HOT SPOT!

Grade 4

Lesson at a Glance

Students compare Hawaiian *mo'olelo* (myths, legends) to the hot spot theory regarding the formation of the Islands.

Key Concepts

According to the hot spot theory, the Hawaiian Islands were and continue to be formed as the Pacific plate moves over a hot spot that supplies molten rock from beneath the ocean floor. According to some Hawaiian *mo'olelo*, the Hawaiian Islands were formed when Maui pulled them up with his fishhook and secondary cones were formed when Pele dug them with her 'ō'ō (digging stick).

Objectives

Students will be able to:

1) Develop hypotheses about the formation of the Hawaiian Islands.
2) Write a comparison of Hawaiian *mo'olelo* and scientific theory regarding the formation of the Islands.

Time

three class periods

Subject Areas

science, Hawaiian studies, language arts

Materials

- student activity sheet (provided)
- Pacific plate map (provided)
- student readings (provided)
- colored markers
- 1 small knife
- 1 hard-boiled egg
- "Hawai'i and Planet Earth: The Hawaiian Geology," Science in Hawaii, ITV No. 7. (Optional: see Unit Resources.)

Preparation

Prepare one hard-boiled egg.

Teacher Background

The structure of the Earth can be compared to a hard-boiled egg, where the yolk represents the **core**, the white represents the **mantle**, and the shell approximates the **crust**. The Earth's core is approximately 3,500 km (2,200 mi) thick and consists of a solid inner core and a fluid outer core. Surrounding the core is molten rock of the mantle, about 2,900 km thick (1,800 mi). The thin crust of the Earth is about 5-40 km (3-25 mi) thick. It is thicker beneath the continents than the oceans.

Scientists believe the Earth's crust is made up of oceanic and continental plates. (See the Geology Appendix for a map of the Earth's plates.) These plates can be compared to the pieces of a cracked eggshell. Unlike the eggshell pieces, the Earth's plates are moving. According to the **hot spot** theory, the Hawaiian Islands were formed as one of the Earth's plates, the **Pacific plate,** moved over a stationary hot spot, located in the general area of the island of Hawai'i.

Secondary or renewed volcanic activity occurred on most of the Islands when volcanoes were approximately 150 km (90 mi) away from the hot spot. (See the Unit Introduction for more information.)

Mo'olelo are narratives about Hawaiian traditions and legends. According to one Hawaiian legend, some of the Hawaiian Islands are the children of Papa, the earth mother and Wākea, the sky father. Mutual jealousies led to an embittered relationship between Papa and Wākea. An affair between Wākea and the goddess Hina produced the island of Moloka'i, and in retaliation, the embrace of Papa and the warrior Lua resulted in the birth of O'ahu. The *mo'olelo* included in this activity relate the story of Maui pulling up the Islands and Pele digging the pits that represent secondary volcanic activity. Hawaiians were keen observers of nature and, from the *mo'olelo* of Pele, we can see that they were probably aware of the age progression of the Islands. Pele visited Ni'ihau, the oldest of the main islands, first and then moved down the chain until she reached the island of Hawai'i where she now resides. On Hawai'i, Pele is associated with building primary shield volcanoes instead of secondary activity cones.

Teaching Suggestions

1. Crack and peel an egg and save the eggshell pieces. Cut the egg in half and review the structure of the Earth, comparing the core and mantle to the parts of the hard-boiled egg. Compare the cracked eggshell to a "cracked Earth shell" that is composed of approximately 12 major plates.

2. Distribute the Pacific plate map to students. Point out the hot spot and explain that, unlike the eggshell, the Earth's plates are moving.

3. Ask students to guess how fast we are "riding" on the Pacific plate. Then compare the plate's movement to the growth rate of students' fingernails—approximately 10 cm (4 in) per year.

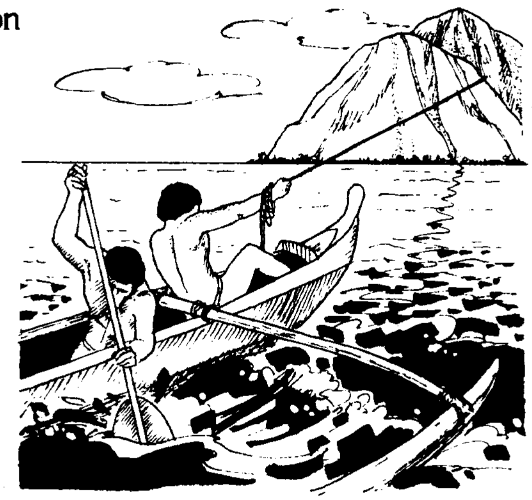
4. Have students follow the Hawaiian chain up to Midway and then all the way to the Emperor Seamounts, which extend to where the Pacific plate goes beneath the Eurasian and North American plates. Explain that the bend in the island chain is thought to be due to a change in the plate's movement. Point out where new crust is formed along the oceanic ridge at the southeast portion of the Pacific plate.

