Seismic Waves

Lesson Overview

In this lesson, students will read from their textbook, take notes, compare and contrast, and use Slinkys to learn about seismic waves.

Standards Addressed

SC 2005 8-3.8 Explain how earthquakes result from forces inside Earth.

SC 2005 8-3.2 Explain how scientists use seismic waves-primary, secondary, and surface waves-and Earth's magnetic fields to determine the internal structure of Earth.

SC 2014 8.E.5B.2 Construct explanations of how forces inside Earth result in earthquakes and volcanoes.

Disciplinary Literacy Best Practices

PIR (Prepare, Interact, Respond) reading strategy
Notetaking from Text
Graphic Organizer

Lesson Plan

Time Required: One 55-minute class period

Disciplinary Vocabulary: primary/longitudinal wave, secondary/transverse wave, surface wave

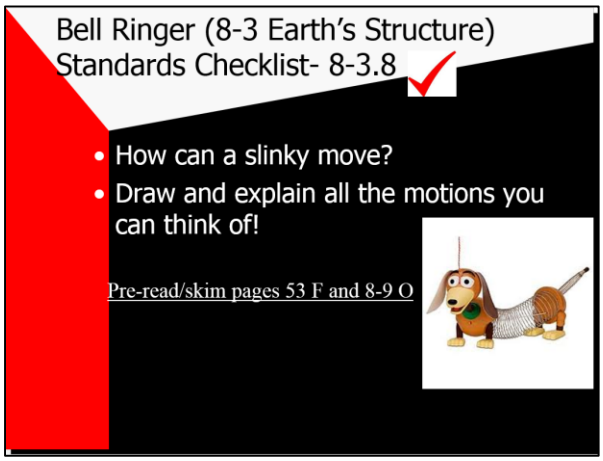
Materials Needed:

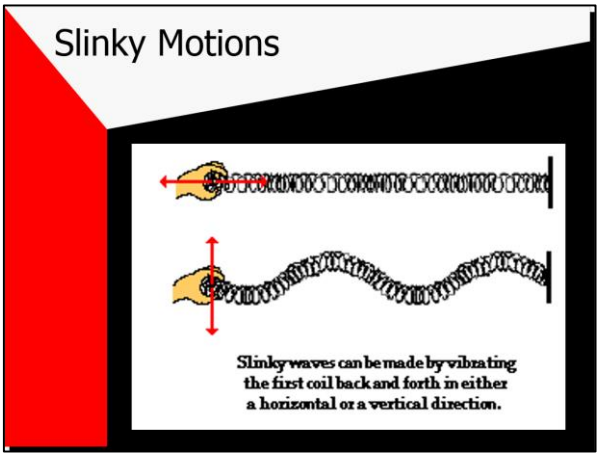
- Student textbook or other source with text selection about seismic waves
- Slinkys (one per group of students)
- Video Demonstration of Wave Motion (https://www.classzone.com/books/earth_science/terc/content/visualizations/es1002/es1002page01.cfm?chapter_no=visualization)

Assessment: Class discussion, graphic organizers, demonstration with slinky

Engage

- Students start with a bell ringer, where they think about Slinkys and how they move.
- The teachers will display the slide and instruct students to complete the task in their notebooks as they come in and are seated at the beginning of class.
- Teacher shared the "Slinky Motions" slide shows how students may have responded.
- Discuss the drawings and explanation before going on to the lesson.





Explore

- The teacher will *prepare* students to read by indicating what they will be reading about.
- The teacher will provide focus questions to guide notetaking; and instruct students to read with "partners and pencils." Students *interact* with the text by using the focus questions to pull pertinent information from the reading, discussing what they are reading with their partners, and recording the answers to the questions in their notes.
    - First chunk: Section of text that provides information about *primary waves*.
        - Focus questions: What are P waves? How do they move?
    - Second chunk: Section of text that provides information about *secondary waves*.
        - Focus questions: What are S waves? What do they move through?
    - Third chunk: Section of text that provides information about *surface waves*.
        - Focus questions: What are surface waves? How do they move?

NOTE: This lesson was taught using the Prentice Hall 8th grade text (see text at end of lesson). Any suitable text or article may be used. Focus questions may be adjusted as needed.

