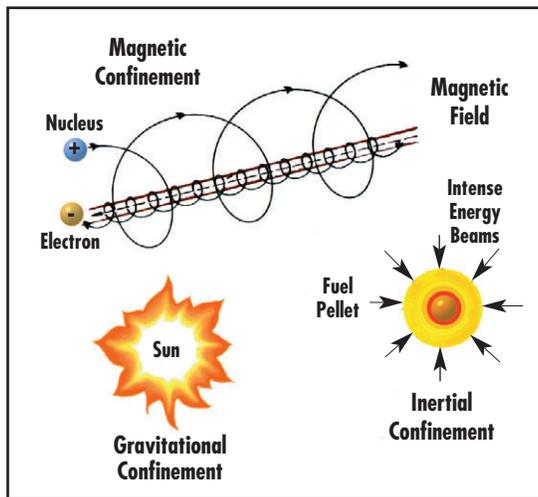
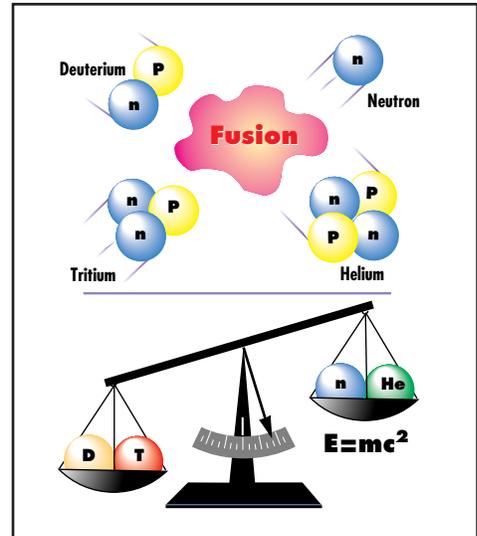


WHAT IS FUSION?

Fusion is the process that powers the sun and the stars. It is the reaction in which two atoms of hydrogen combine together, or *fuse*, to form an atom of helium. In the process some of the mass of the hydrogen is converted into energy. The easiest fusion reaction to make happen is combining *deuterium* (or “heavy hydrogen”) with *tritium* (or “heavy-heavy hydrogen”) to make *helium* and a *neutron*. Deuterium is plentifully available in ordinary water. Tritium can be produced by combining the fusion neutron with the abundant light metal *lithium*. Thus fusion has the potential to be an inexhaustible source of energy.

To make fusion happen, the atoms of hydrogen must be heated to very high temperatures (100 million degrees) so they are ionized (forming a *plasma*) and have sufficient energy to fuse, and then be held together i.e. confined, long enough for fusion to occur. The sun and stars do this by gravity.



More practical approaches on earth are *magnetic confinement*, where a strong magnetic field holds the ionized atoms together while they are heated by microwaves or other energy sources, and *inertial confinement*, where a tiny pellet of frozen hydrogen is compressed and heated by an intense energy beam, such as a laser, so quickly that fusion occurs before the atoms can fly apart.

Who cares? Scientists have sought to make fusion work on earth for over 40 years. If we are successful, we will have an energy source that is inexhaustible. One out of every 6500 atoms of hydrogen in ordinary water is deuterium, giving a

gallon of water the energy content of 300 gallons of gasoline. In addition, fusion would be environmentally friendly, producing no combustion products or greenhouse gases. While fusion is a nuclear process, the products of the fusion reaction (helium and a neutron) are not radioactive, and with proper design a fusion power plant would be passively safe, and would produce no long-lived radioactive waste. Design studies show that electricity from fusion should be about the same cost as present day sources.

We're getting close! While fusion sounds simple, the details are difficult and exacting. Heating, compressing and confining hydrogen plasmas at 100 million degrees is a significant challenge. A lot of science and engineering had to be learned to get fusion to where we are today. Both magnetic and inertial fusion programs expect to build their next experiments that will reach *ignition* and produce more energy than they consume shortly after the year 2000. If all goes well, commercial application should be possible by about 2020, providing humankind a safe, clean, inexhaustible energy source for the future.

