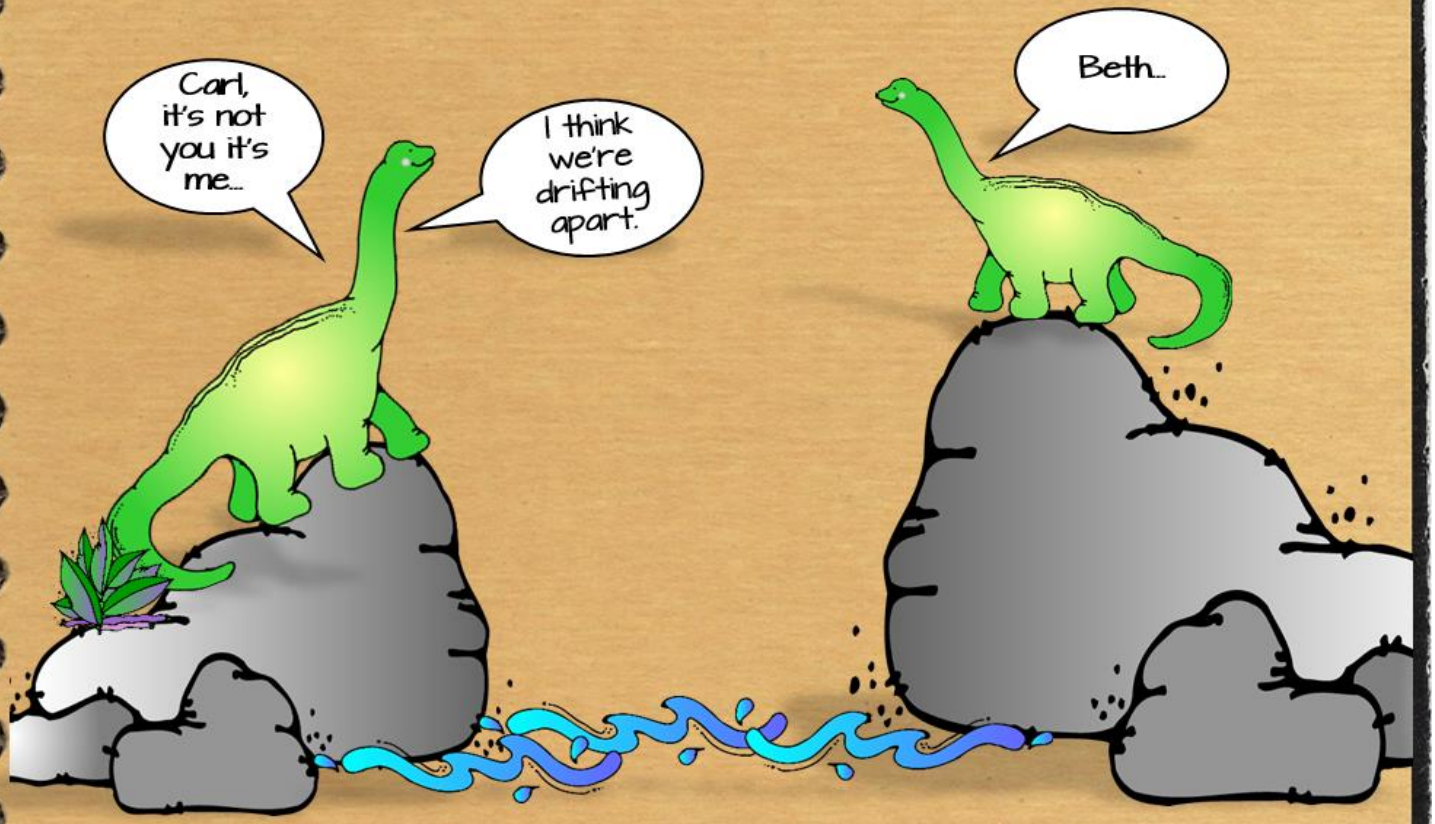
EARTH SCIENCE

Interactive Notebook

Plate Tectonics



Created for you by Dr. Erica Colón

Table of Contents:
Plate Tectonics

Introduction

If you are new to the idea of using a Science Interactive Notebook in your classroom, **stop by my Nitty Gritty Science shop and download my Intro to Science Interactive Notebooks tutorial for FREE!** In there you will find tips on how to begin with your students, what materials to have on hand and, most importantly, how it will enhance your students learning through reflection and creativity.

Focused Lessons with Differentiated Instruction

The lessons shared on the following pages cover National Science Standards and meet students' needs. I have given you the notes that I would give my students (Right Side - Input Side of Notebook) so you can understand what I'm having the students focus on when working on their creative assignments (Left Side - Output Side of Notebook). Each lesson focuses on a Question of the Day (QOD) represented in red in the top margin of each "Input" page with student giving answer in red on "Output" page.

Left Side - Output

Instructions for each Output Side are included. This includes cut-outs, foldables or master copies where applicable. You may find that students work slow at first, but once groups are organized and students know what is expected from them, not only will you see more energy focused on the final product, but also you will be shocked at the level of creativity certain students have in certain areas.

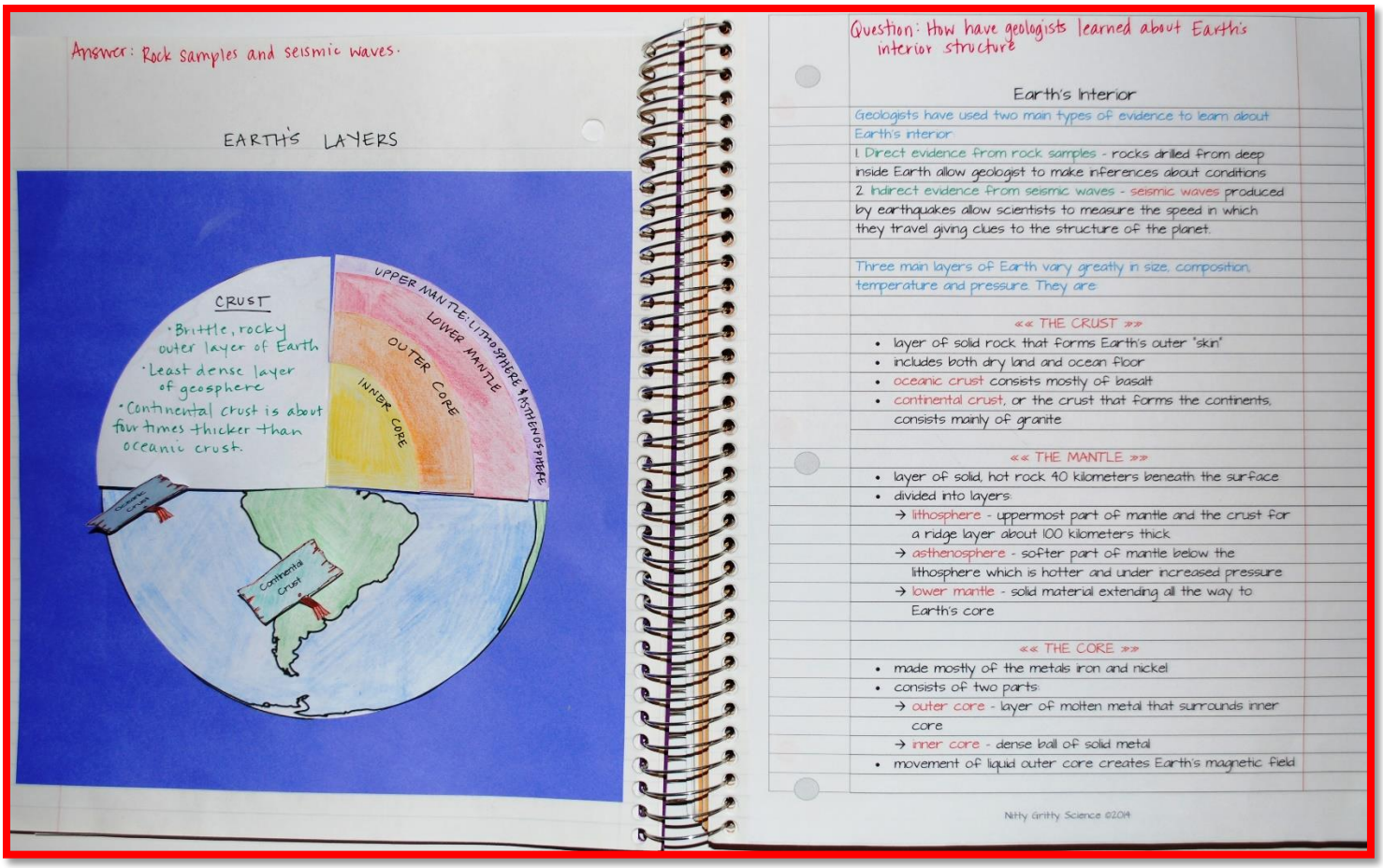
Mini-Assessments

Mini quizzes will be given for each section so you may monitor student's level of understanding. For reproduction purposes, there are two quizzes to a page so you can cut in half and save on some paper ☺

