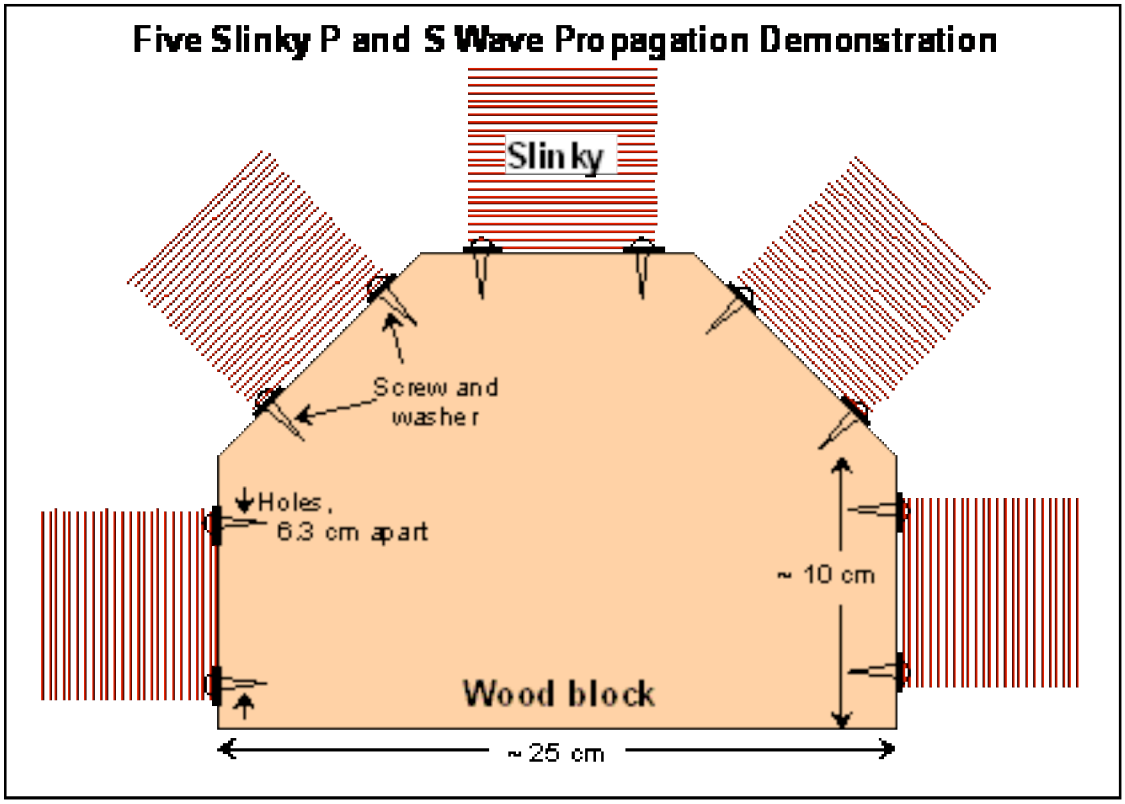
Slinkies to Show Different Waves

Concept: Energy produced by an earthquake travels as two distinct types of waves, known as primary and secondary waves, through the planet.

Objective: Students will
- be able to distinguish between primary (P-waves) and secondary waves (S-waves)
- state that waves spread out in all directions from the focus or hypocenter of the quake
- see that waves take different times to travel different distances
- show how these waves affect a structure, such as bridge or house

Materials
- A classroom of students
- Plenty of space
- Six Slinkies (or more if you have them)
- Colored yarn
- Electrical tape
- Five-sided wood block



Drawing from: www.eas.purdue.edu/~braile/edumod/slinky/slinky.htm

Teacher Note:

- An uncontrolled Slinky can be dangerous.
- Metal Slinkies work better than plastic ones.
- Mark one spot on each coil with bright yarn or tape to make it easier for students to see the wave motion.

Procedure

1. Have class describe an earthquake. Review or explain that energy from quake is released as wave. Point out that all the energy moves from the focus or hypocenter of quake.

Procedure for P-wave

1. Divide into pairs or groups of even numbers, depending upon the number of Slinkies available.
2. Two students will each hold an end of the Slinky and stretch it out 10 to 12 feet between them. Students can also do this activity with the Slinky stretched out on the floor.
3. Ask one of each pair to compress between 10 and 20 coils and then release them rapidly. Both students should continue to hold the Slinky during the compression and release.

