Slinky Waves

Contributors

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Intended Audience

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<tbody>
<tr>
<td>K-4</td>
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<td>5-8</td>
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<td>9-12</td>
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Activity Characteristics

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<table>
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<tbody>
<tr>
<td>Classroom Setting</td>
<td></td>
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<tr>
<td>Requires special equipment</td>
<td></td>
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<tr>
<td>Uses hands-on manipulatives</td>
<td>X</td>
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<tr>
<td>Requires mathematical skills</td>
<td>X</td>
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<tr>
<td>Can be performed individually</td>
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<tr>
<td>Requires group work</td>
<td>X</td>
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<tr>
<td>Requires more than one (45 min class) period</td>
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<tr>
<td>Appropriate for special needs student</td>
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Introduction

Description
Students will learn how energy is transferred through waves.

Abstract
Students will observe how the characteristics of waves affect each other. Students are able to visualize these changes using Slinkies to create transverse and longitudinal waves. In this manner, they will see the role force plays in producing, how amplitude can affect frequency and wavelength, and how positive and negative interference occurs.

Core Themes Addressed

<table>
<thead>
<tr>
<th>Core Themes Addressed</th>
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<tbody>
<tr>
<td>Microbial Cell Biology</td>
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<tr>
<td>Microbial Genetics</td>
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<td>Microorganisms and Humans</td>
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<td>Microorganisms and the Environment</td>
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<tr>
<td>Microbial Evolution and Diversity</td>
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<tr>
<td>Other –Physical Science</td>
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Keywords
Waves, Transverse, Longitudinal, Compression, Amplitude

Learning Objectives
At completion of this activity, learner will:

1. Differentiate between transverse and longitudinal waves
2. Explain how waves travel
3. Explain how amplitude affects other wave characteristics

National Science Education Standards Addressed

Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry

Standard B: Physical Science
- Interactions of energy and matter
Teacher Handout
Slinky Waves

Student Prior Knowledge

Students should have an understanding of the parts of a wave and how waves transfer energy.

Teacher Background Information

Waves are a disturbance that carries energy through matter or space. A medium is the matter through which a wave travels.

Longitudinal waves are waves that cause the particles in a medium to vibrate parallel to the direction of wave motion. The point in a longitudinal wave where the density is decreased is known as rarefaction. The point where the density is increased is known as compression.

Transverse waves are waves in which the particles of the medium move perpendicularly to the direction the wave is traveling. Crests are the high points of the wave and troughs are the lowest points of the wave. The distance between two crests is known as the wavelength.

Class Time

This activity will require a minimum of one 45 minute class period.

1. Give a lecture detailing the characteristics of waves and describing longitudinal and transverse waves: 10 minutes.
2. Students should move to their lab stations and begin the lab: 30 minutes.
   a. Activity 1 – Wave Pulses: 10 minutes
   b. Activity 2 – Wave Characteristics: 10 minutes
   c. Activity 3 – Multiple Wave Interaction: 10 minutes

Teacher Preparation Time

This lesson will require approximately 5 minutes of preparation time.

1. Supplies should be laid out at each lab station: 5 minutes.

Safety Precautions

Students should take caution not to injure themselves with the Slinkys.
Materials and Equipment (Per Group of 4)

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<tbody>
<tr>
<td>Slinky</td>
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<tr>
<td>Meter Stick</td>
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Methods

A. Activity 1 – Wave Pulses

1. Stretch the Slinky out on the table. Shake the Slinky sharply to the right one time to produce a wave pulse.
2. Make a sketch of what the Slinky looked like to show the progression of the wave.
3. Stretch the Slinky out on the table. Quickly push the Slinky inward one time.
4. Make a sketch of what the Slinky looked like to show the progression of the wave.

B. Activity 2 – Wave Characteristics

1. Stretch the Slinky and create a transverse wave pulse.
2. Record the time it takes to get to the other end.
3. Repeat this several times changing the height (amplitude) of the pulse each time and recording the time from one end of the Slinky to the other.

C. Activity 3 – Multiple Wave Interaction

1. With one person on each end of the Slinky, have each person create one transverse wave of about the same size with a disturbance in the same direction.
   a. Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.
2. Now have each person create a transverse wave, but this time make the disturbances in opposite directions (one right, one left).
   a. Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.
3. Now make one big pulse and one small pulse.
   a. Describe what happens when the disturbances meet along the medium, and after they meet. Sketch a picture of what you see.
References
This activity was modified from a similar activity by Jenny Dickson of the Molecular Biology Initiative.

Answers to Student Handouts
Activity 1 – Wave Pulses

1. Was the wave produced in Step 1 transverse or longitudinal?
   Transverse

2. Was the wave produced in Step 3 transverse or longitudinal?
   Longitudinal

3. In what ways are these two waves (transverse and longitudinal) different? In what ways are they the same?

   Transverse waves move perpendicular to the direction of the wave, but longitudinal waves move parallel to the direction of the wave. They are the same in that they both transfer energy and can travel through a medium.
Student Handout
Slinky Waves

Introduction

Waves can be observed in everyday life, be it the waving of a flag or the mighty waves of the ocean. What you are seeing in these instances is not the waves themselves, but the movement of the medium through which they are flowing. Waves are simply energy that can be carried through matter or space.

Student Background Knowledge

Waves are a disturbance that carries energy through matter or space. A medium is the matter through which a wave travels.

Longitudinal waves are waves that cause the particles in a medium to vibrate parallel to the direction of wave motion. The point in a longitudinal wave where the density is decreased is known as rarefaction. The point where the density is increased is known as compression.

Transverse waves are waves in which the particles of the medium move perpendicularly to the direction the wave is traveling. Crests are the high points of the wave and troughs are the lowest points of the wave. The distance between two crests is known as the wavelength.

Vocabulary

Wave: Disturbance that carries energy through matter or space.

Medium: Matter through which a wave travels.

Safety Considerations

Students should take caution not to injure themselves with the Slinkys.

Materials Checklist (Per Group of 4)

| Slinky
| Meter Stick |
Procedure

Activity 1 – Wave Pulses

1. Stretch the Slinky out on the table. Shake the Slinky sharply to the right one time to produce a wave pulse.
2. Make a sketch of what the Slinky looked like to show the progression of the wave.
3. Stretch the Slinky out on the table. Quickly push the Slinky inward one time.
4. Make a sketch of what the Slinky looked like to show the progression of the wave.

Questions:

1. Was the wave produced in Step 1 transverse or longitudinal?

2. Was the wave produced in Step 3 transverse or longitudinal?

3. In what ways are these two waves (transverse and longitudinal) different? In what ways are they the same?
Activity 2 – Wave Characteristics

1. Stretch the Slinky and create a transverse wave pulse.
2. Record the time it takes to get to the other end.
3. Repeat this several times changing the height (amplitude) of the pulse each time and recording the time from one end of the Slinky to the other.

<table>
<thead>
<tr>
<th>Amplitude of Pulse (cm)</th>
<th>Time to Reach Other End (seconds)</th>
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<tbody>
<tr>
<td>10</td>
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<td>20</td>
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<td>30</td>
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4. How does changing the amplitude of the pulse affect how long it takes to get from one end to the other?

Activity 3 – Multiple Wave Interaction

1. With one person on each end of the Slinky, have each person create one transverse wave of about the same size with a disturbance in the same direction.
   a. Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.

2. Now have each person create a transverse wave, but this time make the disturbances in opposite directions (one right, one left).
   a. Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.

3. Now make one big pulse and one small pulse.
   a. Describe what happens when the disturbances meet along the medium, and after they meet. Sketch a picture of what you see.