Explain

- After reading, students use their choice of graphic organizer (Venn diagram, double bubble, or t-chart) to compare and contrast p and s waves. Sample graphic organizers are included at the end of the lesson.

Extend

- Teacher shows online demonstrations of wave motion (https://www.classzone.com/books/earth_science/terc/content/visualizations/es1002/es1002page01.cfm?chapter_no=visualization)
- Students will use slinkys to demonstrate various wave motion.

Teacher Reflections and Biographical Information

This is my 8th year of teaching 8th grade science. I have found that having students read, write, and discuss is a lot of work at the beginning of the year, training students, but they gain a lot out of the process. Each day, I am a monitor, and constantly walk around to ensure students are behaving, staying on task, etc. My hope is that by having them do most of the work, they are better prepared for high school and college!

The Venn Diagram/double bubble concept mapping strategy is one that my students are very comfortable with. There was a school-wide focus on concept mapping a couple of years ago, so all teachers and students have practice using multiple maps. I like to give students a choice on which compare and contrast map to use. Some students even chose to do a modified T-chart to compare and contrast P and S waves. I think as long as they are doing the work, they can pick whatever concept map they feel the most comfortable with. I was very happy with the results for this part of the lesson.

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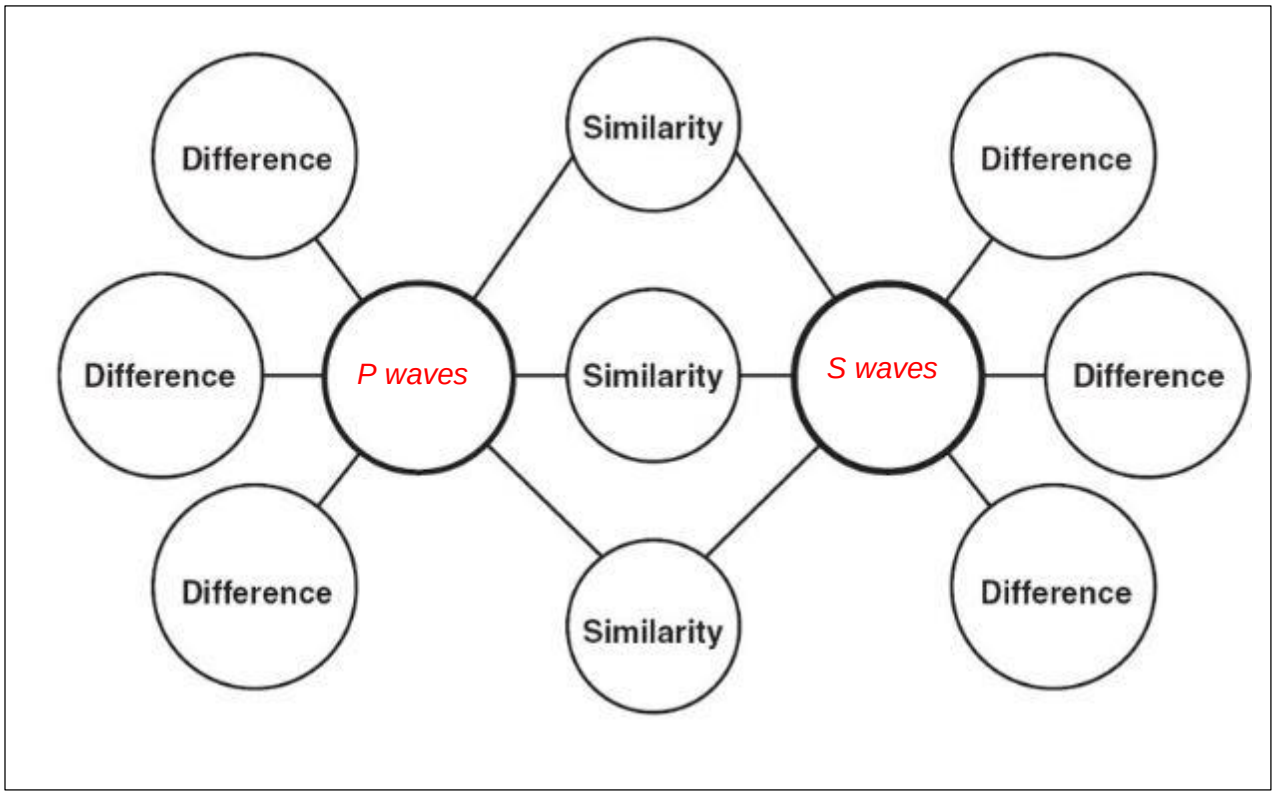
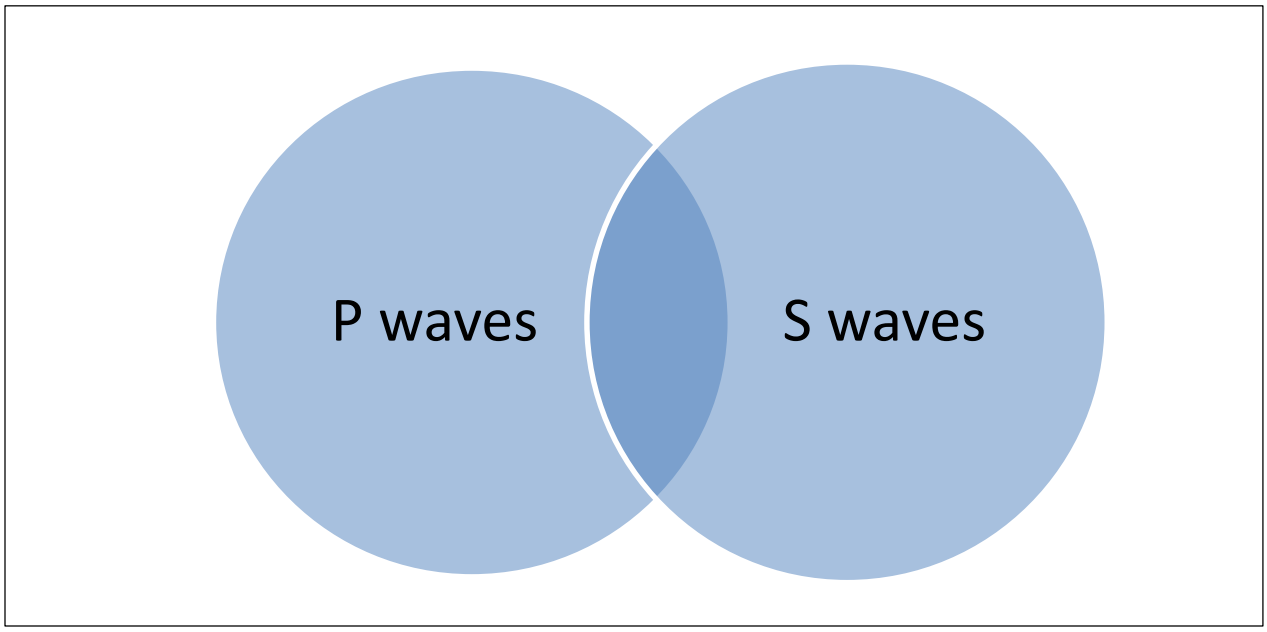
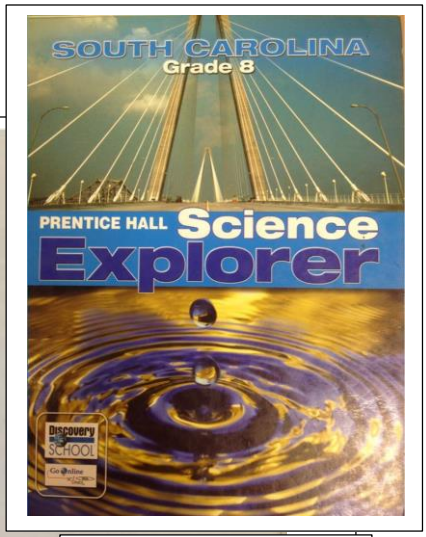
Example of Double Bubble graphic organizer



Example of Venn Diagram



The following pages used for the PIR section of the lesson are from the SC Grade 8 Edition of the Prentice Hall Science Explorer text.



ISBN 013203610X

P Waves The first waves to arrive are primary waves, or P waves. **P waves** are seismic waves that compress and expand the ground like an accordion. Like the other types of seismic waves, P waves can damage buildings. Look at Figure 7 to see how P waves move.

