# Energy Transfer - Waves and Particles

DURATION: (6 weeks)

## Rationale

“Why are we learning this?”
* “So that you can change the world.”
* Paulo Freire indicated that education is largely about putting names and labels on the world. Names and labels give us handles on the world. By these handles, we can ‘steer’ the world, take mastery over it, and change it.
* We deliver a wide curriculum in order to prepare students for problem-solving and mastery over the world. Different disciplines give students practice in solving different types of problems, in thinking in different modes.

*Through an understanding of waves and light students are challenged with the question marks surrounding the basic building blocks of the universe. WE DON’T KNOW.*

## The One Idea!

*Energy* follows rules and has quirks. The history and future of technology is largely about making machines that exploit the rules and quirks of *energy* so humans can be lazy, get out of yucky jobs and play badminton instead. Some machines even play badminton *for* us.

### Expand it

The universe is partly made of ‘not-stuff’.
It has no mass.
We can’t create it or destroy it. It’s just there.
We can’t observe it, but we can see how it changes the shape of ‘stuff’.
It follows its own rules and is highly predictable.
We can trap it and move it.
It takes on many different ‘forms’.
We call it “*energy*”

The wave model (e.g. ‘humps in a hose’) and the particle model (e.g. ‘super-balls in a bathroom’) are attempts to explain how energy is moved from one location to another.

**Description**

Students develop their understanding of... how systems at a range of scales are shaped by flows of energy and matter... and... begin to develop a more sophisticated view of energy transfer.

**Science Understanding**

Energy transfer through different mediums can be explained using wave and particle models

28. exploring how and why the movement of energy varies according to the medium through which it is transferred

29. discussing the wave and particle models and how they are useful for understanding aspects of phenomena

30. investigating the transfer of heat in terms of convection, conduction and radiation, and identifying situations in which each occurs

31. understanding the processes underlying convection and conduction in terms of the particle model

33. exploring the properties of waves, and situations where energy is transferred in the form of waves, such as sound and light

**Science as Human Endeavour**

Advances in scientific understanding often rely on developments in technology and technological advances are often linked to scientific discoveries

39. considering how common properties of electromagnetic radiation relate to its uses, such as radar, medicine, mobile phone communications and microwave cooking

Advances in science and emerging sciences and technologies can significantly affect people’s lives, including generating new career opportunities

46. investigating how technologies using electromagnetic radiation are used in medicine, such as in the detection and treatment of cancer.

48. considering the impact of technological advances developed in Australia, such as the cochlear implant and bionic eye.

49. considering how communication methods are influenced by new mobile technologies that rely on electromagnetic radiation

The values and needs of contemporary society can influence the focus of scientific research

51. considering how technologies have been developed to meet the increasing needs for mobile communication

55. considering safe sound levels for humans and implications in the workplace and leisure activities.

**Science Inquiry Skills**

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data

Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

**Achievement Standard (Students will be able to...)**

describe models of energy transfer and apply these to explain phenomena.

describe social and technological factors that have influenced scientific developments and predict how future applications of science and technology may affect people’s lives.

**Cross Curriculum Priorities**

**Aboriginal and Torres Strait Islander histories and culture.**
??

**Asia, and Australia's engagement with Asia.**
Communication and Technology in Japan, for example.
Telephony - Make a telephone call to a school in Japan?
Use Google Translate to talk with them.

**Sustainability**
Energy drain, carbon footprint?

**Seventh-day Adventist Special Character**

The early Scientists were Christian, trying to understand how the created world worked, and therefore understand God.

"Creation subject to frustration" - Romans 8:20.

**Interpersonal Skills**

Not this unit! (Sorry)

## Assessment

A. 5 question spot Tests OR draw me a poster/diagram (with notes)
- Particle Model and Heat
- Wave Model.
- Harnessing Light Waves.

B. Infographic and Verbal Presentation. (Choose ONE)
- a) Strange Life and Inventions of Alexander Graham Bell
- b) Bionic Eye/Cochlear Implants and its inventors.
- c) Science of long distance military communication before radio.
- d) Whale/dolphin sonar.

