TOPIC 1.1: Waves in One Dimension

Students will be able to:

S3P-1-01 Describe a wave as a transfer of energy.

Include: medium, mechanical wave, pulse, periodic wave

S3P-1-02 Describe, demonstrate, and diagram the characteristics of transverse and longitudinal waves.

Include: crest, trough, amplitude, wavelength, compression, rarefaction

S3P-1-03 Compare and contrast the frequency and period of a periodic wave.

Include: $T = \frac{1}{f}$

S3P-1-04 Derive and solve problems, using the wave equation ($v = f\lambda$).

S3P-1-05 Describe, demonstrate, and diagram the transmission and reflection of waves travelling in one dimension.

Include: free and fixed ends, different media

S3P-1-06 Use the principle of superposition to illustrate graphically the result of combining two waves.

Include: constructive and destructive interference, nodes, antinodes, standing waves

S3P-1-07 Investigate the historical development of a significant application of communications technology that uses waves.

Examples: telephone, radio, television, cell phone, communications satellite, motion detectors, remote controls…

General Learning Outcome Connection

Students will…

Understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts (GLO D4)

Specific Learning Outcomes

S3P-1-01: Describe a wave as a transfer of energy.

Include: medium, mechanical wave, pulse, periodic wave

S3P-1-02: Describe, demonstrate, and diagram the characteristics of transverse and longitudinal waves.

Include: crest, trough, amplitude, wavelength, compression, rarefaction

S3P-1-03: Compare and contrast the frequency and period of a periodic wave.

Include: $T = \frac{1}{f}$

Suggestions for Instruction

Entry-Level Knowledge

In Grade 8 optics, students developed an understanding of the behaviour of waves by investigating light rays (ray optics). Students explored the principles of reflection and refraction, and of electromagnetic radiation.

Notes to the Teacher

Waves are ubiquitous. Sound waves, microwaves, water waves, and "The Wave" are terms we hear almost every day. There also exist many different phenomena that can be represented by waves. Two very common examples are the swing of a pendulum and the to-and-fro movement of a mass suspended by a spring.

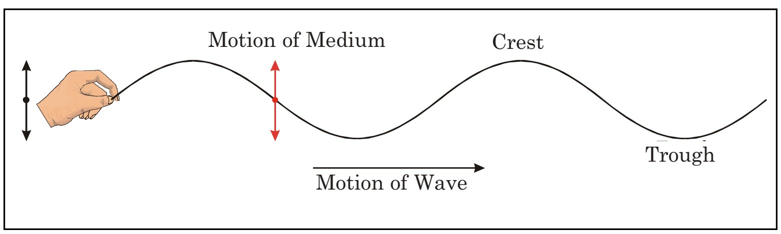
A mechanical wave is a disturbance, a transfer of energy that travels through a medium from one place to another. A wave is not an object in the same sense as a particle: a particle exists at rest, a wave does not. A pulse is a single disturbance, and a periodic wave is a continuing disturbance that is moving through the medium. A sound wave is an example of a mechanical wave.

A medium is the substance or material that carries the disturbance (either a pulse, wave, or periodic wave) from one place to another. For example, sound waves use air as a medium. Sound waves cannot be transmitted through a vacuum.

An electromagnetic wave is a wave that is able to transmit its energy without a medium (i.e., through a vacuum). A radio wave is an example of an electromagnetic wave.

There are two types of waves: transverse and longitudinal. In transverse waves, the particles move perpendicular to the wave motion. In longitudinal waves, the particles move parallel to wave motion.

Transverse Wave (e.g., water waves, waves on a string)



SKILLS AND ATTITUDES OUTCOMES

S3P-0-4b: Work cooperatively with a group to identify prior knowledge, initiate and exchange ideas, propose problems and their solutions, and carry out investigations.

S3P-0-2f: Record, organize, and display data, using an appropriate format.