S Waves After P waves come secondary waves, or S waves. **S waves** are seismic waves that vibrate from side to side as well as up and down. They shake the ground back and forth. When S waves reach the surface, they shake structures violently. Unlike P waves, which travel through both solids and liquids, S waves cannot move through liquids.

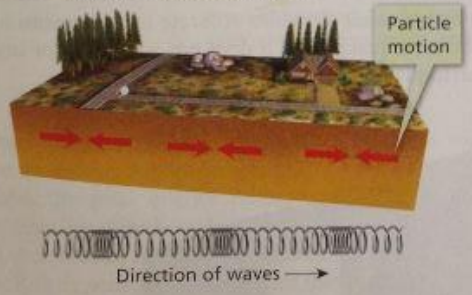
Surface Waves When P waves and S waves reach the surface, some of them become surface waves. **Surface waves** move more slowly than P waves and S waves, but they can produce severe ground movements. Some surface waves make the ground roll like ocean waves. Other surface waves shake buildings from side to side.

Reading Checkpoint **Which type of seismic wave causes the ground to roll like ocean waves?**

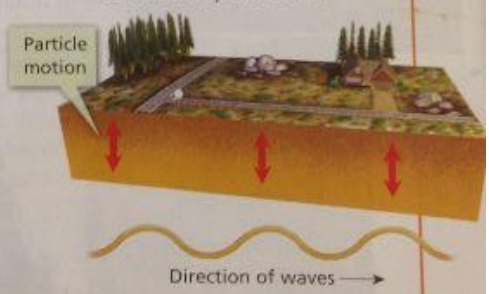
Go online **active art**

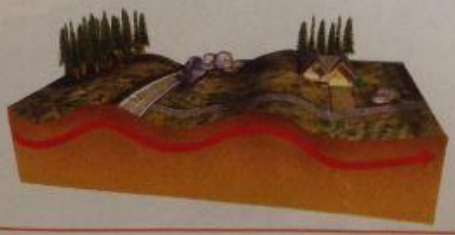
For: Seismic Waves activity
Visit: PHSchool.com
Web Code: cfp-1022

P waves ▼
The crust vibrates forward and back along the path of the wave.



S waves ▼
The crust vibrates from side to side and up and down.





◀ **Surface waves**
The ground surface rolls with a wavelike motion.

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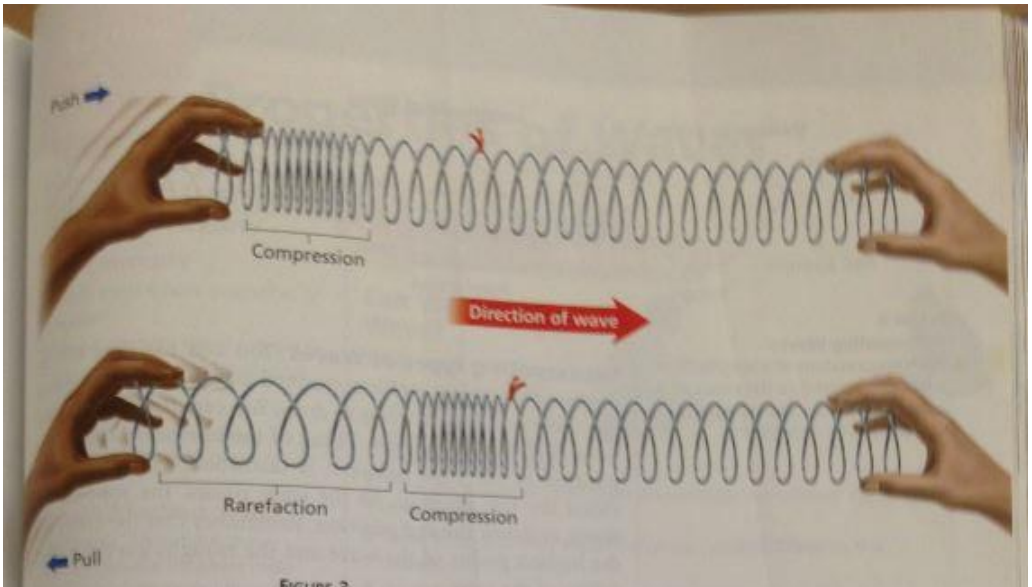


FIGURE 3
Longitudinal Waves
A longitudinal wave moves the coils of a spring toy back and forth in a direction parallel to the direction the wave travels. **Comparing and Contrasting** *How do the coils in a compression compare to the coils in a rarefaction?*

Longitudinal Waves Figure 3 shows a different kind of wave. If you stretch out a spring toy and push and pull one end, you can produce a longitudinal wave. **Longitudinal waves** (lawn juh TOO duh nul) move the medium parallel to the direction in which the waves travel. The coils in the spring move back and forth parallel to the wave motion.

