

McConnell Active Learning Lesson Example

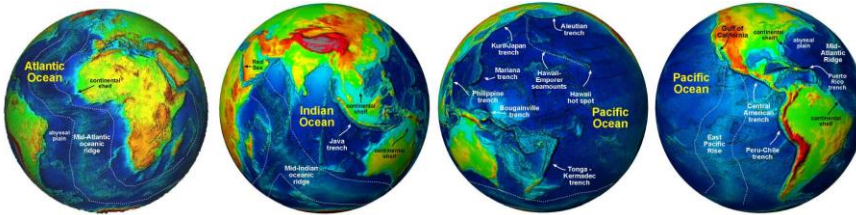
NC STATE UNIVERSITY

Learning Sequence for Physical Geology

# of learning objectives per class (75-minute lectures)	~ 5
# of questions on preclass homework assignments (learning journals)	~ 8 - 10
# of questions/activities per class meeting	~ 3 - 6
# of questions per optional topic (2-3 classes) mastery quiz	~ 50

MEA 101-002 Physical Geology

Topic 3: Plate Boundaries and Continental Formation



Task Calendar

1. Complete attempts at Topic 3 CLASS quiz
2. Complete Learning Journal 6 (due Tu 9/18)
3. Complete Topic 2 CLASS Learning Objective analysis exercise (due 9/11, TODAY)

Topic 3: Learning Objectives

1. I can interpret the pattern of hot spots to determine the direction of plate motion.
2. I can describe the physical features and geologic processes at a convergent plate boundary.
3. I can compare and contrast the three types of convergent plate boundary.
4. I can identify examples of transform plate boundaries around the world.
5. I can describe the physical features and geologic processes at a transform plate boundary.

red = learning journal

red = learning journal and lecture activity

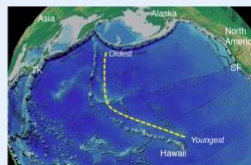
black = lecture activity only

Hot Spots

- Hot spots form above **magma plumes** rising through the mantle from the core/mantle boundary
- Hot Spot fixed in place in mantle, plate moves over it
- Relative ages and orientation of volcanoes interpreted to indicate plate motion

ConceptTest

The Hawaiian Islands make up the southern end of a long L-shaped chain of volcanoes and seamounts (underwater volcanoes). Use this pattern to predict the two directions the Pacific plate moved in while these features were formed.



- A. First northwest, then north
- B. First south, then northwest
- C. First north, then northwest
- D. First northwest, then south



Plate Tectonics Animation

Where is the . . . ?

- a) Continental crust
- b) Oceanic crust
- c) Lithosphere
- d) Asthenosphere
- e) Oceanic ridge
- f) Trench
- g) Subduction zone
- h) Directions of plate motions

Concept Sketch (Handout)

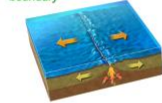
Plate Tectonics Animation

Where is the . . . ?

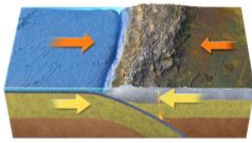
- a) Continental crust
- b) Oceanic crust
- c) Lithosphere
- d) Asthenosphere
- e) Oceanic ridge
- f) Trench
- g) Subduction zone
- h) Directions of plate motions

Plates of lithosphere . . .

Move apart: **divergent boundary**

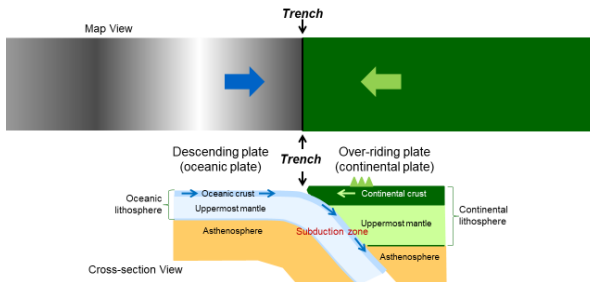


Move toward each other: **convergent boundary, 3 types**



Move horizontally past one another: **transform boundary**

Plate Motions and Physical Features



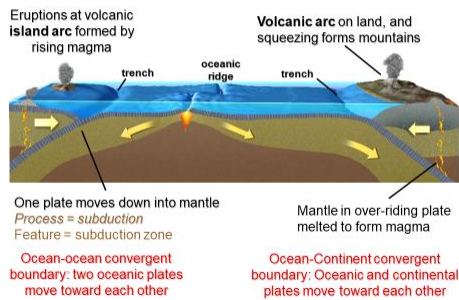
How many of these features form where two oceanic plates collide at a convergent boundary?

- Island arc
- Subduction zone
- Rift valley
- Transform boundary
- Hot spot

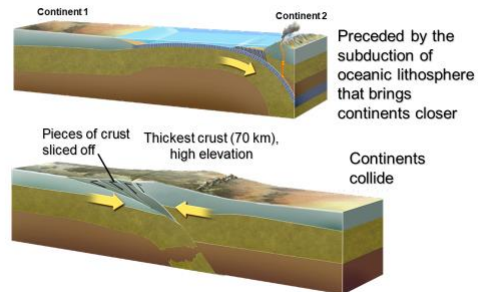
45% **A. 2**
46% **B. 3**
6% **C. 4**
3% **D. 5**

ConcepTest

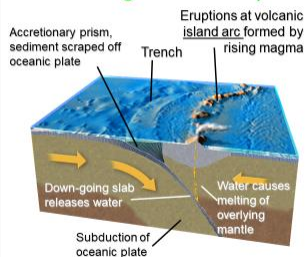
Convergent w/Oceanic Lithosphere



Continent-Continent Convergence



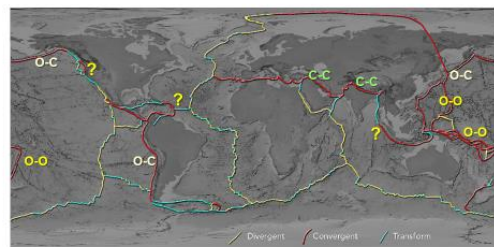
Ocean-Ocean Convergent Boundary



Ocean-Continent Convergent Boundary



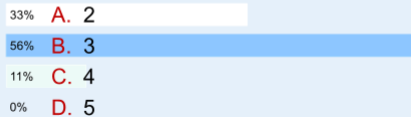
Identify the different types of convergent plate boundaries



O-O Ocean-ocean convergent boundary
O-C Ocean-continent convergent boundary
C-C Continent-continent convergent boundary

How many of the these boundaries are examples of **convergent** plate boundaries?

- Pacific and Antarctica plates
- Indian-Australian plate and Eurasian plate
- Indian-Australian plate and Antarctica plate
- North American plate and Eurasian plate
- Pacific plate and Indian-Australian plate
- Nazca plate and Pacific plate



ConcepTest

Defining Features Matrix (Handout)

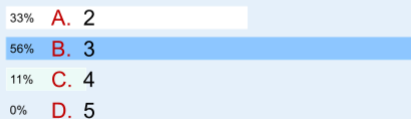
Compare and contrast ocean-ocean, ocean-continent, and continent-continent convergent boundaries

1 with no correct answer; 4 with one correct answer

Features	Ocean-Ocean	Ocean-Continent	Continent-Continent
Trenches currently present	•	•	
Island arc present			
Mountain belts on overlying plate			
Volcanoes on descending plate			
Oceanic plate currently descends subduction zone			
Magma rises through overlying plate			
Thickest crust on Earth			
Volcanoes on overlying plate			
Subduction zone currently present			
Example: Nazca plate collides with S. America			
Example: India collided with Eurasia			

How many of the these boundaries are examples of **convergent** plate boundaries?

- Pacific and Antarctica plates
- Indian-Australian plate and Eurasian plate
- Indian-Australian plate and Antarctica plate
- North American plate and Eurasian plate
- Pacific plate and Indian-Australian plate
- Nazca plate and Pacific plate



ConcepTest

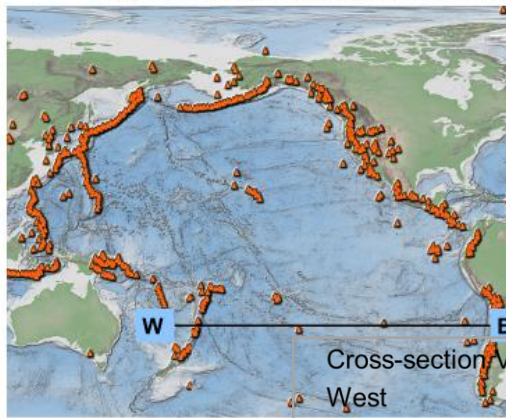
Defining Features Matrix (Handout)

Compare and contrast ocean-ocean, ocean-continent, and continent-continent convergent boundaries

1 with no correct answer; 4 with one correct answer

Features	Ocean-Ocean	Ocean-Continent	Continent-Continent
Trenches currently present	•	•	
Island arc present	•		
Mountain belts on overlying plate		•	•
Volcanoes on descending plate			
Oceanic plate currently descends subduction zone	•	•	
Magma rises through overlying plate	•	•	
Thickest crust on Earth			•
Volcanoes on overlying plate	•	•	
Subduction zone currently present	•	•	
Example: Nazca plate collides with S. America		•	
Example: India collided with Eurasia			•

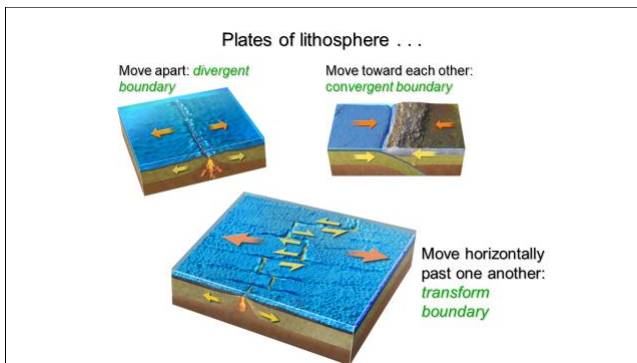
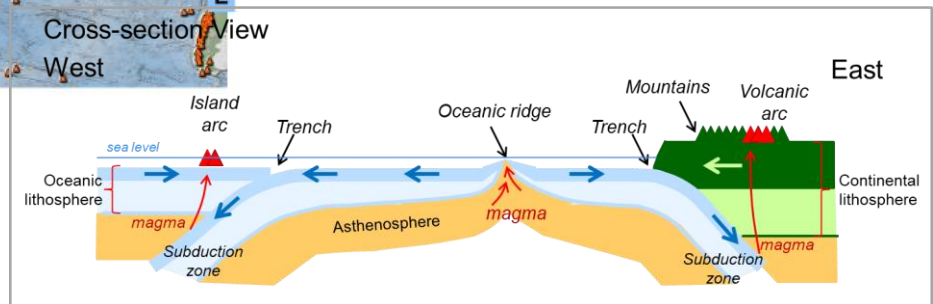
Use what you know about plate tectonics to sketch a cross section through the outer layers of Earth along the W-E line



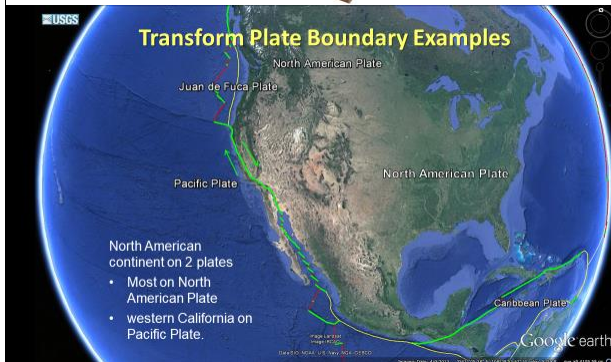
Label:

- Physical features,
- Geologic processes
- Indicate the directions of plate motions

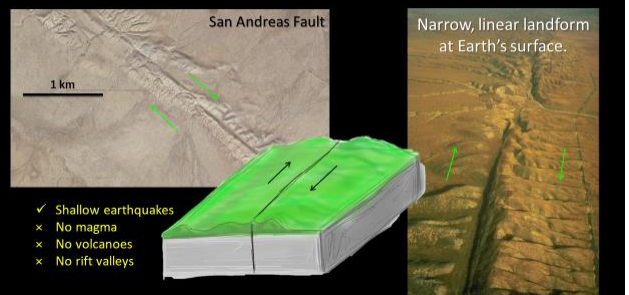
Concept Sketch



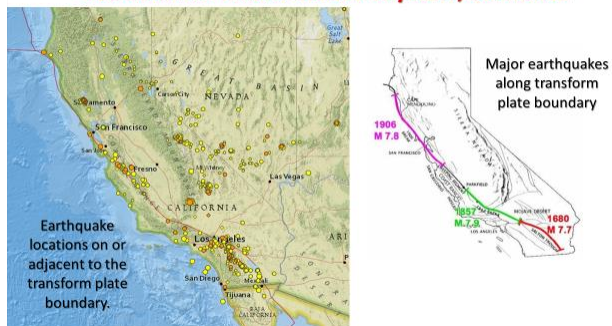
San Andreas Transform Fault system, California



San Andreas Fault system, California



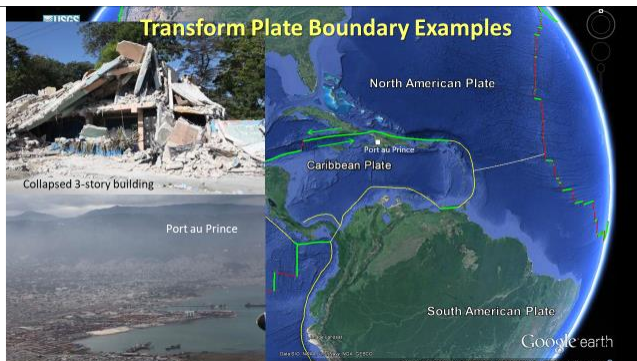
San Andreas Transform Fault system, California



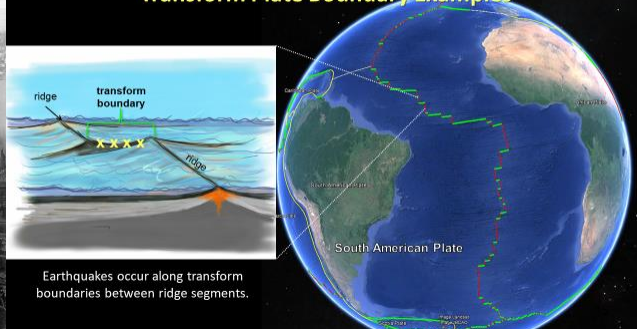
San Francisco Earthquake (1906)



Transform Plate Boundary Examples



Transform Plate Boundary Examples



Which location(s) represent(s) a transform boundary?

- A. 1 only
- B. 2 and 3
- C. 3 only
- D. 2 and 4
- E. 5 only



0% 0% 0% 0% 0%

1 2 3 2 5
only and only and only

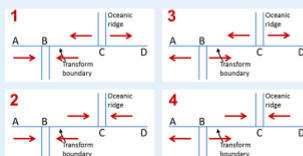
ConceptTest

ConceptTest

Examine the idealized maps that shows the location of two segments of oceanic ridge separated by a transform plate boundary.

Which map shows the correct orientation of plate motions?

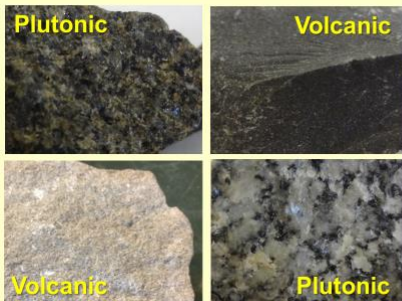
- 1. 1
- 2. 2
- 3. 3
- 4. 4



0% 0% 0% 0%

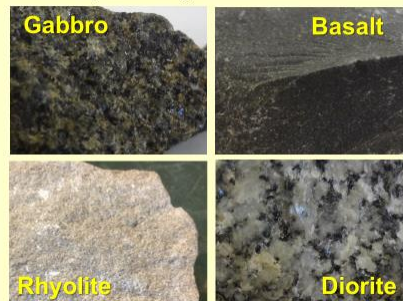
1 2 3 4

I can explain how to use texture to place an igneous rock into one of two major groups.



Classify these igneous rocks as **volcanic or plutonic** on the basis of their texture

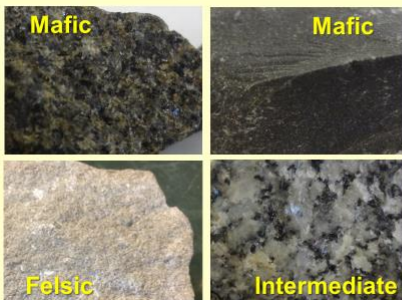
I can classify common igneous rocks on the basis of texture and composition.



Name (classify) these igneous rocks on the basis of their texture and composition

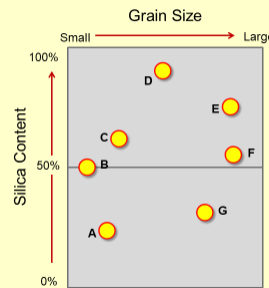
Think – Pair – Share Activities w/ Igneous Rocks

I can describe how geologists



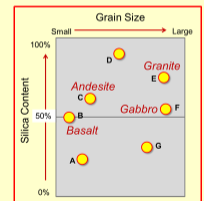
Classify these igneous rocks as **felsic, intermediate, or mafic** on the basis of the color of their minerals

texture and composition.

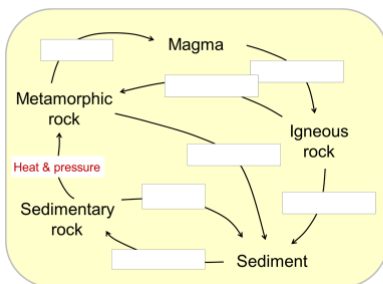


Match the names of the igneous rocks with the lettered symbols on the diagram.

Granite
Basalt
Gabbro
Andesite



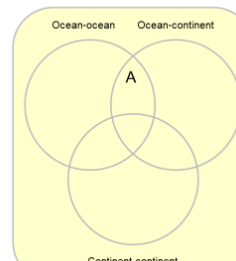
I can sketch and label a diagram to summarize the rock cycle.



Place these terms on the relevant blanks in the Rock Cycle

- Heat & pressure
- Weathering & erosion
- Melting
- Cooling & Solidification
- Lithification

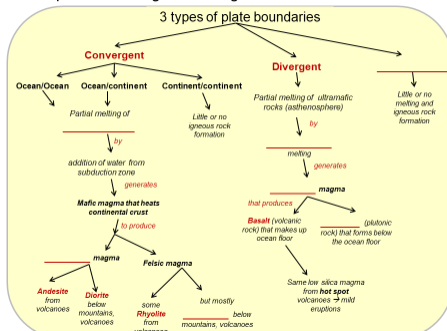
I can compare and contrast ocean-ocean, ocean-continent, and continent-continent convergent boundaries



- Trenches currently present
- Island arc present
- Mountain belts on over-riding plate
- Volcanoes on descending plate
- Magma rises through over-riding plate
- Thickest crust on Earth
- Volcanoes on overlying plate
- Driven by convection in Earth's interior
- Example: Nazca plate collides with S. America
- Example: India collides with Eurasia

Concept Maps and Venn Diagrams

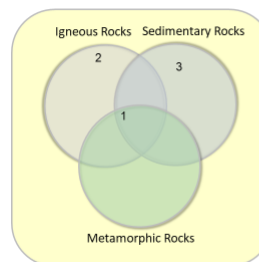
I can explain how magmas and igneous rocks form in association with plate settings



Fill in the blanks to complete this concept map.

- Ultramafic rocks
- Transform
- Decompression melting
- Mafic magma
- Intermediate
- Granite
- Gabbro

I can compare and contrast the features of igneous, sedimentary, and metamorphic rocks



- Present on Earth
- Formed from magma
- Form exclusively at or near the surface
- May form many kilometers below the surface
- Example: Gneiss
- Classification of this/these rock type(s) considers texture
- Form beds
- Can be deposited in running water
- May form at a temperature of 400°C
- Example: Andesite
- May be composed of small grains or crystals
- May undergo weathering at Earth's surface to form sediment
- Can form as a result of crystallization
- Form under conditions of increasing heat and pressure
- Solidify under conditions of decreasing temperature
- Coal, coral, and chalk are examples

High utility activities provide opportunities for instructors and students to readily assess learning

Examples of high utility active learning strategies:

- Conceptests
- Think-Pair-Share
- Concept maps and Venn diagrams
- Concept Sketches