Earthquakes happen every day, every hour somewhere in the world. 95% of seismicity in Hawaii is due to volcanism – magma movement. Other 5% is due to tectonic forces on the seafloor.

>380 major cities lie on or near unstable regions of Earth’s crust (potential for devastation is high)

Most Earthquakes Occur at Plate Boundaries, but Intraplate Seismicity Is Also Common.

Divergent Seismicity

Convergent Seismicity

Transform Seismicity
Divergent, Convergent, and Transform Margins Are the Sites of Frequent Earthquake Activity. KOBE – 1995, 5100 deaths

KOBE – 1995, 5100 deaths

Sichuan Quake, 2008, 87,000 deaths

Kashmir, 2005, 75,000 deaths

Tohoku Japan, 2011, 20,000 deaths, 1 million buildings destroyed

An Earthquake Is Sudden Shaking of the Crust.

3/18/2013
MEGATHRUST EARTHQUAKE
OCCURS WHEN "LOCKED" SUBDUCTION ZONE RUPTURES

1. Strain accumulates.
2. Crust shortens.
3. Uplift occurs.
4. Plates unlock.
5. Crust extends rapidly culminating in a Megathrust Earthquake

Tohoku Earthquake, 2011; 15,000 – 20,000 deaths; moved Japan 8 ft east, tsunami 133 ft high

Disaster–Tsunami–Tohoku

Tsunami attacked near the coast line near the Sendai Airport

Tsunami Video

http://www.youtube.com/watch?v=5_dfBCQg818&feature=relmfu

http://www.youtube.com/watch?v=w3AdFjklR50&playnext=1&list=PL8ECD3140BD2935F8&feature=results_main

https://dl.dropbox.com/u/68500077/2011KesennumaB.mp4
Eventually a fault, or other preexisting weakness, is no longer able to accommodate the buildup of strain and ruptures!

The Elastic Rebound Theory ...

... Explains the Origin of Earthquakes.

Two types of wave groups generated –
1. Surface waves (two types: Rayleigh, Love)
   Travel along outer layer of crust at the surface causing ground roll like a water wave and lateral shifting...travel slowly and generate the most damage

   Love Wave

   Rayleigh Wave

Two types of wave groups generated –
2. Body waves (two types: P and S)
   Primary waves (P) – compress and pull (dilate) rocks in the direction of movement, changing the volume and shape of material...solids, liquids and gases resist compression and will spring back. Thus they propagate the waves forward.

   P waves travel through all types of matter

   Fastest wave

**Secondary waves (S)** - motion is 90 degrees to direction of propagation (up and down), involves only changing the shape of transmitting media. Fluid and gas do not resist shape change hence they will not spring back and will not transmit the wave forward. S waves travel only through solids.

Second fastest wave

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A SEISMOGRAM is made by a SEISOMETER.

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Seismometers in Denver and Phoenix are used to triangulate ...
P-wave and S-wave Shadow Zones

(a) Global earthquake epicenters

(b) Global seismograph stations

Earthscope – NSF
http://www.youtube.com/watch?v=‐‐WsXg86WSg

Depth 200 km
High: 2.2%
Low: -1.9%

> A TECTONIC PLATE SINKING UNDER THE UNITED STATES

This actual seismic tomography image shows a cross section of the crust and upper mantle beneath North America. Blue and green shades mean cooler and denser rock, and red and orange shades mean warmer and less dense rock. Seismic data points showed that the green region shows that the Earth's mantle has been pulled down below it and the crust and upper mantle has been stretched down the North American plate. In this region of the Earth, the Pacific plate has subducted beneath the North American plate, and there is a sinking of the oceanic crust. Science has been conducted on this region to check why the plate is sinking, and whether it is moving or not. The bottom of the plate is deep beneath the Earth's core.
Modeling with Tomographic Images

Seismic Data Confirm the Existence of Discontinuities in Earth’s Interior.

Mohorovicic Discontinuity

- ~8 km beneath oceanic basins
- ~20 to ~70 km beneath continents

Seismic Tomography Uses Seismic Data to Make Cross-Sections of Earth’s Interior