Incorporated Research Institutions for Seismology—Informal introduction to accompany fault animations on IRIS' page: http://www.iris.edu/hq/inclass/search/animation

Earthquake Faults—Background

What is a fault?

A fault is a rock fracture where the two sides have been displaced relative to each other. An earthquake is what happens when these two blocks of the earth, seemingly stuck together, suddenly slip past one another. The surface where they slip is called the fault or fault plane. The slip causes a sudden shaking or vibration in the Earth due to the sudden release of energy from within the Earth.

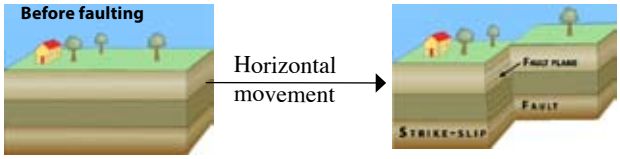
Because of pressure and friction at depth, plates rarely slide quietly past each other. Stress builds up between them until it reaches a critical strain, and the accumulated potential energy is released as the earthquake. The higher the stress, the greater the energy released. (Remember when you first learned about the energy release of a rubber band under stress?) The relative motion between the plates controls what type of a fault results. (Note: The fault-model video lecture after the animations further describes the concepts above.)

When you snap your fingers (box on right) the whole "fault plane" moves due to uniform friction release; an earthquake happens on a discrete area of the fault plane that becomes un-stuck.

Fault slip occurs in three stages:

1) initiation of sliding on a small part of the fault,
2) growth of the slip surface, and
3) termination of slip and fault healing.

Earthquakes occur on preexisting faults operating in a "stick- slip" mode. Earthquakes are "slip" episodes; they are followed by periods of no slip ("stick"), during which elastic strain increases away from the fault. Although some growth of the fault may occur with each earthquake, we can generally assume that for large earthquakes (M>6) the faulting process primarily involves repeated breaking of the same fault segment rather than creation of a new fault surface."



Watch video lecture on faulting and folding here:

http://www.iris.edu/hq/inclass/video/54

It's a Snap —*Quick Demo*

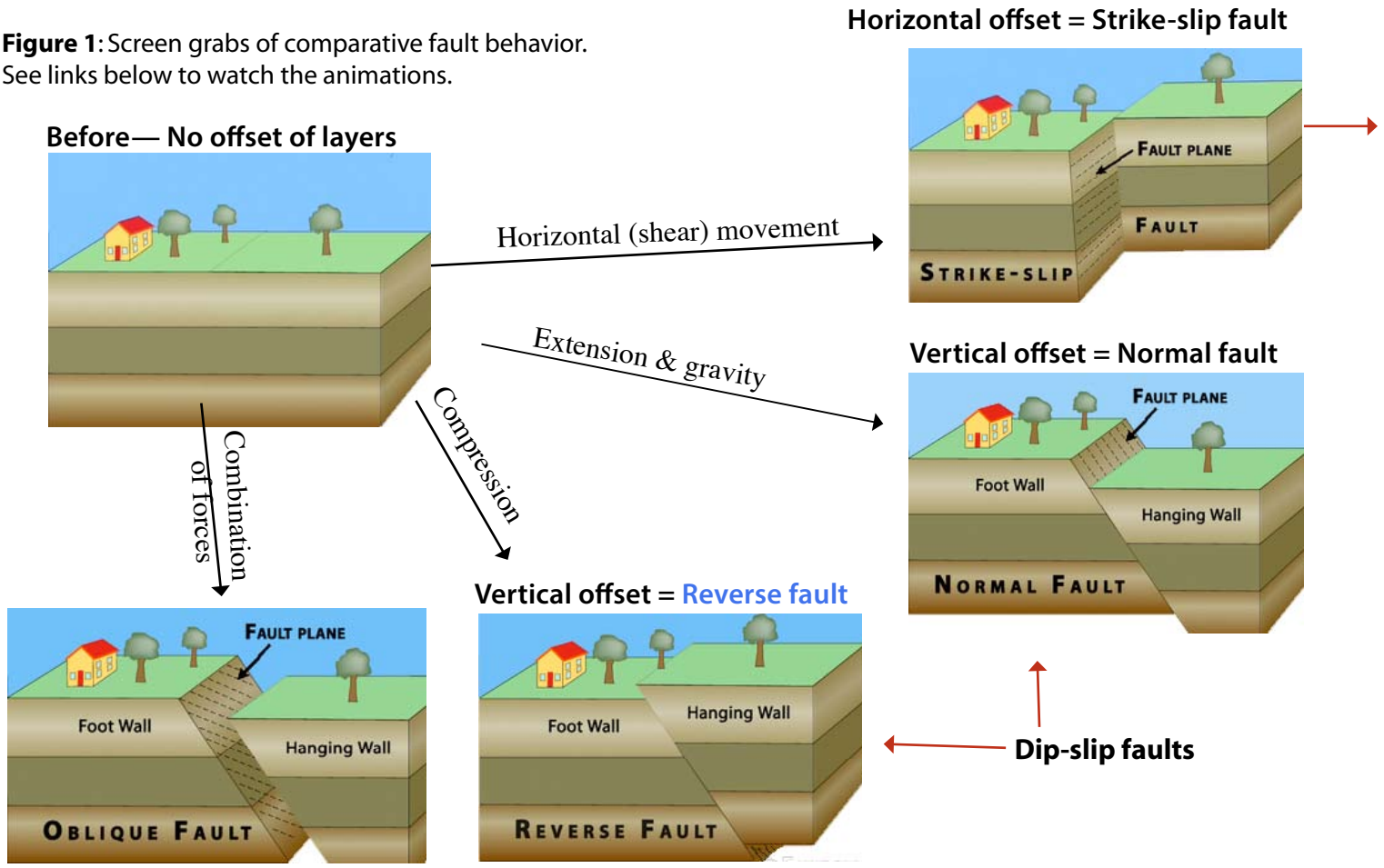
It's a Snap! An earthquake is caused by a sudden slip on a fault, much like what happens when you snap your fingers.