Include: labelled diagrams, tables, graphs

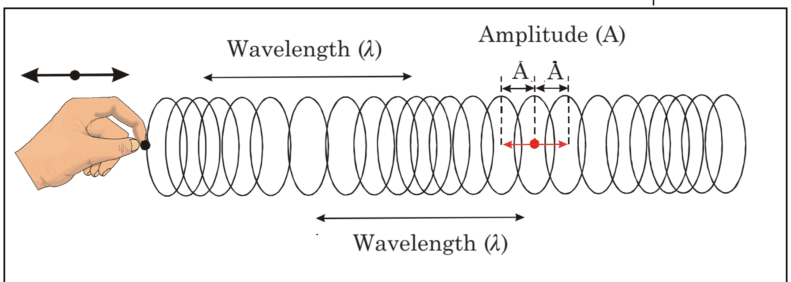
GENERAL LEARNING OUTCOME CONNECTION

Students will…

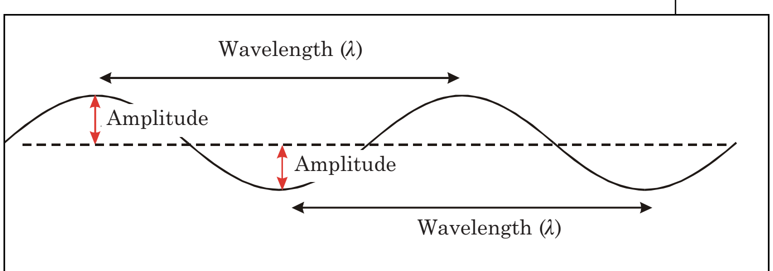
Recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them (GLO E4)

SUGGESTIONS FOR INSTRUCTION

Longitudinal Wave (e.g., sound waves or waves in a coil spring toy like a Slinky™)



Although transverse and longitudinal waves are physically different, they have the same characteristics of amplitude and wavelength. Therefore, both can be described by the same mathematical model. On a graph, both types of waves are represented by a sinusoidal wave.



SUGGESTIONS FOR ASSESSMENT

Science Journal Entries

Students illustrate with a diagram the difference between a pulse and a travelling wave.

Students provide examples of waves that travel from a source and expend their energy at a different location (i.e., earthquakes, tsunamis).

Students label diagrams of transverse and longitudinal waves.

Performance Assessment

Students:

- measure the amplitude and wavelength of actual waves.
- illustrate and/or describe the difference between transverse and longitudinal waves.
- calculate frequency and period for a given motion.

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts (GLO D4)

SPECIFIC LEARNING OUTCOMES

S3P-1-01: Describe a wave as a transfer of energy.

Include: medium, mechanical wave, pulse, periodic wave

S3P-1-02: Describe, demonstrate, and diagram the characteristics of transverse and longitudinal waves.

Include: crest, trough, amplitude, wavelength, compression, rarefaction

S3P-1-03: Compare and contrast the frequency and period of a periodic wave.

Include: $T = \frac{1}{f}$

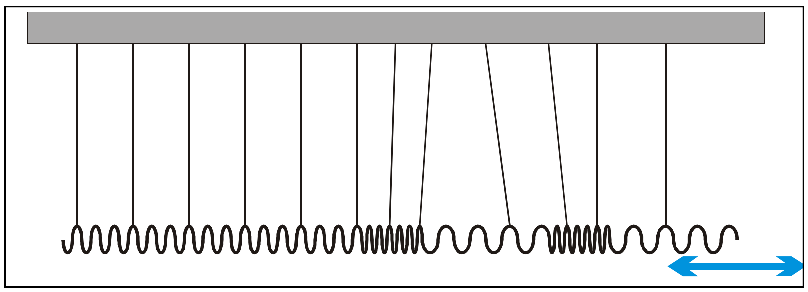
SUGGESTIONS FOR INSTRUCTION

Class Activities

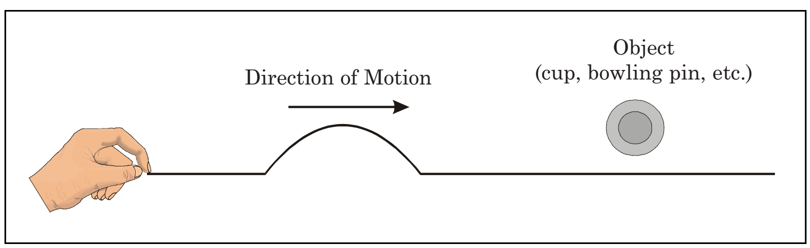
Perform "The Wave" (as at a football game) to imitate a transverse wave. The students represent the particles of the medium and, as they move up and down in a vertical plane, the disturbance moves horizontally through the students. Once the wave has passed a point, the medium is exactly the same as before. To illustrate frequency and period, the students perform "The Wave" for a period of time, such as 30 s, counting the number of times the disturbance passes through them. The frequency (number of waves per unit time) and the period (time for one complete wave) can be calculated. (For an interesting simulation, see kettering.edu resource.)

