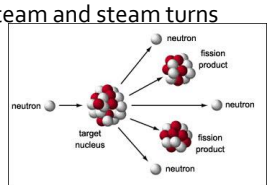
NUCLEAR POWER!

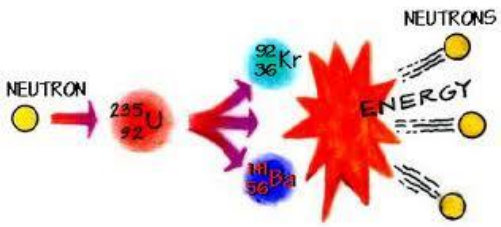
What is nuclear energy?

- One of the most controversial sources of energy
- Potential for disaster BUT these are unlikely
- Very low CO_2 emissions
- Energy generated by steam-turbines just as in coal electric plants, but the source of the heat is different

Nuclear Fission

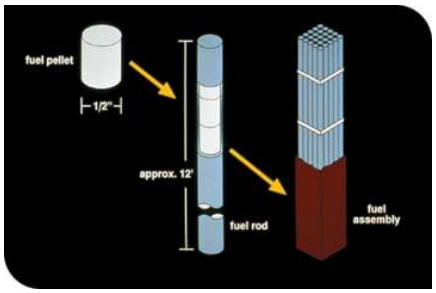
- A large atom is split into bits when it is hit by a neutron
- Atom hit is typically Uranium-235
- Lots of energy given off as heat as a result
- Heat boils water into steam and steam turns turbines

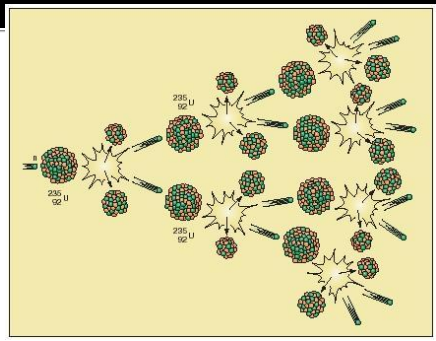




How it works…

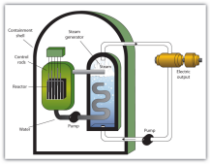
- Uranium pellets are contained in fuel rods in a containment structure
- Initial volley of neutrons starts the decay process, which works in a chain reaction fashion





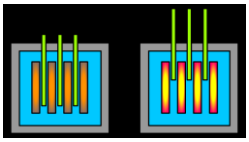
How it works…

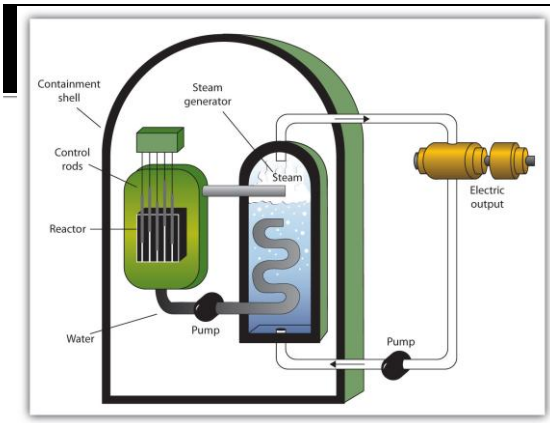
- Core of the reactor heats water, which heats other water
- Water in a nearby generator turns a turbine
- Turbine powers a generator



How it works… Preventing a disaster

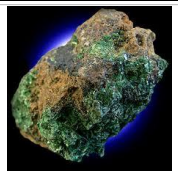
- To prevent chain reactions from getting out of hand, fuel rods are interspersed with control rods
- Control rods absorb excess heat along with water and prevent the chain reaction from continuing uncontrolled





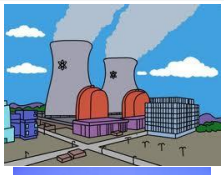
Nuclear Fuel

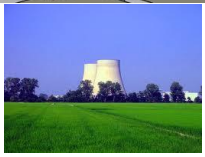
- Up to 900kg of ore might be needed to extract just 3kg of fuel
- Uranium ore ultimately is still a non-renewable resource
- Most ore has the wrong kind of uranium in it (U-238 when reactors use U-235), so fuel has to be **enriched** with the proper isotope



Advantages

- NO air pollution and virtually no CO_2 emissions
- Once a reactor is built, energy is cheap
- Potential alternative to fossil fuels
- ~20% of the energy in the USA is nuclear and up to 70% in some countries like France





Disadvantages- Meltdowns

- Always the potential for nuclear meltdown
- Uranium fuel can over heat and radioactive waste can be released

3 Mile Island Disaster

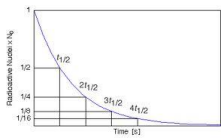
- March, 1979 in Pennsylvania
- Workers didn't notice a closed water valve
- Overheated and causes a partial meltdown
- More than 200,000 people evacuated

Chernobyl

- MUCH worse than 3 Mile Island
- April, 1986 in the Ukraine
- Workers were testing plant and removed control rods and disconnected cooling systems
- Explosion and fire that killed 31 people
- Radiation spread across Europe
- USSR very secretive about cleanup, but US National Academy of Sciences estimates an additional 4,000 cancer deaths over a 50 year period

Radioactive Waste

- Spent Uranium is still radioactive and difficult to dispose of
- Half-life: the period of time for ½ of the radioactive atoms in a fuel source to decay
  - Uranium-235 has a half life of 704 million years



Radioactive Waste

- Currently stored on site in water
- Some locations running out of room
- Proposals to bury the nuclear waste in Yucca Mountain in Nevada have been met with considerable controversy



Nuclear Fusion

- Opposite of fission: smashes atoms together
- Requires temperatures of 10x the core of the sun, soo…
  - Bit hard to contain.