**** NEW - CHECK OUT MY STORE!! ****

You asked, I listened...I will be offering **EDITABLE NOTES** with an **EDITABLE CHAPTER TEST** for each chapter of my Earth Science Interactive Notebooks!

Section 1: Earth's Interior



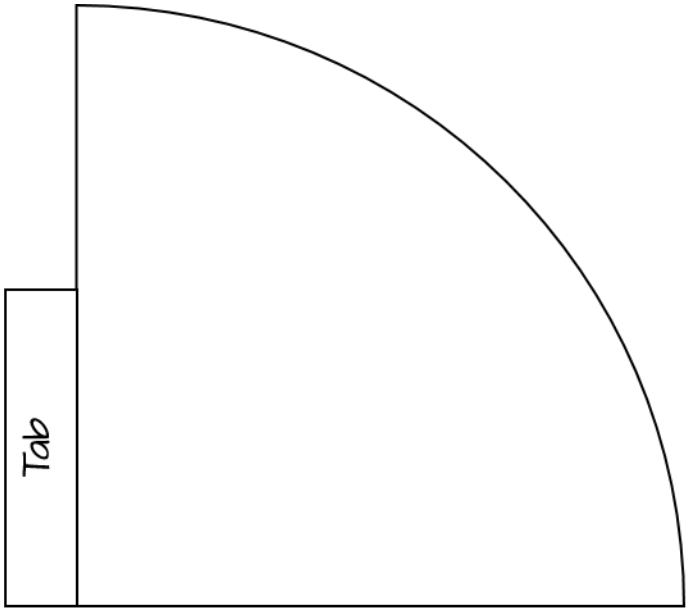
Description:

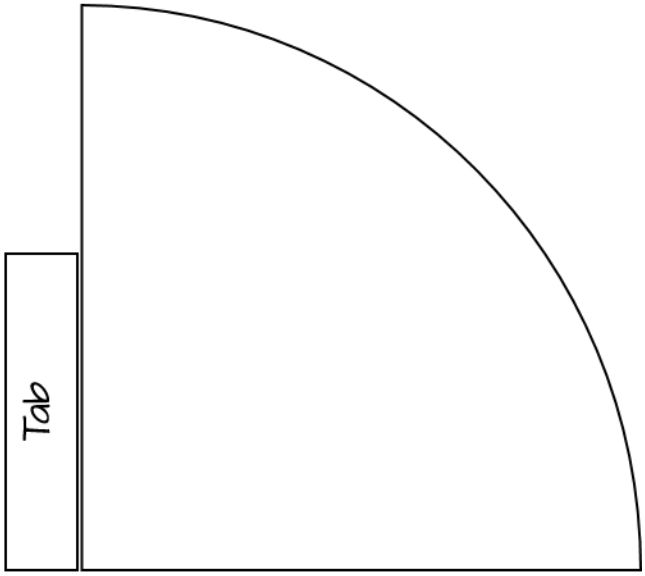
Students will create a flap-book of Earth where they will need to stack, color and describe each of Earth's layers. In addition, fun little signs are included to allow students to label continental and oceanic crust. Printables with cut-outs and a mini-quiz are included.

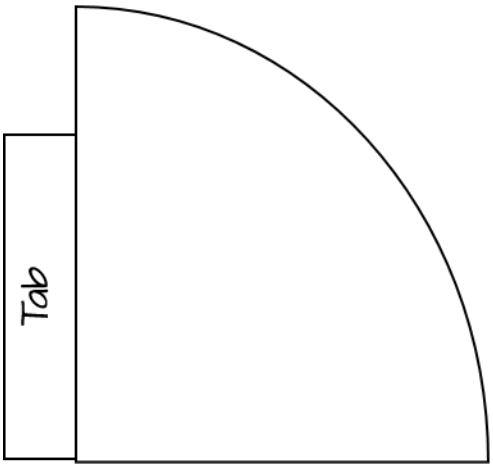
Earth's Layers

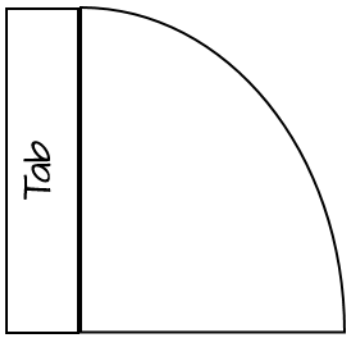
Directions: Color the Earth diagram below then cut out, including making a cut on the inner solid line. Fold along dotted line to reveal the "window" to showcase the Earth's layers.

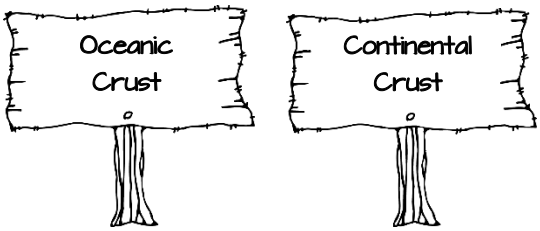
Directions: Cut out each layer of Earth's interior and stack in the correct order. Use a different color to identify each layer then glue each tab under the "Earth" diagram. Once glued in correct order, label each Earth layer then describe each layer on the reverse side.











Post these signs in the correct location on your Earth model to represent the two types of crust.

Name ---------- Date ----------

Quiz: Earth's Interior

Identify the layers of the Earth.

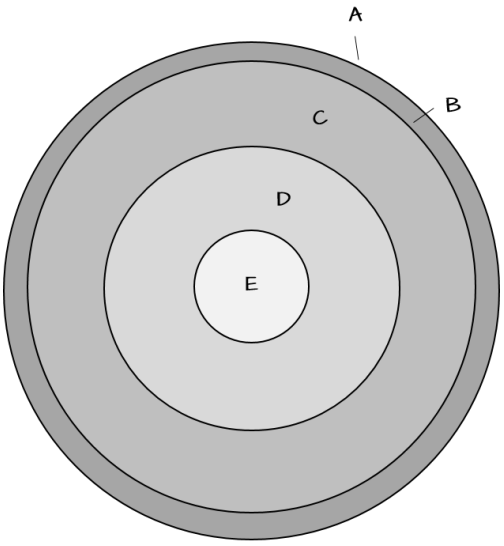
A. ----------

B. ----------

C. ----------

D. ----------

E. ----------



Earth's Interior

List two types of evidence that geologists have used to learn about Earth's interior.