Teacher Demonstration

The students' understanding will be increased if they experience wave phenomena through a series of laboratory exercises. Waves in one dimension can be investigated with strings, springs, and/or a coil spring toy like a Slinky™. A coil spring toy is quite useful in demonstrating wave phenomena. For convenience, the toy can be suspended from the ceiling or a support system (see diagram).



The spring toy can also be used on a smooth tabletop or on the floor. This demonstration uses a bowling pin (or foam cup) to distinguish between the motion of the particles and the motion of the wave.



Students may have difficulty with the distinction between the motion of the wave and the motion of the particles of the wave. Wave phenomena often occur so rapidly that they are difficult to observe. Place a piece of masking tape on a coil of the toy spring. This will help students focus on the movement of a single particle. Students can also videotape both types of waves and analyze the wave motion using slow motion, or frame-by-frame advance. A scale can be

SKILLS AND ATTITUDES OUTCOMES

S3P-0-4b: Work cooperatively with a group to identify prior knowledge, initiate and exchange ideas, propose problems and their solutions, and carry out investigations.

S3P-0-2f: Record, organize, and display data, using an appropriate format.

Include: labelled diagrams, tables, graphs

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them (GLO E4)

SUGGESTIONS FOR INSTRUCTION

used so students can take measurements of amplitude and wavelength. This activity will help students to develop skills in estimating and measuring using Système International (SI) units.

Students also commonly confuse the concepts of period and frequency. There are a number of simple activities that students can do to calculate frequency and period.

Student Activities

- Students count their heart rate for a set amount of time. The pulses per minute indicate the frequency of the heartbeat.
- Set a mass on a coiled spring and let the mass oscillate (up and down). Students can count the number of oscillations for 20 seconds and calculate the frequency and period. An Ultrasonic Motion Detector can be used to illustrate how the back-and-forth motion can be represented mathematically as a transverse wave. For both these activities, students collect data, organize them in a table, and analyze them.
- Swing a tennis ball on a string like a pendulum and have students record the time it takes the tennis ball to complete one oscillation (to-and-fro motion). This represents the period of the motion.

SUGGESTIONS FOR ASSESSMENT

Lab Report

Students design an experiment where they measure λ, T, and f of transverse waves. Students describe the methodology of their experiment. They collect data and organize the results in a format of their choice. Students also include labelled diagrams, and write the lab report.

SUGGESTED LEARNING RESOURCES

Teacher References

Spivey, J. (1986) “A Versatile Mount for Slinky Wave Demonstrator.” *AAPT Potpourri of Physics Teaching Ideas*: 226.

Software

Logal: Waves Exploration 7: Periodic, Traveling Waves

Logal: Waves Exploration 1: Introduction

Exploring Physics and Math with the CBL System (Texas Instruments, 1994), Activity 22

Physics with CBL Experiment 15, Simple Harmonic Motion (Vernier, 1998)

General Learning Outcome Connection

Students will…

Understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts (GLO D4)

Specific Learning Outcomes

S3P-1-01: Describe a wave as a transfer of energy.

Include: medium, mechanical wave, pulse, periodic wave

S3P-1-02: Describe, demonstrate, and diagram the characteristics of transverse and longitudinal waves.

Include: crest, trough, amplitude, wavelength, compression, rarefaction

S3P-1-03: Compare and contrast the frequency and period of a periodic wave.

Include: $T = \frac{1}{f}$

Suggestions for Instruction

- Use a strobe to calculate the frequency of periodic motion. (See Appendix 1.1 for an example.)

Senior Years Science Teachers' Handbook Activities

Working in groups, students use Compare and Contrast Frames (see *Senior Years Science Teachers' Handbook*, page 10.15) for longitudinal and transverse waves.

Students use Compare and Contrast Frames for frequency and period.

Students use a Three-Point Approach to develop concepts such as medium, transverse wave, longitudinal wave, crest, trough, frequency, period, rarefaction, compression, mechanical waves, travelling wave, wave pulse, amplitude (see *Senior Years Science Teachers' Handbook*, page 10.9).

Journal Writing: Students imagine themselves sitting on a raft in a wave pool and describe the motion of the raft relative to the motion of the wave. Students can also imagine themselves surfing a wave and describe the amplitude, period, wavelength, speed, and frequency of the wave.

