18.3 Nuclear Reactions

Part 2

Review

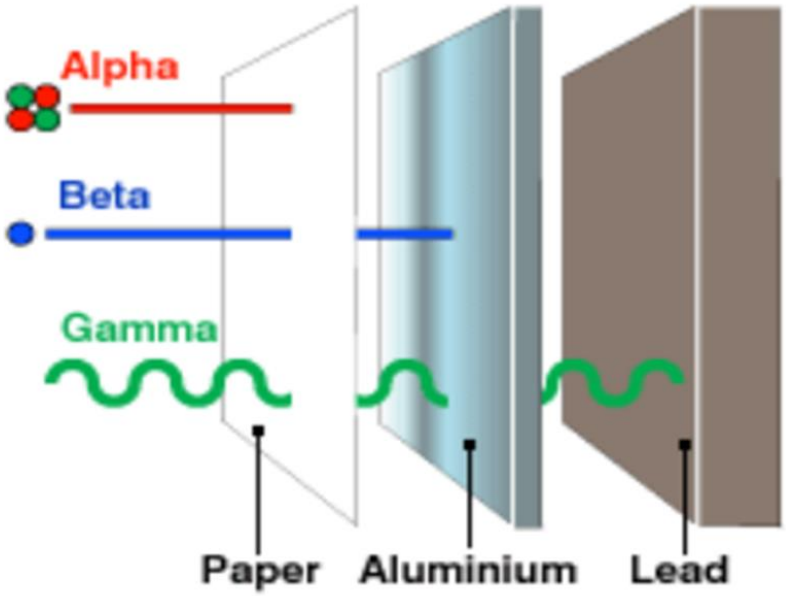
	Chemical Rxns	Nuclear Rxns
Part of Atom	Outermost (valence) electrons	Nucleus (neutrons and protons)
Start of Rxn	High temp, high pressure, catalysts, increasing concentration	High temp OR bombardment with high speed particles
Rxn Outcome	Formation of ionic or covalent bonds	# of protons or neutron changes
Energy Involved	Small amount	HUGE amount
Examples	Burning fossil fuels, digesting food	Nuclear energy, x-rays, chemotherapy, pasteurization

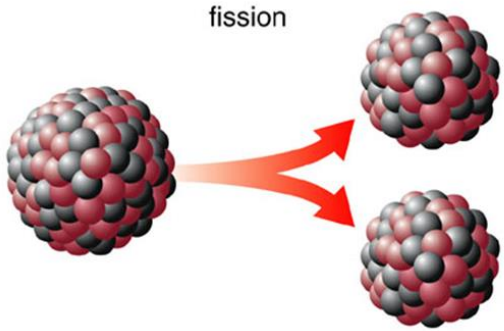
Review

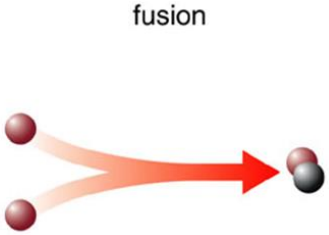
$$^{58}_{26}\mathrm{Fe} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{59}_{26}\mathrm{Fe}$$

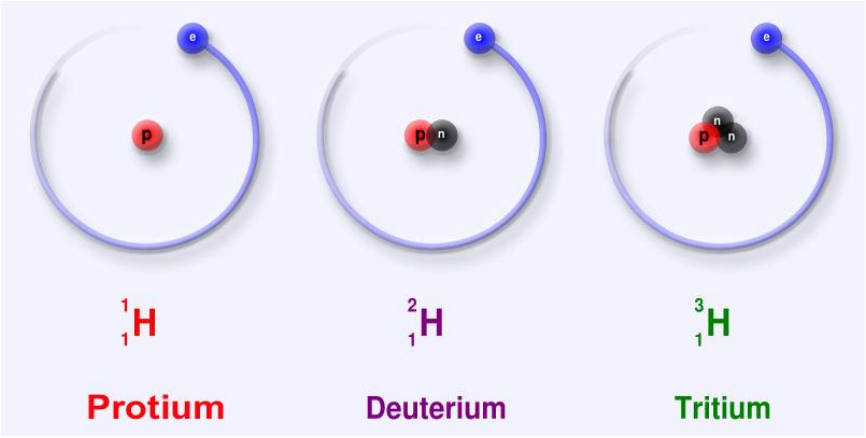
$$^{59}_{26}\mathrm{Fe} \rightarrow {}^{59}_{27}\mathrm{Co} + {}^{0}_{-1}\mathrm{e}$$