3a. Another way to show this is to have the one student cup his or her hand over the end of the Slinky (last few coils) and, when the Slinky is at rest, hit that hand with the fist of the other hand.

4. Ask students to describe what they see and how the Slinky moves. Did the string move? What direction did it travel?
5. Ask the students to draw how the wave moves down the Slinky.

Result: *Students should see a wave of coils spread down length of Slinky. This is equivalent to a P-wave (compression) propagating through the earth.*

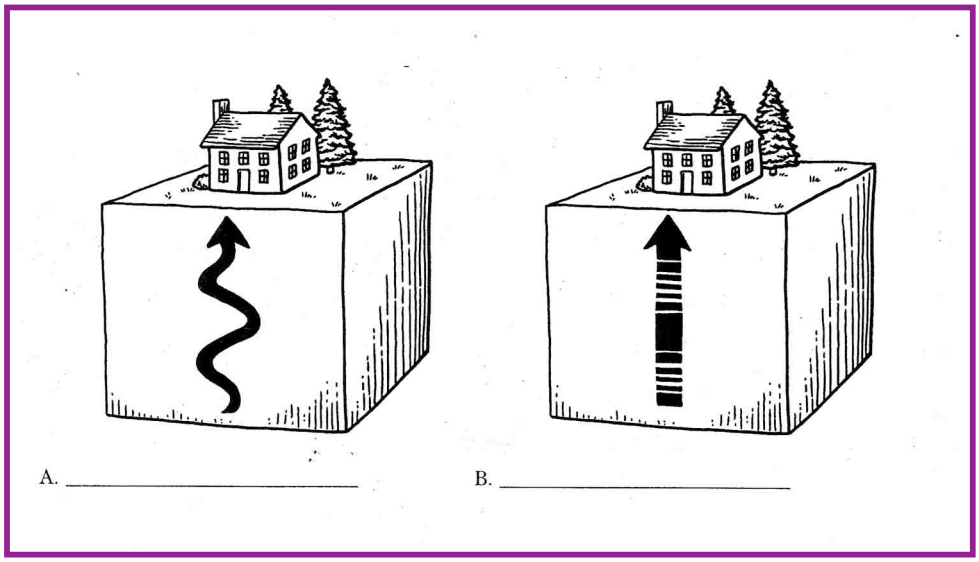
Procedure for S-wave

1. Divide into pairs or groups of even numbers, depending upon the number of Slinkies available.
2. Two students will each hold an end of the Slinky and stretch it out 10 to 12 feet between them. Students can also do this activity with the Slinky stretched out on the floor. This shows horizontal versus vertical shear.
3. The Slinky should be still. One students should move his or her hand quickly up and down (or side to side). Both students should continue to hold the Slinky during the shaking.
4. Ask students to describe what they see and how the Slinky moves. Did the string move? What direction did it travel?
5. Ask the students to draw how the wave moves down the Slinky.
6. Ask the students to show what direction they think a house would move (up-and-down or side-to-side) after a S-wave hit it.

Result: *Students should see a sinuous wave of coils snake down length of Slinky. This is equivalent to an S-wave (shear or side-to-side) propagating through the earth.*

You can also enhance the visuals of this project by taping a felt tip pen to a coil in the Slinky and recording the motion on a piece of butcher paper. The simplest way to do this may be to only attach tape and pen to one Slinky and show this to the entire class.

Discussion: You could draw the following sketch on a black board or pass it out and ask students to label the drawings either P-wave or S-wave.



Procedure for Five Slinky Wave Propagation

1. Attach Slinkies to enclosed block of wood by sliding a couple of coils under the bike tube.
2. Have five students each grasp end of one Slinky and stretch it out 10 to 12 feet. Have one student hold wood block.
3. Have student holding block hit the end of it with his or her fist. Ask if this is a P-wave or S-wave. It is a P-wave. Students may have to experiment to generate good P-waves.
4. Have student holding block move it up and down or right to left. Ask if this is a P-wave or S-wave. It is an S-wave.
5. Attach a plastic Slinky to one of the metal ones. Have one student collapse another Slinky in half. Repeat steps three and four.

Result: *Students should see waves spread down the length of each Slinky in steps three and four. Students should see waves take different times to travel different lengths and types of Slinkies.*

Discussion: *These procedures show how a single source generates waves in all directions and how they take different times to travel different distances and in different media (plastic vs. metal).*