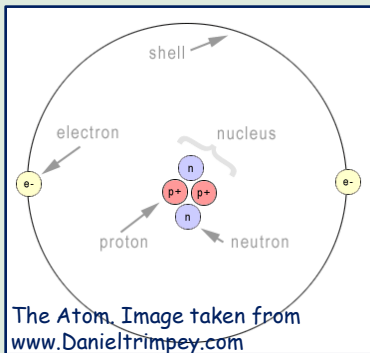


Radiation in the real world

Radiation can be used in many practical areas of science, namely in medical physics for the treatment of cancer.

How does radiation work?

Every substance in the universe can be broken down into its smallest unit, these units are called **atoms**. Atoms consist of several sub atomic particles. These are **electrons** (negative charge), **protons** (positive charge), and **neutrons** (no charge ie neutral).



The protons and neutrons make up the **nucleus** at the centre. The nucleus has a net positive charge. The electrons are contained within energy levels or shells around the nucleus and have a negative charge.

The total combined charge of an atom has to be neutral, therefore the number of protons and electrons will be the same. This doesn't however restrict the number of neutrons that can be present in an atom as they contribute no charge. If an atom of a certain element has a varying number of neutrons the atom is said to be an **isotope** of that element.

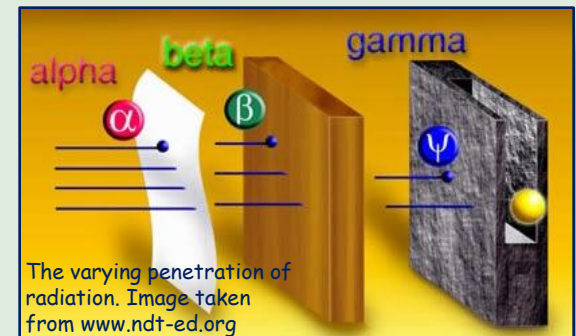
Every chemical element will have stable or unstable isotopes. As some are unstable they will undergo radioactive decay and emit either a subatomic particle or electromagnetic radiation.

What types of radiation are there?

An unstable atom will emit one of three types of radiation.

- **Alpha radiation**- An alpha particle consisting of two protons and two neutrons is emitted.
- **Beta radiation**- A high energy electron is emitted.
- **Gamma Radiation**- High frequency electromagnetic radiation is emitted.

When this radiation is emitted it will interact with obstacles in its path for example the air or body tissue.



These interactions could be either beneficial or detrimental. The varying degrees of penetration are shown in the diagram.

How can radiation be used in medical physics?

Due to the nature and long distance range of gamma radiation it can be used in radiotherapy techniques such as **Brachytherapy**.

Brachytherapy is a procedure used to treat cancer.

What is cancer?

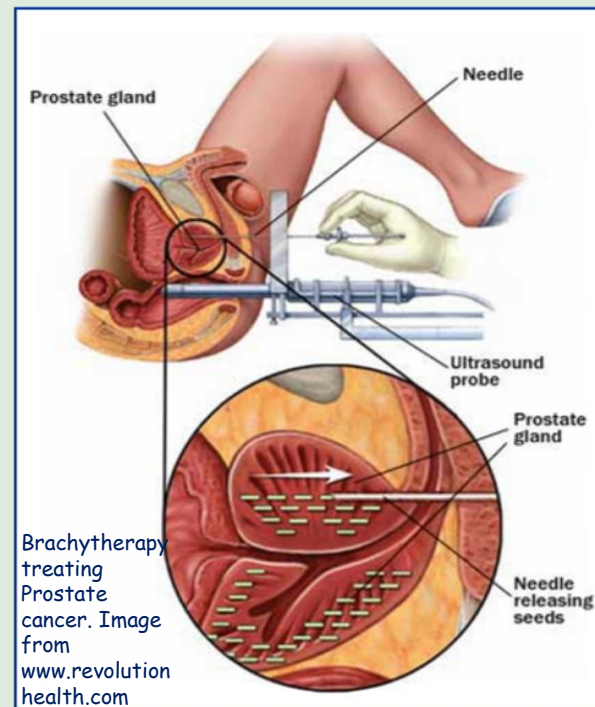
Cell's in the body are designed to grow, develop and divide naturally for healing and growth. The code that governs these processes is contained within the **DNA** of the cell housed in the nucleus. Many things can go wrong which interferes with these processes. When this happens the cells can become **cancerous** and often reproduce rapidly causing a **tumour** to form.

How can Radiation help?

Radiotherapy is the process of deliberately damaging cells in the body using radiation. The cells in the tumour are bombarded with radiation particles. These interfere and damage the DNA within the cancer cells that are causing them to reproduce rapidly.

This will either cause the cell to 'commit suicide' or produce free radicals which will in turn go on to damage more cells. This is the basis for using radioactive substances to treat cancer.

This can be done either by an external beam of radiation or by implanting radioactive substances either in or next to the tumour, this is Brachytherapy, where needles, wires and tubes are used to get the radiation dose as close to the tumour as possible.



Further reading

- To read more on how the atom works see *Clugston, M & Flemming, R. (2000) Advanced Chemistry*
- To read more on radiotherapy and its practices see *Bomford, C & Kunkler, I. (2003) Textbook of Radiotherapy: Radiation Physics, Therapy and Oncology.*
- For an advanced look into Brachytherapy see *Hoskin, P & Coyle, C. eds. (2005) Brachytherapy.*
- For an advanced look into General Physics see *Hackett, R & Hutchings, R. (2007) OCR AS Physics.*

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