$$^{59}_{27}\mathrm{Co} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{60}_{27}\mathrm{Co}$$





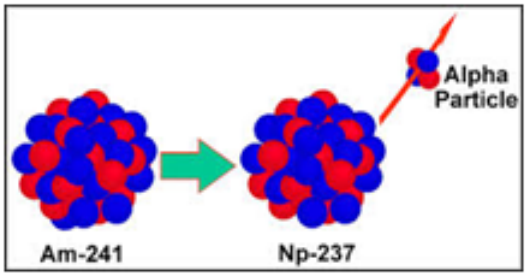




Radioactive Decay

- **Alpha**

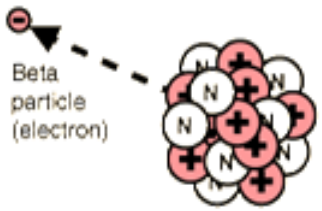
A helium is released [2 (+) & 2 (n)], causing the atomic # to go down by 2



Helium >

Beta

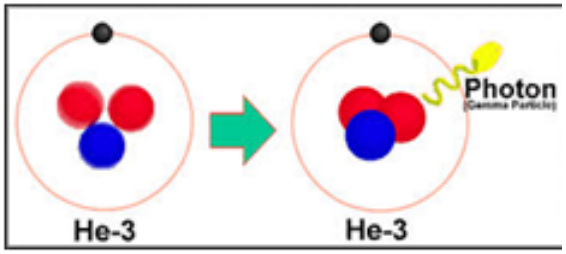
A (n) is turned into a (+) and an e^-. The e^- is then emitted



