Earthquakes and Volcanoes

What are Earthquakes?
- The shaking or trembling caused by the sudden release of energy
- Usually associated with faulting or breaking of rocks
- Continuing adjustment of position results in aftershocks

What is the Elastic Rebound Theory?
- Explains how energy is stored in rocks
  - Rocks bend until the strength of the rock is exceeded
  - Rupture occurs and the rocks quickly rebound to an undeformed shape
  - Energy is released in waves that radiate outward from the fault

What is Seismology?
- The point within Earth where faulting begins is the focus, or hypocenter
- The point directly above the focus on the surface is the epicenter
What is Seismology?
- Seismographs record earthquake events.
At convergent boundaries, focal depth increases along a dipping seismic zone called a Benioff zone.

What are Seismic Waves?
- Body waves
  - P or primary waves
  - Fastest waves
  - Travel through solids, liquids, or gases
  - Compressional wave, material movement is in the same direction as wave movement
  - S or secondary waves
  - Slower than P waves
  - Travel through solids only
  - Shear waves - move material perpendicular to wave movement

What are Seismic Waves?
- Surface waves
  - Travel just below or along the ground's surface
  - Slower than body waves; rolling and side-to-side movement
  - Especially damaging to buildings

How is an Earthquake's Epicenter Located?
- Seismic wave behavior
  - P waves arrive first, then S waves, then L and R
  - Average speeds for all these waves is known
  - After an earthquake, the difference in arrival times at a seismograph station can be used to calculate the distance from the seismograph to the epicenter.

How is the Size and Strength of an Earthquake Measured?
- Magnitude
  - Richter scale measures total amount of energy released by an earthquake; independent of intensity
  - Amplitude of the largest wave produced by an event is corrected for distance and assigned a value on an open-ended logarithmic scale.
What are the Destructive Effects of Earthquakes?
- Building collapse
- Fire
- Tsunami
- Ground failure

Volcanism
- Processes which lead to the extrusion of lava, gases, and pyroclastic materials onto the surface and into the atmosphere
- Active volcanoes
- Dormant volcanoes
- Extinct volcanoes

Volcanic Gases
- 50 to 80% is water vapor, also carbon dioxide, nitrogen, sulfur dioxide, hydrogen sulfide, carbon monoxide
- Gases contained in rising magma expand and can contribute to violent explosions

Lava Flows
- Paths are predictable
- Rarely a danger to human life
- Two types are recognized from Hawaiian flows: pahoehoe and aa

Pyroclastic materials are deposited as solid fragments of explosive volcanism
- Ash
- Lapilli
- Bomb, block

Volcanic Gases
- Many fatalities have resulted from exposure to toxic gases, or suffocation from the displacement of oxygen by denser volcanic gases
What are Volcanoes?

- Conical mountains formed around a vent where lava, gases, and pyroclastic materials are erupted
  - Variations in lava composition and other factors distinguish three types
  - Most have a central crater, while calderas and fissures are also common

What are Volcanoes?

- Calderas form when an emptied magma chamber collapses

What are Volcanoes?

- Shield Volcanoes
  - Low, rounded profiles; slope angles 2-10°; composed of numerous flows of mafic composition and little explosive activity
  - Largest of all volcanoes

What are Volcanoes?

- Cinder Cones
  - Composed of pyroclastic materials that accumulate around the vent; steep slopes (33°)
  - Usually short-lived and may represent final eruptive stages

What are Volcanoes?

- Composite Volcanoes
  - Also called stratovolcanoes, are composed of alternating layers of pyroclastics and lava flows
  - Composition is intermediate, with andesite common
  - Eruptions are infrequent, violent, and may involve lahars

What are Volcanoes?

- Lava Domes
  - High-viscosity, felsic magmas move slowly upward to form steep-sided lava domes
  - Sudden collapse or explosive eruption may cause a nuée ardente to move rapidly downslope, incinerating everything in its path