Station 1 - Vocabulary

<u>Your task</u>: At this station, you will learn some of the vocabulary associated with nuclear energy. On your worksheet, write down each word along with its definition. Where indicated, draw a diagram to go along with it. When finished, take some time to quiz each other before time is called to move onto the next station.

Chain Reaction

A continuous splitting of atoms in which neutrons split atoms, which in turn release more neutrons.

Fission (draw a diagram)

Nuclear fission is a nuclear reaction in which the nucleus of an atom splits into smaller parts (lighter nuclei), often producing free neutrons and photons (in the form of gamma rays), as well.

Fusion (draw a diagram)

Nuclear fusion is the process by which multiple atomic nuclei join together to form a single heavier nucleus. It is accompanied by the release or absorption of energy. Large scale fusion processes, involving many atoms fusing at once, must occur in matter which is at very high densities.

Nuclear Reactor

The heart of a nuclear power plant, in which nuclear fission may be initiated and controlled in a self-sustaining chain reaction to generate energy or produce useful radiation. Although there are many types of nuclear reactors, they all incorporate certain essential features, including the use of fissionable material as fuel, a moderator (such as water) to increase the likelihood of fission, a reflector to conserve escaping neutrons, coolant provisions for heat removal, instruments for monitoring and controlling reactor operation, and protective devices (such as control rods and shielding).

Isotope

An atom of an element having a different number of neutrons than other atoms of the same element that has very similar chemical properties but different atomic masses (different numbers of neutrons in their nuclei) and distinct physical properties. All elements have more than one isotope. Among their distinct physical properties, some isotopes (known as radioisotopes) are radioactive because their nuclei emit radiation as they strive toward a more stable nuclear configuration. For example, carbon-12 and carbon-13 are stable, but carbon-14 is unstable and radioactive.

Boiling Water Reactor

A common nuclear power reactor design in which water flows upward through the core where it is heated by fission and allowed to boil in the reactor vessel. The resulting steam then drives turbines, which activate generators to produce electrical power. BWRs operate similarly to electrical plants using fossil fuel, except that the BWRs are powered by 370–800 nuclear fuel assemblies in the reactor core. For additional detail, see Boiling Water Reactors (BWRs).

Pressurized Water Reactor (PWR)

A common nuclear power reactor design in which very pure water is heated to a very high temperature by fission, kept under high pressure (to prevent it from boiling), and converted to steam by a steam generator. The resulting steam is used to drive turbines, which activate generators to produce electrical power. A PWR essentially operates like a pressure cooker, where a lid is tightly placed over a pot of heated water, causing the pressure inside to increase as the temperature increases (because the steam cannot escape) but keeping the water from boiling at the usual 212°F (100°C). About two-thirds of the operating nuclear reactor power plants in the United States are PWRs.

Critical Mass

The smallest mass of fissionable material that will support a self-sustaining chain reaction.

Uranium-235
A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of approximately 238. The two principal natural isotopes are uranium-235 (which comprises 0.7 percent of natural uranium), which is fissile, and uranium-238 (99.3 percent of natural uranium), which is fissionable by fast neutrons and is fertile, meaning that it becomes fissile after absorbing one neutron. Natural uranium also includes a minute amount of uranium-234.

Nuclear Waste
A subset of radioactive waste that includes unusable byproducts produced during the various stages of the nuclear fuel cycle, including recovery (or extraction), conversion, and enrichment of uranium; fuel fabrication; and use of the fuel in nuclear reactors. Specifically, these stages produce a variety of nuclear waste materials, including uranium mill tailings, depleted uranium, and spent (depleted) fuel, all of which are regulated by the NRC.

Station 3 - Video Clips

Your task: At this station you will be watching a few video clips. These video clips will cover a range of topics that are all related to nuclear energy. After you have finished watching the clips, answer the corresponding questions for each clip. Feel free to discuss anything you might have found interesting in the clips with those at your station.

Nuclear Power – How it Works
http://www.youtube.com/watch?v=fjgdgAhOzXQ

Teacher's Domain – Nuclear Reaction: Meltdown
http://www.teachersdomain.org/resource/phy03.sci.phys.matter.meltdown/
The tremendous energy content and radioactivity of the fuels used in nuclear power plants pose potentially devastating consequences to surrounding communities and environments in the event of a reactor meltdown. This video segment adapted from *FRONTLINE* describes the series of events that led to the 1986 Chernobyl nuclear power plant disaster, the worst accident of its kind in history.

