Topic: Waves: Sound and Ultrasound

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Issues tackled:

1. **Key ideas, use of language and terminology – Diffraction and refraction.**
2. **Practical work – Using a cathode ray oscilloscope.**
3. **Applications, relevance and cross-curricular issues – Ultrasound.**

Issue 1: Key ideas, use of language and terminology – Diffraction and refraction.

Trainees have already covered on their PGCE course:

Tasks for trainees:

Preparation for tutorial:
1. Prepare a starter activity to demonstrate the diffraction of sound or light waves.
2. Prepare an analogy / explanation of refraction.

Possible activities during tutorial:
1. Present the starter activity to show the diffraction of sound and light waves. Discuss the strengths and pitfalls of the starter.
2. Present the analogy and discuss it. Test it by explaining various refraction scenarios.

Mentor Input:

- Go through diffraction with the trainee. Make sure they understand the link between the wavelength and gap size to produce large diffraction effects.
- Show diffraction effects with a LASER (may have been done as task1).
- Go through the health and safety of using a LASER, pupils sat behind laser, use of key, risk of laser swivelling. Trainees to look at CLEAPSS folder.
- Discuss the diffraction of radio waves by a hill or buildings and the dependence on wavelength.

Reading:

Subject knowledge and understanding

Subject pedagogy

Johnson.K., (1996), **Physics for You**, Stanley Thornes, Cheltenham. Pages186-187. Gives an explanation and analogy for refraction.

Useful websites and applications

http://www.gmi.edu/~drussell/Demos/refract/refract.html discusses refraction of sound waves.

http://www.isvr.soton.ac.uk/SPCG/Tutorial/Tutorial/Tutorial_files/Web-inter-refrac.htm has notes and animations about refraction.

Resources:

Task 1
Apparatus for demonstration, this may involve one or two loudspeakers, signal generator and baffle or a laser with slits.

Tutorial
LASER and slides of slits, for example the SEP LASER and single slit for diffraction demo, see information at www.sep.org.uk/
CLEAPSS folder (section on LASERs).

Issue 2: Practical work – Using a cathode ray oscilloscope

Trainees have already covered on their PGCE course:

Tasks for trainees:

Preparation for tutorial:
(For both tasks use the reference materials and produce a script.)
1. Devise a demonstration using a cathode ray oscilloscope (CRO) to show the relationships between amplitude and loudness, frequency and pitch.
2. Devise an activity to show the difference between longitudinal and transverse progressive waves.

Possible activities during tutorial:
1. and 2. Demonstrate the activities as planned. Discuss the use of the equipment and the language.

Mentor Input:

- Talk about the typical problems and solutions of using a CRO and Signal generator;
  - No Trace – using horizontal and vertical position.
  - No wave on trace.
  - Whole wave not displayed.
  - Wave moving.
  - Settings on signal generator.
  - Use of a microphone.
- Give examples of tricks and experiments to perform with a slinky.
- Discuss health and safety, for example issues of low frequencies and epilepsy.
- Discuss encouraging pupil participation in demonstrations.
- If possible show alternatives to a traditional oscilloscope e.g. Picoscope.

Reading:

Subject knowledge and understanding

Johnson. K., (1996), **Physics for you,** Nelson Thornes, Cheltenham. Pages 222-232.

Abbot. A.F., (1979), **Ordinary Level Physic,** Heinemann, London.

Johnston, B., (1986), **Physics for GCSE**, Heinemann, London. Pages 153-154.

Subject pedagogy

Useful websites and applications

http://www.picotech.com/picoscope-oscilloscope-software.html. This page will enable a demonstration version to be down loaded if the school doesn't have a picoscope.

Resources:

Task 1
CRO, signal generator and connecting lead.

Task 2
At trainee's selection, but may involve a rope and a slinky spring.

Tutorial
CRO, signal generator, microphone, slinky, computer oscilloscope (if available).

Issue 3: Applications, relevance and cross-curricular issues – Ultrasound

Trainees have already covered on their PGCE course:

Tasks for trainees:

Preparation for tutorial:

1. Prepare a PowerPoint presentation on the variety of uses of ultrasound (to suit school specification content).
2. Find out about careers in radiography and other medical applications of physics.
3. Plan an activity to show a class that ultrasound exists even though it cannot be heard?

Possible activities during tutorial:

1. Give the presentation. Discuss any further uses of ultrasound perhaps not mentioned on the specification and the relevance to pupils of the various uses. Uses could include pre-natal scanning, cleaning delicate instruments or jewellery, testing of solid materials for cracks, heart monitoring (echocardiogram), use in animal communication and echo location.
2. Discuss careers in ultrasound and broaden the discussion to radiography and medical physics.
3. Demonstrate the activity to show the ultrasound exists and discuss the importance of illustrating this point to pupils.

Mentor Input:

- Show that a microphone will pick up near ultrasound when placed next to a speaker (if speaker will produce high frequencies).
- Discuss how one example of ultrasound use works in detail.

Reading:

Subject knowledge and understanding

Johnson, K., (1996), **Physics for You,** Stanley Thornes, Cheltenham. Pages 234-235.

Johnson, Adamson and Williams, (1995), **Spotlight Science 9**, Stanley Thornes, Cheltenham. Pages 68-69.

Jones, Jones and Marchington, (1993), **Coordinated Science; Physics**, Cambridge University Press, Cambridge. Pages 114-115.

Subject pedagogy

Useful websites and applications

Plenty of ultrasound images can be found by searching the Internet.

A teacher resource of higher ability reading; http://health.howstuffworks.com/ultrasound.htm

Middle and lower group reading/research on uses; http://www.gcse.com/waves/ultrasound.htm

Royal society of radiographers careers web site. A great resource for careers advisors and teachers; http://www.radiographycareers.co.uk/

Resources:

Tasks 1, **2** and **3**.
Enter “ultrasound” in Google search engine, then click on “Images” on the tabs. A selection of images called “ultrasound” will be displayed. (This works for any topic.)