F. ----------

G. ----------

Name ---------- Date ----------

Quiz: Earth's Interior

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A. ----------

B. ----------

C. ----------

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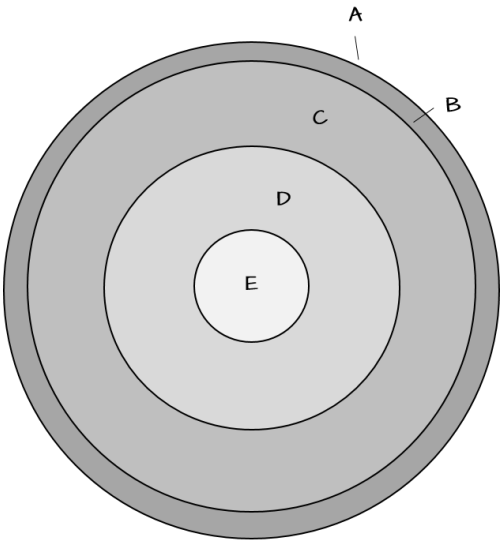

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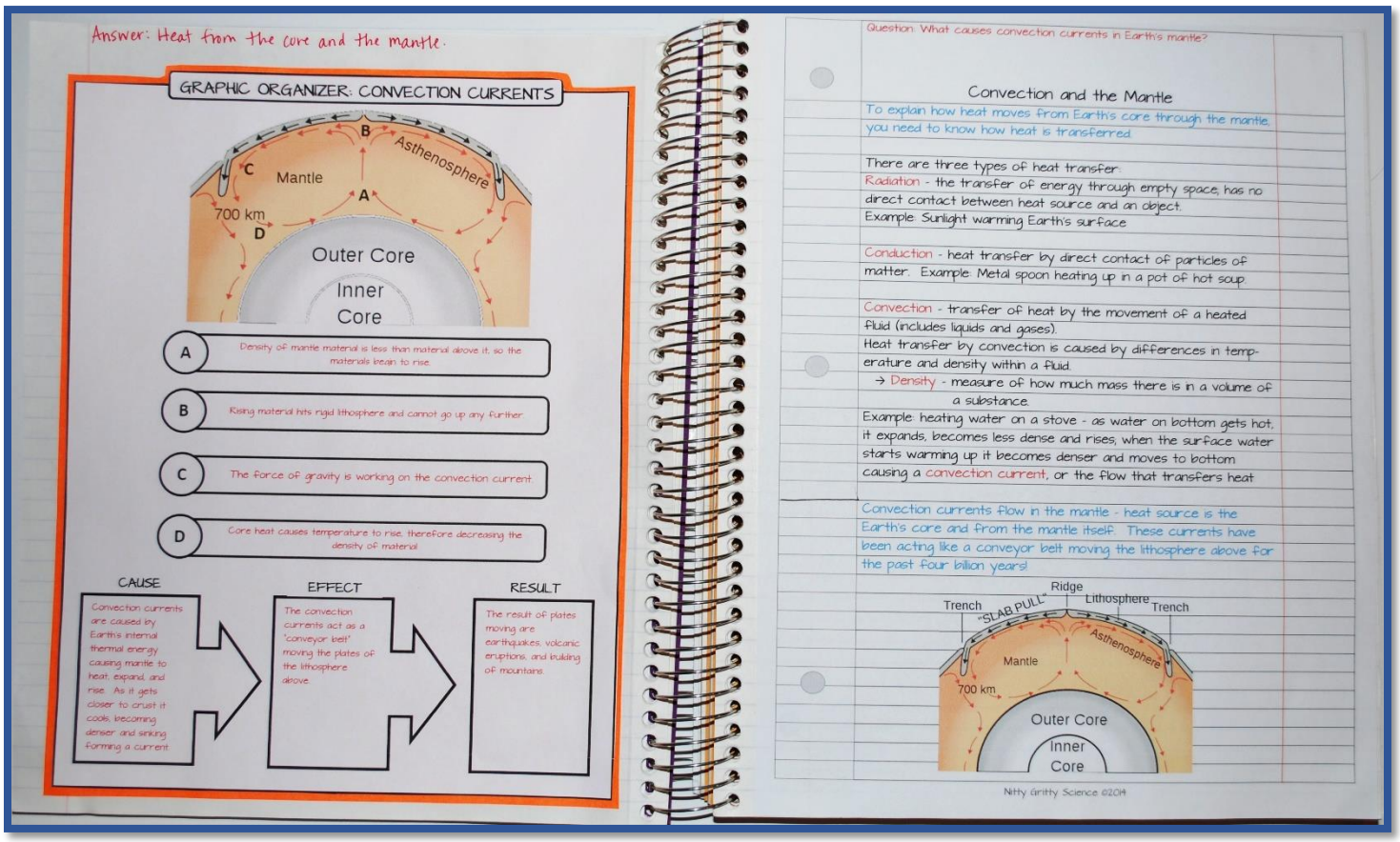
G. ----------

Section 2: Convection and the Mantle



Description:

This activity is a graphic organizer duo - the first section students will need to cut out the steps describing the action of convection currents and place them in the correct order of the corresponding diagram. The second part of the graphic organizer is to have students explain, in their own words, the cause and effect of convection currents and what results because them.

Printables, cut-outs, teacher answer key and a mini-quiz are all included for this concept.

Convection Currents

Directions: Cut out the descriptions below and paste each statement next to the letter (A-D) that is describing the convection current in the diagram at the corresponding letter.

Next complete the graphic organizer by describing the cause and effects of convection currents in the mantle and the result of these actions. Paste completed page into your Science Interactive Notebook.

The force of gravity is causing denser material to fall.

Density of mantle material is less than material above it, so the materials begin to rise.

Core heat causes temperature to rise, therefore decreasing the density of material

Rising material hits rigid lithosphere and cannot go up any further.

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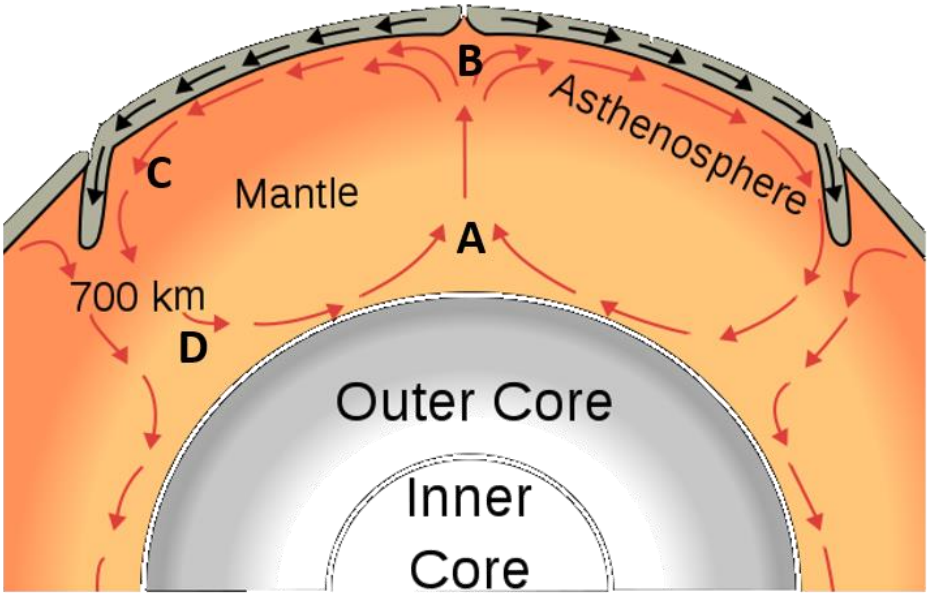
GRAPHIC ORGANIZER: CONVECTION CURRENTS



