Chapter 12
Earthquakes

Standards

SCSh3c. Collect, organize and record appropriate data
SCSh4a. Develop and use systematic procedures for recording and organizing information
SCSh4b. Use technology to produce tables and graphs.
SCSh4c. Use technology to develop, test, and revise experimental or mathematical models
SES2c. Relate certain geologic hazards to specific plate tectonic settings

Vocab

Section 1 – How and Where Earthquakes Happen

Earthquake
Elastic rebound
Focus
Epicenter
Body wave
Surface wave
P wave
S wave
Shadow wave
Fault zone

Section 2 – Studying Earthquakes

Seismograph
Seismogram
Magnitude
Intensity

Section 3 – Earthquakes and Society

Tsunami
Seismic gap

Outline

Section 1 – How and Where Earthquakes Happen

- Earthquake – movements of the ground caused by a sudden release of energy when rocks along a fault move. - Earthquakes are the result of stresses in Earth's lithosphere.

Fault – break in a body of rock where one block moves relative to another
    Caused by elastic rebound – sudden return of elastically deformed rock to its unreformed shape. When rocks under stress shift
    Focus – point where first motion occurs
    Epicenter – point on the earth's surface above the focus
Seismic Waves – released as rocks move – travel outward in all directions
    Body wave – travels through the body of a medium
        P wave – primary wave – compression wave – moves back & forth – fastest waves – travel through solid, liquid, & gas

S wave – secondary wave – shear wave – moves sides-to side direction – travels only through solids

Surface wave – travels along the surface of a medium – slowest moving – cause greatest Damage

Scientists study seismic waves to determine structure and make-up of Earth's interior

Compositional layers - Crust, mantel core

Structural layers – Lithosphere, Asthenosphere, Mesosphere, Outer core, inner core

Shadow zone - area on Earth's surface where no direct seismic waves from a particular earthquake can be detected

- When seismic waves travel through materials of different rigidity, they change in both speed and direction.
- S waves do not reach the S wave shadow zone because cannot pass through the liquid outer core.
- P waves do not reach the P wave shadow zone because of the way the P waves bend and they travel through Earth's interior.

Most earthquakes occur at or near tectonic plate boundaries, where stress on the rock is greatest.

Three main types of tectonic settings

- convergent oceanic environments - plates move toward each other and collide.
  - occur between two oceanic plates or between one oceanic plate and one continental plate.
  - The denser plate moves down, or *subducts,* into the asthenosphere under the other plate, causing earthquakes.

- divergent oceanic environments - plates are moving away from each other - make up the mid-ocean ridges
  - Earthquakes occur along mid-ocean ridges because oceanic lithosphere is pulling away from both sides of the ridge.

- continental environments - where two continental plates converge, diverge, or move horizontally in opposite directions.
  - As the continental plates interact, the rock surrounding the boundary experiences stress, which causes earthquakes.

Not all earthquakes result from movement along plate boundaries.

- In 1811 and 1812 the most widely felt series of earthquakes in United States history occurred in the middle of the continent near New Madrid, Missouri.
- In the late 1970s scientists discovered an ancient fault zone deep within the crust of the Mississippi River region.

Section 2 – Studying Earthquakes

Seismology - study of earthquakes and seismic waves
seismograph an instrument that records vibrations in the ground
seismogram a tracing of earthquake motion that is recorded by a seismograph

- Seismographs record three types of ground motion—vertical, east-west, and north-south.
- Because they are the fastest, P waves are the first seismic waves to be recorded by a seismograph.
- S waves are the second seismic waves to be recorded, and surface waves are the last to be recorded by a seismograph.
- To determine the distance to an epicenter, scientists consult a lag-time graph and analyze the arrival times of the P waves and S waves.
- The start time of an earthquake can also be determined by this graph.
- triangulations based on information from several seismograph stations to determine the location of an earthquake.

magnitude a measure of the strength of an earthquake

- determined by measuring the amount of ground motion caused by an earthquake.
- While the Richter scale was widely used for most of the 20th century
- Moment magnitude is a measure of earthquake strength based on the size of the area of the fault that moves, the average distance that the fault blocks move, and the rigidity of the rocks in the fault zone.

intensity the amount of damage caused by an earthquake

- *Mercalli scale* expresses intensity in Roman numerals from I to XII and provides a description of the effects of each earthquake intensity.

Section 3 Earthquakes & Society

- Most earthquake injuries result from the collapse of buildings and other structures or from falling objects and flying glass.
- Other dangers include landslides, explosions caused by broken electric and gas lines, and floodwaters released from collapsing dams.

tsunami a giant ocean wave that forms after a volcanic eruption, submarine earthquake, or landslide

- may begin to form when the ocean floor suddenly crops or rises because of faulting associated with undersea earthquakes.
- A tsunami may also be triggered by an underwater landslide caused by an earthquake.

Seismic gap - an area along a fault where relatively few earthquakes have occurred recently but where strong earthquakes are known to have occurred in the past
Foreshocks - Some earthquakes are preceded by little earthquakes called *foreshocks* that can occur from a few seconds to a few weeks before the main earthquake.Only one earthquake has been successfully predicted using foreshocks.