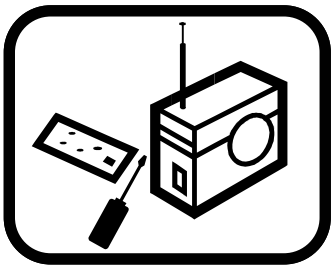
Science Revision Notes

Electromagnetic Spectrum

In order of **wavelengths** the electromagnetic spectrum from longest to shortest is: radio waves, microwaves, infra-red, light, ultraviolet, x-rays and gamma rays. All these waves travel at the **same speed,** equal to 300 million m/s. The number of waves passing a point each second is the **frequency.** The speed of a wave = wavelength x frequency. The wavelength of red light is 700nm, yellow about 500nm and violet 300nm. (nm stands for nanometre = a thousand millionth of a metre).

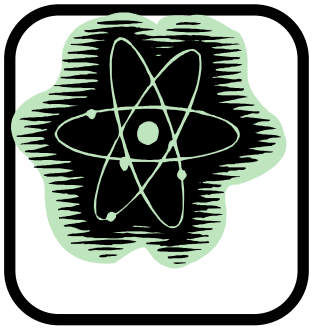


The **longest** radio waves can **bounce** off layers of the **atmosphere,** but shorter waves need to travel in **straight lines**. Electromagnetic radiation creates alternating current in an **aerial**.
Microwaves can travel from Earth to a satellite and are used for mobile telephone **communications.**
Toasters and ordinary light bulbs give out **infra-red** radiation. When electromagnetic radiation is absorbed, the energy makes the substance hotter. TV remote controls use infra-red waves. Infra-red rays and light rays can travel through **optical fibres**.

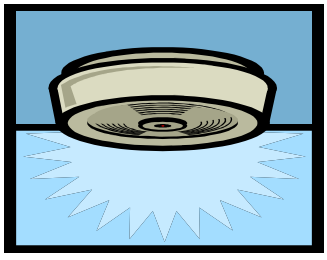
Analogue signals are continuously varying. **Digital** signals are a series of 'on's and 'off's. Noise occurs in digital signals and analogue signals, but it is easier to remove it from the digital.

Light is **absorbed** by metal objects but gamma rays can pass right through metals. The earth's **ozone** layer absorbs **ultra-violet** radiation. Ultra violet light damages the **skin and eyes**. Skiers have an increased risk of damage from the sun because the snow **reflects** the sun's rays. Cricketers protect their noses with cream that absorbs ultraviolet rays.
Shadow pictures of bones are produced by **x-rays**.
Gamma rays are used to sterilise surgical instruments.

Radioactivity



An atom contains **protons** and **neutrons** in the nucleus and **electrons,** in orbit around the nucleus. Protons have a **positive** charge, electrons, a **negative** charge and neutrons have a **no charge**. **Ionisation** is when an atom loses or gains an electron. An **isotope** of Americium would have a different number of neutrons from the normal atom.



Alpha radiation consists of a Helium nucleus and can travel no further than 10cm in air. Alpha radiation will not pass through paper, aluminium or lead. It is positively charged and can be deflected by a **magnetic field**. Alpha particles are very damaging to human cells if swallowed. Americium which emits alpha particles (that are very ionising) is used in household **smoke alarms**.

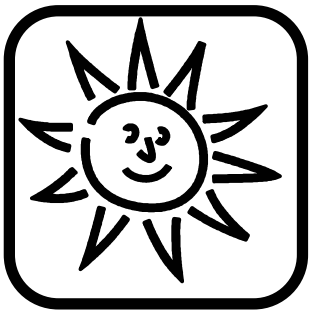
Beta radiation consists of a high speed **electron** and can be stopped by thin aluminium but not paper. Beta radiation is negatively charged and deflects in the **opposite** direction to alpha in a magnetic field. Beta can be used to control the **thickness** of sheets of paper, plastic or foil.

Gamma radiation is uncharged, so is **not deflected** by a magnetic field.

Radioactive **decay** is unaffected by pressure, temperature, or any other external condition. **Half life** is the time for ½ the atoms to decay and also the time for the radiation to reduce to ½ its original value. A gold brooch could not be dated using the **Carbon 14** method because it does not contain carbon and was never alive. Carbon 14 dating cannot be used to date things older than 45,000 years because the half life is 5,300 years and after 8 half lives the radioactivity too **small** to measure.

Radioactive **tracers** can be injected into a patient's body to detect blockages, cancers and other conditions. The best radioactive tracer for hospital patients is gamma with a short half life. **Health workers** monitor their exposure to radiation by wearing a photographic **film badge** and reduce their exposure to radiation by wearing a **lead lined** apron.

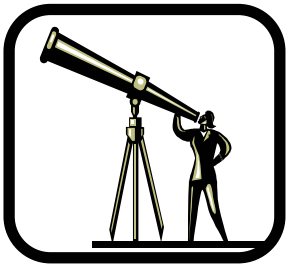
When assessing the effectiveness of a treatment, increasing the number of patients surveyed will make **data** more reliable.



The Universe

The **Sun** is the main source of energy for the Earth. It is the largest object in our solar system and is orbited by eight planets. The planets reflect light from the Sun. Ancient Greeks were able to observe **Venus** because it is close to the Sun and bright, and **Jupiter** because it is the largest planet, but were not able to observe **Uranus** because it is small and far away from the Sun. Our sun is one star in our **galaxy** called the Milky Way.

The Universe is thought to have been created in a massive explosion called **'big bang'** which happened thirteen billion years ago. Since then, astronomers believe the Universe has continued to **expand. Red-shift** in light from stars provides evidence for the 'big bang' theory. Light from a distant galaxy is shifted to the red end of the spectrum because it is **stretched** out by the galaxy moving **away** from us. The more **distant** the galaxy is, the larger the re-shift and the **faster** it is moving away.



You should never look at the sun through a telescope because it would damage your eye. Bigger **telescopes** collect more light and so they can see further into space. Telescopes can detect radio waves, microwaves and x-rays as well as visible light. The **Hubble** telescope is a satellite and gives better images than earth based ones because the light is not distorted by the atmosphere. **Observations** taken by satellites are sent back to Earth using microwaves.