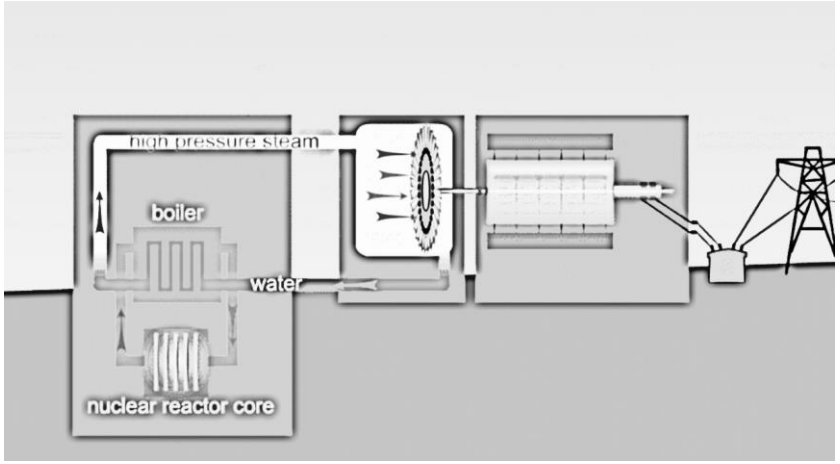
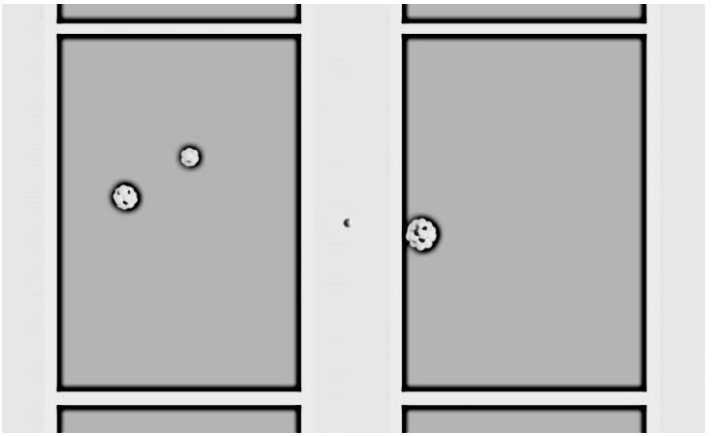
9.1 Generating electricity

- Electricity is generated by spinning coils of wire very fast near a very strong magnet
- It doesn't matter if you spin the wire or spin the magnet
- To cause the spinning you blast super-heated, high-pressure steam through a turbine
- Hot metal rods in a nuclear reactor are used to boil water into the steam that blasts through the turbine
- The hollow metal 'fuel rods' are filled with finger-tip-sized uranium fuel pellets
- It's the uranium fuel pellets where the nuclear reactions happen, and it's the fuel pellets that get hot



9.2 Fission and moderators

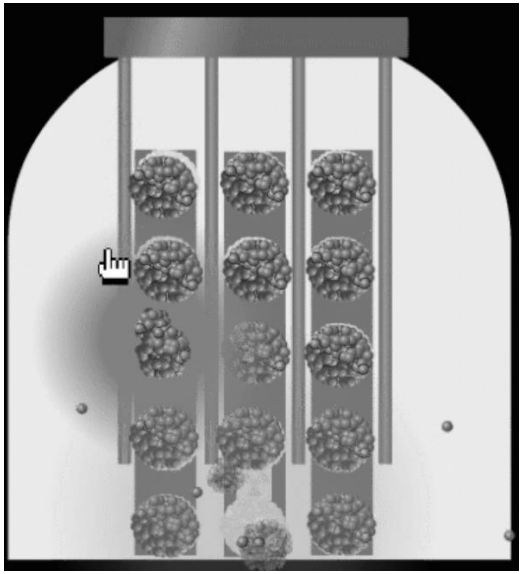
- Fission is when a nucleus breaks apart into two smaller nuclei
- Fission doesn't normally happen spontaneously - you need to add a neutron to a large, already unstable nucleus
- After a fission the two smaller nuclei created are moving very fast, and as they slow, they heat the material they're in
- A neutron needs to be going comparatively slowly to be absorbed by a nucleus and cause fission
- A moderator is a material that slows down fast neutrons enough to cause fission
- Water is the most common moderator, but some older reactors use a type of carbon called graphite



Fission in one uranium fuel pellet releases neutrons, which is slowed by the water between fuel rods, and cause fission in a neighbouring pellet.

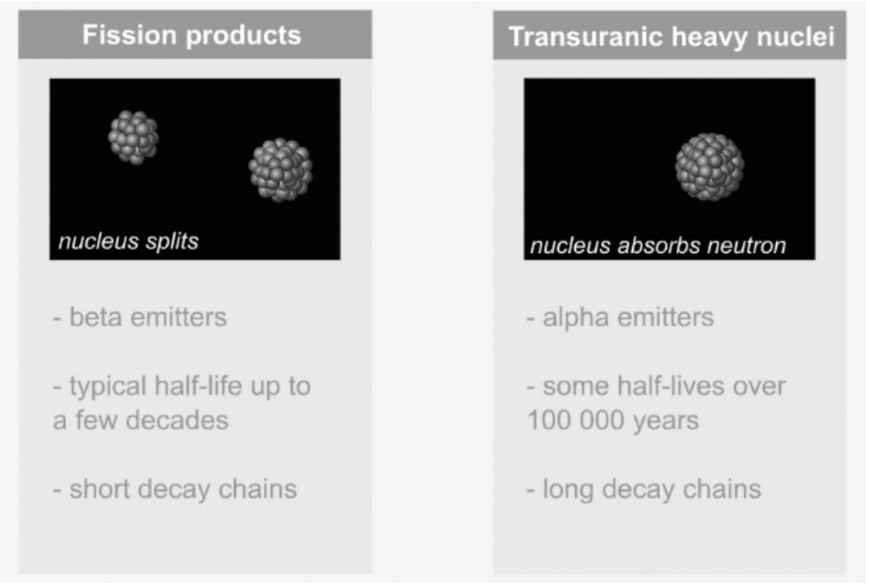
9.3 Chain reactions and control rods

- When a big nucleus fissions some free neutrons are released
- These free neutrons can go on to cause further fissions in a 'chain reaction'
- In a nuclear reactor the chain reaction is controlled using control rods
- The control rods fit between the fuel rods and absorb neutrons



9.4 Radioactive waste

- Uranium fuel pellets are hardly radioactive when they are new
- They are highly radioactive when they come out of the reactor
- Fission creates radioactive isotopes
- Radioactive waste can be safely disposed of because it's a solid and placed out of the way deep in the bedrock



9.5 Nuclear fusion

- Nuclear fusion involves temperatures and pressures that are normally only found at the centre of stars
- It involves smashing small nuclei like hydrogen together to make a bigger nucleus like helium
- It is very difficult because the electrostatic repulsion is so big
- No one knows if we will ever generate electricity from fusion at scale, but it is unlikely to happen before 2050
- Fusion involves readily available fuel - e.g. hydrogen from water - and leaves very little radioactive waste