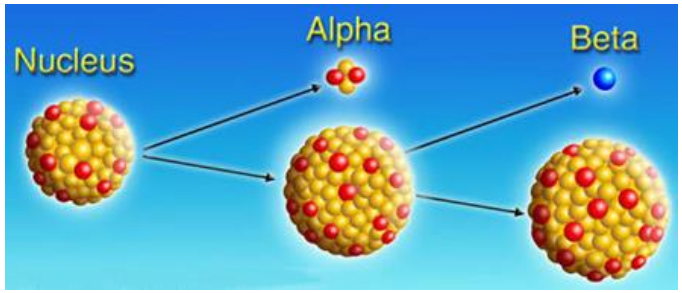
Electron >

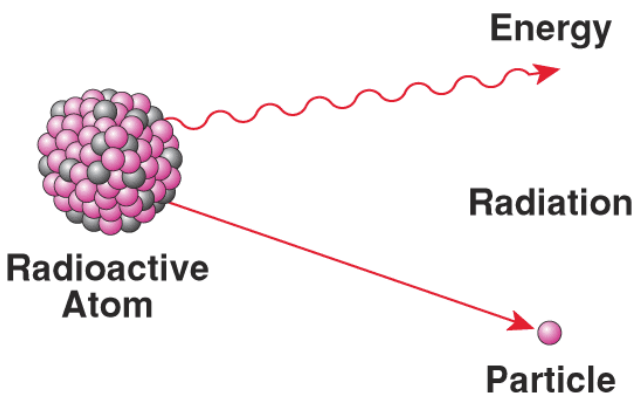
Gamma

Emits a high energy photon known as a gamma particle



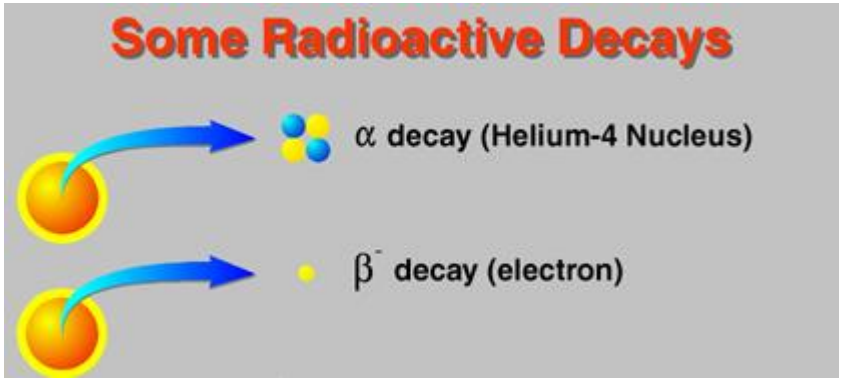
Photon





Alpha vs. Beta Decay

Protons	Dec. by 2	Inc. by 1
Neutrons	Dec. by 2	Dec. by 1
Atomic #	Dec. by 2	Inc. by 1
Mass #	Dec. by 4	Stays the same

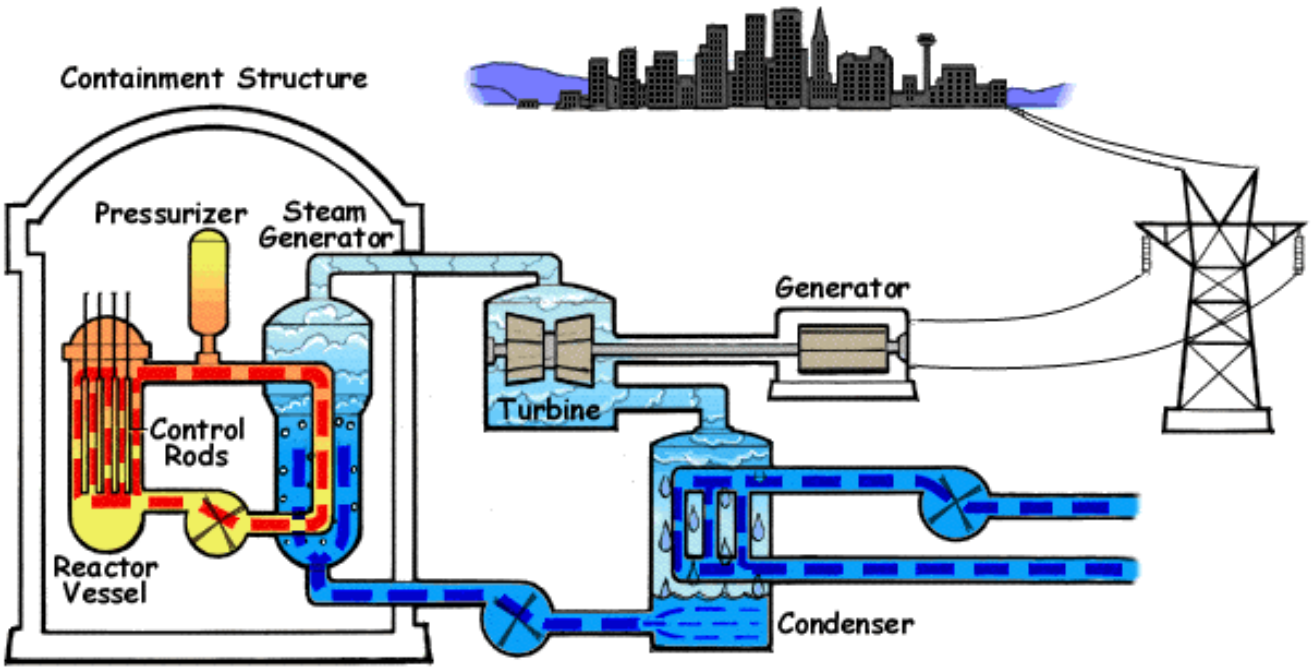


Nuclear Reactors

- The biggest nuclear reactor is the sun. It uses nuclear FUSION.
- Chain reactions of nuclear FISSION is what humans use in nuclear reactors

