



# Causes and Effects of Radiation



**Learning Goal: Students will be able to...**

- explain what holds a stable nucleus together;**
- explain why some isotopes are radioactive rather than stable;**
- describe some positive ways in which the effects of radiation are utilized.**

# What Holds a Nucleus Together? (Pt 1)

- From your previous studies, you should know that two charges that have the same sign tend to repel one another.
- So a logical question about a nucleus, which contains multiple positively-charged protons, is why the nucleus stays together. Shouldn't it fly apart?
- It turns out that the electric repulsion between the charges isn't the only force acting in a nucleus. Another important force called the Strong Nuclear Force also acts within a nucleus.

## What Holds a Nucleus Together? (Pt 2)

- **The Strong Nuclear Force is an attractive force that acts between all protons and neutrons, and is VERY powerful at small distances, like those within a nucleus.**
- **So in a stable nucleus, there is a balance between the repulsive electric force (between the protons) trying to make the nucleus fly apart, and the attractive Strong Nuclear Force (between protons and neutrons) that tries to pull the nucleus back together.**

# **Why are some isotopes radioactive rather than stable? (Pt 1)**

- When a nucleus has too many or too few neutrons compared to its protons, the two forces will be out of balance and the nucleus will be unstable.**
- These unstable nuclei eventually 'break apart' by radioactive decay. (So the whole nucleus doesn't break apart, it just emits some sort of radiation to turn the nucleus into a more stable nucleus.) We call these unstable types of isotopes "radioactive".**

## **Why are some isotopes radioactive rather than stable? (Pt 2)**

- For elements with a small number of protons (up to approx 30 or 40), stable nuclei tend to have approximately as many neutrons as protons.**
- For larger nuclei with more protons, stable nuclei tend to need more neutrons than protons to be stable.**
- There are no completely stable nuclei with more than 82 protons, because no amount of neutrons in these large nuclei can hold the nucleus together. So Lead-208 is the largest stable nucleus.**

## What are the positive ways that radiation is utilized?

- The word geothermal comes from the Greek words *geo* (earth) and *therme* (heat).
- So, geothermal energy is heat from within the Earth.
- We can recover this heat as steam or hot water and use it to heat buildings or generate electricity.
- Geothermal energy is a renewable energy source because the heat is continuously produced inside the Earth.

# What are the positive ways that radiation is utilized?

