**Mantle Plumes**

**Doodle Reading**

by Real Ms. Frizzle

**Purpose:** To teach students about mantle plumes and their role in helping scientists determine the direction and speed of plate movement. What is a Doodle Reading? It is an informal reading article that targets students who don’t typically like reading. Each paragraph includes an opportunity for students to doodle, sketch, summarize, outline, or organize what they have read. Doodle reading articles can be used to introduce a topic, as an extension assignment, a supplemental assignment for students who are absent or need more instruction, or as an emergency sub plan.

**Time Needed:** 20-30 minutes

**Background Knowledge Required**: Students should know that the Earth’s crust is broken into plates that are in constant motion.

**Materials Included**:

* Complete teacher instructions
* Student doodle reading and assessment questions
* Answer key

**Teacher Prep Time**: About 8 minutes—or the amount of time it takes you to make copies

**Teacher To-Do List:**

* Make sure you can open all files in this purchase. If you have any problems, please email [skipper\_coates@hotmail.com](mailto:skipper_coates@hotmail.com).
* Print and copy the student doodle reading

**Teaching Instructions:**

This is a great stand-alone lesson, but can also be a supplemental piece to an existing lesson or video.

Good Luck! And happy teaching!

**Real Ms. Frizzle--Skipper Coates**

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Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mantle Plumes

(Go ahead and color it!)

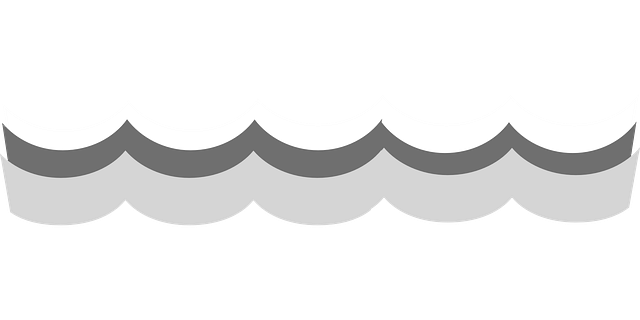
First of all, WHAT THE HECK IS A MANTLE PLUME ANYWAY?!?! Well, let’s look at each word. The MANTLE is the layer of earth below the crust. It is made of semi-solid rock that can move and flow under the surface. A PLUME is a whole lot of magma that rises and creates a big bubble of HOT rock in the crust.

Hawaiian Mystery

The islands of Hawaii are found in the middle of the Pacific Ocean. Like, REALLY in the middle. There’s nothing around them…except the ocean, of course!

*Make a Doodle of seven islands in the middle of the ocean:*

Ahh, such cute and lonely islands! But what if I told you they were NEVER supposed to be there. Well, in the 1960s Hawaii was a great, big “WHAT-THE-HECK-IS-THIS?!” Active volcanoes, like those on the big island of Hawaii, were supposed to only be found near tectonic plate boundaries (the places where tectonic plates meet). But like I said, Hawaii was in the middle of the Pacific Ocean, on the Pacific Plate.



*Plate Boundary*



*Plate Boundary*

*Finish the Doodle! Add an island in the middle of this tectonic plate. It will be very large under the water, with only a small amount of rock above the water.*

Comparing Volcanic Rocks

Scientists were really confused about how and why there were active volcanoes in the middle of the ocean. They were used to seeing volcanoes along the Ring of Fire: you know, places like New Zealand, Indonesia, Japan, Alaska, the west coast of North America, Ecuador, and Chile. The ENTIRE Ring of Fire is found along different tectonic plate boundaries!

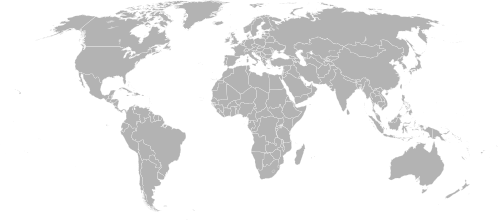
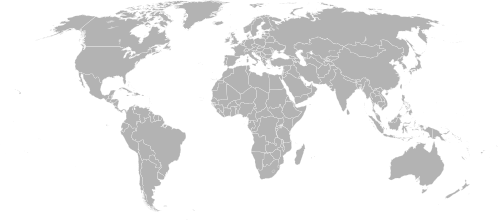
*Doodle 20 red dots, one for each of*

*20 volcanoes, on this map to show*

*the Ring of Fire. You can use a*

*textbook or the internet if you need*

*help.*



Geologists decided to start comparing the rocks on Hawaii to the rocks along the Ring of Fire. They gathered volcanic rocks from Alaska, Washington, Russia, New Zealand, Peru, and Hawaii. They used computers and other machines to analyze all of the elements found in the rock samples.

|  |  |
| --- | --- |
| *Use a periodic table to doodle the atomic number (or electron dot structure) next to the name of each element:* | |
| **Elements in Ring of Fire Rocks** | **Elements in Hawaiian Rocks** |
| Silicon  Aluminum  Magnesium  Oxygen | Silicon  Oxygen  Magnesium  Iron  Titanium |

Iron: The Big Clue!

