Topic: Waves: Electromagnetic Spectrum

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Issues tackled:

1. **Key ideas, use of language and terminology – Wave characteristics and equation.**
2. **Differentiation and SEN – The electromagnetic spectrum.**
3. **Applications, relevance and cross-curricular issues/Ideas and evidence – The safety of mobile phones.**

Issue 1: Key ideas, use of language and terminology – Wave characteristics and equation.

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Learn the wave equation and how to manipulate it ($v = f \times \lambda$).
2. Find a useful website which shows wave characteristics.
3. Put together a PowerPoint presentation to show the relationship between frequency and wavelength.

Possible activities during tutorial:

1. Using the wave equation, demonstrate the solutions to some problems.
2. Present the website found and discuss its use/relevance in a lesson.
3. Give the presentation showing how it could be used in a lesson to reinforce the relationship between the frequency and wavelength of an electromagnetic wave.

AST Input:

- Advise on the possible difficulties and strategies with the wave equation. For example;
  - standard form
  - algebraic manipulation
  - use of symbols.

Reading:

Subject knowledge and understanding

Avison.J (2004), **The World of Physics** (Second Edition), Nelson Thornes, Cheltenham.

Muncaster.R., (1993), **A-Level Physic,** Nelson Thornes, Cheltenham.

Johnson,K., (2001), **Physics for You**, Nelson Thornes, Cheltenham. Chapter 8.

Subject pedagogy

http://imagine.gsfc.nasa.gov/docs/teachers/lessons/roygbiv/roygbiv.html

Useful websites and applications

http://www.hazelwood.k12.mo.us/~grichert/sciweb/applets.html

Resources:

Task 2
Computer with access to the Internet.

Task 3
Computer with PowerPoint software.
Digital projector if possible.

Tutorial
Calculator (scientific).
Suitable problems/exam questions on the wave equation and wave characteristics.

Issue 2: Differentiation and SEN – The electromagnetic spectrum.

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:
1. Find an interactive electromagnetic spectrum from the internet.
2. Make some sort of display to show the order of the spectrum.
3. Invent a card matching / sorting exercise to show the order of the spectrum.
4. Make up ways to learn the spectrum.

Possible activities during tutorial:
1. 2. 3. and 4. Present the resource prepared. Explain its significance for the lesson and the time it will take.

AST Input:

- From the activities decide with the trainees the amount of information which would be needed by lower, middle and higher ability pupils. For example less able pupils may only need to know the order, middle may need to know that frequency increases as you move from radio to gamma rays, etc..
- Discuss the continuous nature of the spectrum and the differences between the different radiations.
- Ready for the issue 3 please point out that in some documents mobile phones use radio waves while others say microwaves.

Reading:

Subject knowledge and understanding

Breithaupt.J (2001), **Key Science: Physics**, Nelson Thornes, Cheltenham, pages 197 – 202.

Subject pedagogy

Nuffield Co-ordinated Sciences: Physics, Worksheet Activity P15E.

Useful websites and applications

http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html
http://hyperphysics.phy-astr.gsu.edu/hbase/ems1.html

Resources:

Issue 3: Applications, relevance and cross-curricular issues/Ideas and evidence – The safety of mobile phones.

Prior knowledge and experience:

Possible tasks:

Preparation for tutorial:

1. Collect together images and information to make (or add to) a display about the uses of the electromagnetic spectrum.
2. Research the health and safety issues relating to mobile phones, by looking at information from department of health and other sources.

Possible activities during tutorial:

1. Show the display collated and discuss how the various sections of the spectrum impact on pupils' lives.
2. Present information and personal opinions on the safety of mobile phones.

AST Input:

- Lead a card sorting exercise about mobile phones using the attached resource sheet. The cards should be sorted according to whether they are for allowing everyone to have mobile phones, wherever and whenever they want or restricting mobile phones to a limited number of people and situations.
- Discuss how to organize a debate in a lesson on mobile phones and their possible effect on the body.
- Inform the trainees that in reality there is very little hard evidence but there is enough concern nationally to recommend further research. Stress the difference between evidence and hear say.
- Use the SEP microwave indicator to measure the output of a mobile phone.

Reading:

Subject knowledge and understanding

The Department of Health web site is at www.doh.gov.uk search for mobile phones and pay particular attention to the findings of the Stewart report.

The full text of the Stewart report can be found at http://www.iegmp.org.uk/report/text.htm

Subject pedagogy

There is a very useful lesson plan about the safety of mobile phones in the Pupil Researcher Initiative Ideas and Evidence CD Rom available from Collins. It can also be downloaded from http://extra.shu.ac.uk/rinr/ click on the link to the PRI archive, and download the file about mobile phones.

Useful websites and applications

Resources:

Task 1 and **2**
Access to the Internet and a printer.
Tutorial
SEP microwave indicator http://www.sep.org.uk/

Mobile phone card sort, photocopiable sheet attached
Mobile phone activity sheets (these may be printed off from the CD ROM or website listed under subject pedagogy).

Mobile phones emit microwaves.	Radio waves and microwaves have been used safely for over 100 years.
Microwaves emitted above a certain level can cause heating of the body.	Transmitters should not be placed near schools.
People living close to base stations are exposed to whole body radiation.	A cover is recommended on transmitters.
There are exclusion zones around antennae.	Independent experts commissioned by the government have recommended that you keep your calls short
Some people may be more sensitive to microwaves, this may be age linked.	Mobile phones only affect parts of the body near the phone.
Changes in brain activity can occur when exposed to radiation lower than the national guidelines.	Telecommunication workers can be exposed to 5 times more radiation than allowed by members of the public.