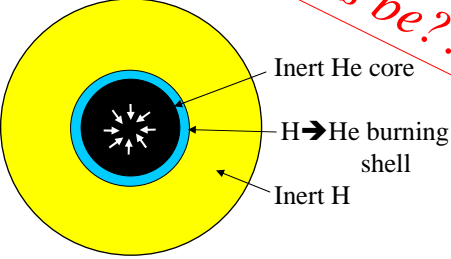
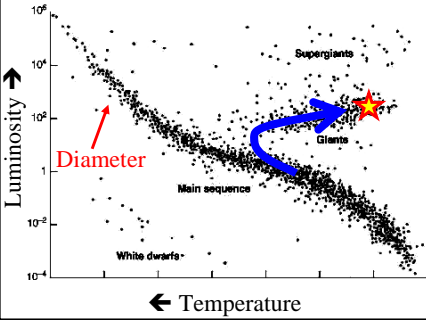


*Q. Which of these will NOT happen down in the core, after the nuclear energy source shuts off?*

A. The core will cool down.  
 B. Its pressure will decrease.  
 C. The “weight” of the outer layers will then compress the core.  
 D. The core will become denser *and* hotter.  
 E. All of the above will happen.

*How can this be??*

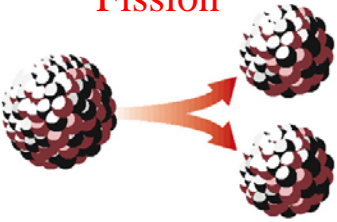



face.

## Fission vs. Fusion


Iron (Fe) is the most stable nucleus.

**Fission**



Heavy nucleus (e.g. Uranium) breaks up into lighter nuclei.

**Fusion**

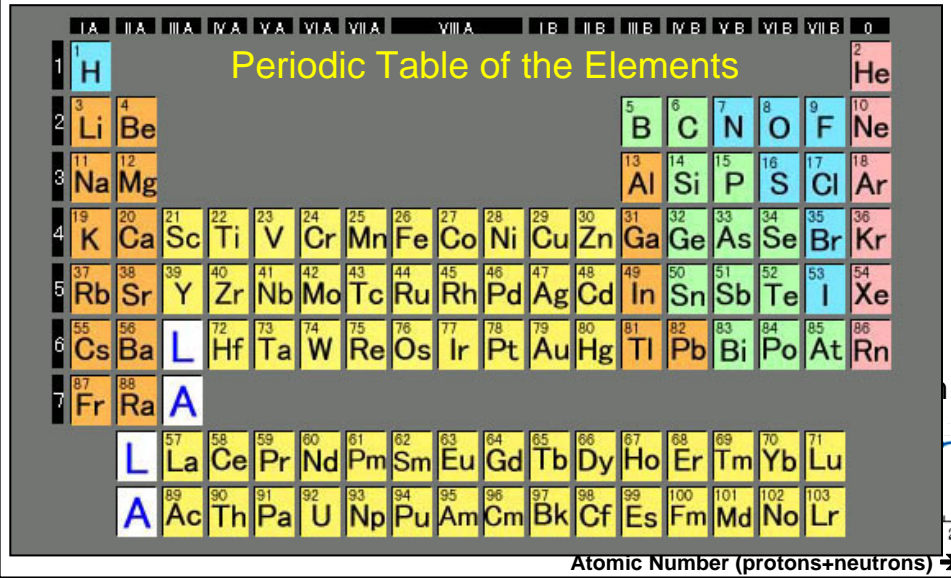


Light nuclei (e.g. Hydrogen) combine to form heavier nucleus.

