



# **UNIT 4- EARTH'S CRUST**

## **Chapter 11- Earthquakes, Volcanoes, and Mountains**

# EARTHQUAKES

- earthquake → a disturbance and movement of Earth's crust due to a build-up of stress.

## Measuring Earthquakes

seismologists → scientists who study earthquakes.

seismograph → a sensitive machine that is attached to bedrock in order to measure the strength of earthquakes.



**bedrock** → the solid rock that lies beneath the soil and looser rocks.

-Seismographs must be attached to bedrock in order to feel the vibrations that result from an earthquake.

-Several seismographs are mounted together in order to sense the different directions of movement that can happen in an earthquake. One measures up-and-down movement, while another measures side-to-side movement.



**magnitude**→ strength of an earthquake.

**Richter scale**→ a scale on which the magnitude, or strength, of an earthquake is measured.



- The scale starts at 0 and can go as high as necessary.
  - Each number on the scale represents an earthquake with about 30 times more power than the previous number.
- EX. An earthquake that registered 5 would be 30 times stronger than one measured at 4.



- Most earthquakes that cause damage and loss of life register between 6 and 8 on the Richter scale. The Kobe earthquake in Japan (1995) registered 7.2.
- <2 - generally not felt, but recorded (600 000/yr)
- 4.0-4.9- felt by most (6200/yr)
- 6.0-6.9- destructive in populous regions (266/yr)
- 7.0-7.9- major earthquakes, which inflict serious damage (18/yr)
- 8.0 and larger- great earthquakes, which produce total destruction to communities near the source (1.4/yr)



# EARTHQUAKE WAVES

- During an earthquake there can be many episodes of ground-shaking movement caused by seismic waves. These aftershocks are actually smaller earthquakes. Aftershocks can cause damaged buildings to collapse.
- The Kobe earthquake in Japan produced over 600 aftershocks.
- seismic waves → the energy waves (either primary, secondary, or surface) that are released by an earthquake and travel outward from the source of the earthquake.



- aftershocks → smaller ground movements caused by seismic waves moving outward from an earthquake's source.

## Types of Earthquake Waves

1. Primary or P waves →
  - represented by the compression waves of a Slinky.
  - fastest travelling wave
  - can pass through solids, liquids, and gases





- cause a slight vibration (compression) that would rattle dishes on a shelf.
- these waves warn people that an earthquake is happening giving them a few seconds notice before the movement to come.

## 2. Secondary or S waves →

- represented by side-to-side movement of a Slinky.
- travel more slowly than P waves.



-can only pass through solids

### 3. Surface waves →

-represented by the double-wave movement of a Slinky.

-the slowest of the 3 waves, but do the most damage.

-can break up roads and buildings.

-these waves travel through the earth the same way ripples occur when you throw a stone into water. Therefore, one part of a building can be caused to move up, while another moves down.



## LOCATING AN EARTHQUAKE

- P waves travel faster than S waves. The farther apart the P and S waves are, the farther away the earthquake is.
- \*\*\*Draw diagram on page 319.\*\*\*
- A. Sudden movement in the Earth's crust releases energy that causes an earthquake.
- **focus**- This is where an earthquake begins. The point beneath Earth's surface where the movement occurs is called the focus of the earthquake.



- B. P waves and S waves originate at the focus and travel outward in all directions. P waves travel about twice as fast as S waves.
  - C. **epicentre** → the place on the Earth's surface directly above the focus of the earthquake.
- When P and S waves reach the epicentre, they generate the slowest kind of seismic waves, surface waves.
- Floating on a tube in a wave pool, you will experience waves similar to surface waves.



- D. surface waves → travel outward from the epicentre along Earth's crust.
- They move similarly to the ripples that travel from a stone thrown into a pond.

- **FUN FACTS- Canada**

1.  $\frac{1}{4}$  of earthquakes in Canada take place in northern regions where there are few people to notice the vibrations.



2. First major Canadian earthquake on record-  
1535→ near Quebec City
  
3. We only occasionally experience earthquakes in Canada, but we rarely feel them because most of them register low on the Richter scale.

## Types of Rock Movement in Earthquakes

\*\*\*The rock in Earth's crust is under pressure all the time from tremendous forces. The pressure keeps the rock in constant movement.\*\*\*



- Seismologists have identified 3 basic kinds of ground movement that cause earthquakes:

\*\*\*\*Draw the diagrams on page 321.\*\*\*\*

1. Two enormous rock surfaces are pushing together.
  - In places where the rock surfaces push together, tremendous pressure can bend them into folds. Sometimes one piece of rock will get pushed under the other and dip deep into the Earth. This is referred to as a subduction zone.



- Scientists can tell what kind of rock movement is occurring in an area by measuring the depth of the focus of each earthquake.
- The deepest earthquakes are usually caused by rocks that have been pushed together.
- One of the deepest subduction zones in the world is in the Pacific Ocean, in the Marianas Trench off the coast of Japan.





2. Two enormous rock surfaces are pulling apart.

-This creates very shallow earthquakes which mostly happen on the sea floor and cause little damage.

-The rocks pull apart when hot magma beneath Earth's crust bubbles upward to a small opening. As pressure increases, the rocks pull apart.

-Iceland experiences many shallow earthquakes and has large cracks on its surface where the rocks have pulled apart.



3. Two enormous rock surfaces are sliding past each other.

-Rock surfaces slide past each other and lock in place until the pressure becomes too great. When the rocks shift, an earthquake happens.

-**fault**- An area where two very large rock surfaces break and move against each other.

EX. The San Andreas fault in California is so large, it is visible from the air.



# EFFECTS OF EARTHQUAKES ON PEOPLE

- People who live in earthquake zones prepare for earthquakes:
  1. Schools have earthquake drills.
  2. In homes, people attach furniture to the walls so that it won't fall over or shift during an earthquake.
  3. Heavy items are stored near the floor.
  4. Buildings and roads are built differently in earthquake zones in order to make them able to withstand the shaking of the ground that occurs during an earthquake.



- Rigid structures made of bricks or solid concrete break during earthquakes because they have very little flexibility.
- Buildings made of steel, wood, and reinforced concrete can bend a little without breaking.

## Liquefaction

- the process of changing solid material into a liquid-like substance, such as quick sand.



- 1985- one of the most damaging earthquakes occurred 350 km east of Mexico City.
- Over 5000 people died.
- When the shock waves reached the city, their size was increased by the soft sediments on which the city is built. The sandy base turned into quicksand, and many buildings fell over.



## FUN FACT

**tsunami**→ a very large wave caused by an earthquake under a large body of water.

-Tsunamis are common along Japan's coastline.

-Tsunami is a Japanese word meaning "harbour wave."



ASSIGNMENT: DUE → THURSDAY, MAY 31

- Page 340

