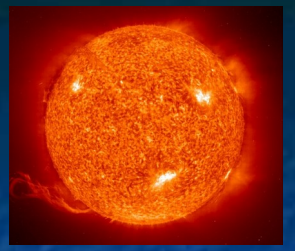
Unit 2: The Sun and Other Stars

Objective:

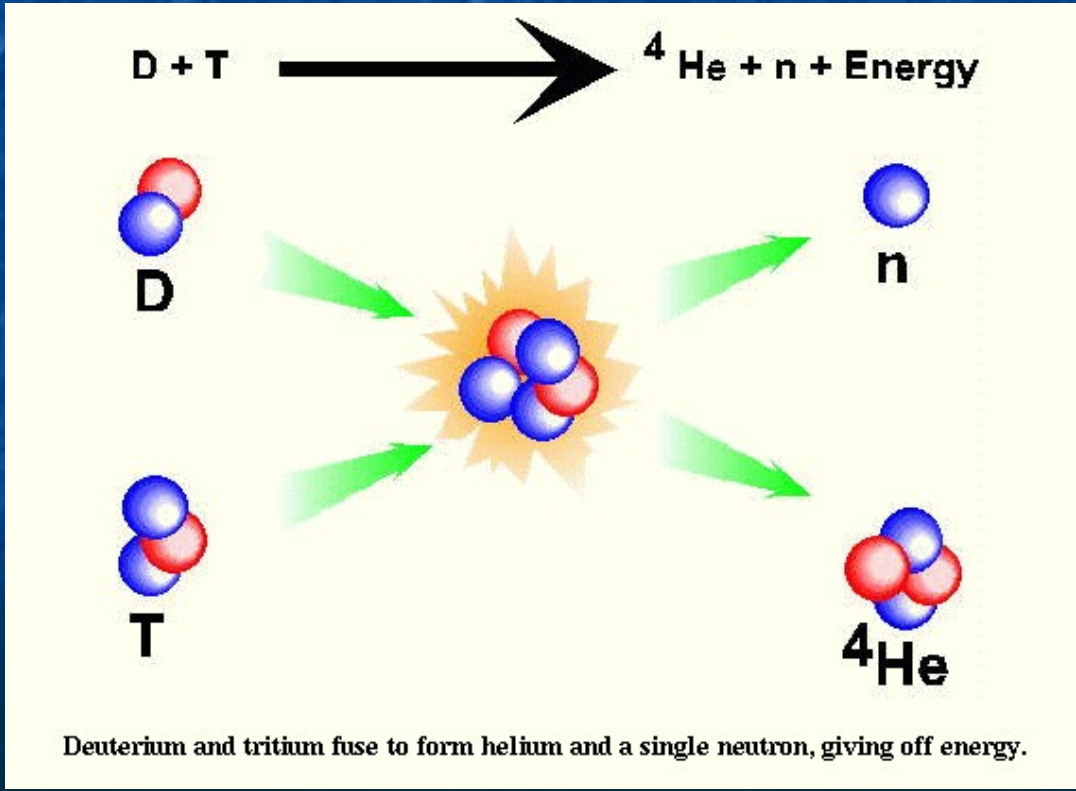
E5.2C - Describe how nuclear fusion produces energy in the Sun.

E5.2D - Describe how nuclear fusion and other processes in stars have led to the formation of all the other chemical elements.



Nuclear Fusion

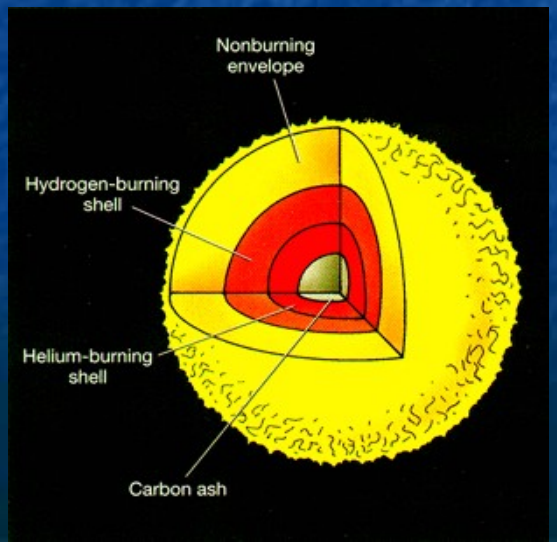
Nuclear fusion is a process that combines the atomic nuclei of lighter elements to form heavier elements. In the case of our Sun, the two isotopes of hydrogen (deuterium and tritium) are combined (under tremendous pressure) to form helium. In the process of forming helium, energy is released which can be captured and used to generate heat and eventually electricity.