Teaching Notes

SKILLS AND ATTITUDES OUTCOMES

S3P-0-4b: Work cooperatively with a group to identify prior knowledge, initiate and exchange ideas, propose problems and their solutions, and carry out investigations.

S3P-0-2f: Record, organize, and display data, using an appropriate format.

Include: labelled diagrams, tables, graphs

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them (GLO E4)

SUGGESTIONS FOR INSTRUCTION

SUGGESTIONS FOR ASSESSMENT

SUGGESTED LEARNING RESOURCES

Applets (websites)

<http://www.kettering.edu/~drussell/Demos.html>
This site focusses on applets and animated demos for waves, including a simulation of "The Wave" with people.

<http://www.kamikawas.com/physics/java_e.htm>

<http://www.kamikawas.com/physics/java_e.htm>

<http://www.mta.ca/faculty/science/physics/suren/Applets.html>

<http://www.mta.ca/faculty/science/physics/suren/Applets.html\>

Multimedia

Cinema Classics videodisc Disk C: Waves (1), Chapter 12, Energy Transfer

Cinema Classics videodisc Disk C: Waves (1), Chapter 11, Wave Vocabulary; Chapter 14, Wave Machine

GENERAL LEARNING OUTCOME CONNECTION

Students will...

Demonstrate appropriate scientific inquiry skills when seeking answers to questions (GLO C2)

SPECIFIC LEARNING OUTCOME

S3P-1-04: Derive and solve problems, using the wave equation ($v = f\lambda$).

SUGGESTIONS FOR INSTRUCTION

Entry-Level Knowledge

From Senior 2 Science, students are familiar with the definition of speed as

$$v = \frac{\Delta d}{\Delta t}$$

Notes to the Teacher

The wave equation can be derived from the definition of speed. The wavelength represents the distance between two successive crests, and the period is the amount of time it takes for one wavelength to pass a given point. Thus,

$$v = \frac{\Delta d}{\Delta t} \qquad \Delta d = \lambda \qquad \Delta t = T$$

Therefore,

$$v = \frac{\lambda}{T}$$

Students can then formulate the relationship for speed in terms of frequency, since $f = \frac{1}{T}$.

The wave equation is generally written as $v = f\lambda$, but either form can be used to solve problems.

Senior Years Science Teachers' Handbook Activities

Students write process notes to summarize their strategies for solving problems using the period, the frequency, and the wave equation (see *Senior Years Science Teachers' Handbook*, Writing to Learn Science for Information on Process Notes, page 13.14).

Student Activities

(See Appendix 1.1: Strobe Template.)

SKILLS AND ATTITUDES OUTCOMES

S3P-0-2c: Formulate operational definitions of major variables or concepts.

S3P-0-2a: Select and use appropriate visual, numeric, graphical, and symbolic modes of representation to identify and represent relationships.

S3P-0-2g: Interpret patterns and trends in data, and infer or calculate linear relationships among variables.

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts (GLO D4)

SUGGESTIONS FOR INSTRUCTION

Teaching Notes

SUGGESTIONS FOR ASSESSMENT

Teacher Observations

Students use the wave equations to solve problems for speed, wavelength, and frequency.

Students complete a Concept Map (see Appendix 1.2 for an example). Students identify variables for the wave equation and show how they are related.

Pencil-and-Paper Tasks

Students compare and contrast the equations:

$$v = \frac{\Delta d}{\Delta t} \text{ and } v = f\lambda$$

SUGGESTED LEARNING RESOURCES

Software

Logal: Waves Exploration 1: Introduction—wave speed

Appendix 1.2: Concept Map for Wave Equation Variables

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SPECIFIC LEARNING OUTCOME

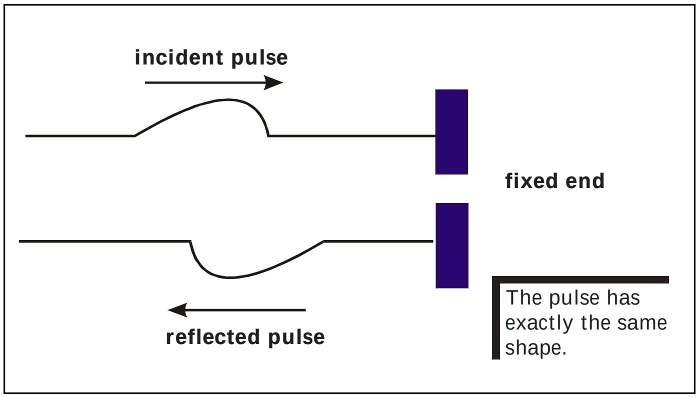
S3P-1-05: Describe, demonstrate, and diagram the transmission and reflection of waves travelling in one dimension.