A

B

C

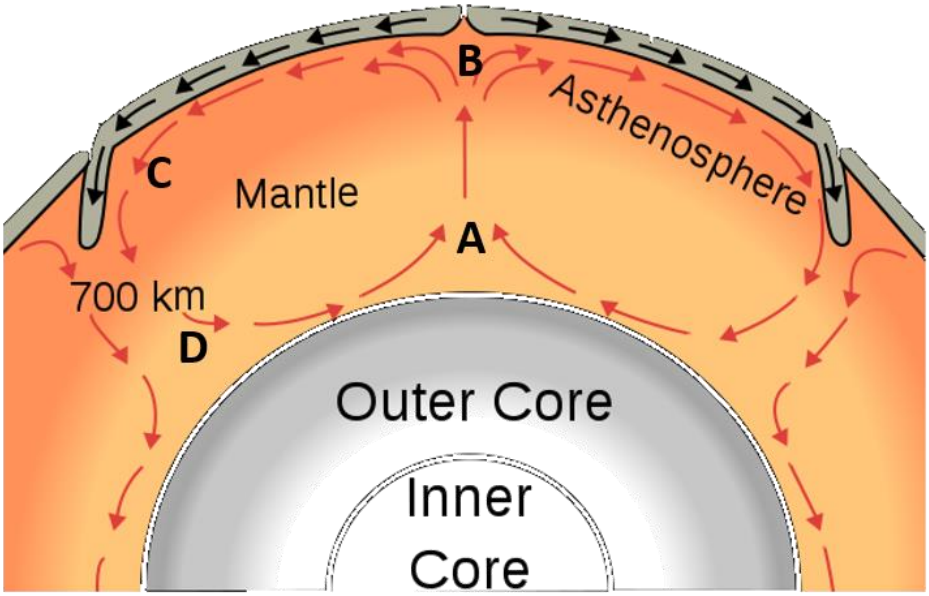
D

CAUSE

EFFECT

RESULT

GRAPHIC ORGANIZER: CONVECTION CURRENTS



A Density of mantle material is less than material above it, so the materials begin to rise.

B Rising material hits rigid lithosphere and cannot go up any further.

C The force of gravity is causing denser material to fall.

D Core heat causes temperature to rise, therefore decreasing the density of material

CAUSE	EFFECT	RESULT
Convection currents are caused by Earth's internal thermal energy causing mantle to heat, expand, and rise. As it gets closer to crust it cools, becoming denser and sinking forming a current.	The convection currents act as a "conveyor belt" moving the plates of the lithosphere above.	The result of plates moving are earthquakes, volcanic eruptions, and building of mountains.

Name _____ Date _____

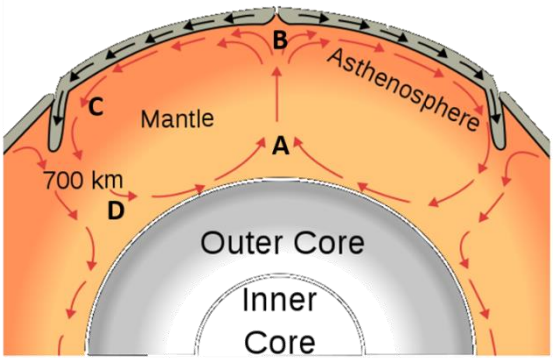
Quiz: Convection and the Mantle

Use the diagram and your knowledge of convection currents to help you answer the following questions.

1. Where are convection currents found?

_____

_____



2. Convection currents are caused by differences in what two things?

_____

_____

3. Explain what is happening at each point on the diagram:

A. _____

B. _____

C. _____

D. _____

Name _____ Date _____

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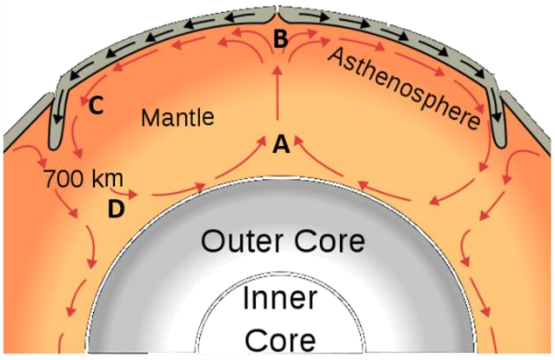
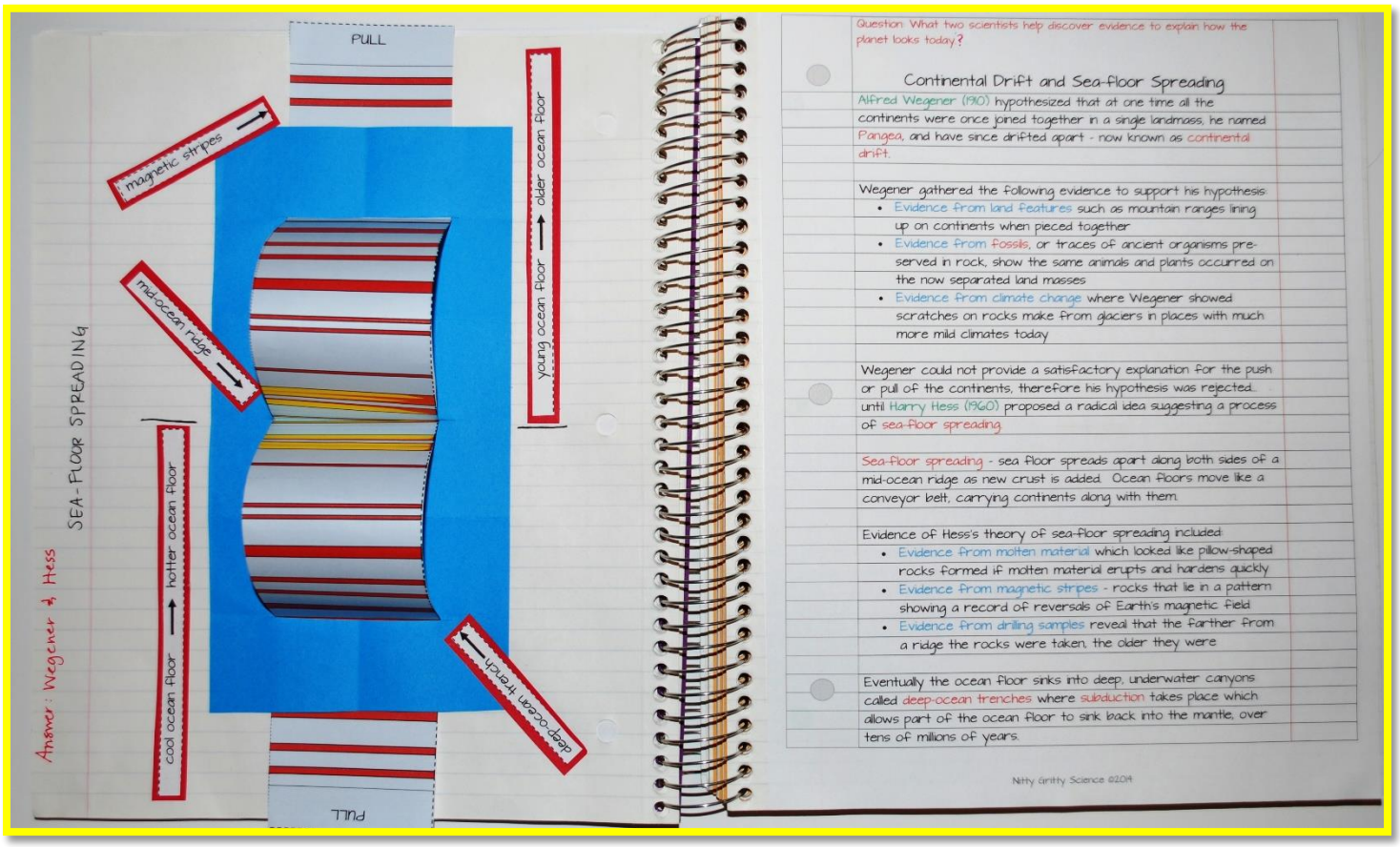
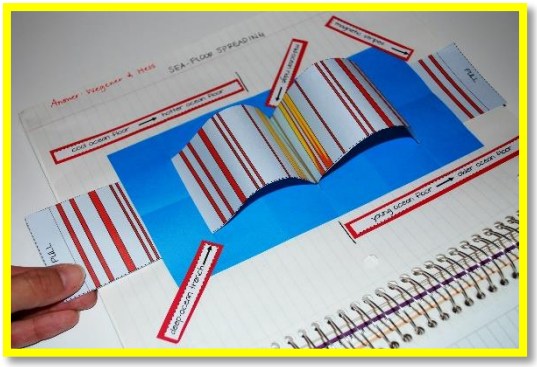