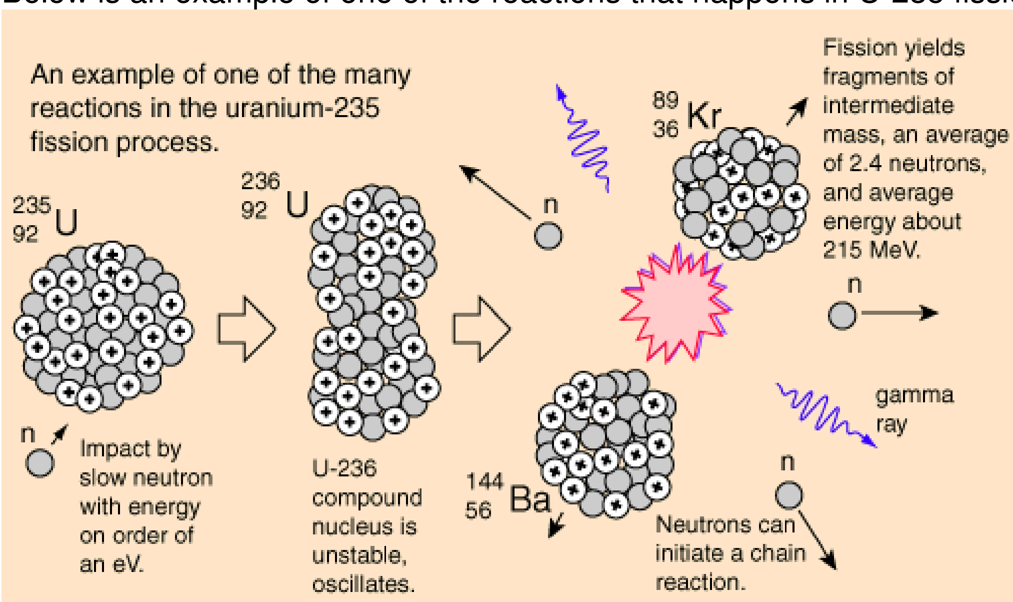
Nuclear Fusion
http://www.youtube.com/watch?v=vDAZsPkTkMM&feature=related

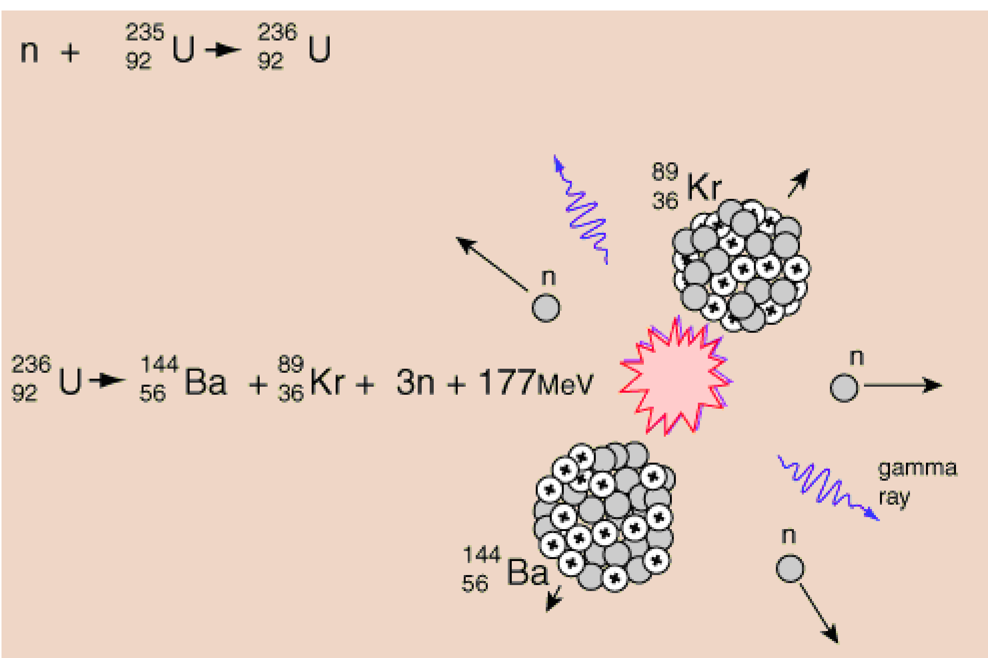
Station 4 - Nuclear Reactions

<u>Your task</u>: At this station you will learn about two commonly used isotopes for nuclear reactions.