Include: free and fixed ends, different media

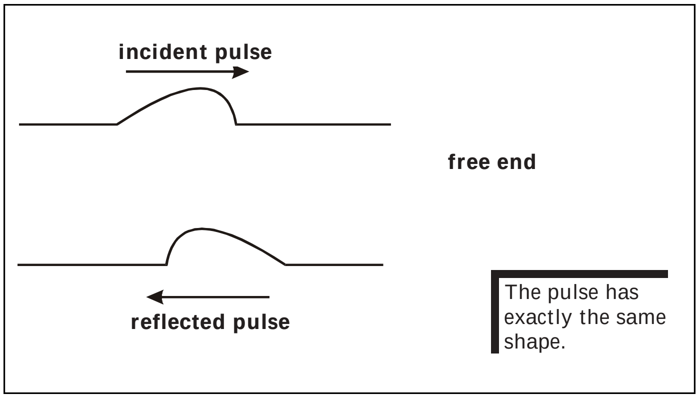
SUGGESTIONS FOR INSTRUCTION

Notes to the Teacher

Waves incident on a fixed end are reflected on the opposite side.



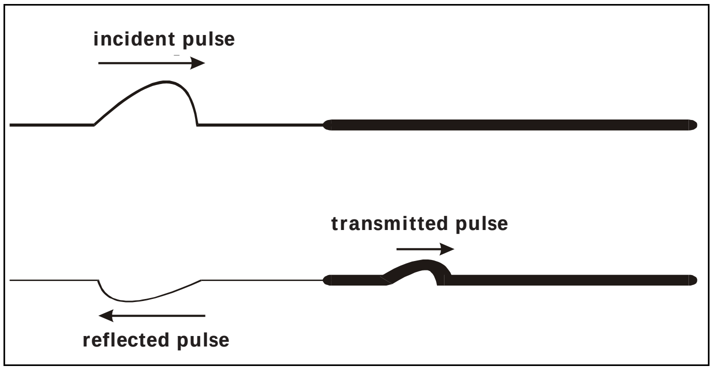
Waves incident on a free end are reflected on the same side.



Demonstration of fixed-end reflection is easy. However, demonstration of reflection from a free end is much more difficult because of the damping effect of the wave. Videotape and frame-by-frame advance can be used to reveal same-side reflections.

The frequency of a wave depends on the source alone. The energy of a wave only changes the amplitude of the wave as it moves from one medium to another. Once a wave is produced, the frequency remains the same regardless of the medium. Consequently, as a wave travels from one medium to another, its velocity and wavelength change.

Waves travelling from a light medium to a heavy medium result in partial transmission and partial reflection. The partial reflection is like reflection from a fixed end.



SKILLS AND ATTITUDES OUTCOME

S3P-0-2a: Select and use appropriate visual, numeric, graphical, and symbolic modes of representation to identify and represent relationships.

GENERAL LEARNING OUTCOME CONNECTION

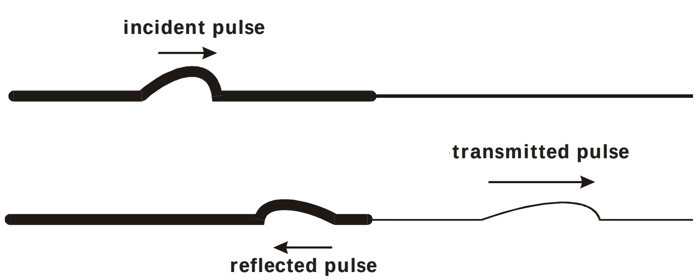
Students will...

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SUGGESTIONS FOR INSTRUCTION

The reflected pulse is on the opposite side of the incident pulse, and the transmitted pulse is on the same side. The reflected pulse has the same wavelength as the incident pulse, since the speed is constant in the same medium. The transmitted pulse has a shorter wavelength than the incident pulse, since speed decreases in a heavier medium. The reflected and transmitted pulses have smaller amplitudes, since some of the energy is transmitted and some is reflected.