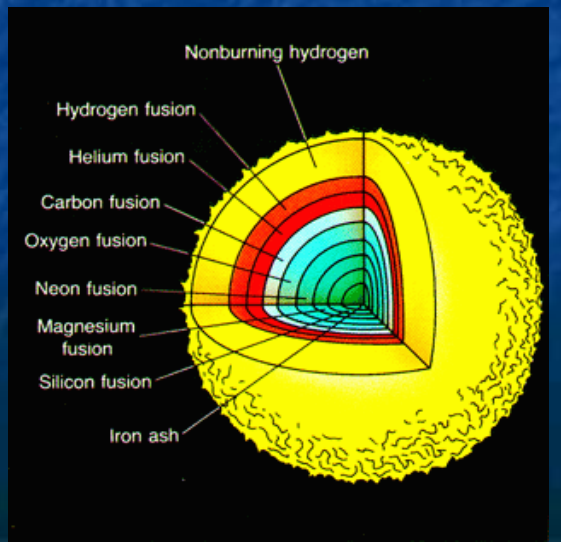
Deuterium and tritium fuse to form helium and a single neutron, giving off energy.

Forming Elements from Nuclear Fusion

Scientists believe that the lightest elements, hydrogen, helium, lithium, and beryllium were created in the first few minutes of the Big Bang. Stars have the capability, through their nuclear fusion process, to create lighter elements (from helium up to iron). Remember, stellar nebula start with large amounts of hydrogen. The fusion of lighter elements will continue until iron is created by the star. Fusing iron into heavier elements actually requires an input of energy. At this stage of their life, stars do not have the additional energy to fuel the fusion process and they collapse.



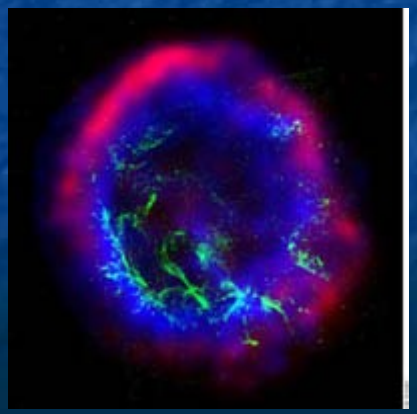
A star similar to the size and mass of our Sun (left) and a star about 100 times the size of our Sun (right).



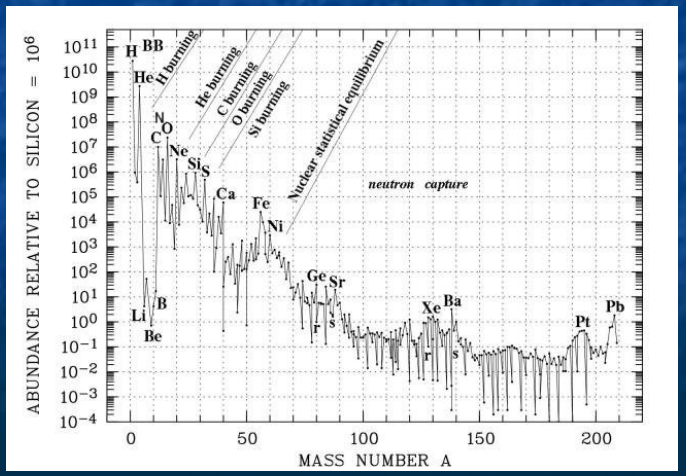
Forming Other Elements

As stars collapse, a shock wave forms and blasts out through the star, releasing enormous amounts of energy in a few seconds. All the outer layers of the star become superheated plasmas, with temperatures high enough to fuse iron and heavier elements, like gold and uranium. These bright outer layers are ejected by the star (which we call a supernova).

While scientists still don't completely understand the process, the collision of neutron stars and supernova explosions appear to be the "creators" of the heavier elements.



Remnant of supernova E-0102-72.



Periodic Table of Elements

Between the Big Bang , stellar nuclear fusion, colliding neutron stars, and supernovae, we have now accounted for the existence of all 92 naturally occurring elements in our universe. What about the elements numbered 93 and above?

The remaining elements are “created” through processes that require the collision of atomic particles (many times this is accomplished in a laboratory).