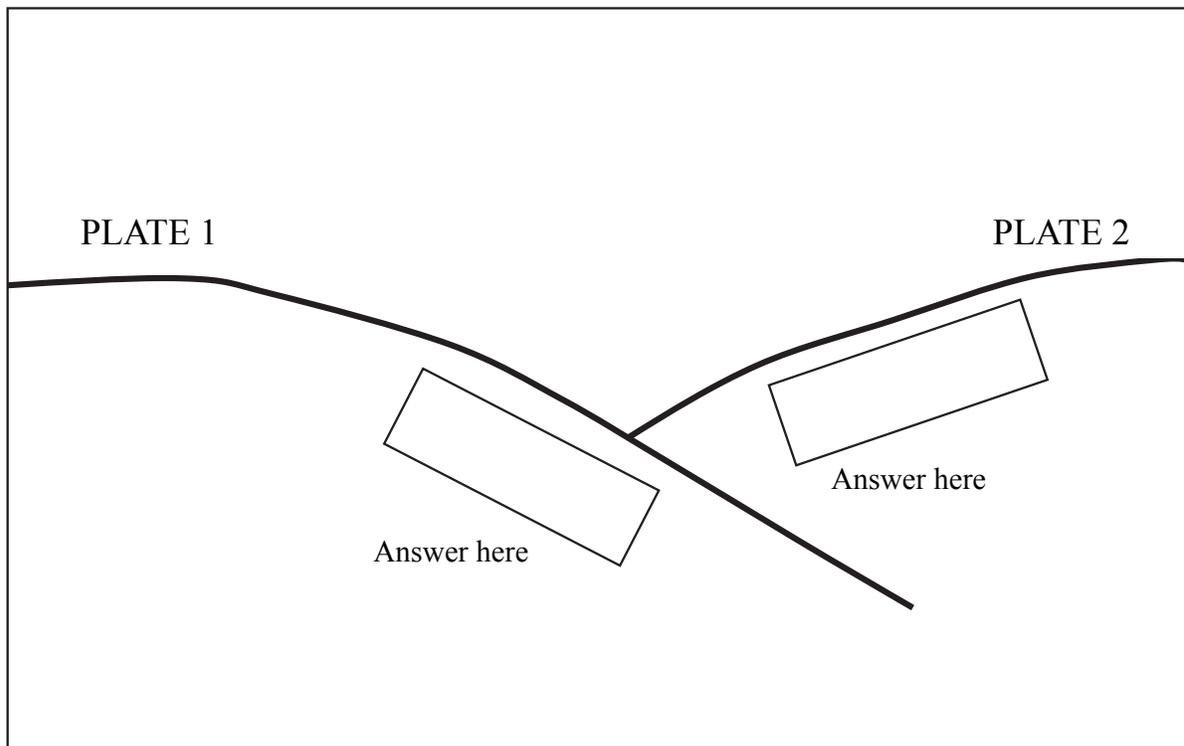
# LESSON 3 Plate Tectonic Drawings

Name: \_\_\_\_\_ Date: \_\_\_\_\_

(BENCHMARK:SC 4.8.1. Describe how slow processes sometime shape and reshape the surface of the Earth.)