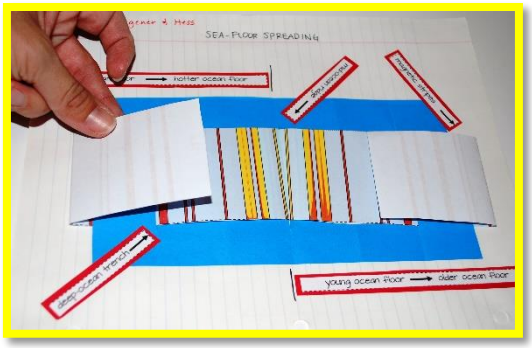
Section 3: Continental Drift and Sea-floor Spreading



Description:

Students will build a model of sea-floor spreading along with labeling actions and features associated with it. I've made it so that the model can fold up nice and flat in the students' interactive notebooks and have included step-by-step directions along with pictures to help the activity run smoothly. You know how I love to save you time, so I've also included a colored version for your master notebook and a black and white student printable, with labels, and of course the mini-quiz.





Sea-floor Spreading

Directions:

To make the sea floor:

1. Take a full size sheet of paper and fold into eighths. Then fold in half lengthwise, cutting down the fold - share the other half with a partner.

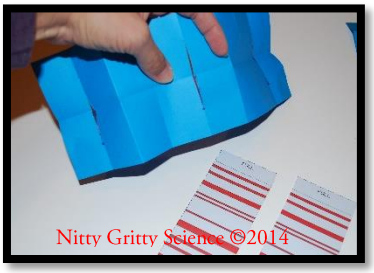
2. Where the paper is folded into eighths, cut off the two bottom folds, now making the paper into sixths.

3. Fold this half lengthwise and find the middle crease. At the middle crease, mark a line 3 cm long. Mark two more lines (3 cm) at the creases closest to the ends of the paper. Cut these lines.

To prepare the "molten" material:

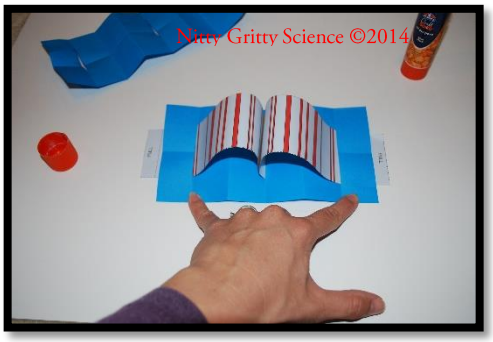
1. Color the striped cut-out having two colors alternating with the stripes.

2. Cut out the striped cut-out along the dotted lines - you should now have two strips.



To model sea-floor spreading:

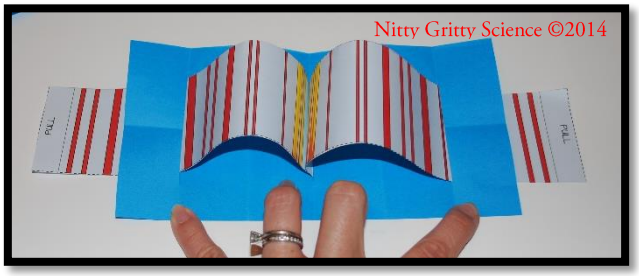
1. Place the two colored strips facing each other and insert them up through the center slit, making sure the "pull" end comes through first.



2. Separate the strips and pull each toward the side slits carefully inserting them in.

3. Glue the "paste tab" at the bottom of each strip to the back side of the "sea floor" to ensure the strips do not fall out.

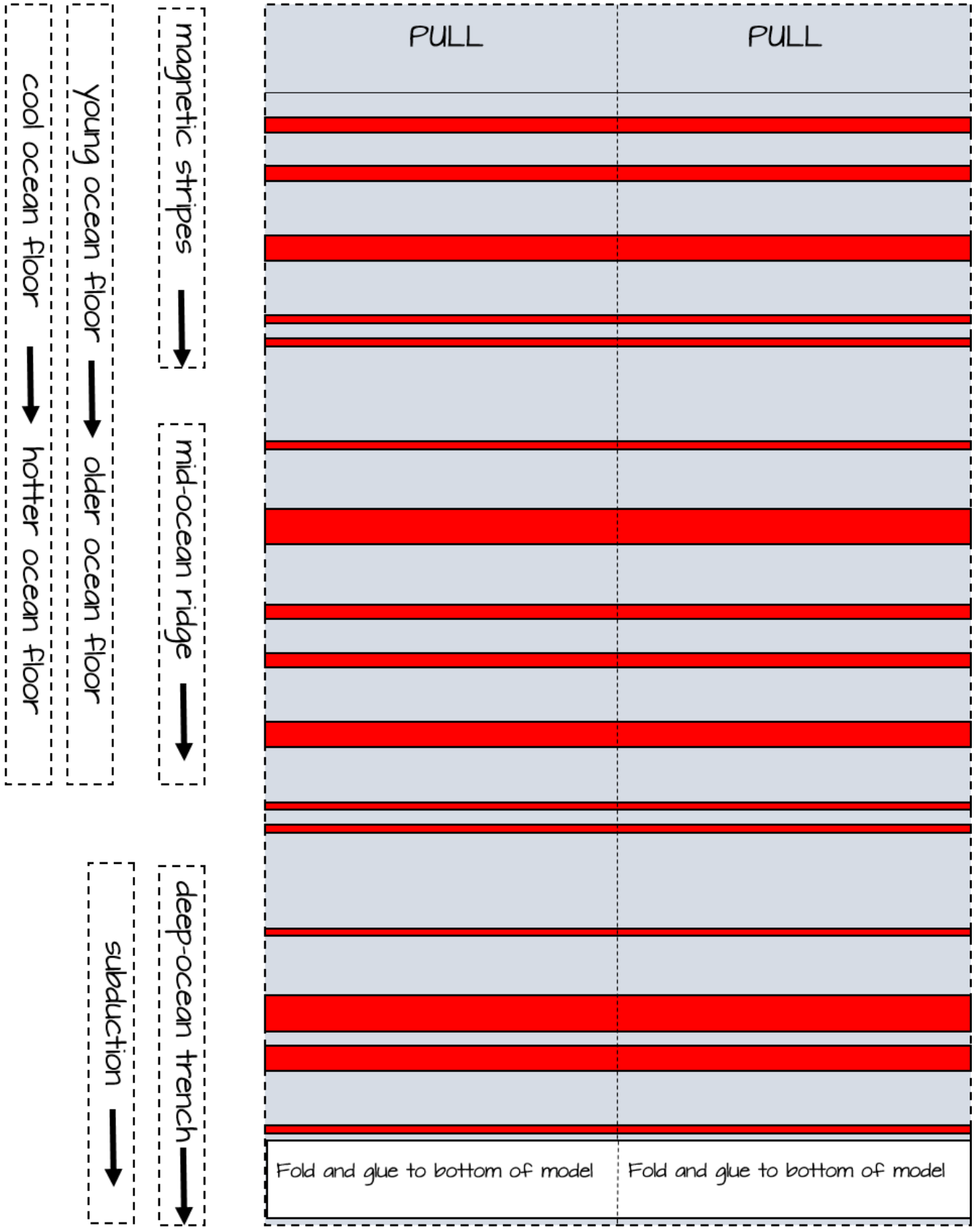
4. Place glue around edges of "sea floor" and paste into Science Interactive Notebook, making sure to NOT place glue around slits.



5. Cut out all labels and properly place them around the Spreading Sea-floor Model making sure to mark the appropriate features.