Waves travelling from a heavy medium to a light medium result in partial transmission and partial reflection (like from a free end).



Both of the reflected and the transmitted pulses are on the same side as the incident pulse. The reflected pulse has the same wavelength and a smaller amplitude. The transmitted pulse has a longer wavelength as the wave speeds up in the lighter medium.

SUGGESTIONS FOR ASSESSMENT

Pencil-and-Paper Tasks

Students diagram and explain what happens at the junction of two media for a given wave. Examples should include: heavy medium to light medium; light medium to heavy medium.

Students diagram and explain what happens when a wave reflects from a fixed end and from a free end.

Students compare and contrast the effect of light and heavy mediums on transmission and reflection of waves.

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SPECIFIC LEARNING OUTCOME

S3P-1-05: Describe, demonstrate, and diagram the transmission and reflection of waves travelling in one dimension.

Include: free and fixed ends, different media

SUGGESTIONS FOR INSTRUCTION

Student Activity

Students perform a lab, use computer simulations, and/or use a video camera to film the motion of waves. For a light medium, they could use a common coil spring toy; for a heavy medium, they can use a heavier, tightly coiled spring (sets are available from science suppliers).

Teaching Notes

SKILLS AND ATTITUDES OUTCOME

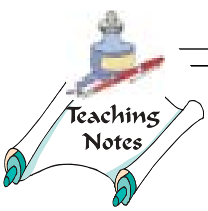
S3P-0-2a: Select and use appropriate visual, numeric, graphical, and symbolic modes of representation to identify and represent relationships.

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SUGGESTIONS FOR INSTRUCTION



SUGGESTIONS FOR ASSESSMENT

Lab Report

Students observe the speed of the wave, the wavelength, the amplitude, and how the wave is reflected at the junction or endpoint. Students describe their observations in the lab report. (See *Senior Years Teachers' Handbook*, Laboratory Report Format, page 14.3.)

SUGGESTED LEARNING RESOURCES

Multimedia

Physics: Cinema Classics videodisc Disk C: Waves (1), Chapter 52, Wave Machine

Software

Logal: Waves Exploration 3: Behaviour at the End of a String

Applets (Websites)

<http://www.kamikawas.com/physics/java_e.htm>

<http://www.kamikawas.com/physics/java_e.htm>
Wave Machine (can show the reflection of waves from a free or fixed end; must be done step by step)

<http://www.kettering.edu/~drussell/Demos/reflect/reflect.html>

GENERAL LEARNING OUTCOME CONNECTION

Students will…

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SPECIFIC LEARNING OUTCOME

S3P-1-06: Use the principle of superposition to illustrate graphically the result of combining two waves.

Include: constructive and destructive interference, nodes, antinodes, standing waves

SUGGESTIONS FOR INSTRUCTION

Notes to the Teacher

When waves travel in the same region of space, they may interfere with each other. The resultant displacement is the sum of the individual displacements of the interfering waves. Waves can interfere constructively (the result is a larger amplitude) or destructively (the result is a smaller amplitude). Total destructive interference can occur when the interfering waves have identical wavelengths and amplitudes. The result is a region of no disturbance called a node.

If two opposing waves have the same amplitude and wavelength, they interfere with each other such that there are points in the medium that appear to be standing still. These points are called nodes and the interference pattern is called a standing wave. A standing wave can easily be produced by fixing one end of a coil spring toy, and vibrating the other end at just the right frequency. The pattern is regular and repeatable with a series of nodal points clearly visible. Try attaching a piece of tape to a nodal point to illustrate that it is not moving.

Waves generated on the same side of the spring will produce constructive interference as they overlap. Waves generated on opposite sides of the spring will produce destructive interference as they overlap. The points on the spring between the nodes move back and forth rapidly. These points are where constructive interference occurs and are called antinodes. The distance between successive nodes or antinodes in a standing wave interference pattern is one-half the wavelength of the interfering waves.

Student Activities

Students perform a lab, computer simulation, videodisc observation, and/or “paper lab” task. Students can also measure the displacement of each of the wave pulses and add them to determine the total displacement.

In a “paper lab” task, students can analyze waves with ideal shapes, such as rectangles and triangles, to practise using the principle of superposition. Students will develop the skill of measurement as they add up individual displacements of the waves. (See Appendix 1.3: Superposition of Waves.)

SKILLS AND ATTITUDES OUTCOMES

S3P-0-2d: Estimate and measure accurately, using Système International (SI) units.