## Notice of Assessment

Create an Infographic, uploaded to http://www.hendersonscience.wordpress.com or an infographic style poster that explores one of the following topics in terms of *energy transfer* and/or *information transfer*.

a) Life and Inventions of Alexander Graham Bell
b) Bionic Eye/Cochlear Implants and their inventors.
c) Science of long distance military communication before radio.
d) Whale/dolphin sonar.

| Descriptors | Points |
|---|---|
| Mastery<br>* Demonstrates mastery of energy/information transfer (e.g. wave/particle theory)<br>* Demonstrates extensive research and internalisation of ideas by presenting in student's own words and style.<br>* Demonstrates an intuitive understanding of the relationship between science and society.<br>* Infographic represents information clearly, quickly, stylistically themed, and "with synergy" - i.e. the spatial arrangement and choice of graphics and text work together to add more meaning.<br>* The verbal presentation is engaging, concise and memorable. | 18-20 |
| Solid<br>* Demonstrates a solid understanding of energy/information transfer (e.g. wave/particle theory), but there a few innacuracies and hesitations in terminology and explanation.<br>* Demonstrates solid research and some internalisation of ideas by presenting using some of your own words and style.<br>* Demonstrates a firm understanding of the relationship between science and society.<br>* Infographic represents information clearly, quickly, and with a stylistic theme.<br>* The verbal presentation is interesting and concise. | 14-17 |
| General<br>* Demonstrates an understanding of energy/information transfer (e.g. wave/particle theory) but it is marked with generalisation and underdevelopment.<br>* Demonstrates generic research methods (e.g. do searches and paraphrase) but no demonstration of internalisation of ideas.<br>* Demonstrates an understanding of the relationship between science and society.<br>* Infographic represents information neatly, but without theme or 'synergy'.<br>* The verbal presentation is "from K-mart." Factual, but not really interesting. | 10-13 |
| Token<br>* Use of key vocab and generalisations, with little understanding of *extended meaning* demonstrated.<br>* Demonstrates token research (e.g. do *one* search, and paraphrase or copy) and no demonstration of internalisation of ideas.<br>* Refers to the relationship between science and society.<br>* Infographic represents information but is the bare minumum.<br>* Makes a verbal presentation on the topic. | 6-9 |
| Fragmented<br>* Scientific understanding is partial and fragmented, with key vocab words identified, but not explained.<br>* No self-directed research demonstrated.<br>* Refers vaguely to society.<br>* Infographic attempted.<br>* Makes a verbal presentation. | 0-5 |

What do you think was the *key* Scientific discovery that made these advances possible.

**Unit Content**

| **Date** | **Assessment** | **Description** |
|---|---|---|
| Mon 13 August | Preassessment | Lecturette - Energy Transfer... Huh? |
| Mon | | Lecture - Waves 1 |
| Thur | | Lecture - Waves 2 |
| Fri | | Student Response |
| | | |
| Mon 20 Aug | Test/Poster 1 | Lecture - Particles 1 |
| Thur | | Lecture - Particles 2 |
| Thu | | Student Response |
| | | |
| Mon 27 Aug | Test/Poster 2 | Lecturette - Yr 12 Stuff. |
| Mon | | Lecture - Harnessing Radiation - Medicine |
| Thurs | | Lecture - Harnessing Radiation -Commun |
| Fri | | Student Response |
| | | |
| Mon 3 Sept | Test/Poster 3 | Lecturette - Dangers of |
| Thurs | | Lecture - Alexander G. Bell |
| Thur | | Lecture - Tessler |
| | | |
| ***Mon 10 Sept*** | ***Excursion*** | |
| ***Mon*** | ***Excursion*** | |
| Thurs | | Work on Project |
| Fri | | Work on Project |
| | | |
| Mon 17 Sept | | Work on Project |
| Thurs | Presentations | |
| Thurs | Presentations | |

Mr Kingston's Fragmented Notes

OVERVIEW
- Energy flow, energy transfer.
- Encoding information on energy.

THEORY
- 28. Movement of Energy through mediums
  - Speed of light
  - Speed of sound
  - Speed of wave on the ocean
  - e.g. Seismic waves
- 29. Wave and particle model - use of.
- 30. heat - convection, conduction, radiation.
- 31. Particle model of convection, conduction, radiation.
- 33. Exploring properties of waves.
  - http://en.wikipedia.org/wiki/Wave is great.

HARNESSING LIGHT WAVES

A. Communication
- 39. Electromagnetic radiation re communication etc.
- 49. Communication re electromagnetic radiation
- 51. Technologies to meet needs for mobile communication

B. MEDICINE
- 46. Electromagnetic radiation re medicine
- 48. Cochlear and Bionic eye

C. DANGERS OF...
- 55. Safe sound levels
- 5. electromagnetic radiation on humans

STRANDS

**Science Understanding** through Key Vocab.
wave, particle, frequency, wavelength, convection, conduction, radiation, electromagnetic spectrum, heat, speed of light, speed of sound, ether, space-time, reflection, refraction, total internal reflection, normal, critical angle, decibels, Marconi.

**Science as Human Endeavour**
- Brief history of development of wave theory, touching on key advances.
- EM Spectrum: Microscope, telescope, wireless, radio (marconi), TV.
- Alexander G. Bell -
- Tessler's crazy experiments.
- Internet

**Inquiry Skills**
Covered in Project.