

What is Light?

Light is a form of energy called *electromagnetic radiation*. Electromagnetic radiation occurs as waves and includes visible light, invisible light (such as infrared and ultraviolet), X-rays, microwaves and radio waves.

The components of visible light can be memorised by using the mnemonic ROYGBIV: an abbreviation of red, orange, yellow, green, blue, indigo and violet. ROYGBIV also helps you to remember the wavelength of the different colours. Red has the longest wavelength and these decrease in order through to violet which has the smallest wavelength. Infrared occurs 'before' red light and ultraviolet occurs 'beyond' violet light.

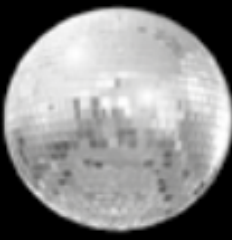

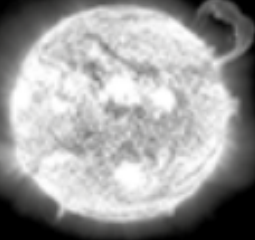


Light has properties that are responsible for the phenomena that will be studied in this course. These properties are:

- Light travels in straight lines.
- Light travels at $300\,000\,000\text{ m s}^{-1}$ ($3 \times 10^8\text{ m s}^{-1}$) in a vacuum.
- Light can travel through a vacuum (empty space).

Sources of Light

Light is a wave that is emitted by from a light source. There are many different light sources. Anything that is hot enough will start to glow and emit light.

1. Identify whether the following objects are light sources. Tick the box (below the pictures) if you believe it is a source of light.

A mirror ball	The Moon	The Sun	A match	A phone
				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Light is Energy

Light is a type of energy. Light sources change some other type of energy into light energy. Stars (like our Sun) change nuclear energy into heat and light. Light bulbs change electrical energy into heat and light. A fire changes chemical potential energy into heat and light.

1. Complete the following energy change diagrams.



Stars

_____ energy \longrightarrow _____ energy + _____ energy



Light bulb

_____ energy \longrightarrow _____ energy + _____ energy



Fire

_____ energy \longrightarrow _____ energy + _____ energy

Speed of Light

Light travels at approximately $300\,000\,000\text{ m s}^{-1}$ (metres per second) or $300\,000\text{ km s}^{-1}$ (kilometres per second). This speed is almost unimaginable to us. To give you an idea of how fast this is, if you were travelling by road at the speed of light it would take 0.0067 seconds to get from Cape Reinga (the top of the North Island) to Bluff (the bottom of the South Island). Or to put it more simply, you could drive the entire length of New Zealand 150 times in one second!

1. Use the formula below to calculate how long it would take to travel between the following places if you were travelling at the speed of light.

$$\text{Time taken (s)} = \frac{\text{Distance (km)}}{\text{Speed of light (km s}^{-1}\text{)}}$$

- (a) Auckland to London. Distance = 18 300 km Time = _____
- (b) Earth to the Moon. Distance = 390 000 km Time = _____
- (c) Earth to Mars. Distance = 80 000 000 km Time = _____
2. The average distance between the Earth and the Sun is 150 000 000 km. Calculate how long it would take light given off by the Sun to reach Earth. Express your answer in minutes. Show the formula you are using and all working.
- (a) Formula: _____
- (b) Working: _____
- (c) Answer: _____ seconds Answer: _____ minutes

Optical Science - The Study of Light

Optical science (optics) is a branch of physics that deals with light. Optics is the science of light and how it interacts with the world around us. Optics explains how rainbows form, how light reflects off of mirrors, or refracts through a glass of water, and why light waves separate when travelling through prisms.

Optics is both a science and an area of engineering. It has been used to make many useful things, including eyeglasses, cameras, telescopes and microscopes. Many of these things are based on lenses, that focus light waves and can make images of things that are bigger or smaller than the original.

While optics is an old science, new things are still being discovered by it. Scientists have learned how to make light travel through a thin optical fibre made of glass or plastic. Light can go long distances in these fibres and can be used to carry phone calls and the internet.

1. After reading the text, answer the following questions.
- (a) Define optical science. _____
- (b) State three everyday phenomena optical science can explain:
- (i) _____
- (ii) _____
- (iii) _____
- (c) Optical science can be applied to make instruments that help us see very small objects, or objects that are very far away. List three examples of such instruments:
- (i) _____
- (ii) _____
- (iii) _____