You might have noticed that Hawaiian rocks have heavier elements within them, and if you didn’t notice I’ll tell you now: Hawaiian rocks have heavier elements within them! And iron is heavy! As a brand new baby planet, the Earth was a molten (liquid) ball of rock. This liquid-i-ness allowed all of the heaviest elements to sink to the center of the planet.

If Hawaiian rocks had more iron in them than other volcanic rocks, then the magma making the rocks must be coming from much deeper inside the earth than plate boundary volcanoes.

*Finish the Doodle! Draw the magma that supplies the Hawaiian volcanoes and the magma that supplies a volcano on the Ring of Fire.*

Hawaiian volcano

Ring of Fire Volcano

Hot Spot, Baby!

Scientists called that very deep spot of magma a “Hot Spot” or a Mantle Plume. It was a stationary spot under the crust that had lots and lots of magma and energy. But here’s the crazy part: the crust IS NOT stationary! What that means is that as the crust moves over top the mantle plume, one or several volcanoes poke up through the surface and make an island. Then the island/crust slowly moves away from the hot spot so that a new volcano can appear. Scientists call these rows of islands an “island chain.”

*Doodle an island chain in this box. Don’t forget to give the island on the end and active volcano! Label the youngest and the oldest islands.*

Mantle Plumes and Plate Movement

After scientists learned what created the Hawaiian Islands they were able to use the island chain to determine the rate of speed and direction of the tectonic plate. Too many words in that last sentence? Basically, an island change tells us which direction a plate moves!

Imagine that you placed an inflated balloon on your desk and covered it with a table cloth. You mark a “volcano” on the table cloth right on top of the balloon. Then, you slide the table cloth to the left 2 inches. Where did the volcano go? It should have been pulled off the balloon and moved to the left 2 inches! Now draw another mark on the table cloth right on top of the balloon. You guessed it! Move the table cloth. Repeat the steps 3 more times. You just modeled a mantle plume!

*Doodle an illustration of this imaginary experiment!*

Now, thinking about your imaginary experiment…or hey, if you actually did it then a billion points to you! Anyway, what was I saying? The experiment: if you know where the oldest “island” on the table cloth was, and you know where the active volcano is, you also know which direction the table cloth was moving! You just got tricked into learning. Sorry, not sorry! The table cloth represents the Earth’s crust and the balloon represents a mantle plume. In the same way that you could tell which way the table cloth was moving, scientists can tell which direction a tectonic plate is moving by examining the age of the islands in a chain.

Did you learn anything? Let’s find out!

1. Why are the Hawaiian Islands different from volcanoes that are part of the Ring of Fire?
2. There is Iron is Hawaiian rocks. What does the presence of Iron tell scientists?
3. How can a mantel plume tell scientists which direction a tectonic plate is moving?

Sources: Yes, They Matter

<http://www.nature.com/news/earthquakes-make-gold-veins-in-an-instant-1.12615>

<http://chemwiki.ucdavis.edu/Physical_Chemistry/Nuclear_Chemistry/Nucleosynthesis%3A_The_Origin_of_the_Elements>

<http://www.ptable.com/>

**Suggested Answer Key:**

Your students’ doodles will all be unique. It would be appropriate to check their work to make sure they are correctly understanding the concepts taught.

Answers to the assessment questions on the last page:

1. Why are the Hawaiian Islands different from volcanoes that are part of the Ring of Fire?

**THE HAWAIIAN ISLANDS ARE NOT PART OF THE RING OF FIRE, AND ARE THEREFORE IN THE MIDDLE OF A TECTONIC PLATE (INSTEAD OF AT THE BOUNDARIES). THE HAWAIIAN ISLANDS ALSO HAVE DIFFERENT ELEMENTS IN THE ROCKS THAN THOSE ROCKS PROCUDED AT THE RING OF FIRE.**

1. There is Iron is Hawaiian rocks. What does the presence of Iron tell scientists?

**THE PRESENCE OF IRON IS EVIDENCE THAT THE MAGMA IS COMING FROM MUCH DEEPER IN THE EARTH THAN MAGMA NEAR PLATE BOUNDARIES.**

1. How can a mantel plume tell scientists which direction a tectonic plate is moving?

**THE OLDEST ISLAND WAS CREATED FIRST. IT’S MOVEMENT AWAY FROM THE MANTLE PLUME SHOWS US THE DIRECTION THE PLATE HAS MOVED OVER TIME!**