[Fig. 10.4]

## Nucleosynthesis: where we came from.

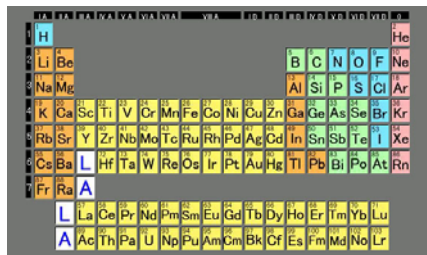
- H, He, Li are only elements formed in initial formation of universe.
  - simplest stable combinations of protons, neutrons and electrons



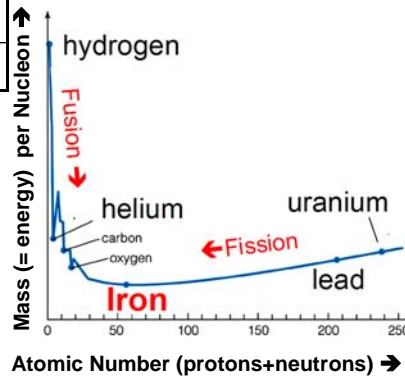
Reaction	Min. Temp.
$4 \text{ } ^1\text{H} \rightarrow \text{}^4\text{He}$	$10^7 \text{ } ^\circ\text{K}$
$3 \text{}^4\text{He} \rightarrow \text{}^{12}\text{C}$	$2 \times 10^8$
$\text{}^{12}\text{C} + \text{}^4\text{He} \rightarrow \text{}^{16}\text{O, Ne, Na, Mg}$	$8 \times 10^8$
$\text{Ne} \rightarrow \text{O, Mg}$	$1.5 \times 10^9$
$\text{O} \rightarrow \text{Mg, S}$	$2 \times 10^9$
$\text{Si} \rightarrow \text{Fe peak}$	$3 \times 10^9$

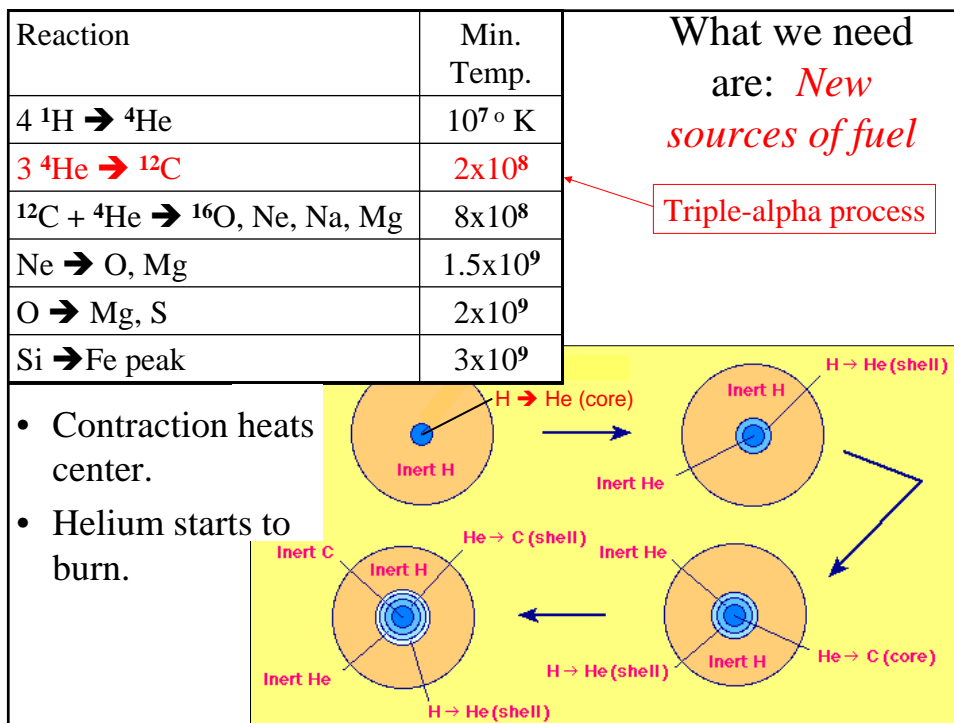
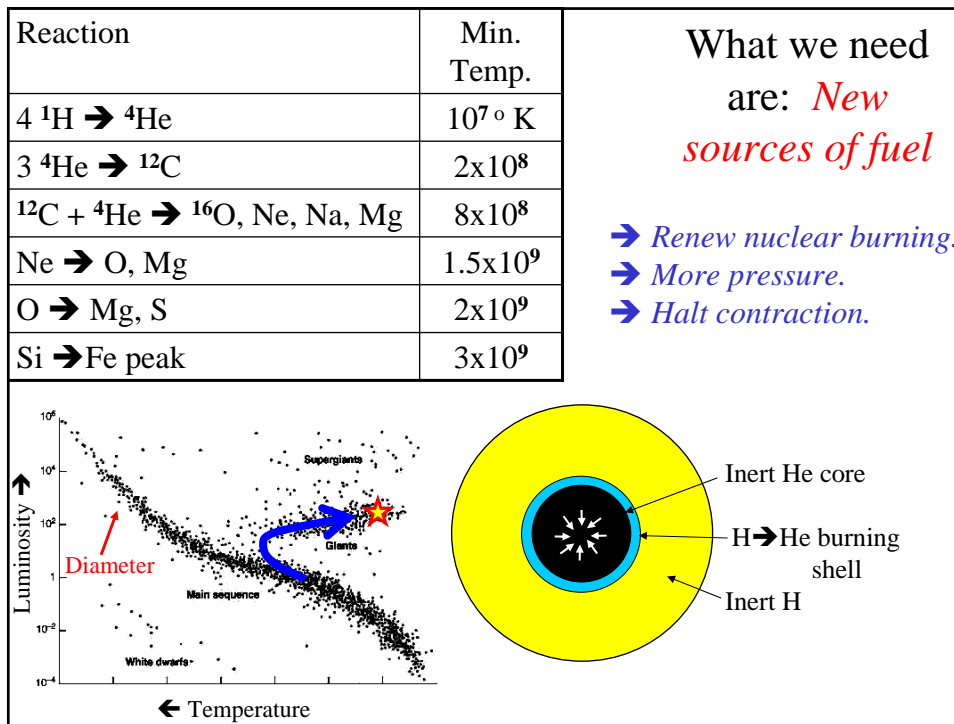
Fusion in stars → increasingly more complicated, but more stable nuclei.