5. ✔ Explain that the movement of the plates causes volcanoes and earthquakes to occur at the plate boundaries. Ask students to generate some ideas about how the Hawaiian Islands formed in the center of the plate. Write their ideas on the board.

6. Have students read the two *mo'olelo* provided and summarize how the early Hawaiians explained the formation of the Islands.

7. Show the geology video (see Materials) and discuss the formation of the Hawaiian Islands.

8. Distribute the student activity sheet and review students' initial hypotheses about the formation of the Islands. Which hypotheses were closest to the hot spot theory? Which other hypotheses still seem possible? Why?



✔ 9. Ask students to complete the activity sheet and write a comparison of the two Hawaiian *mo'olelo* to the scientific theory. Students may also include a discussion of their own hypotheses about how the Islands were formed.

10. Discuss students' comparisons of *mo'olelo* and scientific theory.

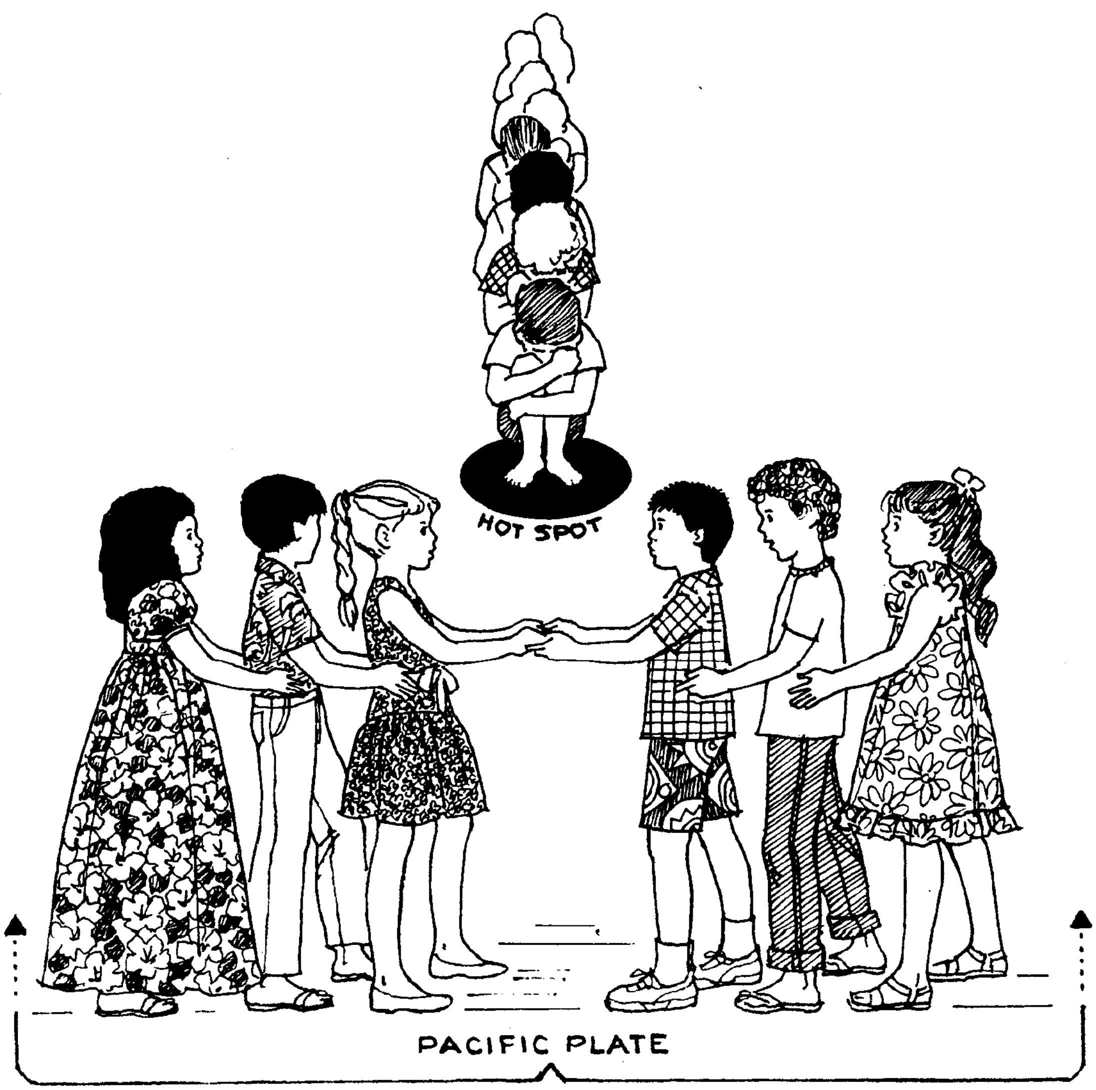
Formation of the Hawaiian Islands

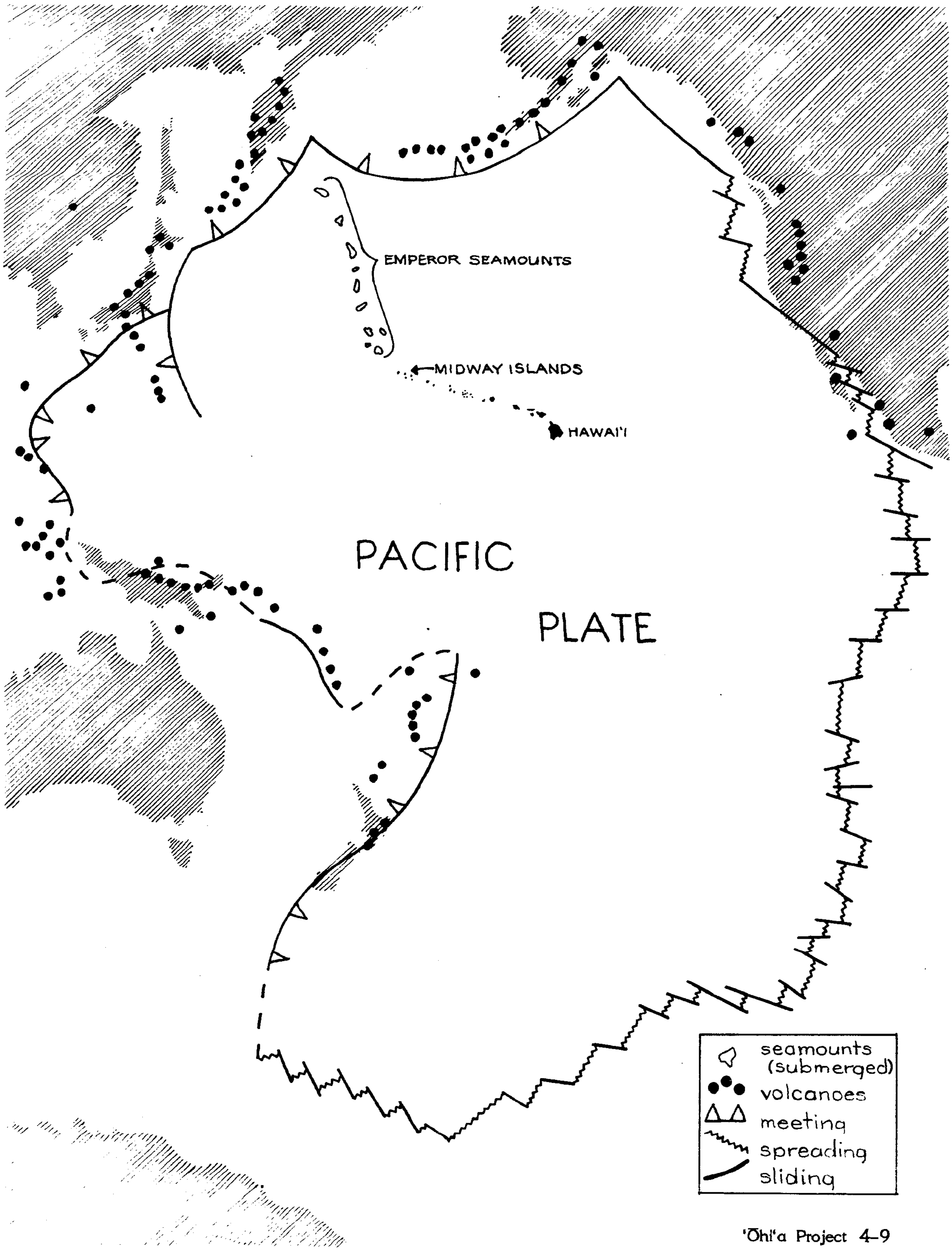
	Mo'olelo	Scientific Theory
Similarities	Pele creates secondary volcanic cones after islands are formed.	Secondary volcanic cones erupt after the Islands are formed.
	Pele creates cones on oldest islands first.	Secondary activity may occur when each island is a certain distance from the hot spot.
Differences	Islands are created by pull of Maui's hook.	Islands are created as the plate moves over a hot spot.
	Islands are created all at once.	Islands are created one at a time.
	Secondary activity is caused by Pele.	The cause of secondary activity is unknown.

