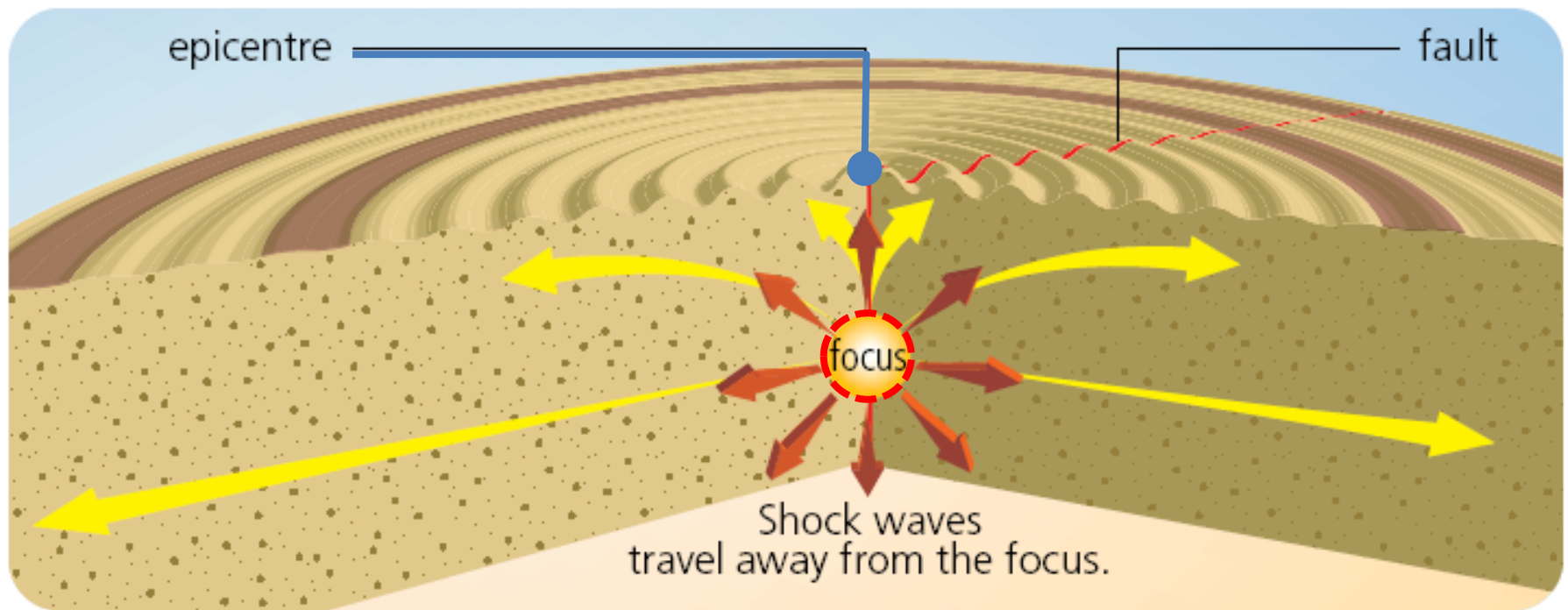




Earthquakes

Focus and Epicenter



- **Focus** – point inside the Earth where an earthquake begins (*point of initial rupture*). The majority of tectonic earthquakes originate in depths not exceeding tens of kilometers.
- **Epicenter** – point on the surface of the Earth directly above the focus where the shaking is usually felt most strongly.

What is an earthquake?

