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# Warm-Up | Earthquakes

## Lesson Question

## Lesson Goals

- **Describe** the causes of an earthquake.
- **Explain** how the _____ of an earthquake travels.
- **Describe** methods used to measure earthquakes.
- **Explain** how geologists locate the epicenter of an earthquake.

## Words to Know

*Fill in this table as you work through the lesson. You may also use the glossary to help you.*

| | |
|---|---|
| earthquake | the shaking that results from _____ under Earth's surface |
| epicenter | the place on Earth's surface directly over the focus of an _____ |
| focus | the place deep inside Earth where a _____ in Earth's crust occurs, causing an earthquake |
| magnitude | a number that characterizes the relative _____ of an earthquake |

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## Words to Know

| | |
|---|---|
| seismic wave | a [ ] produced by an earthquake |
| seismograph | an instrument that measures and [ ] details of earthquakes |
| wave | a movement that transfers energy through a [ ] |

## Stress and Faults

The movement of Earth's [ ] causes stress in the crust.

- The [ ] types of stress are:
  - tension.
  - compression.
  - shearing.

**Stress adds energy to the [ ], which then bends and [ ], forming faults.**

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## Causes of Earthquakes

An **earthquake** is the [ ] that results from movement under Earth's surface. Earthquakes are caused by forces of [ ] movement.

| | |
|---|---|
| **Plate movement** | causes stress. |
| [ ] | increases along faults. |
| **Excess stress** | leads to [ ] breaking, and an earthquake begins. |

Even though we feel the effects of an earthquake on Earth's surface, the earthquake actually begins about [ ] km [ ] Earth's surface.

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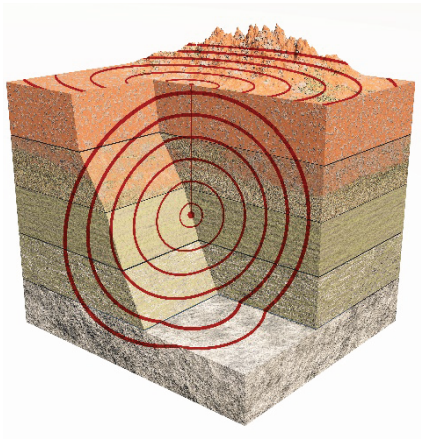
## Focus and Epicenter

Earthquakes begin in the _____, usually about 100 km below the surface.

- Earthquakes have _____ centers.
  - The **focus** is the area beneath the surface where rocks break under stress. It is the _____ point of an earthquake.
  - The **epicenter** is the point on the surface directly _____ the focus.



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## Energy Released by Earthquakes

Earthquakes produce vibrations called _____.

- Waves carry _____ as they travel.
- The waves produced by an earthquake are called _____.

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## Categories of Seismic Waves

Seismic waves are classified into [ ] categories.

### P Waves (Primary)

- Arrive first, travel [ ]
- Compress and expand the ground like an accordion
- Travel through solids and [ ]

### S Waves (Secondary)

- Arrive after P waves
- [ ] from side to side and up and down
- Shake [ ] violently
- Travel only through [ ]

### Surface Waves

- Travel only on the [ ]
- Were P and S waves
- Move slowly
- Can produce dramatic [ ] movement

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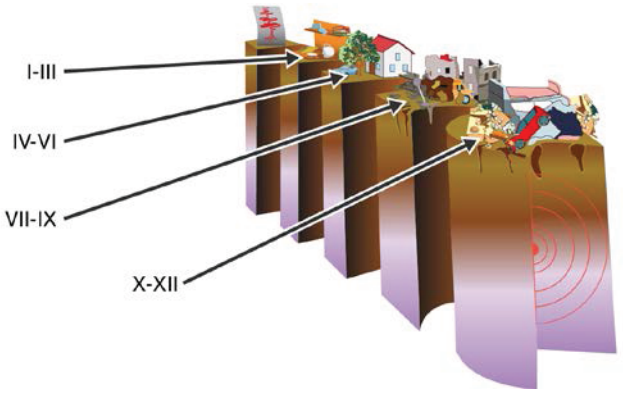
## The Mercalli Scale

The Mercalli scale rates an earthquake according to how much [ ] it causes.

The scale uses [ ] numerals one through [ ], I–XII, to rank the damage caused by an earthquake.




## The Richter Scale

The Richter scale measures **magnitude** based on the size of [ ] waves.