Extended Activities

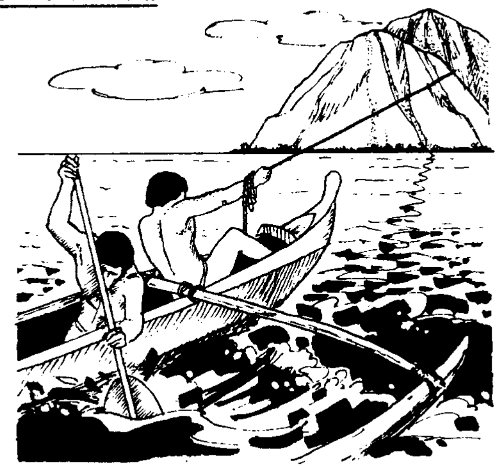
- To reinforce the hot spot theory, have students act it out! Place a red paper circle in the center of the floor to represent the hot spot. Have eight students represent the main islands waiting to be formed by kneeling around the hot spot. The remainder of the class could form the Pacific plate (see illustration). As the plate moves slowly over the hot spot, the islands should pop up successively from Ni'ihau to Hawai'i. When each island pops up, it should move slowly with the plate and gradually assume a lower posture to indicate erosion and sinking. Have the plate continue moving toward the northwest carrying the islands along, until they reach a wall that could represent the edge of the continental plate.

- Use creative dramatics to represent the Earth's core, mantle and crust with magma coming up through a hot spot to become lava. Have two or three children compact themselves into a solid core and be surrounded by "liquid" children representing the outer core mantle. Students representing the crust should hold hands and stretch around the mantle. Have two children drop hands at a point designated the hot spot, and have one or two children representing magma from the mantle emerge to the outside of the crust as lava.




EMPEROR SEAMOUNTS
MIDWAY ISLANDS
HAWAI'I
PACIFIC
PLATE
seamounts
(submerged)
volcanoes
meeting
spreading
sliding

MO'OLELO O MĀUI



One fine, sunny day, Māui and his brothers went fishing. They paddled their canoe far out to sea. Māui took out his special bone fishhook and prayed to the gods to make it very powerful. The winds blew softly around the canoe as it floated over the rolling sea. The brothers patiently waited for the fish to come.

They watched the sun climb higher and higher in the sky. They grew tired. *Auwē!* Where were the fish? After many hours had passed, the brothers decided to head for home. They were disappointed as they turned their canoe around and paddled toward shore. After they had paddled for a while they felt a strong pull on the canoe. Could they have caught a fish at last? Perhaps Māui's special hook had brought them luck!

The brothers became very excited and paddled faster and faster. Their arms grew tired. Whatever Māui had caught was very strong and very big! They began to wonder what could possibly be on Māui's hook. They were frightened by the thought of a huge, powerful fish. They begged Māui to cut the fishing line, but Māui refused and ordered his brothers to look straight ahead and continue paddling.

It took all of Māui's strength to hold on to the fishing line. His special fishhook had not failed him. What a fish he must have! His tired brothers no longer cared about the fish and wished Māui would cut the line. With aching arms, they kept on paddling and looked only to the front of the canoe.

Māui continued to pull on the line as hard as he could. But he soon realized there was no fish on the end of the line—it was land! As he pulled, he watched land rise slowly out of the sea! Māui was filled with wonder and excitement! With his powerful fishhook, he had caught a huge mass of land. Never had he caught anything so large! The brothers sensed Māui's excitement, but still they looked only to the front of the canoe.

Finally, one of Māui's brothers could stand it no longer. His tired muscles ached and he wanted to know what Māui had caught. As he turned to look, Māui lost some of the catch! Instead of a great mass of land, all he had was a group of islands. But what beautiful islands they were! And that, so the legend says, is the way our Hawaiian Islands came to be.

MO'OLELO O PELE

Pele came to the Hawaiian Islands from a faraway land. She had quarreled with her powerful sister, Nāmakaokaha'i, a goddess of the sea. After their quarrel, Pele left to find a new home.