S3P-0-2f: Record, organize, and display data, using an appropriate format.

Include: labelled diagrams, tables, graphs

GENERAL LEARNING OUTCOME CONNECTION

Students will...

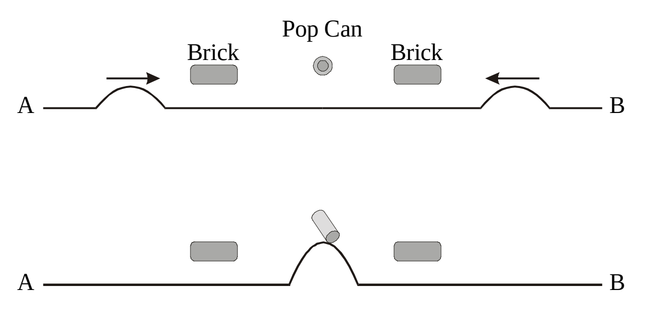
Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data
(GLO C6)

SUGGESTIONS FOR INSTRUCTION

Students can videotape waves travelling in a spring. Pulses can be generated at opposite ends of a spring. Using stop action, students can observe the waves before they overlap, during the period of overlapping while interference is occurring, and after the waves have passed through each other.

Demonstration

The diagram below illustrates constructive interference. Students A and B hold opposite ends of a coil spring toy or similar spring. At the same time, they generate pulses large enough to just clear the bricks. When the waves meet, they constructively interfere and produce a larger wave that knocks over the pop can. The waves then continue to travel past the bricks without touching. With a little practice, this can be accomplished with regularity. Videotape and play back the tape in slow motion.



SUGGESTIONS FOR ASSESSMENT

Teacher Observation

Students measure the displacements of the overlapped waves.

Students diagram two waves overlapping to illustrate the Principle of Superposition.

Students draw wave pulses that are travelling towards each other in the same medium before they overlap, in the region of interference, and after they have passed through each other. (See Appendix 1.3: Superposition of Waves, and Appendix 1.4: Waves in One Dimension.)

SUGGESTED LEARNING RESOURCES

Multimedia

Physics: Cinema Classics videodisc Disk C: Waves (1), Chapter 31, Computer Animation; Chapter 32, Slinky; Chapter 42, Wave Machine

Software

Logal: Waves Core 3 Superposition

Exploration 6: Superposition: When Two Waves Meet

Exploration 8: Standing Waves, Core 4 Standing Waves

General Learning Outcome Connection

Students will...

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

Specific Learning Outcome

S3P-1-06: Use the principle of superposition to illustrate graphically the result of combining two waves.

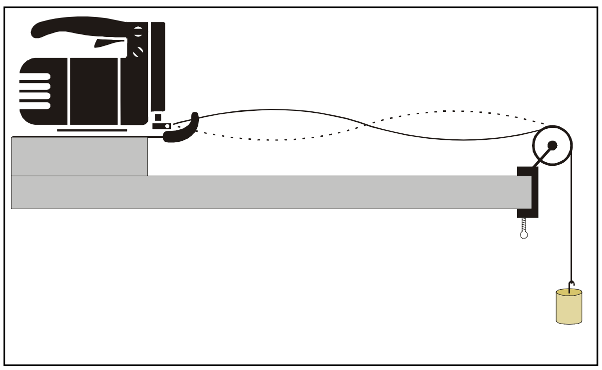
Include: constructive and destructive interference, nodes, antinodes, standing waves

Suggestions for Instruction

Standing waves can also be produced with a skipping rope. Attach one end of the rope to a doorknob. Hold the other end of the rope in your hand. Move your hand up and down to generate a wave of fixed frequency. Points on the rope will become stationary.

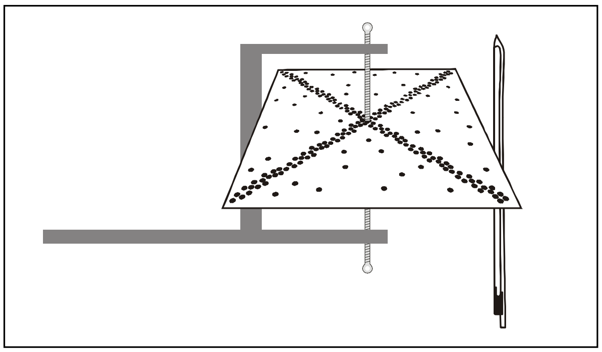
Teacher/Student Demonstration

An old jigsaw (with blades removed!) or other similar device can be used to move a string rapidly up and down to produce standing waves. Use a 1-kg mass to produce up to three nodes. Caution: noisy demo!