Put your thumb and middle finger together. With mild pressure, or with greasy fingers they slide past each other easily with little stress. With dry fingers and higher stress, you can affect an audible response. Before allowing your fingers to snap, push them together and sideways. Allow friction to keep them from slipping. When you apply enough stress to overcome this friction, your fingers move suddenly, releasing energy.

The same "stick-slip" process goes on in the earth. Stresses in the earth's outer layer push the sides of the fault together. The friction across the surface of the fault holds the rocks together so they do not slip immediately when pushed sideways. Eventually enough stress builds up and the rocks slip suddenly, releasing energy in waves that travel through the rock to cause the shaking that we feel during an earthquake.

Snapping fingers can't generate an earthquake, but they do generate energy in the form of sound waves that travel from fingers to ear. Sound waves are compressive waves; the P waves generated from an earthquake are also compressive waves. [modified from USGS' http://earthquake.usgs.gov/learn/topics/megaquakes.php]

Figure 1: Screen grabs of comparative fault behavior. See links below to watch the animations.



Watch these animations: http://www.iris.edu/hq/inclass/search/animation Scroll to *Fault: Normal*, *Fault: Reverse*, etc.

About the Animations

Faults are categorized into three general groups based on the sense of slip or movement. (Figures above.) If the main sense of movement on the fault plane is up or down, the fault is known as a ***dip-slip fault***. Where the main sense of slip is horizontal the fault is known as a ***strike-slip fault***. ***Oblique-slip faults*** have components of both strike and dip slip.

Normal fault—the block above the inclined fault moves down relative to the block below the fault. This fault motion is caused by tensional forces and results in extension. [Other names: normal-slip fault, tensional fault or gravity fault] Examples include Basin & Range faults.

Reverse fault—the block above the inclined fault moves up relative to the block below the fault. This fault motion is caused by compressional forces and results in shortening. A reverse fault is called a thrust fault if the dip of the fault plane is small. [Other names: reverse-slip fault or compressional fault.] Examples include the Rocky Mountains and the Himalayan Mountains.

Strike-slip fault—movement of blocks along a fault is horizontal and the fault plane is nearly vertical. If the block on the far side of the fault moves to the left, as shown in this animation, the fault is called left-lateral (Figure 2). If it moves to the right, the fault is called right-lateral. The fault motion of a strike-slip fault is caused by shearing forces. [Other names: trans current fault, lateral fault, tear fault or wrench fault.] Examples include the San Andreas Fault, California; Anatolian Fault, Turkey.

Oblique-slip faulting suggests both dip-slip faulting and strike-slip faulting. It is caused by a combination of shearing and tension or compressional forces. Nearly all faults will have some component of both dip-slip (normal or reverse) and strike-slip, so defining a fault as oblique requires both dip and strike components to be measurable and significant.

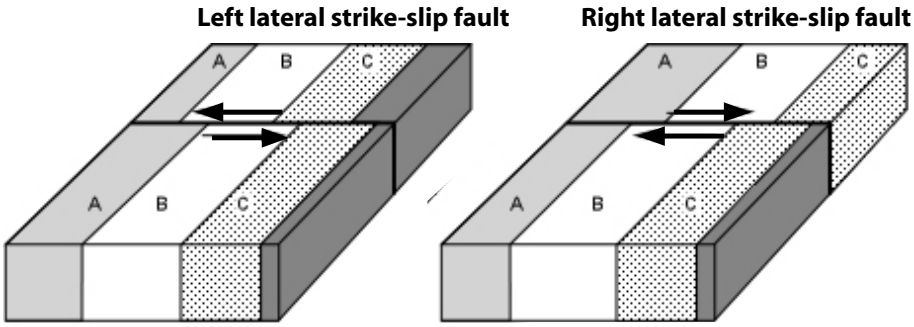


Figure 2: *If the block opposite an observer looking across the fault moves to the right, the slip style is termed* ***right lateral;*** *if the block moves to the left, the motion is termed* ***left lateral****.*

Vocabulary

To accompany Fault Background files for **IRIS' Animation page**. (Definitions from **usgs.gov**, **nasa.gov**; and **fema.gov**)