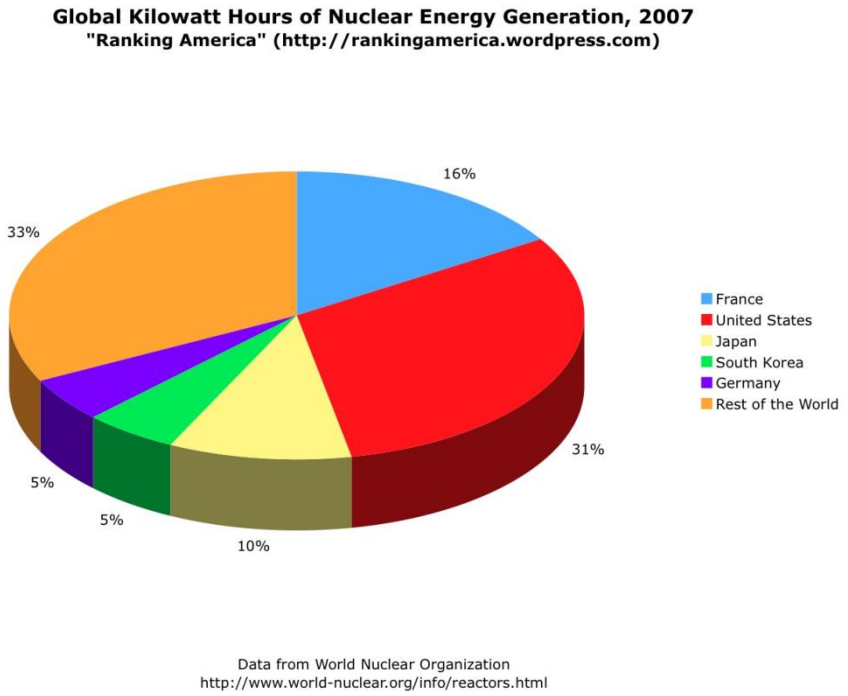
Nuclear Reactions

- Nuclear Power Plant: Fission rxns produce heat. Heat used to generate steam that runs a turbine. The turbine generates electricity.



Nuclear Reactions for Energy Needs

- 31 countries have nuclear power plants
- 20% of US energy comes from nuclear energy
- 75% from fossil fuels



Nuclear Waste

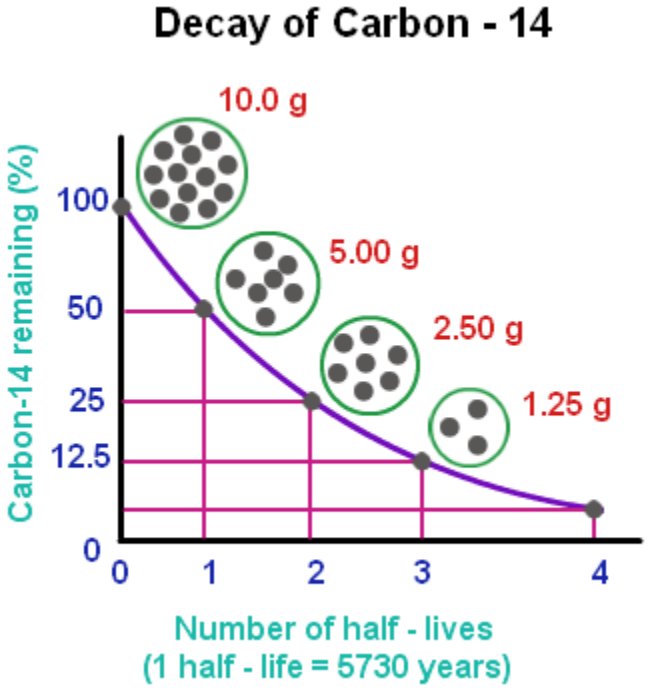
- Put in large barrels
- Takes many years to decay
- Safe?

