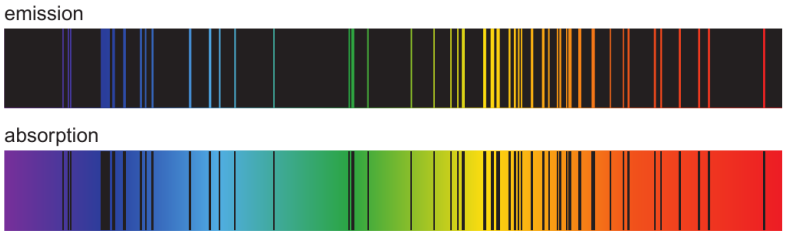
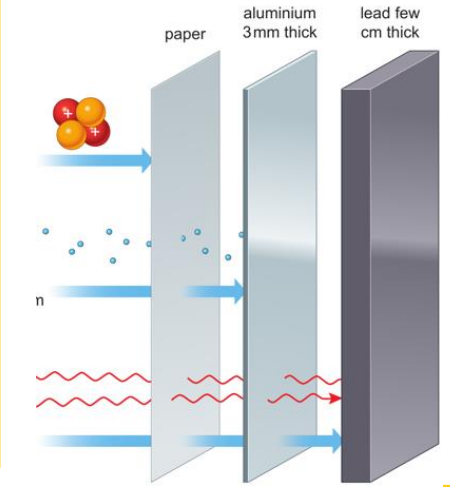
Knowledge Organiser: Physics, CP6a

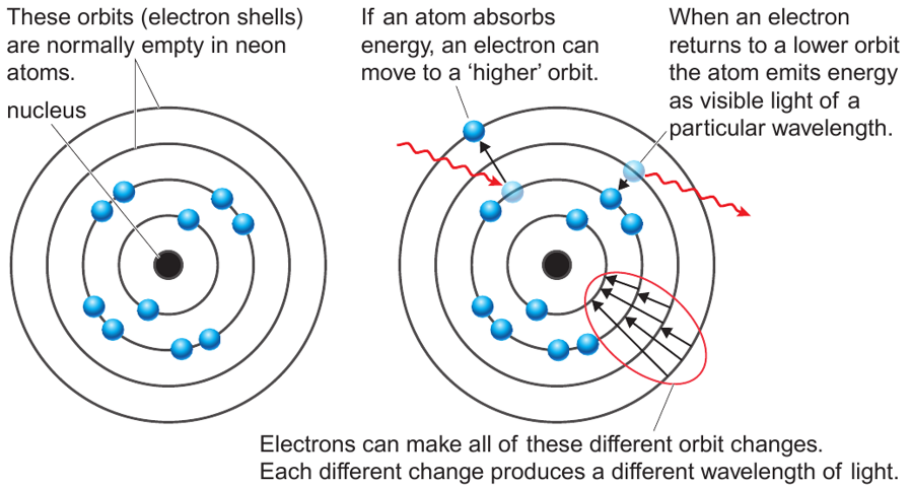
Jesus grew in wisdom and stature" Luke 2:52

1	The atoms are small. The radius of an atom 1 x10-10 m the nucleus is 100,000 times smaller with a radius about 1x10-15 m
2	The **nucleus** of atom contains the **nucleons—protons** and **neutrons**
3	**Rutherford's** fired alpha particles at **gold leaf** as most as went through and some deflected it proved that **nucleus** was positively charged and that atoms are mostly empty space.
4	**Isotopes** are atoms with the same proton number but different number of neutrons
5	Electrons can only exist at specific **energy levels** known as shells (**Bohr Model**)
6	Electrons can absorb and emit energy when they move between energy shells. This results in absorption and emission spectra. This can be used to identify elements in distant stars.
7	Too much energy given to atom can lead to the loss of electrons creating an **ion**. This process is called **ionisation.**
8	We are constantly exposed to a low levels of ionising radiation called **background radiation** . Sources can **natural** such as radioactive minerals in **rocks**, **food**, **cosmic rays** from the Sun to **man-made** e.g. **X rays**, **gamma scans** and past **nuclear weapon tests**.
9	Radioactivity can be measured by a **Geiger- Muller (GM)** tube Radiation passing through the tube **ionises** the gas inside giving a reading. The amount of radiation a person has been exposed to (**dose**) can be measured by a **dosimeter** which contains a photographic film that gets darker.
10	The types of radiation that can be emitted when a nucleus **decays** include **alpha** and **beta** particles, **positrons**, **gamma rays** and **neutrons**.

