teacher guide

Mechanical waves 3: Graphing waves

Components

	NAME	DESCRIPTION	AUDIENCE
	*Graphing waves* teacher guide	This describes the use of a motion detector and device to collect data (computer or calculator) to study wave properties.	teachers
	*Longitudinal waves* worksheet	This worksheet asks students to identify points on a graph that relates to waves they create in the activity.	students
	*Longitudinal waves (advanced)* worksheet	This worksheet is intended for stronger maths students.	students

Purpose

To **Elaborate** on concepts related to wave properties using a mathematical approach.

Outcomes

Students:

- collect and analyse data to determine wave frequency and wavelength,
- give a meaning to coefficients in a wave equation,
- describe a longitudinal wave as a sine function, and
- determine an equation of best fit for data collected from simple harmonic motion.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
In groups, students do the activity and complete the worksheets *Longitudinal waves*, then *Longitudinal waves (advanced)*, followed by teacher-led discussion.	group work

Technical requirements

The teachers guide and worksheets require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheets are also provided in Microsoft Word format.

Introduction

In this activity students become part of a longitudinal wave by controlling aspects of wave motion, leading to rich classroom discussions on amplitude, frequency, wavelength, period and phase.

Students may use graphics calculators or computers for data logging or streaming to collect data. Analysis of these data leads to an increased understanding of wave properties.

Procedure

For this activity your class will need:

- a motion detector,
- a device for data collection (a computer or calculator), and
- any large textbook.

Place motion detector on a tabletop and connect it to computer or calculator. Students should stand, with textbook held in their outstretched hands, facing the motion detector. The textbook should be at least 0.5 m away from the tabletop. The student then bends and extends their arms at a regular pace to simulate the motion of a longitudinal wave.

It is recommended that recorded waves be five seconds long with recordings at every 0.05 s, to give a total of 100 records.

All graphic calculators, and many computer software packages, can give the equation of the curve. This may be used to identify coefficients of motion, and may help to reinforce work done in previous mathematics classes.

Recommended approaches

Suggested activities are outlined in *Worksheet 1: Longitudinal waves* and *Worksheet 2: Longitudinal waves (advanced)*. The first worksheet asks students to identify points on a graph that relate to waves they create in the procedure. A more challenging worksheet is provided for stronger maths students.

The activity may also be successful using either a class- or group-based approach. Groups may be encouraged to engage in discussions highlighting similarities and differences found during the activity.

A whole-class approach may involve projecting the wave onto a screen or white board as each student completes their wave. The class can then analyse aspects of motion, leading to comparison of the students' unique 'wave motion signature'.

Students may also be challenged to replicate a particular trace on screen, modifying their motion in real-time to create the correct wave.

Associated SPICE resources

Mechanical waves 3: Graphing waves may be used in conjunction with related SPICE resources to address the broader topic of mechanical waves.

DESCRIPTION	LEARNING PURPOSE
Mechanical waves This learning pathway shows how a number of SPICE resources can be combined to teach the topic of mechanical waves.	
Mechanical waves 1: The physics of tsunamis Video and a fact sheet compare surface waves with tsunami waves.	Engage
The sequence overview in *Mechanical waves* contains suggested **Explore** activities suitable for use at this point.	Explore
Mechanical waves 2: Wave properties This resource includes a learning object (in which students interact with a variety of waves to understand their properties), and associated student worksheets.	Explain
Mechanical waves 3: Graphing waves These student worksheets describe experiments with longitudinal waves.	Elaborate
Mechanical waves 4: Tsunami problems These student worksheets cover a range of problems concerning the physics of tsunamis and other waves.	Elaborate
The sequence overview in *Mechanical waves* contains suggested **Explore/Explain** activities suitable for use at this point.	Explore/Explain
Mechanical waves 5: The physics of whale stranding An interview with physicist Dr Ralph James illustrates how his research into microwaves led him to develop and test a theory to explain whale beaching.	Elaborate

Acknowledgements

Worksheets designed by Alan Cadby (Centre for Learning Technology, The University of Western Australia). Production by DUIT Multimedia (The University of Western Australia).

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