Physics: Waves

Whole unit overview

Recommended Prior Knowledge: This unit does not require the study of any other unit in advance. It may be appropriate for use in advance of the Light unit for some groups of able students.

Context: The unit introduces the important topic of wave motion. Although in some ways a difficult concept, there is not too much for students to memorise, so this is a suitable unit to teach towards the end of the course.

Outline: The unit begins with the familiar - waves on ropes and water - leading to the wave equation v = f x lambda and work on the electromagnetic spectrum. Finally the concepts are applied to sound waves.

Learning Outcomes		Suggested Teaching Activities	Resources
3.1	Describe what is meant by wave motion as illustrated by vibration in ropes, springs and by experiments using water waves. Use the term wavefront. Give the meaning of speed, frequency, wavelength and amplitude. Distinguish between transverse and longitudinal waves and give suitable examples. Describe the use of water waves to show (i) reflection at a plane surface (ii) refraction due to a change of speed (iii) diffraction produced by wide and narrow gaps.	Begin with waves on ropes and a 'slinky' spring to illustrate transverse and longitudinal waves. A ripple tank can then be used to show reflection, refraction and diffraction of water waves.	This site shows a longitudinal wave that is reflected off a hard surface, an 'echo' can be created. An equivalent transverse wave can also be shown. http://www.explorescience.com/ click on wave motion click on Longitudinal Wave This site has clear demonstrations of transverse and longitudinal waves. http://members.aol.com/nicholashl/waves/movingwaves.html
	Give the meaning of the term wavefront. Recall and use the equation $v = f \times l$. Interpret reflection, refraction and diffraction using wave theory.	Use a set of ripple tank projection slides to reinforce the ripple tank work and focus on more detailed discussion.	
3.2 (e)	Describe the main features of the electromagnetic spectrum and state that all e-m waves travel with the same high speed *in vacuo.*	Include plenty of examples to show students that they already have much general knowledge regarding the uses of electromagnetic waves.	

	State the approximate value of the speed of electromagnetic waves. Use the term monochromatic.		Good presentation of electromagnetic waves showing the link between wavelength and uses. http://www.colorado.edu/physics/2000/index.pl click on Science Trek click on Electromagnetic Waves
3.3	Describe the production of sound by vibrating sources. Describe the longitudinal nature of sound waves. State the approximate range of audible frequencies. Show an understanding that a medium is required in order to transmit sound waves. Describe an experiment to determine the speed of sound in air. Relate the loudness and pitch of sound waves to amplitude and frequency. Describe how the reflection of sound may produce an echo.	Use a variety of musical instruments to introduce this section. A signal generator and loudspeaker can be used to investigate the range of audible frequencies. A bell in a bell jar that can be evacuated can be used to show that a medium is required for the transmission of sound (at the same time showing that light travels through a vacuum). Use of a C.R.O. and microphone gives a visual picture of amplitude and frequency. Extension candidates can analyse the C.R.O. traces in more detail.	This site contains much interesting work on resonance including an opera singer breaking a glass and video of the Tacoma Narrows Bridge disaster. http://www.enm.bris.ac.uk/research/nonlinear/tacoma/tacoma.html - mpeg This site about sound waves is informative and includes audio! http://library.thinkquest.org/11924/index.html
	Describe compression and rarefaction. State the order of magnitude of the speed of sound in air, liquids and solids.	A large-scale, outdoor echo method to determine the speed of sound in air can be used.	