

## P-Waves and S-Waves

**Overview:**

The expansion of the magma chamber and volcanic eruptions often cause earthquakes. During this lesson, students will learn that the shaking movement of the ground when an earthquake occurs sends shock waves through the earth. These shock waves, known as Primary Waves (P-Waves) and Secondary Waves (S-Waves), are recorded by seismometers. The seismometer sends signals to a seismograph, which records the earthquake as a series of lines on a graph called a seismogram.

**Objectives:**

The student will:

- correctly label illustrations of P-Waves and S-Waves;
- correctly label the starting points of P-Waves and S-Waves on a seismograph; and
- use a slinky to demonstrate a P-Wave and an S-Wave.

**Materials:**

- Slinkies
- Table (or desks pushed together)
- Transparency: “Modern Seismograph Array”
- Student Worksheet: “P-Waves and S-Waves”
- Student Worksheet: “Seismograms”

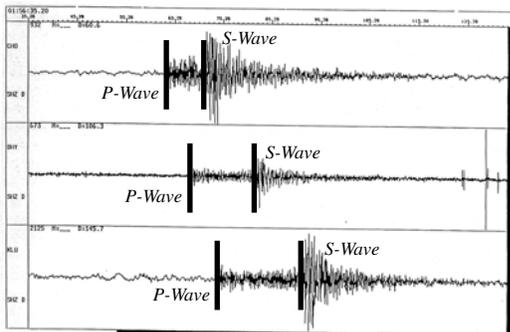
**Answers to Student Worksheets:**

P-Waves & S-Waves:

1. P-Wave
2. S-Wave

P-Waves & S-Waves:

1. Seismometer



## P-Waves and S-Waves

**Activity Procedure:**

1. Explain that volcanic eruptions are one cause of earthquakes. The ground shakes when an earthquake occurs. This shaking movement sends shock waves through the earth. These seismic waves are recorded by a seismometer.
2. Ask students to sit across from each other at a table, or ask them to move their desks so that they are arranged in pairs, facing one another. Distribute one slinky to each pair and a Student Worksheet: “P-Waves and S-Waves” to each student. Explain that students will use slinkies to depict two types of seismic waves. After an earthquake occurs, the first seismic waves to reach a seismometer are called P-Waves, which stands for Primary Waves. P-Waves reach the seismometer first because they move straight through solid rock and liquids (such as water).
3. Ask each pair of students to stretch their slinky between them. Each student should hold on to one end of the slinky. One student should hold the end of the slinky still, and the other student should push their end of the slinky forward abruptly, without releasing the slinky. This will cause a shock wave to move straight through the slinky. This is how P-Waves move through the earth. Students should take turns creating P-Waves.
4. Explain to students that after an earthquake occurs, the second seismic waves to reach a seismometer are called S-Waves, which stands for Secondary Waves. S-Waves can move through solid rock, but cannot move through liquids. S-Waves travel fast, but they take longer to reach a seismometer than P-Waves. Their curvy motion causes rock particles in the earth to move perpendicular to the direction the wave travels. Explain the meaning of perpendicular.
5. Ask each pair of students to stretch their slinky out between them and slide each end from side to side without releasing it. The curvy motion of the slinky represents how S-Waves travel through the earth. Ask students to complete the Student Worksheet: “P-Waves and S-Waves” by labeling the illustrations P-Wave and S-Wave.
6. Collect slinkies and distribute the Student Worksheet: “Seismograms.” Explain that after P-Waves and S-Waves reach a seismometer, they are recorded by a seismograph as a series of lines on a chart called a seismogram. Seismograms often are drawn by a pen on a drum. Place the Transparency: “Modern Seismograph Array” on the overhead projector and point out the drums.
7. Explain that because P-Waves are the first seismic waves to arrive at a seismometer, P-Waves cause the seismograph pen to make the first lines on a seismogram. When S-Waves arrive, they make a new and larger jolt on the seismogram.
8. Ask students to complete their Student Worksheets “Seismograms” by labeling the point where the P-Waves and S-Waves start on the seismogram. Explain that P-Waves are indicated by the small jolt, and S-Waves are indicated by the larger jolt.

