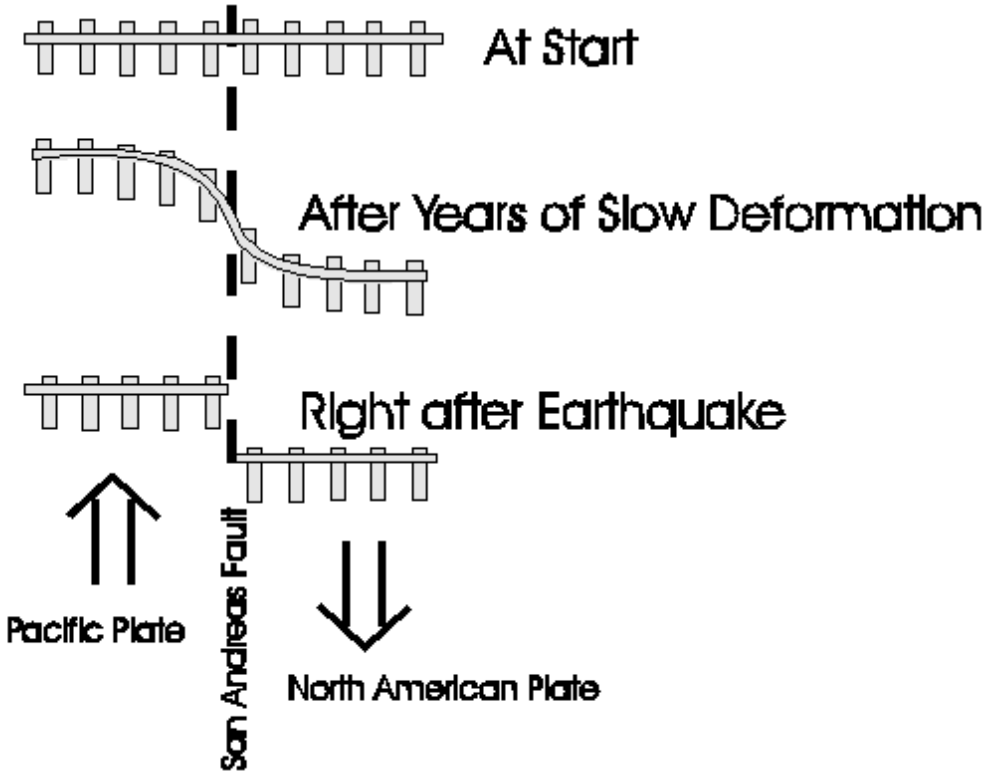
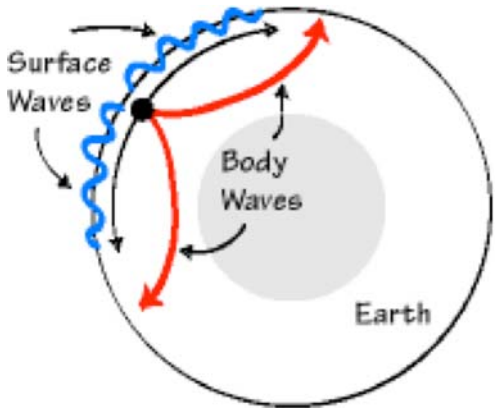
WHAT HAPPENS DURING AN EARTHQUAKE?

Earthquakes occur because friction holds the rock masses on either side of the fault together, while plate motion slowly bends and stretches the rock, storing energy much like the energy stored in a stretched rubber band. An individual earthquake occurs when the stored energy becomes greater than the friction, and the rock masses suddenly slip along the fault. Much of the energy stored in the stretched rock is released in seismic waves, which travel out in all directions from the fault on which the earthquake occurred.

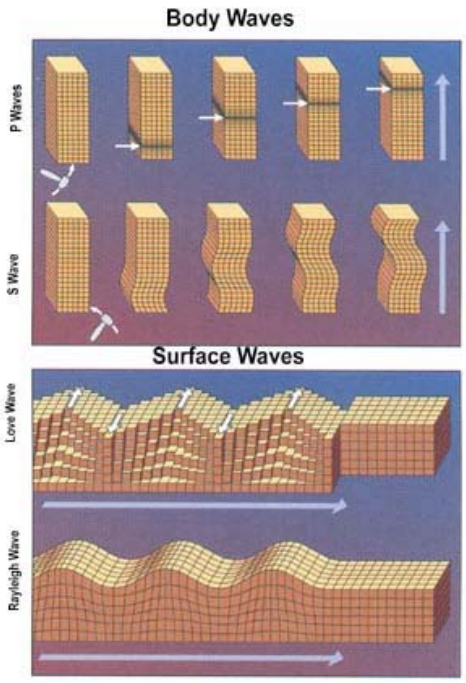


To illustrate how bending an object can generate waves, take a long flexible metal or plastic ruler that can bend, bend it over and then let go. The ruler should swing back and forth as you release it, much like how the earth's crust swings back and forth as seismic waves (S-waves) are generated.

Seismic waves come in two major types, body waves which can travel through the interior of the Earth, and surface waves which are confined to the Earth's surface. Body waves travel the fastest but their strength diminishes quickly; surface waves travel slower but retain their strength over greater distances.



Body waves themselves come in two types: P (primary) waves and S (secondary) waves. They get these names because they are the first two wave types that reach seismographs after an earthquake. The P-wave is a compressional wave like a sound wave, alternatingly compressing and extending the rock mass in the direction that the wave is traveling. P-waves can travel through both solids and fluids and can travel through all parts of the Earth and even through the ocean. S-waves are shear waves whose motion is perpendicular to the direction the wave is traveling.



S-waves can travel through solid materials but not fluids. P-waves have the fastest seismic wave speed and S-waves are the second fastest.

A number of other natural forces and even human activities can generate seismic waves. Landslides and volcanic eruptions shake the Earth and generate seismic waves; ocean waves hitting the beach and continental shelf create what is called microseismic noise. In coastal South Carolina this microseismic noise greatly increases when there is a hurricane creating large waves in the Atlantic Ocean. Human activities that impact the ground also create seismic waves. Seismographs in the city will record seismic waves from cars and trucks driving on nearby roads, pumps and motors from buildings, and even the footsteps of people walking very close to the seismograph. Other activities, such as setting off explosions to break up rocks in mines, also create seismic waves. All of these non-earthquake sources of seismic waves have a distinct type of motion on a seismograph that is different from a natural earthquake. Seismologists are trained to distinguish these different types of signals and can usually quickly discriminate between a natural or man-made source of seismic waves.

Activities

Seismic Waves Slinky
http://web.ics.purdue.edu/~braile/edumod/slinky/slinky.htm

Students Linking Arms
Line up the students standing shoulder to shoulder in two parallel equal length lines, make sure the two lines face each other (one is the P-wave line the other is the S-wave line). Have the students link arms and tell the students they cannot move until they feel the student next to them push or pull on them. Using an assistant to start the P-wave line begin the wave motion on each line simultaneously and see which line reaches the end first.
P-motion: the assistant pushes gently on the shoulder of the first student pushing them into the student next to them.
S-motion: you pull the first student forward into a bow—which should transfer to the next student.

National Science Education Standards Addressed (5-8 and 9-12):

- Science as Inquiry
- Physical Science
  - Transfer of Energy and Interactions in Energy and Matter
- Earth and Space Science
  - Changes in the Earth
  - Energy in the Earth System
- Science in Personal and Social Perspectives
  - Natural and Human-induced Hazards