- Magnitude is determined by measuring seismic waves and [ ] movement.
- Seismic waves are measured by a [ ].
- This scale is good for measuring small, nearby [ ].

| Magnitude | Damage |
|---|---|
| 0–1.9 | Detected by seismograph |
| 2–2.9 | Hanging objects may swing |
| 3–3.9 | Comparable to passing truck |
| 4–4.9 | May break windows |
| 5–5.9 | Furniture moves |
| 6–6.9 | Well-built structures damaged |
| 7–7.9 | Visible cracks on the surface |
| 8–8.9 | Structures destroyed |
| 9 and over | Total destruction |

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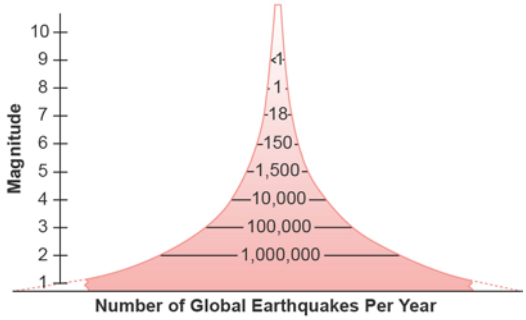
## The Moment Magnitude Scale

Moment magnitude was introduced in _____ by Thomas C. Hanks and Hiroo Kanamori, who wanted a more _____ method to measure earthquakes than the _____ scale

The moment magnitude scale estimates the total _____ released by an earthquake.




- Useful for earthquakes of all _____ and all _____
- _____ collected with seismographs
  - Shows what kind of seismic waves were produced and their _____

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## Sumatra Earthquake of 2004

The Sumatra earthquake of 2004 is the _____ strongest earthquake ever recorded.

- Measured 9.1–9.3 on moment _____ scale
- Measured at the maximum _____ on the Mercalli scale
- Lasted approximately 9 minutes, the longest duration ever measured
- Triggered a massive _____ and killed approximately 250,000 people

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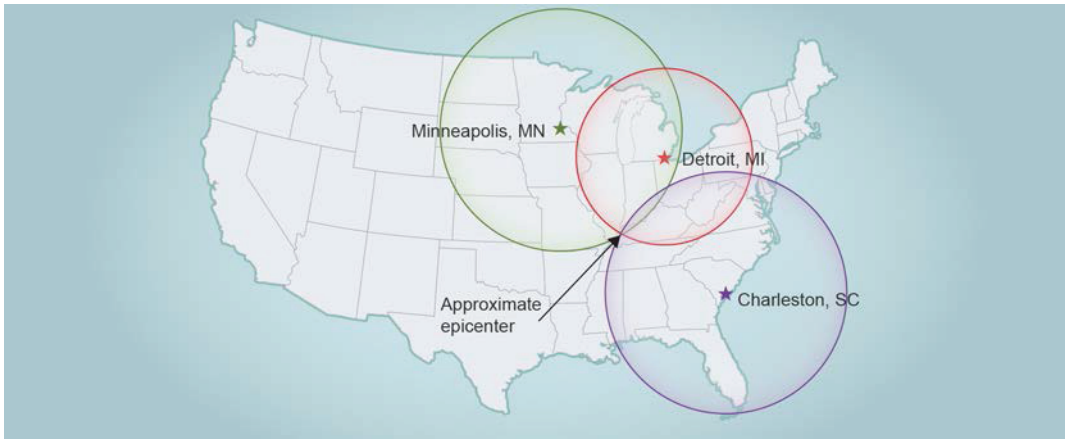
## Locating an Earthquake's Epicenter

Geologists use [ ] waves to locate an earthquake's epicenter.

- Use a [ ] to measure difference between arrival of P and S waves
- Compare [ ] to seismographs from around the world




- Geologists draw a [ ] measuring the distance with a seismograph located in the [ ]—for example, the circle around Charleston, South Carolina.
- The point where the circles [ ] is the location of the epicenter of the earthquake.
- The focus of the earthquake would be approximately [ ] km below the epicenter in the [ ].

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# Summary | Earthquakes

**Lesson Question** What causes earthquakes?

**Answer**

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## Review: Key Concepts

Earthquakes are caused by stress along faults due to [ ] movement.

### Traveling of Energy

- Seismic waves travel in all [ ]
- Three types of waves:
  - P waves (primary)
  - S waves (secondary)
  - Surface waves

### Measuring Earthquake Energy

- Mercalli scale
- Richter scale
- [ ] magnitude scale

### Locating the [ ]

- Distance of epicenter measured from at least three seismographs
- Location of epicenter is where three measurements overlap

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*Use this space to write any questions or thoughts about this lesson.*

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