Decoding the Words:

Word Segment:	Meaning:
seismo-	earthquake
-graph	something that writes or records
-gram	something written down, drawn or recorded
-meter	a device for measuring

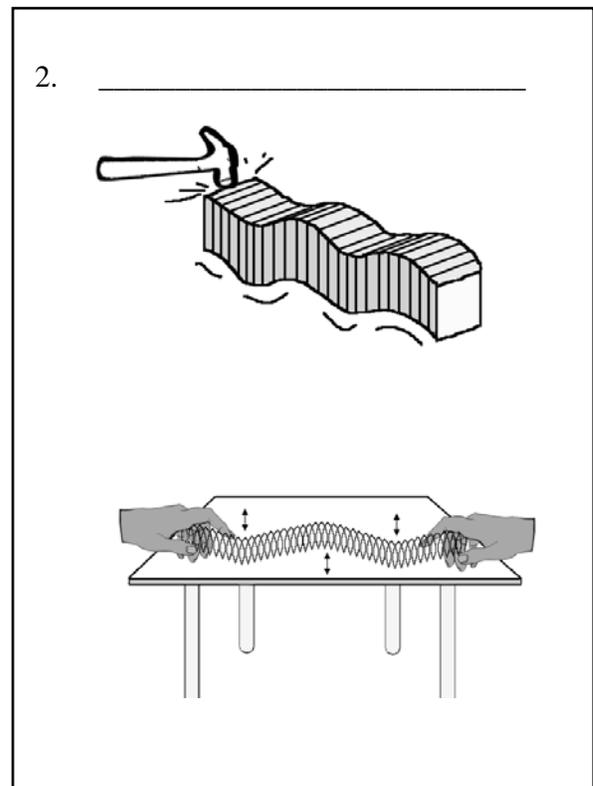
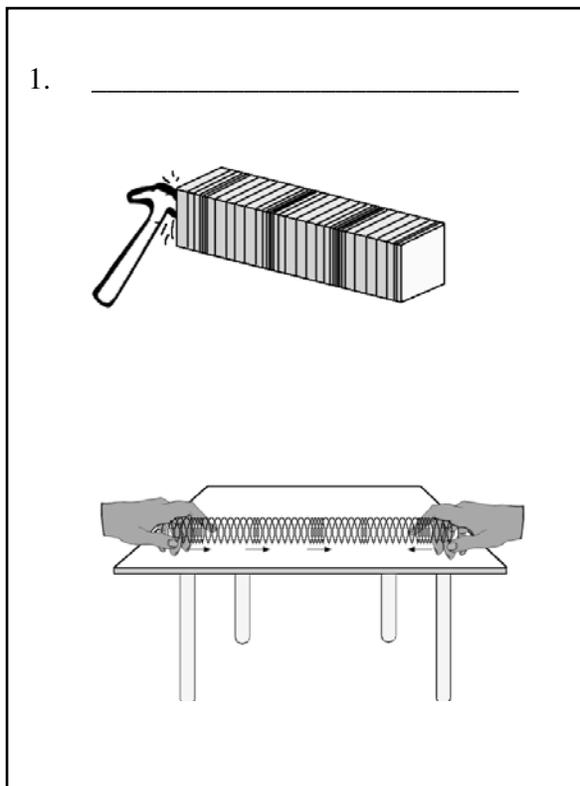
## P-Waves and S-Waves

Volcanic eruptions are one cause of earthquakes. The ground shakes when an earthquake occurs. This shaking movement sends shock waves through the earth. These shock waves, known as seismic waves, are recorded by a **seismometer**. The seismometer sends signals to a **seismograph**, which records the earthquake as a series of lines on a graph called a **seismogram**.

**After an earthquake occurs, the first waves to reach a seismometer are P-Waves (Primary Waves).** P-Waves reach the seismometer first because they move straight through solid rock and liquids (such as water).

**The second seismic waves to reach a seismometer are S-Waves (Secondary Waves).** S-Waves can move through solid rock, but not through liquids. S-Waves travel fast, but they take longer to reach a seismometer than P-Waves. The curvy motion of an S-Wave causes rock particles in the earth to move perpendicular (at right angles) to the direction the wave travels.

**Directions:** Look at the illustration below. Label the P-Wave and the S-Wave.



# Seismograms

After P-Waves and S-Waves reach a seismometer, they are recorded by a seismograph as a series of lines called **seismograms**, drawn by a pen on a drum. When the seismic waves arrive, they cause the pen on the drum to move.

Because P-Waves are the first seismic waves to arrive at a seismometer, P-Waves cause the pen to make the first lines on a seismogram. When S-Waves arrive, they make a new and larger series of lines on the seismogram.

**Directions:** Answer the question then look at the seismograms below. Draw a line on each seismogram showing where the P-Waves begin. Draw a second line showing where the S-Waves begin. Be sure to label your lines. The first one has been done for you.

1. Earthquake vibrations are recorded by what instrument buried in the ground?

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