Pro's and Con's Summary

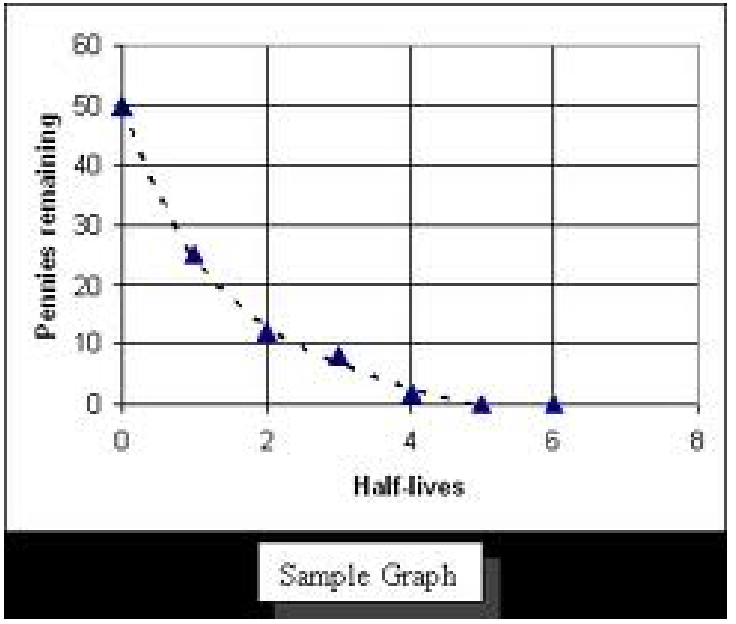
Pros	Cons
No greenhouse gas emissions during operation.	Nuclear waste is dangerous for thousands of years.
Does not produce air pollutants.	High capital and maintenance cost and long construction period.
Small amount of waste is produced.	High cost in decommissioning plants.
Low fuel costs, large fuel reserves, and easy to transport.	Possibly very disastrous accidents.
Only a small number of major accidents so far- only 1 in the type of plants that are now in common use.	

Half-life

- Half-life: a certain length of time in which half the radioactive element has undergone radioactive decay