Teacher Guide (color)

SEA-FLOOR SPREADING



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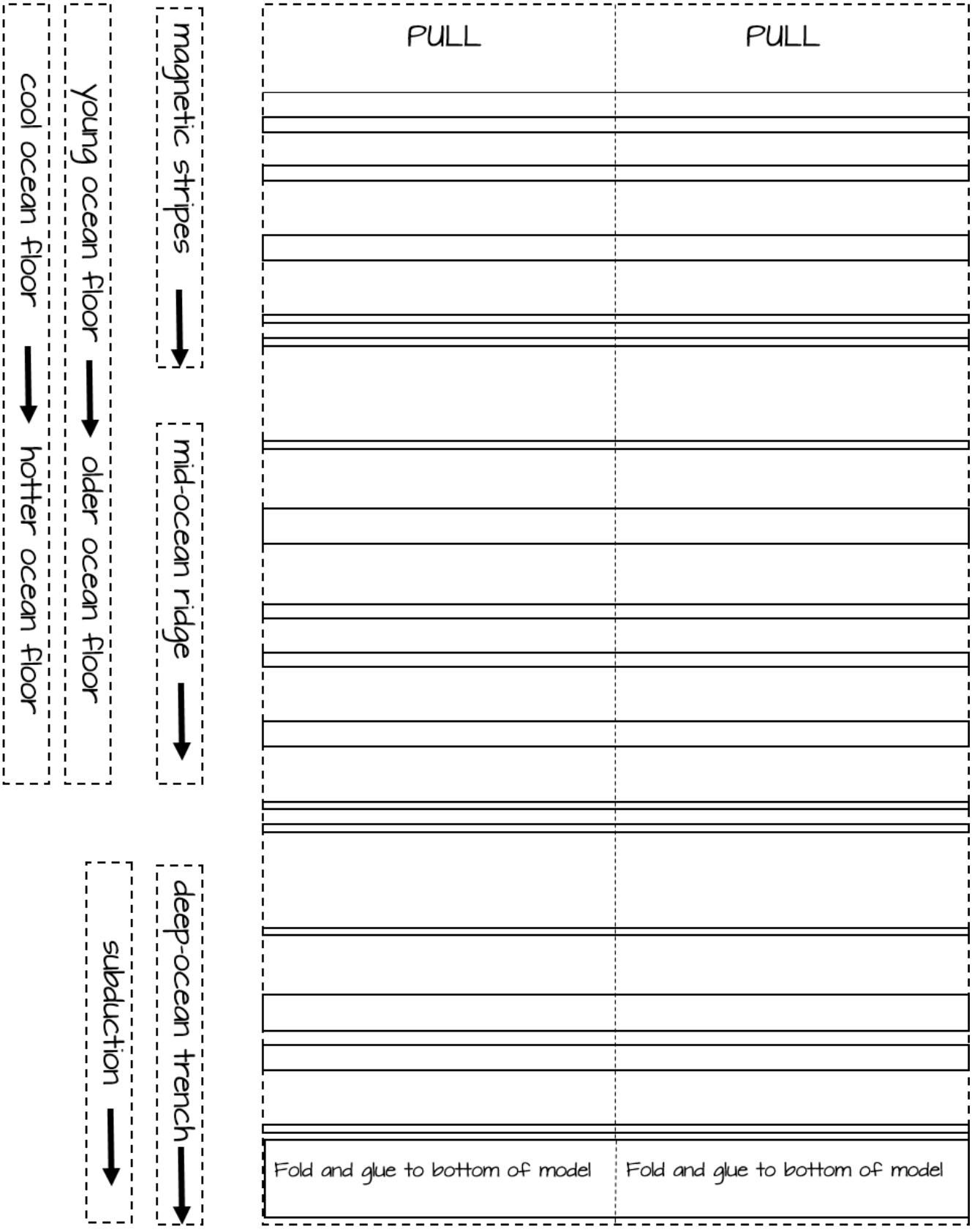

Name _____ Date _____

Quiz: Continental Drift and Sea-floor Spreading

Multiple Choice

_____1. Who first proposed the theory of continental drift?

a. Hess b. Pangea c. Wegener d. Wilson

_____2. All are evidence to support the theory of continental drift EXCEPT

a. land features b. climate change c. fossils d. rainfall

_____3. Sea-floor spreads apart at both sides of a _____ as new crust is added.

a. mid-ocean ridge b. rift valley c. trench d. mountain

_____4. Rocks on the sea-floor that lie in a pattern, show a record of the reversals of Earth's_____.

a. atmospherwe b. magnetic field c. temperature d. diversity

_____5. Drilling samples revealed that rock samples taken farther from a mid-ocean ridge are

a. older b. younger c. hotter d. crystal

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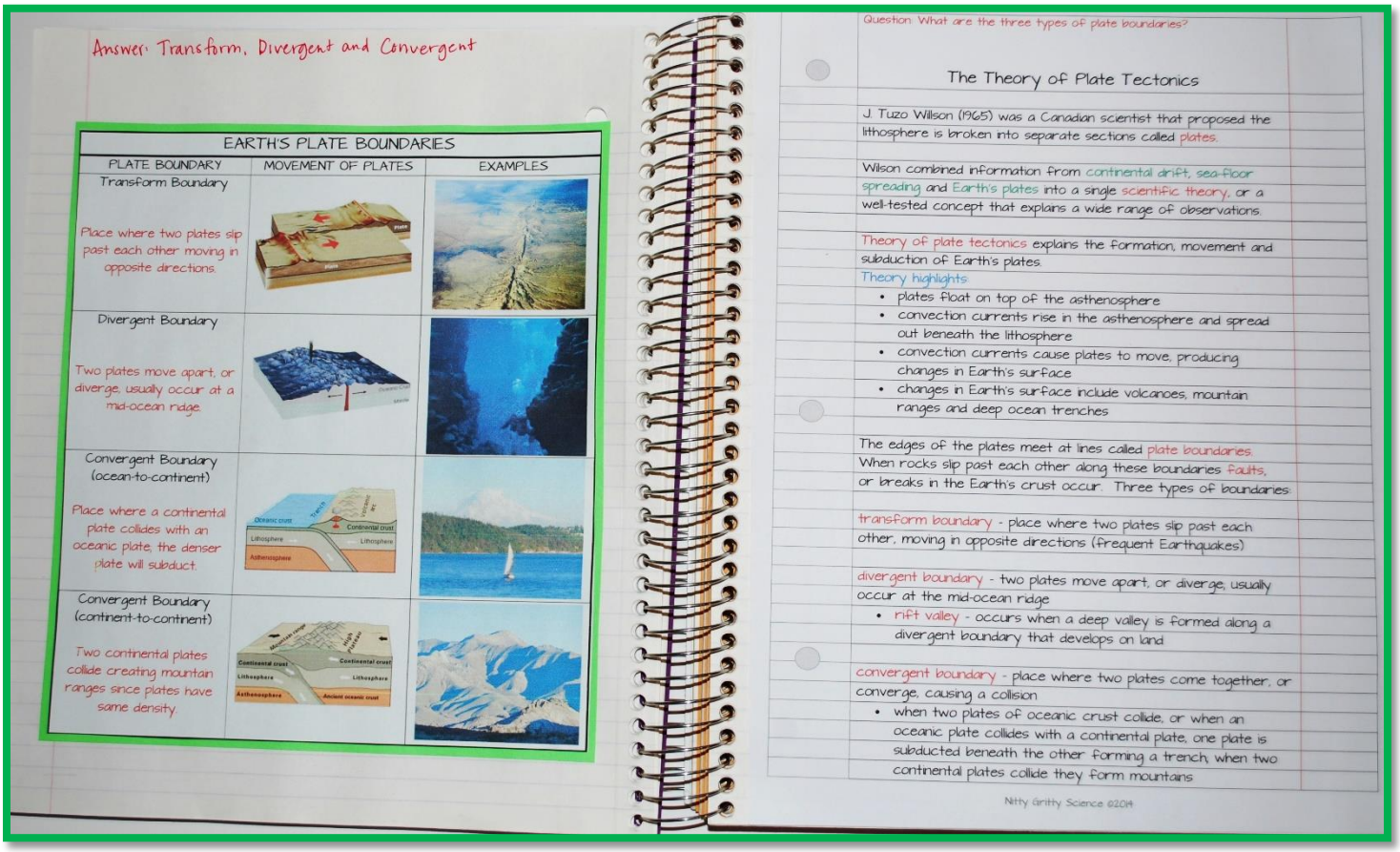
Section 4: The Theory of Plate Tectonics



Description:

Students will understand the different plate boundaries when they complete this informational chart. Students are first asked to describe each boundary in their own words, then they will need to cut out diagrams of different boundaries, as well as real-world examples, and paste them in the appropriate row.

