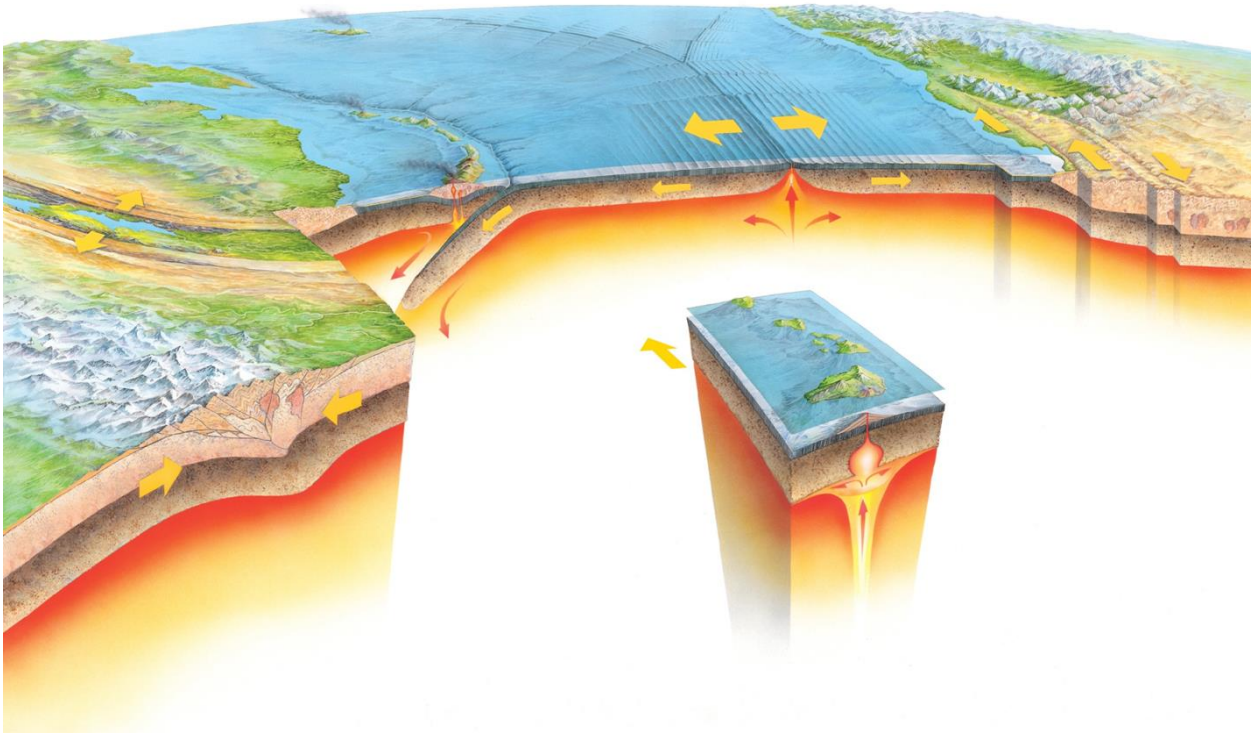
Section 5: Plate Boundary Environments



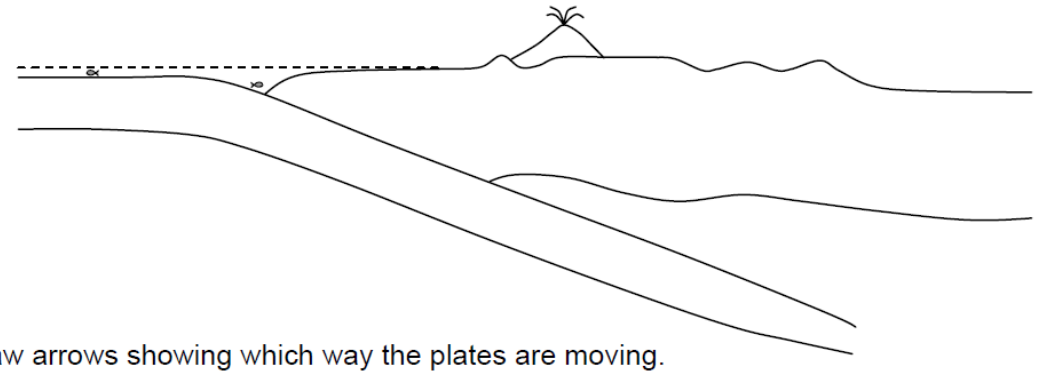
Section 5 Question: How do processes at plate boundaries create features on Earth's surface?

What Do You See?