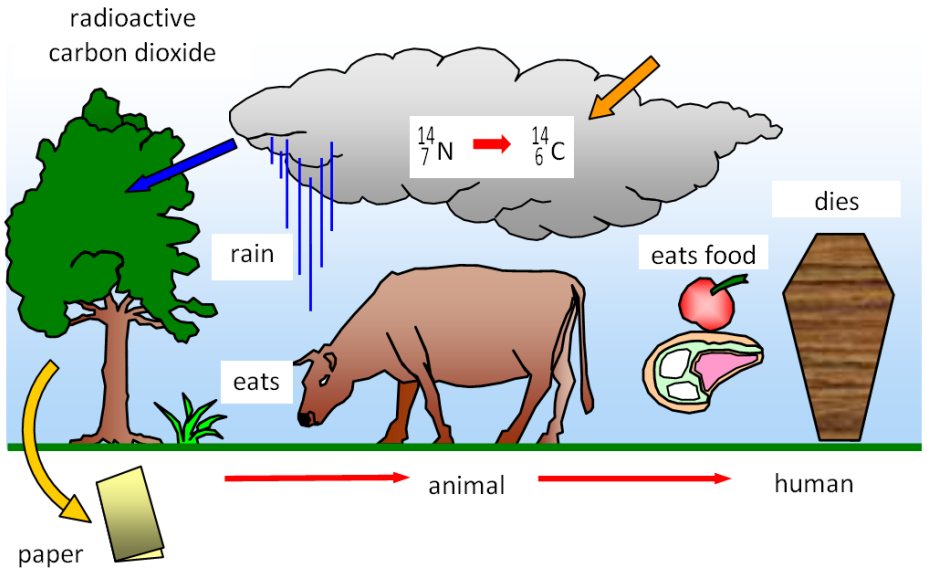


Pennies Experiment



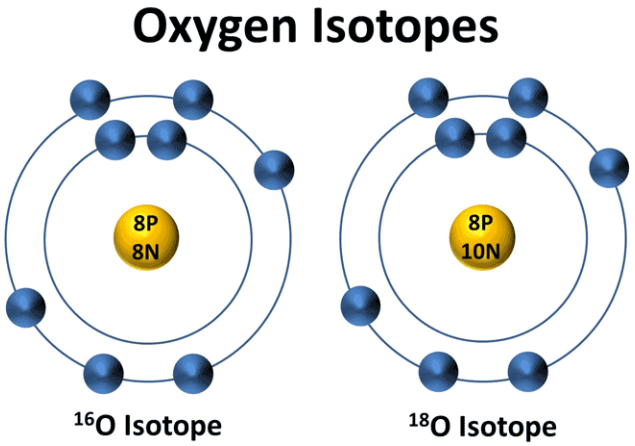
Radioactive Dating

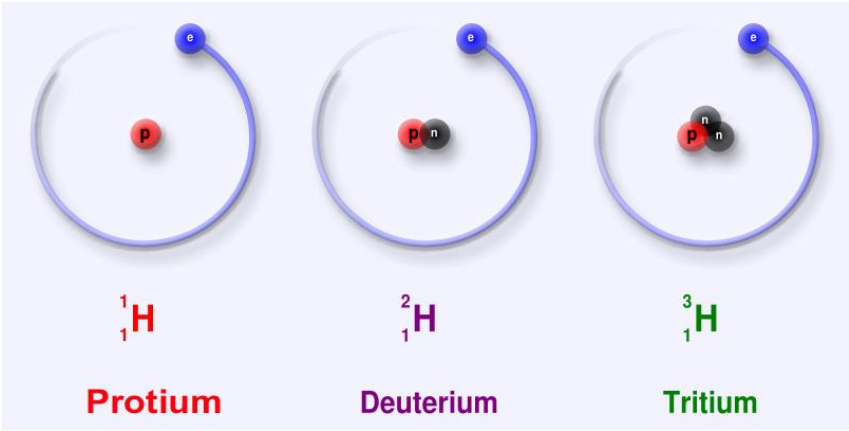
- Cosmic radiation causes atoms in atm to add neutrons
- Up-take by plants
- We eat plants
- We die with same amount of C-14 that was in atm
- C-14 decays over 1000's of years at constant rate



Radioisotopes

- Isotope: An atom of the same element (same # of protons) with different number of neutrons.
- Radioisotope – an isotope that is unstable in nature and will decay overtime





Concept Check

- If I added two neutrons to lithium-7, what would it become?
- Lithium-9 or $^{9}_{3}\mathrm{Li}$
- If you added two proton to lithium-7, what would it become?
- Boron-9 or $^{9}_{5}\mathrm{B}$

Lab 18C

- Like the atom game but with nuclear decay and radioactivity
- I will flip the slide, ONE person from each team must build the atom.
- When you are done, yell “ATOM BOMB”
- +5 if right, -5 if wrong
- Winner gets 5 points extra credit on notes

Ready??!!

Nitrogen

Carbon-12

Hydrogen

Magnesium-26

Fluorine-19

Aluminum-28

Boron atom after it undergoes alpha decay

Sulfur atom after it undergoes alpha decay

Sodium undergoes beta decay

Helium undergoes beta decay

Oxygen-16 undergoes alpha decay, than beta decay

Silicon-15 undergoes alpha decay TWICE

Make the original atom that underwent alpha decay to become oxygen-16