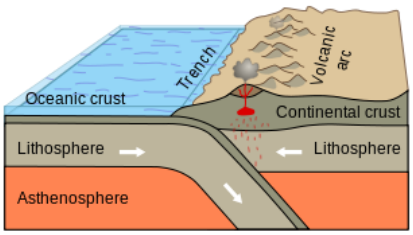
For this concept, I've included the diagrams and pictures in both color and gray-scale for your convenience. A teacher answer key has also been provided along with a mini-quiz.

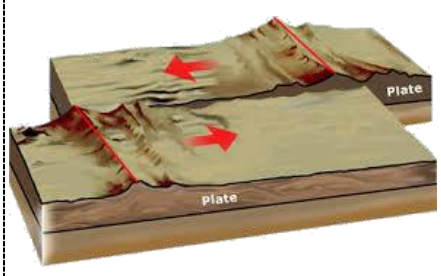
Interactions of Earth's Plates

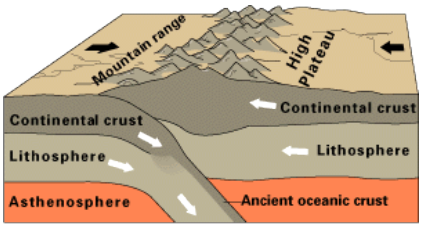
Directions: Fill out the chart by completing the first column with a description of each type of plate boundary in your own words. Next, cut out the pictures of the plate movements and paste them in the appropriate row of each column. Last, cut out the real-image examples and paste them in the proper row. Paste completed table into your Science Interactive Notebook.

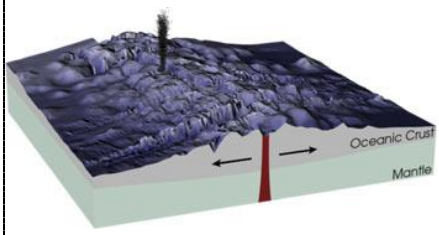
EARTH'S PLATE BOUNDARIES		
PLATE BOUNDARY	MOVEMENT OF PLATES	EXAMPLES
Transform Boundary		
Divergent Boundary		
Convergent Boundary (ocean-to-continent)		
Convergent Boundary (continent-to-continent)		

Plate Movements



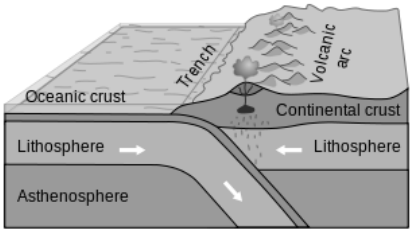


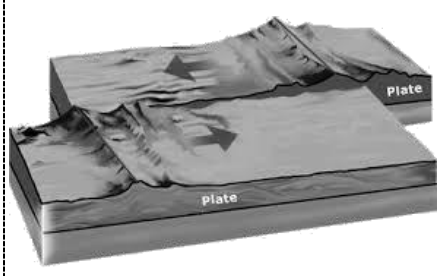


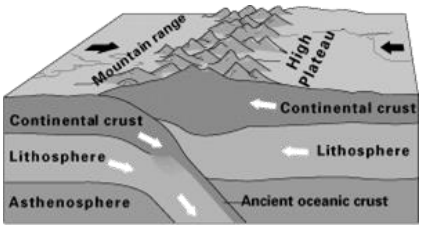


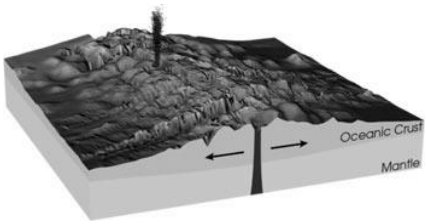
Examples

Plate Movements

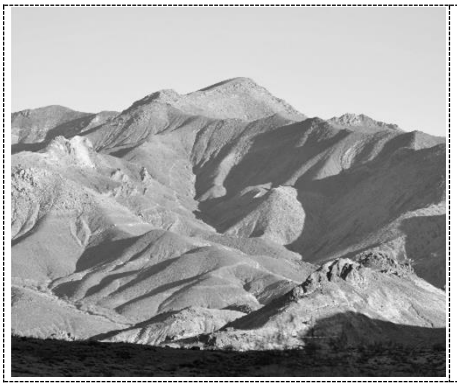






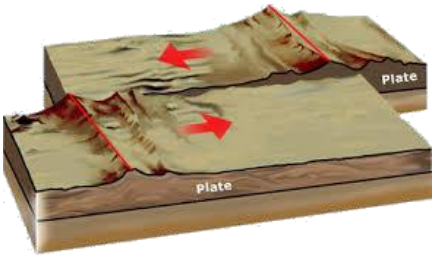
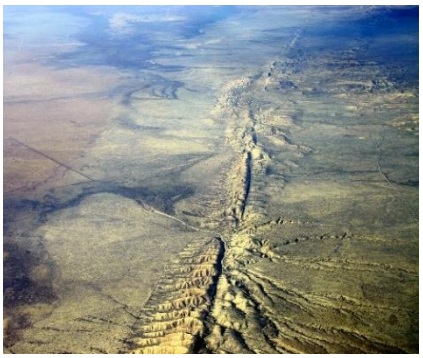
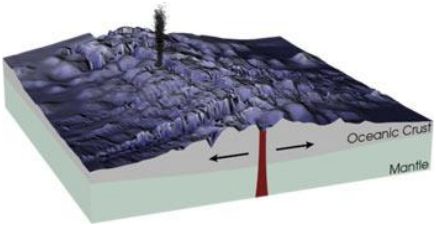
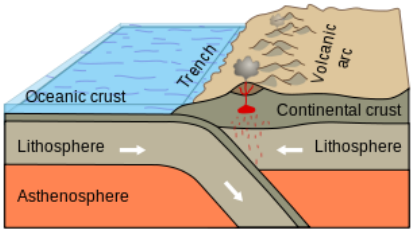
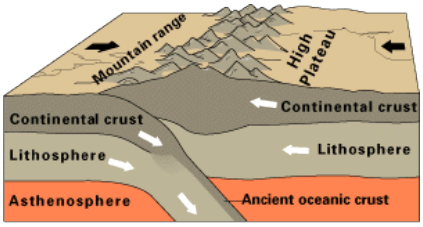


Examples



Answer Key

Interactions of Earth's Plates

EARTH'S PLATE BOUNDARIES		
PLATE BOUNDARY	MOVEMENT OF PLATES	EXAMPLES
Transform Boundary Place where two plates slip past each other moving in opposite directions.		
Divergent Boundary Two plates move apart, or diverge, usually occur at a mid-ocean ridge.		
Convergent Boundary (ocean-to-continent) Place where a continental plate collides with an oceanic plate; the denser plate will subduct.		
Convergent Boundary (continent-to-continent) Two continental plates collide creating mountain ranges since plates have same density.		

Name _____ Date _____

Quiz: The Theory of Plate Tectonics

Fill in the table using the information you know of plate boundaries.