(cartoon)

What Do You Think?

The cross section below shows a subduction zone at an ocean-continent convergent boundary. The ocean surface is indicated by a dashed line.



1) Draw arrows showing which way the plates are moving.

2) On the diagram, label every feature that geologists can see on the Earth's surface related to plate tectonics. A feature is a thing you can see and not something that is happening.

3) Two students are discussing the features they labeled on the diagram.

Student 1: *I labeled the ocean plate, the continental plate, volcanoes, and mountains.*

Student 2: *I labeled those, plus the ocean trench and subduction.*

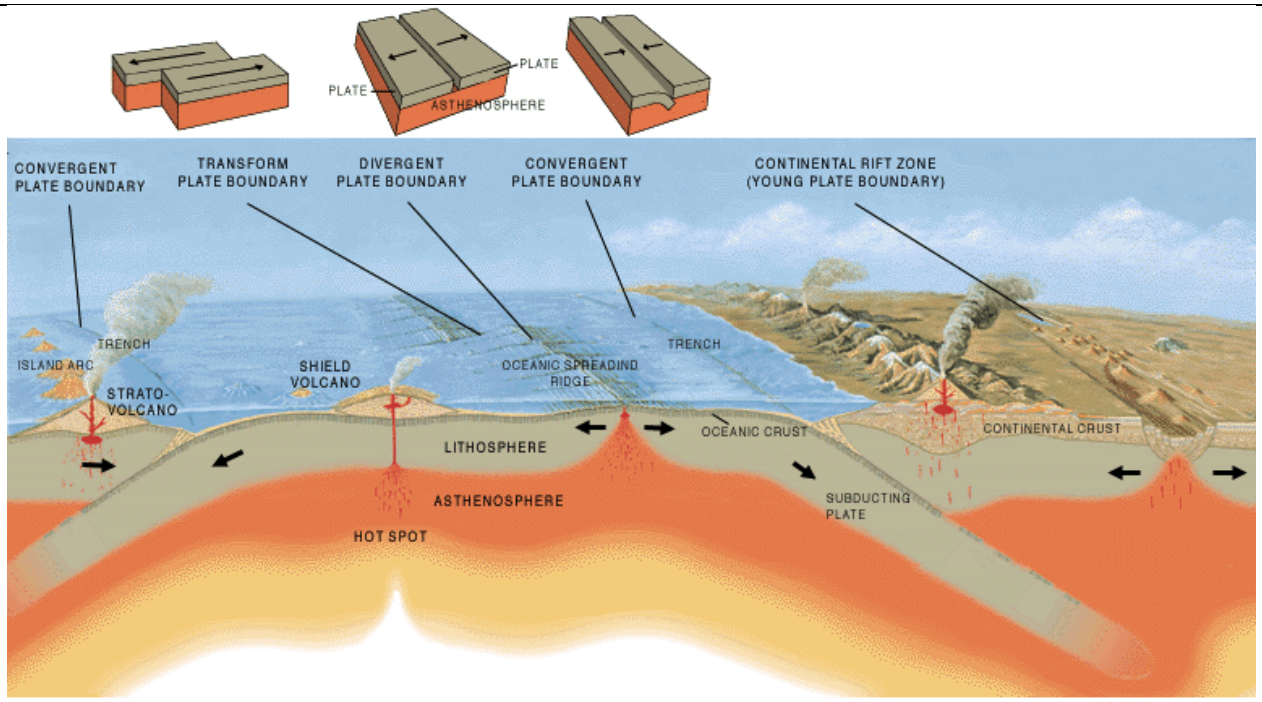
Student 1: *I like that you labeled the trench, but I don't think you can label subduction. Subduction is an action of something happening, and it's not a feature.*

Student 2: *But you can see it on the diagram where the ocean plate is being pushed under the continental plate, so I think you can label subduction as a feature.*

With which student do you agree? Why?

What Do You Think Now?

Focus Question A: How are interactions at plate boundaries different?



Go to www.phet.colorado.edu. Click on the orange "Play With Sims" button. On the right side of the screen, choose the "Earth Science" category. Run the "Plate Tectonics simulation.

Part I:

1. Begin with the "Crust" tab. Under "View," check "Both" and "Show Labels." Use the tools in the lower left corner to qualitatively compare the thickness, density, and temperature of the oceanic and continental crust samples. Complete the table below.

Crust Type	Thickness	Density	Temperature
Oceanic			
Continental			

2. Which property do you think causes continental crust to have a higher elevation (on average) than oceanic crust? Explain.

