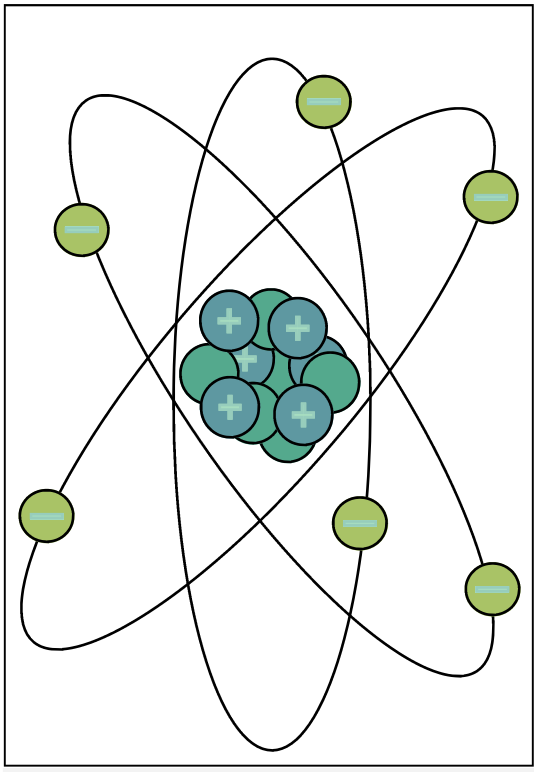
Forms of Energy: Nuclear Energy

The fundamental unit of matter is the atom. The atom is made up of protons, neutrons and electrons. The forces that hold the central part (nucleus) of the atom together are immense, thus possessing great **potential energy**. Two processes are possible that can release this energy. One is called a **nuclear fusion reaction** and involves combining the centers of two or more atoms. The other is called a **nuclear fission reaction** and involves breaking the nucleus apart. In either case very large quantities of energy can be released.

Some nuclear reactors generate heat and large amounts of steam to produce electrical power.

Current nuclear power plants conduct fission reactions. A large portion of the energy produced from these nuclear reactions is released in the form of **thermal energy**. This thermal energy is then used to heat water to steam and turn **turbine** systems and produce **electrical power**. Such fission reactions also produce a form of energy called radiation along with **radioactive waste** products. Radiation is a very powerful form of **radiant energy** and can cause cell damage and impair cell function of living organisms. Care must be taken in designing and operating a nuclear power source to appropriately contain the radioactive byproducts of nuclear power.



This model of a carbon atom has six electrons (-) that orbit the nucleus which consists of six protons (+) and six neutrons.

The heat of our Sun is basically the result of a massive set of on-going nuclear fusion reactions. The process is so intense that you can step outside on a sunny day and feel the heat from these nuclear reactions even though the Sun is more than 80 million miles away. The Sun's gravitational forces and immense heat are so intense that the nuclei (center) of millions of hydrogen atoms are continuously being combined.

Currently, scientific teams are working on ways to create fusion-type reactions for our own power needs. This would be an attractive source of power because many of the radioactive byproducts and disposal problems associated with fission reactions would be eliminated. Scientists have been able to create and briefly sustain fusion reactions, but the amount of energy required to create even a small reaction in the laboratory is greater than the energy gained from the event. Estimates put the achievement of commercially-viable reactors at sometime in the 2040s with commercial use of fusion following soon after. If scientists can determine a practical way to maintain and harness fusion this may be a very attractive energy source indeed.

Glossary

Electrical power: Electrical energy used to conduct work; the measure of the rate of electrical energy used by a circuit. This is usually measured using a unit called a Watt (W)

Nuclear fission reactions: The process of breaking apart the nuclei of atoms through chain reactions to release potential energy

Nuclear fusion reactions: The process of combining the nuclei of atoms to release immense amounts of energy

Potential energy: Stored energy an object possesses that may be released

Radiant energy/Radiation: Transmission or emission of kinetic energy as waves through space. Light is one type of radiant energy. Electromagnetic radiation can be classified by the electromagnetic spectrum

Radioactive Waste: The spent fuel and byproducts from the nuclear fission reactions used to produce nuclear power which continue to emit harmful radiant energy for thousands of years after their use

Thermal Energy: Kinetic energy associated with the movement of molecules; commonly produced from combustion. Heat is the transfer of thermal energy from bodies of higher kinetic energy to lower kinetic energy

Turbine: A device which harnesses the kinetic energy of an incoming force (often steam, water, or air) to spin rotors and create mechanical power. In electrical power generation the spinning motion of turbine rotors is used to turn generators which use rotating magnets inside copper wire to create an electrical current

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