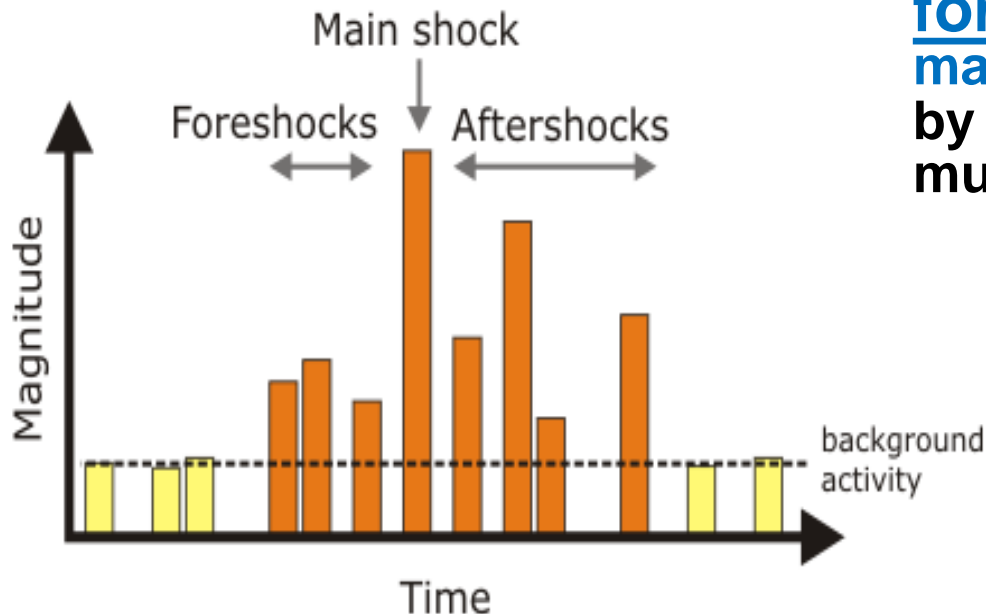
Earthquake is the **vibration (shaking) and/or displacement of the ground** produced by the **sudden release of energy**.

- Rocks under *stress* accumulate *strain energy* over time.
- Stress results from tectonic plate movement, magmatic or volcanic activity.
- When stress exceeds strength of rocks, rock breaks and slips.
- Rock slippage/rupture occurs at the weakest point (*fault*).
- Strain energy is released as **seismic waves**.



Foreshocks and Aftershocks

Earthquakes often occur as a sequence rather than individual events:



- Small earthquakes, called **foreshocks**, often precede a **major earthquake (main shock)** by days or, in some cases, by as much as several years.
- **Adjustments of crust** (redistribution of stress on the fault) that **follow a major earthquake** often generate smaller quakes in the same area called **aftershocks**.

- **Bigger** earthquakes often have **more and larger** aftershocks and the sequences can last for years.
- **Earthquake swarms** are **sequences of earthquakes** striking in a specific area within a short period of time in which **no single earthquake has notably higher magnitudes** than the other.