Experiment with making your own crust using the sliders in the center of the screen. Note that the middle crust sample will turn blue or green depending on whether it is considered oceanic or continental crust.

3. See what happens when you adjust the thickness of the crust. What kind of crust is very thick crust? What kind of crust is very thin crust?

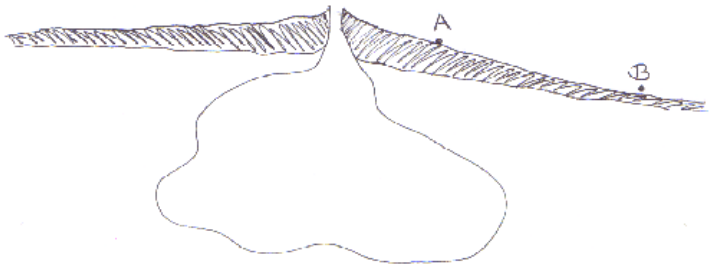
4. See what happens when you change the composition of the crust? Does oceanic crust have more iron or more silica? Does continental crust have more iron or more silica?

5. Set the thickness and composition of your crust somewhere in the middle. Write down what type of crust you have: _____. See what happens when you change the temperature of the crust. What happens to very cool crust? What happens to very warm crust?

6. Based on your answers to # 3 – 5, complete the table below.

Crustal Property	**Result**	
Thickness	thick:	thin:
Composition	more iron:	more silica:
Temperature	warm:	cool:

7. Based on what you know about sea-floor spreading, mark where you think the crustal properties of points A and B would fall on the continua below.



Property	
Thickness	thin.....thick
Composition	iron.....silica
Temperature	cool.....warm
Age	young.....old

Part II:

Now go to the "Plate Motion" tab. Under "View, check "Both," "Show Labels," and "Show Sea Water." Experiment with different types of crust at the plate boundary.

8. Reset the simulation and set it up with a **<u>continental</u>** and an **<u>oceanic (young or old)</u>** crust.
   a. Drag the plate in the direction of the green arrow. What type of boundary is this?

   b. Sketch a time series of this process with at least two diagrams. Label the two types of crust and show the direction of motion.

   c. Which plate subducts beneath the other? Why do you think this is (hint: think of the properties you explored in part I)?

   d. What feature is created on the continental crust parallel to the plate boundary?

9. Reset the simulation and set it up with **<u>two old oceanic</u>** crusts.
   a. Drag the plate in the direction of the red arrow. What type of boundary is this?

   b. Sketch a time series of this process with at least two diagrams. Label the two types of crust and show the direction of motion.

   c. What feature is created at the plate boundary?

10. Reset the simulation and set it up with **<u>two continental</u>** crusts.
    a. Drag the plate in the direction of the blue arrow. What type of boundary is this?

    b. Sketch a time series of this process with at least two diagrams. Label the two types of crust and show the direction of motion.

11. Reset the simulation and set it up with **<u>two continental</u>** crusts.
    a. Drag the plate in the direction of the green arrow. What type of boundary is this?

    b. Sketch a time series of this process with at least two diagrams. Label the two types of crust and show the direction of motion.

    c. What feature is created at the plate boundary? Why does neither plate subduct?

12. Experiment and find two additional scenarios not yet described in this activity. Complete the table below.

Types of Crust	Type of Boundary	What Happens/New Features

13. New crust is created at a divergent boundary. Where does this new crust come from? What happens to the old crust?

Claim:

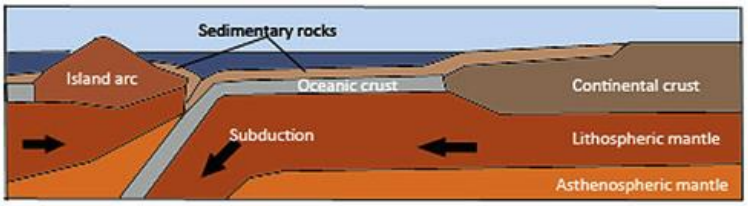
Evidence:

RETURN TO WDYTN

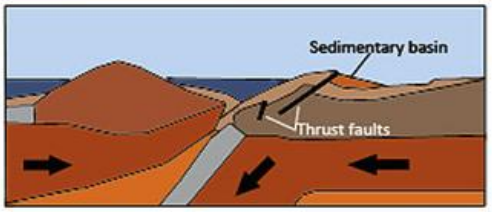
DIGGING DEEPER

Growth of Continents

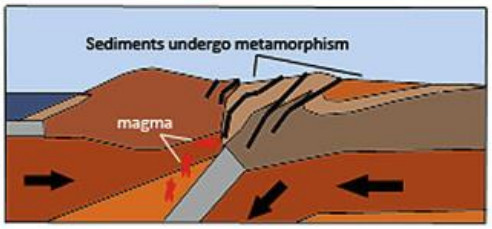
- Continents grow through two main processes called continental accretion
  - The first involves the addition of new land as continents and land masses collide with one-another.
  - The second is through the addition of igneous rock above subduction zones