Teacher/Student Demonstration

Sprinkle some fine dust on a fixed metal plate and stroke the plate with a violin bow. The dust will move away from certain areas and toward others. The particles move away from the interference nodes. The dust formation is called a Chladni pattern.



Senior Years Science Teachers' Handbook Activities

Students use a Concept Map to show the relationships between constructive and destructive interference, nodes, antinodes, and standing waves.

SKILLS AND ATTITUDES OUTCOMES

S3P-0-2d: Estimate and measure accurately, using Système International (SI) units.

S3P-0-2f: Record, organize, and display data, using an appropriate format.

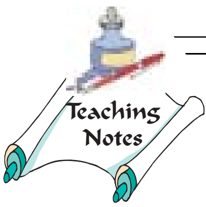
Include: labelled diagrams, tables, graphs

GENERAL LEARNING OUTCOME CONNECTION

Students will...

Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data (GLO C6)

SUGGESTIONS FOR INSTRUCTION



SUGGESTIONS FOR ASSESSMENT

SUGGESTED LEARNING RESOURCES

Applets (Websites)

<http://users.erols.com/renau/applet_menu.html>

<http://www.phys.hawaii.edu/~teb/java/ntnujava/>

<http://www.mta.ca/faculty/science/physics/suren/Applets.html>

<http://www.physicsweb.com>
This site contains an extensive bank of questions dealing with waves.

<http://explorescience.com/activities/activity_ page.cfm?ActivityID=44>
Hear beats produced for fixed frequencies. Change frequencies and hear the number of beats change.

<http://www.cs.earlham.edu/~rileyle/Applet.html>
Adjust the frequency and see the program plot graphically the beats produced.

<http://susy.phys.nwu.edu/%7Eanderson/java/vpl/waves/superposition2.html>

<http://mta.ca/faculty/science/physics.suren/Applets.html>

General Learning Outcome Connection

Students will...

Describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally (GLO B1)

Specific Learning Outcome

S3P-1-07: Investigate the historical development of a significant application of communications technology that uses waves.

Examples: telephone, radio, television, cell phone, communications satellite, motion detectors, remote controls...

Skills and Attitudes Outcomes

S3P-0-1c: Relate the historical development of scientific ideas and technology to the form and function of scientific knowledge today.

Suggestions for Instruction

Notes to the Teacher

Students should understand that waves have very practical applications in modern technological devices. This learning outcome provides a brief introduction to some of the devices that utilize wave technology.

Collaborative Teamwork

Students research and report on one significant product of communications technology.

Students can construct a timeline of the chronological development of significant products of communication technology with a focus on the development of scientific ideas and technology.

Senior Years Science Teachers' Handbook Activities

Students use a jigsaw activity (*Senior Years Science Teachers' Handbook*, page 3.20) so that each student becomes an "expert" on one specific device by meeting and sharing research with other "experts." Each "expert" reports back to her or his original group.

SKILLS AND ATTITUDES OUTCOMES

S3P-0-2i: Select and integrate information obtained from a variety of sources.

Include: print, electronic, and/or specialist sources, resource people

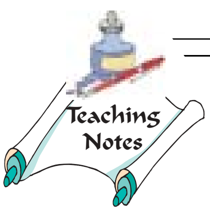
S3P-0-3b: Describe examples of how technology has evolved in response to scientific advances, and how scientific knowledge has evolved as the result of new innovations in technology.

GENERAL LEARNING OUTCOME CONNECTION

Students will...

Demonstrate a knowledge of, and personal consideration for, a range of possible science- and technology-related interests, hobbies, and careers (GLO B4)

SUGGESTIONS FOR INSTRUCTION



SUGGESTIONS FOR ASSESSMENT

Research Report/Presentation

Student/group presentation is made to the class on a significant product of communication technology.

Visual Displays

Students do a gallery walk of historical timeline posters.

Museum Quest: Students research artifacts online in museums of science and technology. Students can then prepare a report, poster presentation, or multimedia presentation.

SUGGESTED LEARNING RESOURCES

Museums

<http://shot.press.jhu.edu/links.htm>

NOTES