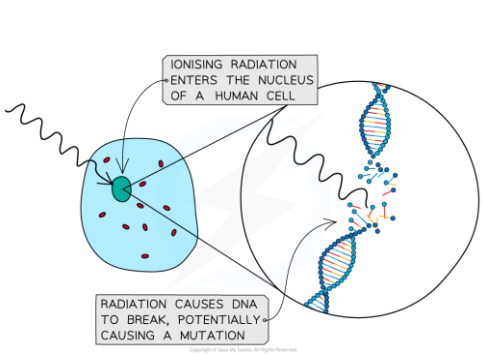


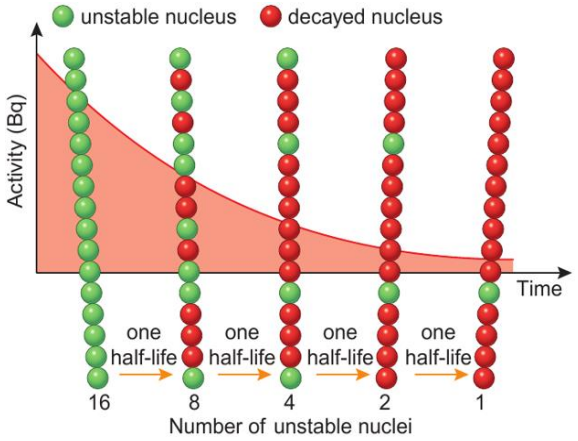
Particle	Symbol	
alpha	α	$^{4}_{2}He$
beta	β^-	$^{0}_{-1}e$
positron	β^+	$^{0}_{+1}e$
neutron		n





1	**Alpha** particles are like **helium nuclei** (relative mass 4, charge of 2+),they are **most ionising** but **least penetrating**. **Beta minus** particles are fast moving electrons are **moderately ionising** and have **medium penetration**. **Gamma rays** are electromagnetic waves-highly penetrating but low ionisation.
2	**Activity** is the number of nuclear **decays** per second and is measured in **Bequerels (Bq)**
3	**Half-life** is the time it takes for **half the unstable nuclei** in a sample to **decay.** Decay is a **random.** Half-life predicts the number of undecayed nuclei but not which nuclei. Elements with **long lives** are used to **date very old things e.g rocks** (U-235 ,700 million years). Where as those with a very short half-life (Tc-99M, 6 hrs) are used in medical scans.
4	**Radiocarbon dating** used to find the age of items once were alive e.g. skeletons
5	Isotopes are used In fire alarms, to determine the thickness of materials, tracers and to kill cancer cells. The role depends on the level of **penetration** and **ionisation** needed.
6	**PET** scanners make images from gamma rays produced when a positron and electron **annihilate** each other.
7	**Internal radiotherapy** has the RA source placed inside the body eternal radiotherapy has gamma rays, x rays or protons fired into the patient .
8	Radioactive materials can damage tissue and can cause **mutations** that can lead to **cancer.**
9	**Precautions** include using tongs, (**intensity** of radiation **decreases** with **distance**), handle for a short period of **time** (lessens exposure), store in a lead lined box. Wear gloves/ googles/ suit/ respirator to prevent contamination.





10	**Irradiation** is when we are exposed to a radioactive source this **stops when we move away. Contamination** is where radioactive substance **gets onto our skin or inside us.**
11	**Nuclear reactors** generate electricity by using the heat energy from the **fission** –splitting of large atoms (Uranium). Control rods are used determine rate of the chain reaction.
12	**Uranium** is a **non renewable** fuel and the **decommissioning** of reactor and management of **nuclear waste** are expensive. Energy produced is large with **no CO_2** when running.
13	**Chernobyl** and **Fukushima** are examples of nuclear accidents where radioactive materials have contaminated the environment for thousands of years due to long half lives.
14	**Nuclear fusion** is where smaller nuclei combine to form larger ones releasing energy. This happens in stars at **high temperature and pressure** Hydrogen is fused to form Helium.
15	Nuclear **fusion** occurs in **atomic (H) bombs**. **Fusion reactors** are being researched but they currently **use more energy** to create the conditions for fusion than is released.