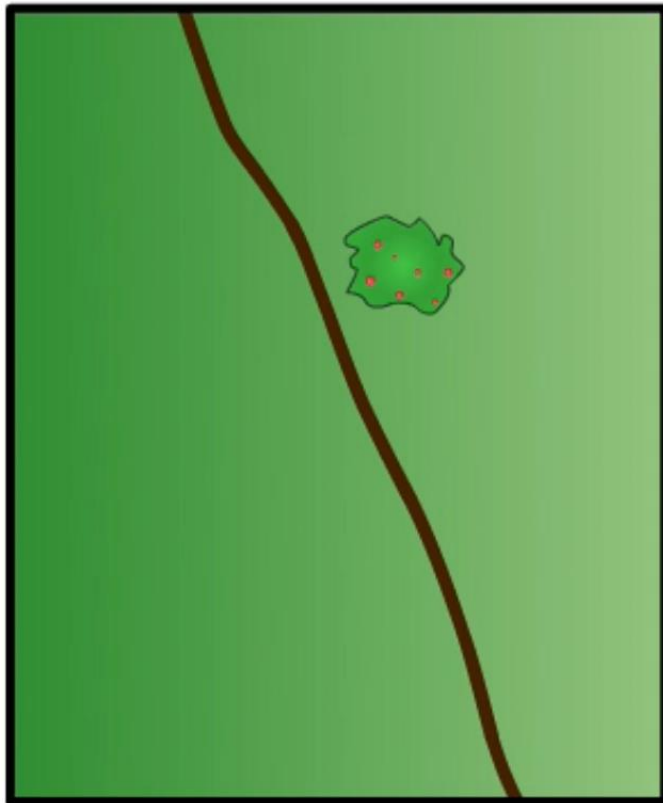


Foreshocks, Mainshocks & Aftershocks

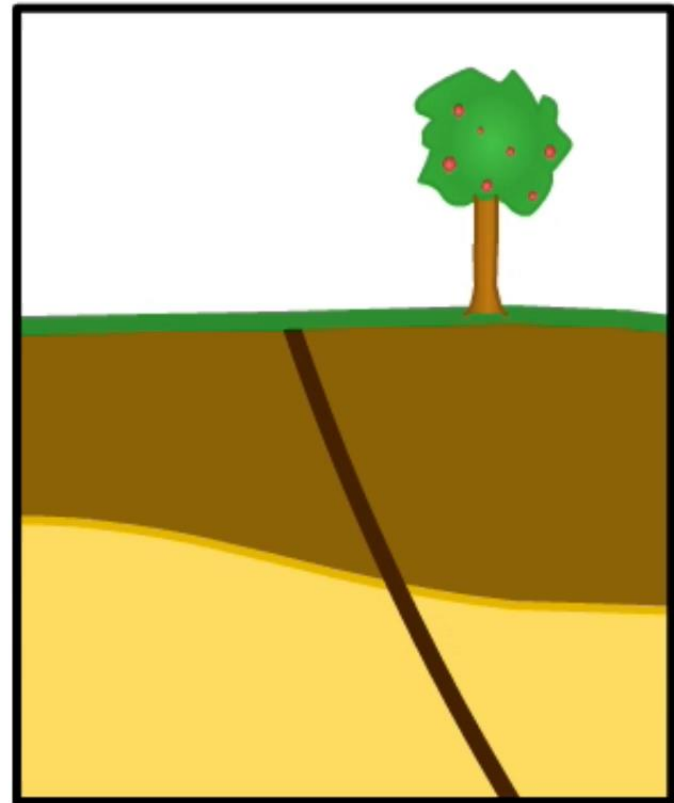
● Foreshock

● Mainshock

● Aftershock



Map View



Cross-Section View

Measuring Earthquakes

Two measurements that describe the “power” or “strength” of an earthquake are:

Mercalli
scale

- **Intensity** – a measure of the **degree of shaking** at a given locale based on the amount of damage.

Richter
scale

- **Magnitude** – estimates the **amount of energy** released at the source of the earthquake:
 - Magnitude is a *logarithmic* scale (not linear!)
 - Magnitude 2 or lower earthquakes cannot be felt by humans.
 - Magnitude 7 and over potentially cause serious damage over larger areas, depending on their depth.
 - The **largest earthquakes in historic times** have been of magnitude **slightly over 9**, although there is no limit to the possible magnitude.

Modified Mercalli Scale vs. Richter Scale



Intensity category	Effects	Magnitude scale
I. Instrumental	Not felt	1-2
II. Just perceptible	Felt by only a few people, especially on upper floors of tall buildings	3
III. Slight	Felt by people lying down, seated on a hard surface, or in the upper stories of tall buildings	3.5
IV. Perceptible	Felt indoors by many, by few outside; dishes and windows rattle	4
V. Rather strong	Generally felt by everyone; sleeping people may be awakened	4.5
VI. Strong	Trees sway, chandeliers swing, bells ring, some damage from falling objects	5
VII. Very strong	General alarm; walls and plaster crack	5.5
VIII. Destructive	Felt in moving vehicles; chimneys collapse; poorly constructed buildings seriously damaged	6
IX. Ruinous	Some houses collapse; pipes break	6.5
X. Disastrous	Obvious ground cracks; railroad tracks bent; some landslides on steep hillsides	7
XI. Very disastrous	Few buildings survive; bridges damaged or destroyed; all services interrupted (electrical, water, sewage, railroad); severe landslides	7.5
XII. Catastrophic	Total destruction; objects thrown into the air; river courses and topography altered	8 +