WJEC (Eduqas) Physics GCSE

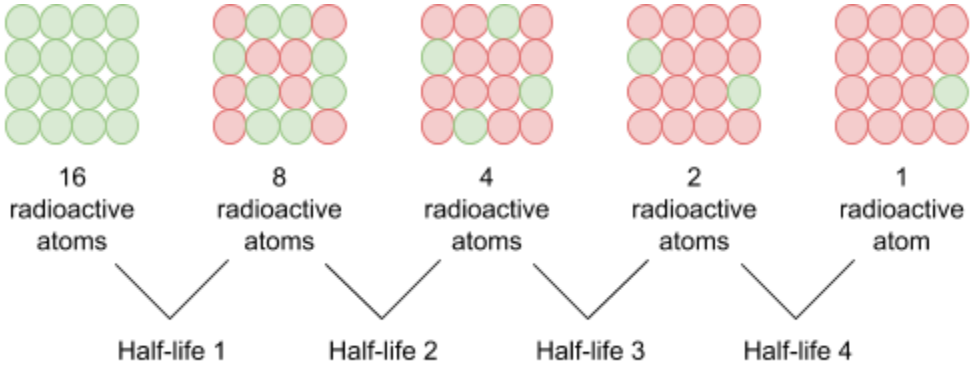
9.3: Hazards and Uses of Radioactive Emissions

Detailed Notes

(Content in **bold** is for higher tier **only**)

Half-life

Half-life of a radioactive element is the time it takes for the **number of nuclei to halve** or the time it takes for the **count-rate** of radioactive radiation to **halve**.



Half-life is **unique** to each radioactive element and can range from a few minutes to millions of years. It can be found experimentally but **many repeat readings** are required over a **long period** of time to calculate an accurate estimate.

Length of half-life can also help to explain some of the hazards associated with different radioactive materials. Those with a **short half-life** tend to be considered safer as the ionising radiation is present for a much **shorter length of time**, however materials with a short half-life tend to be much **stronger ionisers**. For example, **Technetium-99m** used as a medical tracer has a half-life of just **6 hours**. This means it remains detectable for a reasonable amount of time for surgery but won't remain dangerous for long periods of time afterwards.

Materials with a **longer half-life** can remain radioactive for thousands of years meaning they have to be contained very securely, however the overall ionising power tends to be less. For example nuclear waste from nuclear reactors and fuels has to be stored in **casks** in **underwater pools** for **over 20 years** before being buried deep within underground concrete bunkers. It can take **thousands of years** to decay to safer levels.

Common Radioactive Material Half-lives

Radioactive Isotope	Half-life
Uranium - 235	704 million years
Plutonium - 239	24,110 years
Carbon - 14	5,730 years
Technetium - 99m	6 hours
Polonium - 218	3 minutes

Background Radiation

There is radiation all around us from lots of different sources. These sources can be **natural** or **man-made**.

Natural Sources	Man-made Sources
Cosmic Rays *(radiation remaining from the Big Bang that reaches Earth from space)*	X-Rays *(radiation used to image inside the body and present high in the atmosphere when flying)*
Rocks *(certain rock types such as granite are radioactive and some even give off radon gas which is radioactive)*	Nuclear Power Stations *(these release radiation into the air and also produce highly radioactive nuclear waste)*
Living Things *(Plants absorb radiation from the ground which is then passed along the food chain)*	Nuclear Weapons *(man-made bombs and missiles containing radioactive material release radiation into the air upon impact)*

Natural sources, especially rocks and cosmic rays, are the **biggest contributors** to background radiation for the average person. **Man-made** sources account for **~15%** of the average person's background radiation but it is increasing as medical and power sources become more common. This is dangerous as there are links between **radiation exposure** and **cell mutation** diseases such as **cancer**.