Plate Boundary	Type of Motion	Effect on Crust	Feature(s) Formed
1. _____ boundary	4. _____ _____	6. _____ _____	Mid-ocean ridge, sea floor
2. _____ boundary	5. _____ _____	Mountains are built or subduction occurs	8. _____ _____
3. _____ boundary	Plates slide past one another.	7. _____ _____	Fault

---

Name _____ Date _____

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3. _____ boundary	Plates slide past one another.	7. _____ _____	Fault

Answer Key

Quiz: Earth's Interior

A. crust B. upper mantle (lithosphere/asthenosphere) C. lower mantle
D. outer core E. inner core

(students may have F and G in different order) F. rock samples G. seismic waves

Quiz: Convection in the Mantle

1. the mantle

2. temperature and density

3. A. less dense material is heated and begins to rise

   B. rising material hits lithosphere and slides, moving plates with it

   C. material cools, becoming denser, then begins to fall due to gravity

   D. material is heated again by core, lowering the density.

Quiz: Continental Drift and Sea-floor Spreading

1. C 2. D 3. A 4. B 5. A

Quiz: Theory of Plate Tectonics

1. divergent

2. convergent

3. transform

4. plates move apart

5. plates collide

6. crust pulled apart

7. crust is sheared

8. mountains and volcanoes

Thank you for your recent download of the new Earth Science Interactive Notebook series! chapters from the Life Science Interactive Notebook Series!!

I know this resource will allow you and your students to have a successful year using Science Interactive Notebooks and will be a wonderful portfolio to show all they have learned throughout the school year. I can guarantee students will show pride in their work and be willing to share their notebook entries with you, their classmates and their families.

Please check out my store for the Physical and Life Science Interactive Notebook Series, as well as my Science Inquiry Units. Also, check out my new blog www.NittyGrittyScience.blogspot.com to see examples and how we're getting down to the Nitty Gritty in Science Education!!

Happy Investigating,

Dr. Erica L Colón

Question: How have geologists learned about Earth's interior structure?

Earth's Interior

Geologists have used two main types of evidence to learn about Earth's interior:

1. Direct evidence from rock samples - rocks drilled from deep inside Earth allow geologist to make inferences about conditions

2. Indirect evidence from seismic waves - seismic waves produced by earthquakes allow scientists to measure the speed in which they travel giving clues to the structure of the planet.

Three main layers of Earth vary greatly in size, composition, temperature and pressure. They are:

«« THE CRUST »»

- layer of solid rock that forms Earth's outer "skin"
- includes both dry land and ocean floor
- oceanic crust consists mostly of basalt
- continental crust, or the crust that forms the continents, consists mainly of granite

«« THE MANTLE »»

- layer of solid, hot rock 40 kilometers beneath the surface
- divided into layers:
  - → lithosphere - uppermost part of mantle and the crust for a ridge layer about 100 kilometers thick
  - → asthenosphere - softer part of mantle below the lithosphere which is hotter and under increased pressure
  - → lower mantle - solid material extending all the way to Earth's core

«« THE CORE »»

- made mostly of the metals iron and nickel
- consists of two parts:
  - → outer core - layer of molten metal that surrounds inner core
  - → inner core - dense ball of solid metal
- movement of liquid outer core creates Earth's magnetic field

Question: What causes convection currents in Earth's mantle?

Convection and the Mantle

To explain how heat moves from Earth's core through the mantle, you need to know how heat is transferred.

There are three types of heat transfer:

Radiation - the transfer of energy through empty space; has no direct contact between heat source and an object.

Example: Sunlight warming Earth's surface

Conduction - heat transfer by direct contact of particles of matter. Example: Metal spoon heating up in a pot of hot soup.

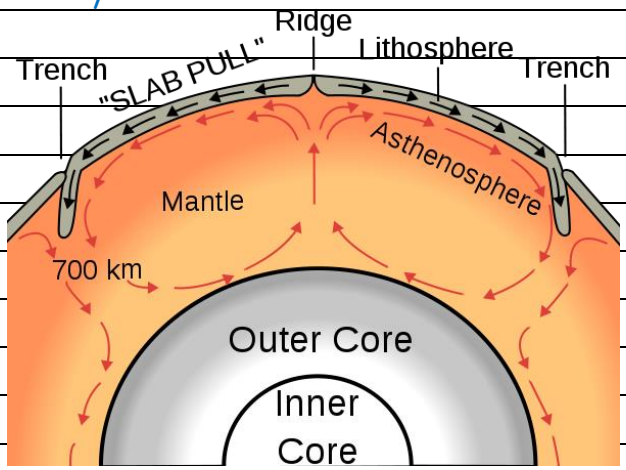
Convection - transfer of heat by the movement of a heated fluid (includes liquids and gases).

Heat transfer by convection is caused by differences in temperature and density within a fluid.

→ Density - measure of how much mass there is in a volume of a substance.

Example: heating water on a stove - as water on bottom gets hot, it expands, becomes less dense and rises; when the surface water starts warming up it becomes denser and moves to bottom causing a convection current, or the flow that transfers heat

Convection currents flow in the mantle - heat source is the Earth's core and from the mantle itself. These currents have been acting like a conveyor belt moving the lithosphere above for the past four billion years!



Question: What two scientists help discover evidence to explain how the planet looks today.

Continental Drift and Sea-floor Spreading

Alfred Wegener (1910) hypothesized that at one time all the continents were once joined together in a single landmass, he named Pangea, and have since drifted apart - now known as continental drift.

Wegener gathered the following evidence to support his hypothesis:

- Evidence from land features such as mountain ranges lining up on continents when pieced together
- Evidence from fossils, or traces of ancient organisms preserved in rock, show the same animals and plants occurred on the now separated land masses
- Evidence from climate change where Wegener showed scratches on rocks make from glaciers in places with much more mild climates today

Wegener could not provide a satisfactory explanation for the push or pull of the continents, therefore his hypothesis was rejected... until Harry Hess (1960) proposed a radical idea suggesting a process of sea-floor spreading.

Sea-floor spreading - sea floor spreads apart along both sides of a mid-ocean ridge as new crust is added. Ocean floors move like a conveyor belt, carrying continents along with them.

Evidence of Hess's theory of sea-floor spreading included:

- Evidence from molten material which looked like pillow-shaped rocks formed if molten material erupts and hardens quickly
- Evidence from magnetic stripes - rocks that lie in a pattern showing a record of reversals of Earth's magnetic field
- Evidence from drilling samples reveal that the farther from a ridge the rocks were taken, the older they were

Eventually the ocean floor sinks into deep, underwater canyons called deep-ocean trenches where subduction takes place which allows part of the ocean floor to sink back into the mantle, over tens of millions of years.

Question: What are the three types of plate boundaries?

The Theory of Plate Tectonics

J. Tuzo Willson (1965) was a Canadian scientist that proposed the lithosphere is broken into separate sections called plates.

Wilson combined information from continental drift, sea-floor spreading and Earth's plates into a single scientific theory, or a well-tested concept that explains a wide range of observations.

Theory of plate tectonics explains the formation, movement and subduction of Earth's plates.

Theory highlights:

- plates float on top of the asthenosphere
- convection currents rise in the asthenosphere and spread out beneath the lithosphere
- convection currents cause plates to move, producing changes in Earth's surface
- changes in Earth's surface include volcanoes, mountain ranges and deep ocean trenches

The edges of the plates meet at lines called plate boundaries. When rocks slip past each other along these boundaries faults, or breaks in the Earth's crust occur. Three types of boundaries:

transform boundary - place where two plates slip past each other, moving in opposite directions (frequent Earthquakes)

divergent boundary - two plates move apart, or diverge; usually occur at the mid-ocean ridge

- rift valley - occurs when a deep valley is formed along a divergent boundary that develops on land

convergent boundary - place where two plates come together, or converge, causing a collision

- when two plates of oceanic crust collide, or when an oceanic plate collides with a continental plate, one plate is subducted beneath the other forming a trench; when two continental plates collide they form mountains

Looking for additional resources for this content??

I've added EDITABLE NOTES and an EDITABLE CHAPTER TEST that you can find here: