Plate Tectonics Basics
Two Types of Tectonic Plates

- Land-based
- Ocean

Which one is more dense? Which one is less dense?
There are 2 types of tectonic plates:

**OCEAN PLATES**
- More Dense
- Low in Silica Content

**LAND-BASED PLATES**
- Less Dense
- High in Silica Content

*** Silica is the most common mineral found in the Earth’s crust
Three Types of Plate Movements

There are 3 ways that tectonic plates can move in relation to each other:

- Plates move away from each other
- Plates move towards each other
- Plates move/slide past each other

- Convergent
- Divergent
- Transform

Which one fits the definitions?
There are 3 ways that tectonic plates can move in relation to each other:

1. Plates move away from each other
   - Called Divergent Movement
   - New crust is formed

2. Plates move towards each other
   - Called Convergent Movement
   - Crust is “destroyed” or consumed back into inner Earth

3. Plates move/slide past each other
   - Called Transform Movement
   - Crust is neither created or “destroyed”
• When taking plate type and movement into account, there are 5 possible tectonic plate interactions. These are:
  – Continental Collision Boundaries
  – Divergent Plate Boundaries
  – Hotspots
  – Subduction Boundaries
  – Transform Boundaries
GEOLOGIC ACTIVITY DUE TO:

TECTONIC PLATE INTERACTIONS

- Two Plates Moving Apart
  - Two Ocean Plates
    - Divergent
  - What is the Name of This Scenario?

- Two Plates Sliding By One Another
  - Transform

- Two Plates Colliding Together
  - Two Land Plates
    - Continental Collision
  - One Land Plate
    - One Ocean Plate
    - Subduction
  - Hotspots

- ACTIONS OTHER THAN TECTONIC PLATE INTERACTIONS
Rules of Earthquake Characteristics

• Magnitude Rules
  – Earthquakes are strong when compression of rock is involved.
  – Rock stores energy well when squeezed; when rock slips, energy is released all at once
  – Stretched rock simply breaks – not storing potential energy

• Depth Rules
  – Deeper earthquakes are a result of plates going under others.
  – Therefore, some form of convergence of plate movements must be involved.
Earthquake Depth Prediction

- Mostly Shallow
- Potentially Deep
- Potentially Deepest

Earthquake Magnitude Prediction

- Mainly weak strength
- Many potentially strong earthquakes
Examples

- Hawaii
- Mid-Atlantic Ridge
- Japan
- Chile
- San Andreas Fault
- Himalayas
- Haiti
- Mid-Indian Ridge
- Yellowstone
- Middle East (Iran/Afghanistan)
Now, fill in the Earthquake Depth Prediction, Earthquake Magnitude Prediction, and Examples Section.
Type 1 -- Divergent Boundaries

- 2 plates moving away from each other
  - Occurs usually with two ocean plates
  - Magma from below spews up and hardens to create new crust. This forces older crust out and away from this plate boundary. So, plates move apart and get bigger as magma cools on the edges of the plates
  - Example: Mid-Atlantic Ridge

The mid-Atlantic Ridge (arrow), clearly visible
Divergent Boundary Video #1

Divergent Boundary Video #2
Type 2 - Convergent Boundaries

• Where plates are colliding together
• Two Types of Convergent Plate Boundaries
  – Subduction – when one plate (oceanic) slides under another (land)
  – Continental Collision – two land plates moving together
What Happens in Subduction?

- Oceanic plate goes under land plate
  - Example: Ring of Fire
- Oceanic plate drawn deep into mantle and melts
  - Large pressures & temperatures cause the rocks to produce water
  - This water in the mantle changes the melting points of surrounding rock and causes rock to melt to magma
  - Magma spews up to surface
What Happens in Subduction?

• Subduction causes deep, large earthquakes – due to compressed plate under other one

• Associated landforms with subduction zones
  – Ocean trenches – due to ocean plate going down
  – Mountain chains – due to plate collision/crunching
  – Volcanoes – due to increased magma production in the mantle
Subduction Video
What Happens in Continental Collision?

- Two land plates collide into each other.
- Very little subduction occurs, since plates are the same density.
- Plates simply crunch together, forming mountains.
- Example: Himalayas.
- Moderately deep and strong earthquakes.

Continental Collision Video
Type 3 - Transform Boundaries

- When two plates slide past each other.
- Earthquakes are result of loosening of plates from one another.
- Earthquakes do not involve compression. So, not very strong.
- Quakes only get strong if plates get stuck on each other, then release all at once.
- Example: California San Andreas Fault.
Hotspot Geological Activity

- Hotspots have earthquake/volcanic action, but it is NOT due to plate movements.
- In most cases, the mantle underneath the hotspot is unusually active and hot.
- A mantle plume will spew to the surface.
Hotspot Geological Activity

- The plume stays still, but the plates above it move!
- As the plate moves above this hotspot, new chunks of material are spewed out & new locales are affected by the plume over time.
- Examples: Hawaii and Yellowstone
Composition of the Earth

• Core – Inner Earth layer
  – Made of iron/nickel mixture
    • Inner core is solid
    • Outer core is liquid

• Mantle – Layer surrounding the core
  – Mostly made of solid rock
  – Mantle is melted, liquid rock towards its upper surface
    • Liquid layer is called the asthenosphere and is highly mobile
    • The uppermost part of the mantle is solid and rigid and is attached to the crust.
Composition of the Earth

• Crust – Upper Earth layer
  – The crust and solid, upper mantle constitute the lithosphere
  – What is the crust made of?:
    • Rock - primarily quartz (which is silicon oxide or SiO$_2$)
  – The elements found in the Earth’s crust in descending order:
    • Oxygen
    • Silicon
    • Aluminum
    • Iron
    • Calcium
Plate Tectonics

- Earth is made of moving, solid plates that are atop the liquid asthenosphere.
- Asthenosphere has heat convection cells.
  - Hot rock rises towards surface in the mantle.
  - This rock cools and falls back toward core.
  - Thus, hot rock creates cycled movement in mantle.
Act Out

- With the people at your table, act out each of the 4 plate interactions. You will be randomly asked to share one of them. Use everyone in acting out your plate movements. These motions are:
  - Continental Collision
  - Divergent
  - Subduction
  - Transform