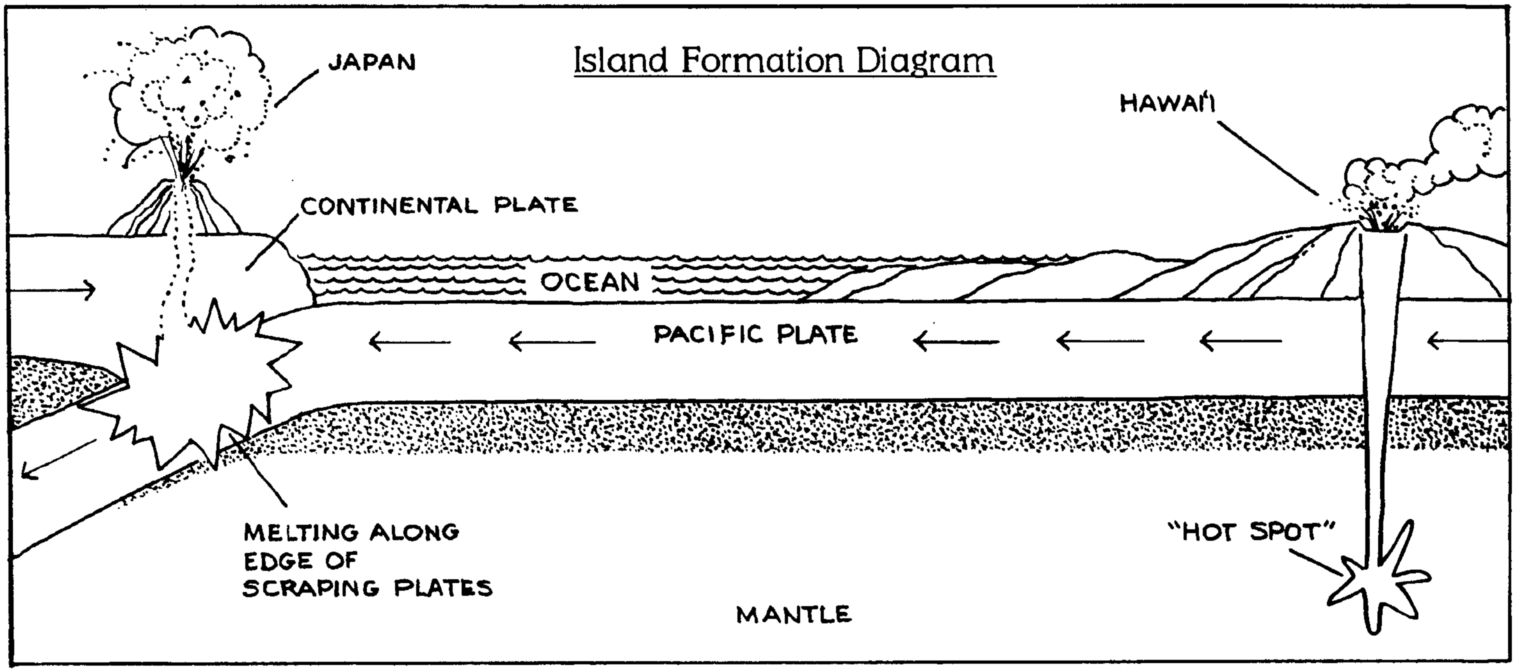
Pele went to Ni'ihau and dug a deep pit in a mountaintop with her *'ō'ō*. She created a volcanic cone with a pit or crater inside it. She liked the hot fires. But her sister, Nāmaka, the sea goddess, followed Pele and destroyed her fiery home with the ocean waters.

Angrily, Pele fled to Kaua'i. There she used her *'ō'ō* to dig a deep fiery pit. But again, the sea goddess followed her and put out the fire. Pele ran away to O'ahu and dug a new home there. But the sea goddess destroyed it. Pele angrily left and tried to make her home in a fiery pit on Moloka'i. Again, her sister, the sea goddess, destroyed it.

Pele fled to the island of Maui where she dug a deep fiery pit as her new home. Her sister followed her and destroyed her home once again. Pele was very angry and she and Nāmaka had a bitter quarrel. Pele was injured in the fight and left some of her bones on a hill in Hāna. Nāmaka thought she had finally stopped the fire-making of her sister, but she learned that the spirit of Pele had fled to the island of Hawai'i.

On Hawai'i, Pele, the volcano goddess, dug a deep, deep pit in the center of Kīlauea. In this fiery pit, Pele still makes her home. The island of Hawai'i continues to grow. Will the sea goddess catch up with Pele once again?

(Adapted from: "Hawai'i: Its Volcanic Beginnings," Jean Min, Kamehameha Schools, 1987.)



1. Color the hot spot red, the Pacific plate brown, and the Hawaiian Islands green.

2. How does the hot spot theory explain the formation of the Hawaiian Islands?

3. How is the hot spot theory different from Hawaiian *mo'olelo* about the formation of the Islands? How is it similar?