Notice in Figure 3 that in some parts of the spring, the coils are close together. In other parts of the spring, the coils are more spread out. The parts where the coils are close together are called **compressions** (kum PRESH unz). The parts where the coils are spread out, or rarified, are called **rarefactions** (rair uh FAK shunz).

As compressions and rarefactions travel along the spring toy, each coil moves forward and then back. The energy travels from one end of the spring to the other, creating a wave. After the wave passes, each coil returns to the position where it started.

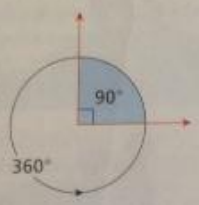
Sound is also a longitudinal wave. In air, sound waves cause air particles to move back and forth. In areas where the particles are pushed together, compressions form. In between the compressions, particles are spread out. These are rarefactions.

Go Online
SCILINKS NSTA
For: Links on waves
Visit: www.SciLinks.org
Web Code: scn-1511

Math Skills

Angles

An angle is formed when two lines meet at a point. Angles are measured in degrees, indicated by the symbol °. A circle has 360 degrees. A right angle is an angle that contains 90 degrees. Two lines that meet at a point to form a 90° angle are said to be perpendicular to each other.



Practice Problems

1. Draw a circle on a piece of paper. How many right angles can you fit in the circle?
2. How many degrees do two right angles contain?

What Causes Waves? Energy always is required to make a wave. **Mechanical waves are produced when a source of energy causes a medium to vibrate. A vibration** is a repeated back-and-forth or up-and-down motion. When a vibration moves through a medium, a wave results.

Moving objects have energy. A moving object can transfer energy to a medium, producing waves. For example, you can make waves by dipping your finger in water. Your finger has energy because it is moving. When your finger touches the water, it transfers energy to the water and makes waves. In the same way, a motorboat slicing through calm water transfers energy to the water and makes waves.

Reading Checkpoint What is a vibration?

Types of Waves

Waves move through mediums in different ways. **Mechanical waves are classified by how they move. There are two types of mechanical waves: transverse waves and longitudinal waves.**

Transverse Waves When you make a wave on a rope, the wave moves from one end of the rope to the other. But the rope itself moves up and down or from side to side, at right angles to the direction in which the wave travels. Waves that move the medium at right angles to the direction in which the waves travel are called **transverse waves.** Transverse means "across." As a transverse wave moves, the particles of the medium move across, or at a right angle to, the direction of the wave.

In Figure 2, you can see that the red ribbon on the rope is first at a low point of the wave. Then it is at a high point. The high part of a transverse wave is called a **crest,** and the low part is called a **trough** (trawf).

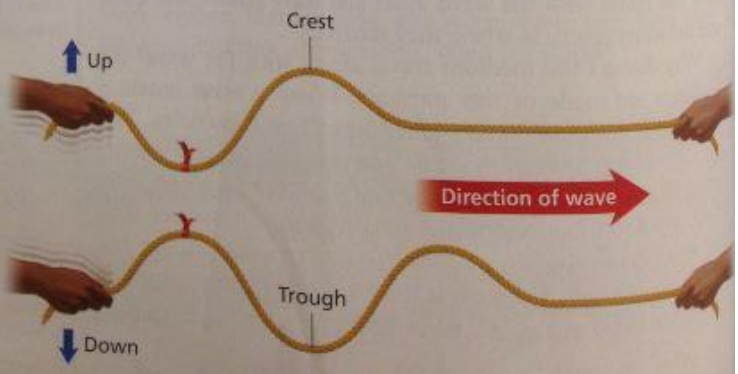


FIGURE 2
Transverse Waves
A transverse wave moves the rope up and down in a direction perpendicular to the direction in which the wave travels.

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