<u>Nuclear fission</u>:
Uranium-235 is an isotope that can sustain fission chain reactions. If at least one neutron from U-235 fission strikes another nucleus and causes it to fission, then the chain reaction continues.

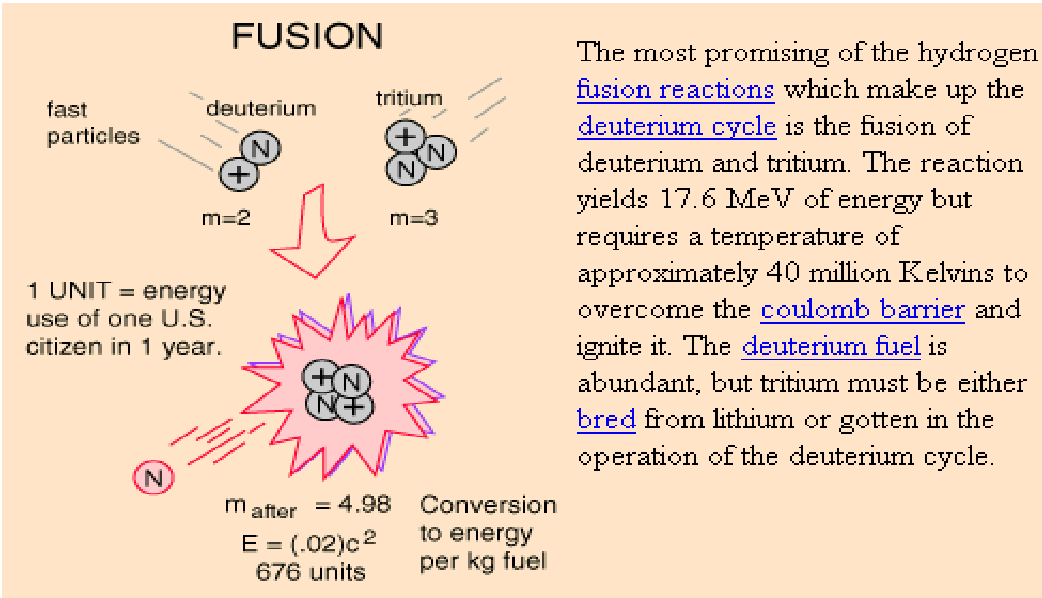
Below is an example of one of the reactions that happens in U-235 fission.





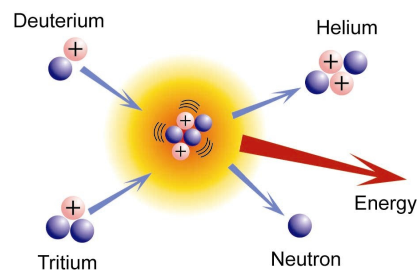
Nuclear Fusion

Nuclear fusion is the process where atomic nuclei join (or fuse) together to form a single heavier nucleus. This process also entails a release or absorption of energy. Fusion occurs naturally in stars. Outside of nature, science has tried to utilize fusion but has yet to learn how to successfully control the fusion process. Deuterium-Tritium fusion is often used because of the ideal nature of their nucleic structures.



More specifically, the reaction that occurs is:

$$^{3}_{1}T + ^{2}_{1}D \rightarrow ^{4}_{2}He + n$$



Deuterium is a stable isotope of hydrogen, sometimes referred to as heavy hydrogen. Tritium is a radioactive isotope of hydrogen, sometimes referred to as Hydrogen-3.

Station 6 - Acrostic Poems

Your task: At this station you will be tapping into your creative powers to create your own acrostic poems! Use the letters in N-U-C-L-E-A-R to create a poem about nuclear power. Be creative with your adjectives. Your poem can express facts, your opinion, and even some questions that you might have about this type of energy source. Use color to add to the visual effects of your poem.

Below is an **example** of an acrostic poem.
School is a place where
Curious minds are fed,
Inquiry is pursued, and
Experiments are performed.
No ideas are too absurd.
Challenging each mind to think beyond
Engaging the mind and changing the world

Station 5 - Article Reading

Your task: At this station you will be reading an article regarding nuclear energy. Read the article and answer the corresponding questions in your packet.

Station 2 - Online Plant Tour

Your task: Visit the following site and embark on an online tour of a nuclear power plant. You will need to summarize what you are learning and seeing on your virtual tour.

http://www.dom.com/about/stations/nuclear/nuctour.html