**Directions:**

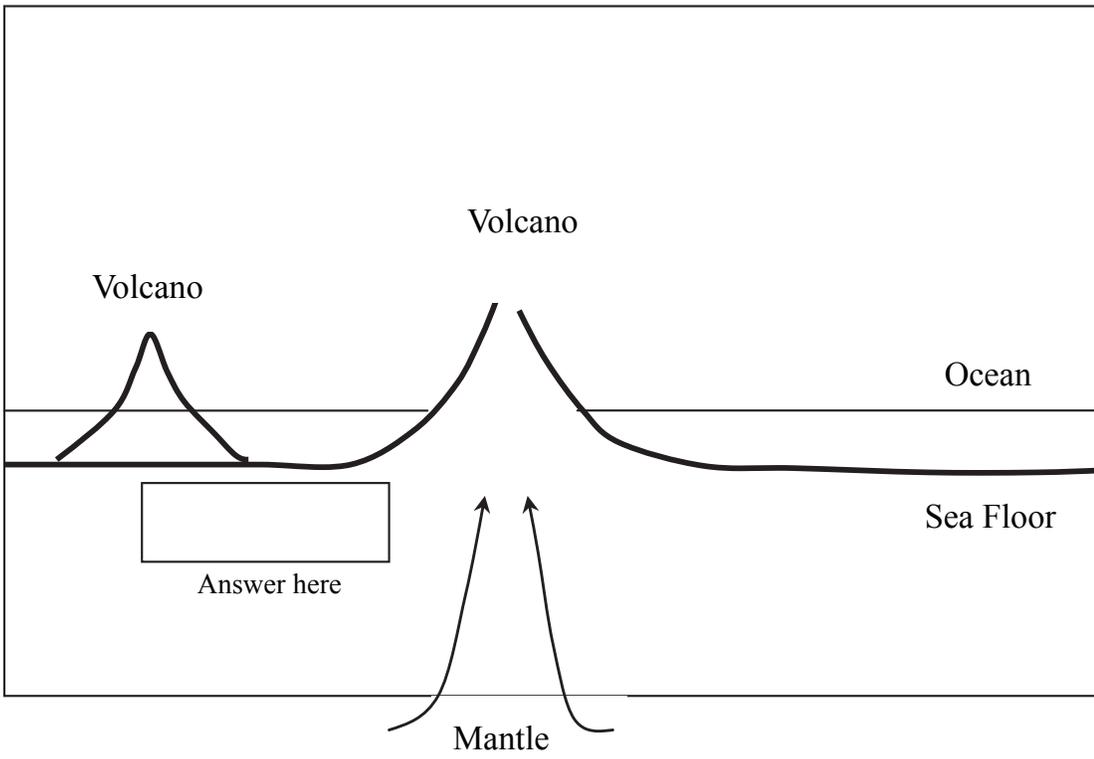
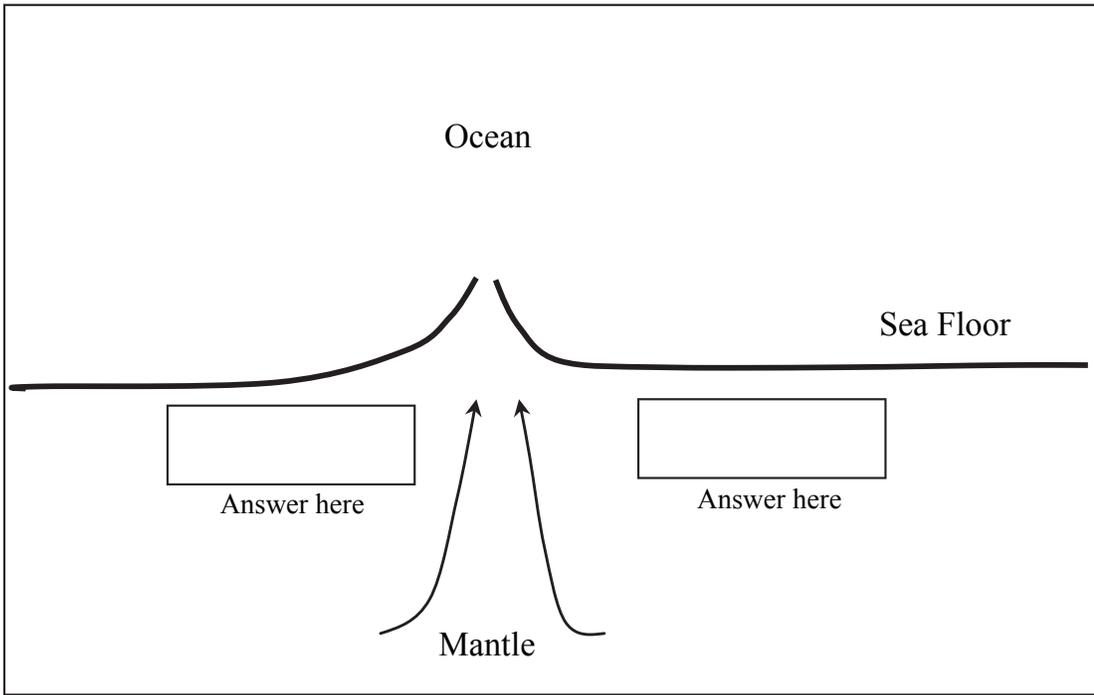
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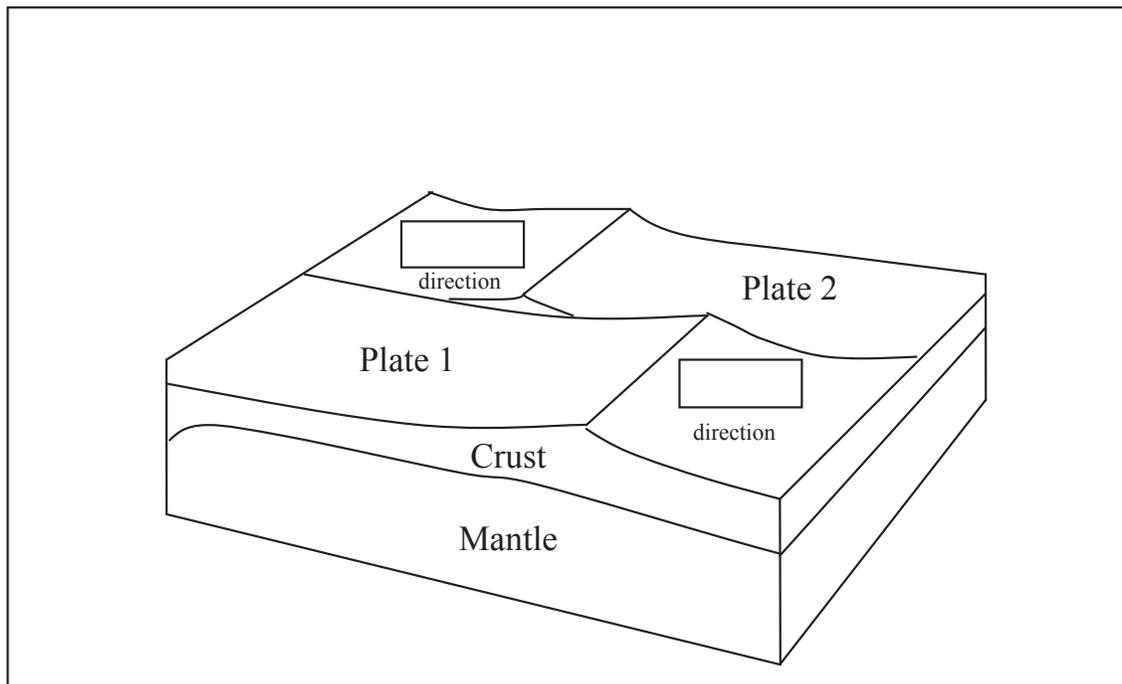



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Explain why Earthquakes and volcanoes occur along plate boundaries.

Define what a *hot spot* in the Earth's crust is, and describe how a hot spot relates to plate tectonics.

Describe how the formation of the islands in the Hawaiian archipelago took place.