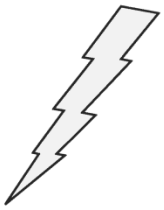
Grade 8 Science Chapter 4 Notes

The History of Light

Pythagoras was a Greek philosopher (~580 B.C.) who believed beams of light were made of tiny particles and the eyes detected these particles and allowed us to see.

There was a lot of research done on the properties of light over the centuries in order to figure out a way to improve vision with lenses (early eye glasses) and eventually with telescopes.

Albert Michelson was the first person to accurately measure the speed of light. Using a strong light source, a rotating mirror and another large mirror, and several years of measuring, he calculated it to be 299 796 km/s.



Speed of Light vs. Sound

Speed of Sound = 1235 km/h

Speed of Light = 1 000 000 000 km/h (1 billion km/h)

This explains why we see lightning before we hear the thunder even though the roar of the thunder is in fact caused by the lightning. They both happen at the same time, but the light takes far less time to travel to your eyes than the sound of thunder takes to travel to your ears.

Light is incredibly fast, BUT it does take time to travel, so when we look at the vast distances in space, the light from a faraway star might take hundreds of years to reach us. This means a star in our night sky might even have burned out long ago, but we don't know it yet, because the light is still travelling to us from when the star was lit!

Light Technology Examples – using mirrors and lenses we are able to manipulate light to do many things...

- Microscope – magnify small organisms
- Telescope – magnify space objects
- Periscope – uses mirrors to allow a submariner to see above the ocean surface
- Binoculars – magnifies a faraway object
- Fibre optics – allows data to travel as light through wire
- Camera – allows an image to be captured in a single picture
- Prescription contact lenses – changes where an image is focused in the eye so it's clear
- Lasers – a device that generates an intense beam of one colour of light
- Movie projectors – projects frames from a moving reel of film to create moving pictures
- Overhead projectors – a device that enlarges a transparency image onto a wall using a mirror

Light

Light is a form of energy that can be detected by the human eye. Visible light is a mixture of all of the colours of the rainbow. The properties of light include:

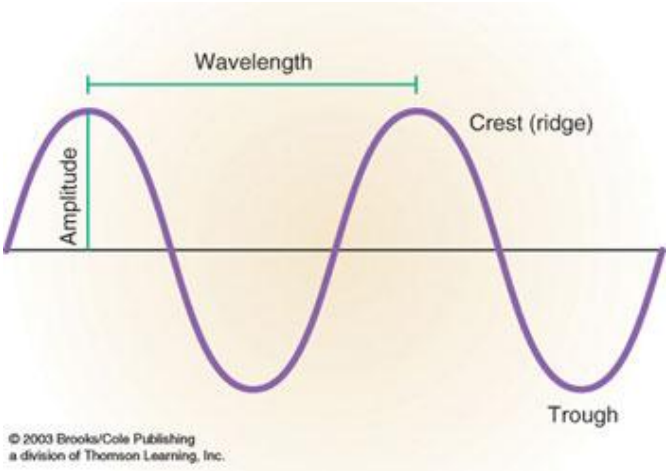
- Rectilinear propagation – light travels in a straight line (creating shadows if it is blocked by an object)
- Light reflects (from a mirror creating a reflection, and from all other objects too causing us to see them as a particular colour)
- Light refracts or bends when it travels from one material to another because it changes speed slightly (making objects appear bent too)
- Light disperses into all the colours that make up WHITE light (red, orange, yellow, green, blue, indigo and violet) when it passes through a prism because each colour is a different wavelength and is bent a different amount
- Light travels through a vacuum (that is, light does NOT require particles of matter to travel) which is why we see light from faraway stars even through empty space
- Light travels through objects to different degrees (e.g. a window pane vs a frosted window pane vs a wooden door)

The Wave Model of Light

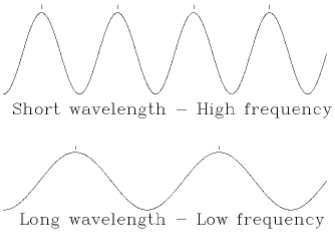
This model explains that light is a type of wave that travels through empty space and transfers energy from one place to another.

Features of a wave:

Amplitude – height of a wave from the "normal" to the top of a crest (the larger the amplitude, the greater the energy)