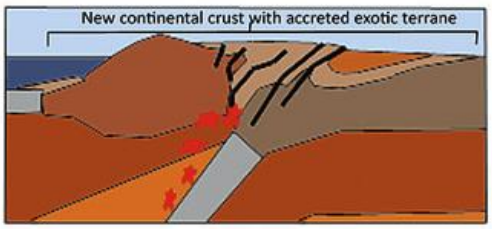
As subduction progresses, the island arc and continental crust resist being subducted and are pulled together, pinching sediments between them. Thrust faults develop.



The oceanic crust subducts and the island arc collides with the continental crust, causing sediments to be metamorphosed and further development of thrust faults. Subducted oceanic crust melts in the mantle and plutons rise along the subduction pathway.



The island arc becomes sutured to the continental crust. Rising plutons become emplaced in the lower crust and drive additional metamorphism of sediments. Subduction below the suture zone ceases.



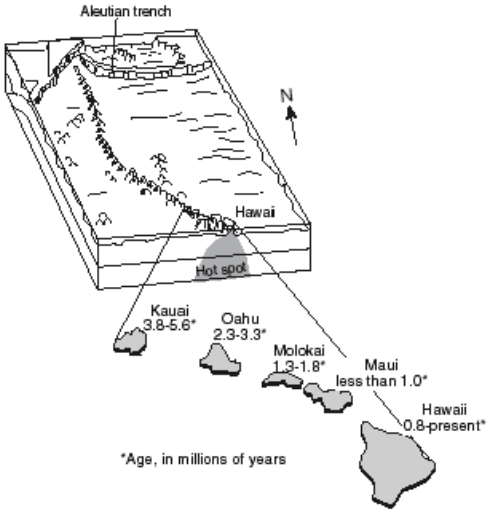
At what types of boundaries does continental crust grow? Why?

How is this different from the formation of crust at divergent boundaries?

What role do these processes have in the formation of continental vs. oceanic rock?

Hot Spots

- Hot Spots are plumes of unusually hot mantle material that are believed to originate from the core/mantle boundary
- Once this magma breaks through the surface, volcanoes are created.
- Other features such as geysers, hot springs, and thermal pools are also associated with mantle plumes and hot spots.
- Mantle plumes are also thought to be the force that initiates continental rifting.
    - The Great Rift Valley of Africa is a modern example of continental rifting



What are two examples of Hot Spots in the United States?

How are they different?

How are they similar?

Compare and contrast a continental rift valley with a mid-ocean ridge

Rift Valley	Mid-Ocean Ridge

Chapter 2, Section 5 E.B.C.
Plate Boundary Environments

Name:_____
Period:_____

Question (2)		
Claim 1 (2)		
A. Supporting Evidence (3)	B. Supporting Evidence (3)	
Claim 2 (2)		
A. Supporting Evidence (3)	B. Supporting Evidence (3)	
Analysis (6)		

	Claim *A statement or conclusion that answers the original question/problem.*	**Evidence** *Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	**Analysis** *A justification that connects the evidence to the claims. It shows why the data counts as evidence by using appropriate and sufficient scientific principles and vocabulary*.
0	Does not make a claim, or makes an inaccurate claim.	Does not provide evidence, or only provides inaccurate or vague evidence.	Does not provide an analysis, or only provides an irrelevant analysis.
1	Makes an accurate but vague or incomplete claim.	Provides vague evidence and does not include specific data.	Repeats evidence and links it to claim, but does not include specific scientific principles.
2	Makes accurate and complete claim.	Provides correct evidence but does not include specific data.	Connects all evidence to the claims using scientific principles or vocabulary but not both.
3		Provides correct evidence and includes specific data.	Connects all evidence to both claims using scientific principles and vocabulary.

CHECKING UP: Page 181, 1 through 10 (2 points each)

____
30

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Although most earthquakes and volcanoes are associated with plate boundaries, they are not always located directly along the boundaries. Considering boundaries between oceanic and continental plates: (5 points each)

Why are volcanoes usually found on the continental side of a plate boundary?

Why do earthquakes usually occur on the continental side of a plate boundary?