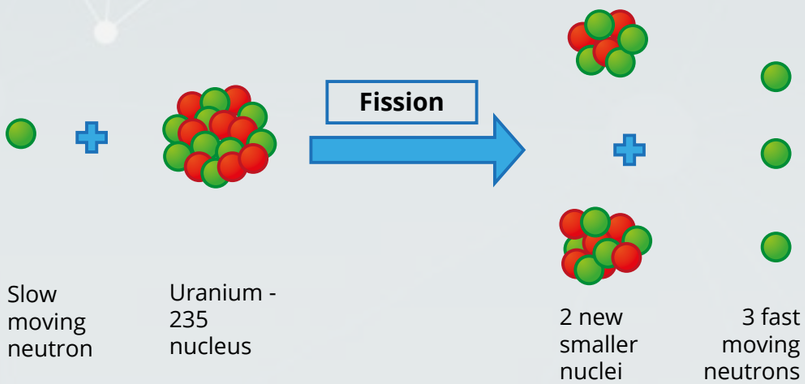
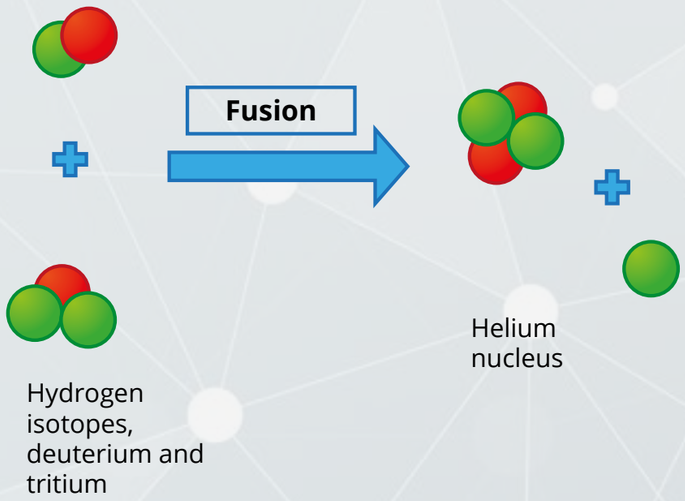
Fission

Fission reactions take place in nuclear reactors to produce energy.
In this reaction a slow-moving **neutron is absorbed** by a uranium-235 nucleus which then **splits into 2 smaller** nuclei and releases 2 or 3 fast moving neutrons.



Fusion

In a fusion reaction, **two small nuclei** are fused together to create **one larger** nucleus. This requires a lot of energy to start as you have to overcome the repulsion between the two positive nuclei.



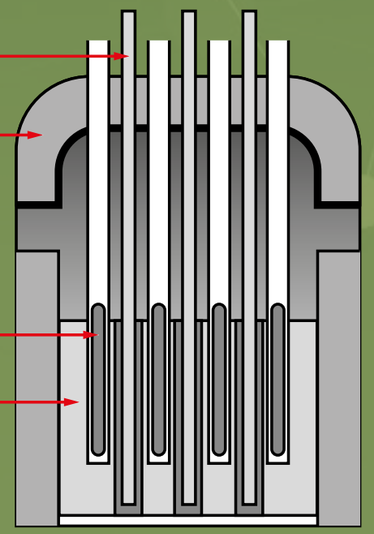
In a fission reaction **one neutron** starts the reaction and **2 or 3 more are released**. In a nuclear reactor these neutrons can go on to **cause another reaction**. If this proses in not controlled this **chain reaction** can become out of control and cause a meltdown.

Control rods: these can be raised or lowered into the reactor to absorb neutrons.

Concrete shield: ensures no radiation escapes.

Uranium fuel

Graphite moderator: this slows the neutrons so they can be absorbed by the uranium nuclei.



The **control rods** are key to ensuring the reaction does not go out of control, they **absorb 2 out of the 3 neutrons** released from each fission reaction and so will only allow **one neutron to cause a reaction**.
The **moderator slows** the neutrons released to ensure that they can be **absorbed by the uranium** nuclei to cause another reaction.

Nuclear **equations** showing fission or fusion follow the same rules as in unit 2.7. **The sum of the nucleon numbers and proton numbers must be equal before and after the reaction**.
Often the symbol for a neutron, ${}^{1}_{0}n$, is used in these equations.

Fission

One nucleus absorbs a neutron	Two new nuclei and three neutrons produced

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{142}_{56}Ba + ^{91}_{36}Kr + 3\,^{1}_{0}n$$

One neutron	**Three** neutrons

Fusion

$$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$$

Two nuclei react	One larger nucleus and a neutron produced

Comparison

Fission	Fusion
Technology already developed	Not possible in a sustainable way
Fuel, uranium, is running out	Fuel, deuterium, is plentiful
The new nuclei produced are radioactive and have a variety of half-lives so must be stored safely	Produces stable helium nuclei
Requires moderators and control rods to ensure a safe and controlled chain reaction	Requires high temperature and pressure
Releases less energy	Releases more energy