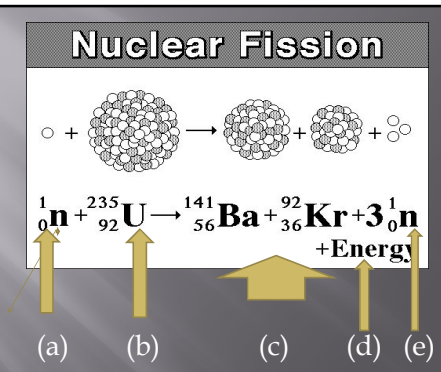
FISSION

Definition – the splitting of a large unstable nucleus into at least two smaller nuclei, releasing a very large amount of energy.

Example:

Nuclear Fission



(a) – the 'bullet' that hits the large nuclei is always a neutron. Think of it as a bullet hitting a watermelon from a gun fired.

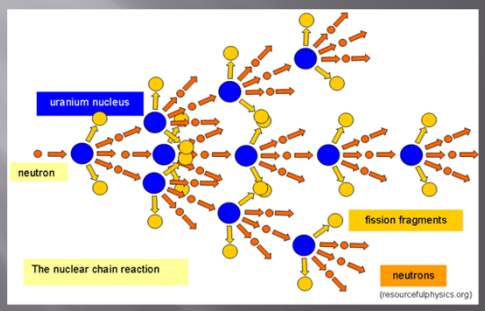
(b) – the nucleus is nearly always a $uranium - 235$ or a $plutonium - 239$ nucleus. Both are very large, unstable and can split easily.

(c) – the smaller nuclei that form as products are always unpredictable, unstable and more than one. Think of a watermelon exploding when hit by a bullet. You cannot predict how big or what shape each chunk will be when hit.

(d) the energy released is enormous. One kg of U-235 (about the size of a volleyball) can produce the same amount of electricity as burning coal from 124 railway cars full of coal. This is because some of the mass of the U-235 or Pu-239 is turned into pure energy. This does not happen in any combustion reaction, or from nuclear decay (like α-decay or β-decay)

(e) more neutrons are released. These are more bullets that can hit more nuclei. If each bullet hits another nuclei, then the release of energy and radioactive products becomes uncontrollable, and you have a nuclear bomb.

A chain reaction in fission looks like this:



Fission Reaction

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\ {}^{1}_{0}n$$

Good points about fission

1. Huge amounts of energy, which we can use to produce electricity
2. No air pollution, or Greenhouse gases
3. Very little waste (one kg of nuclear waste instead of over 30 000 tonnes of CO_2 and H_2O and air pollutants.
4. Many of the radioactive products are now carefully removed from the waste and used in medicine (tests and chemotherapy) or to sterilize medical supplies and cosmetics (the isotopes that produce g-waves) or to check engines for cracks.

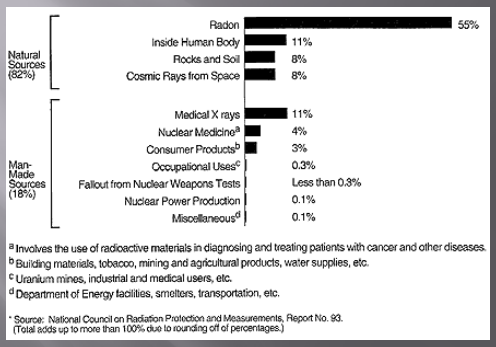
Bad points about fission

1. The waste products are very radioactive and will be radioactive for thousands of years. Where will you store this dangerous stuff?
2. If the nuclear reactor does not control the fission reaction happening inside, you have a nuclear bomb going off.
3. Nuclear reactors are very expensive to build.

Shouldn't we be scared of radiation from nuclear power plants?

- How much radiation do we get exposed to?
- How much of that radiation is natural and how much is man-made?
- What are some of the biggest sources of man-made radiation that we can be exposed to?
- Think about it and discuss before you see the next slide

Sources of Radiation Exposure



From: *National Institutes of Health*

Practice

- Video – Fission (3.34)
- Worksheet - Fission