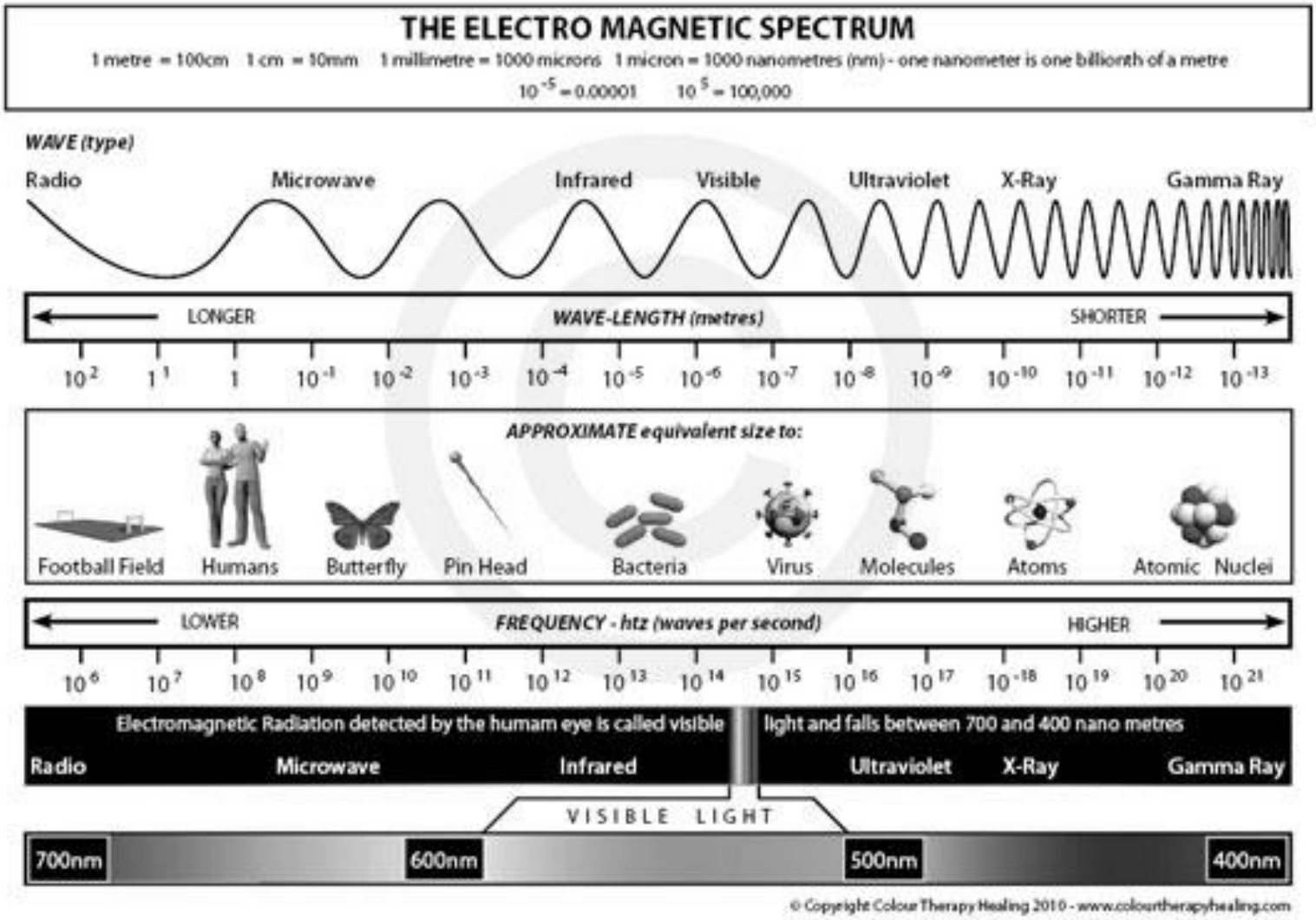
Wavelength – length of a wave from crest to crest OR trough to trough OR one complete crest plus one complete trough and are measured in metres (longer wavelengths refract the least)



Frequency is the number of repetitions that pass a point in 1 second. It is measured in hertz (Hz). High frequency waves have short wavelengths and low frequency waves have long wavelengths

Electromagnetic Radiation

Electromagnetic radiation includes the transmission of energy in the form of waves that extend from the longest radio waves to the shortest gamma rays:



Type of Electromagnetic Radiation	Facts and Examples
1. Radio Waves	• The longest wavelength and lowest energy and frequency • Can be used to help us see the inside of our bodies and diagnose illness and injury (e.g. MRI) • We are not yet certain about the effect of long-term exposure to radio waves
2. Microwaves	• Have the shortest frequency and highest energy of all RADIO waves • Food cooks in a microwave because microwaves cause water molecules in the food to vibrate, gain energy and heat up • Also used in radio telescopes, telecommunications and radar

Type of Electromagnetic Radiation	Facts and Examples
3. Infrared	• Longer wavelength and lower energy and frequency than visible light (infrared means *below* red) • Used in remote controls, heat lamps, motion sensors, thermal imaging
4. Visible Light	• Can be continually detected by our eyes • The complete spectrum of visible light can be seen due to dispersion through a prism. • The constituent colours of white light are red, orange yellow, green, blue, indigo, violet
5. Ultraviolet	• Very energetic – shorter wavelength and higher energy and frequency than visible light • Have the ability to kill bacteria in food, water and medical supplies • Produced by the sun • Necessary for our health and is used as therapy for jaundice in newborns, BUT too much exposure can cause skin cancer • Also used to detect fingerprints by CSI
6. X-Rays	• Even shorter wavelength and higher frequency than UV • Used to photograph teeth and bones and complete security screening of luggage at airports • Over exposure can lead to cancer (protection by lead aprons)
7. Gamma rays	• Highest energy and frequency and the shortest wavelength • Produced by the hottest regions of the universe and by nuclear reactions • Focused bursts of gamma radiation are used to kill cancer cells

Generally higher energy radiation is more harmful to humans. The Earth's atmosphere and magnetic field protect us from some of the more dangerous radiation present in space.

Terms:

- Amplitude
- Crest
- Trough
- Frequency
- Wave
- Wavelength
- Model
- Energy
- Rectilinear propagation
- Reflection
- Refraction
- Spectrum
- Visible light
- Electromagnetic radiation

Review Questions: pg 168 #1, 2, 4, 5, 9, 11, 14, 15, 17, 20, 21, 24