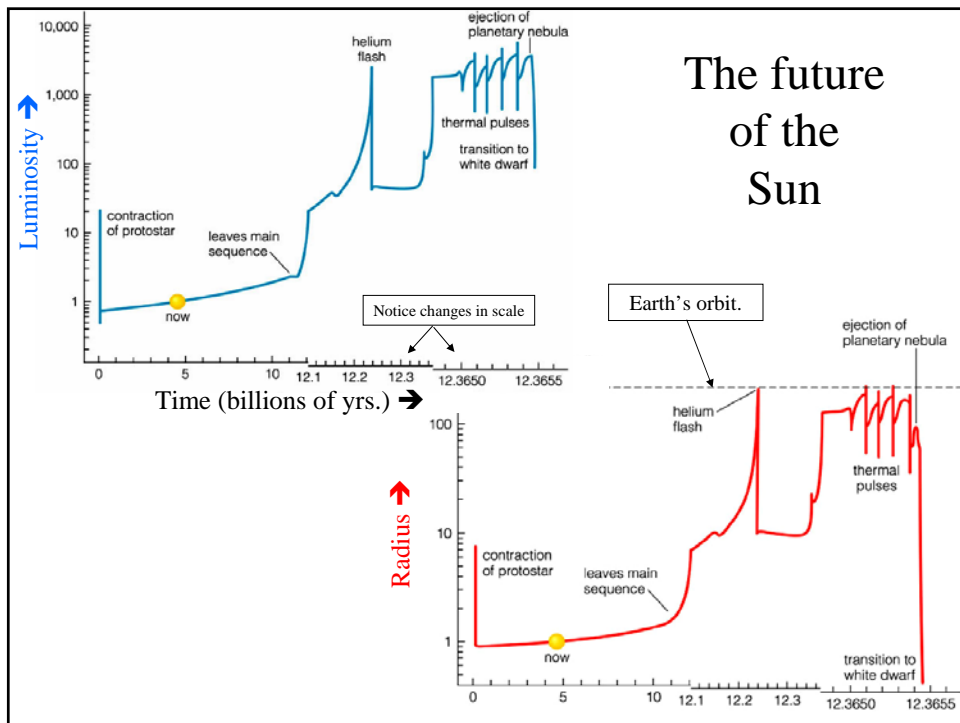
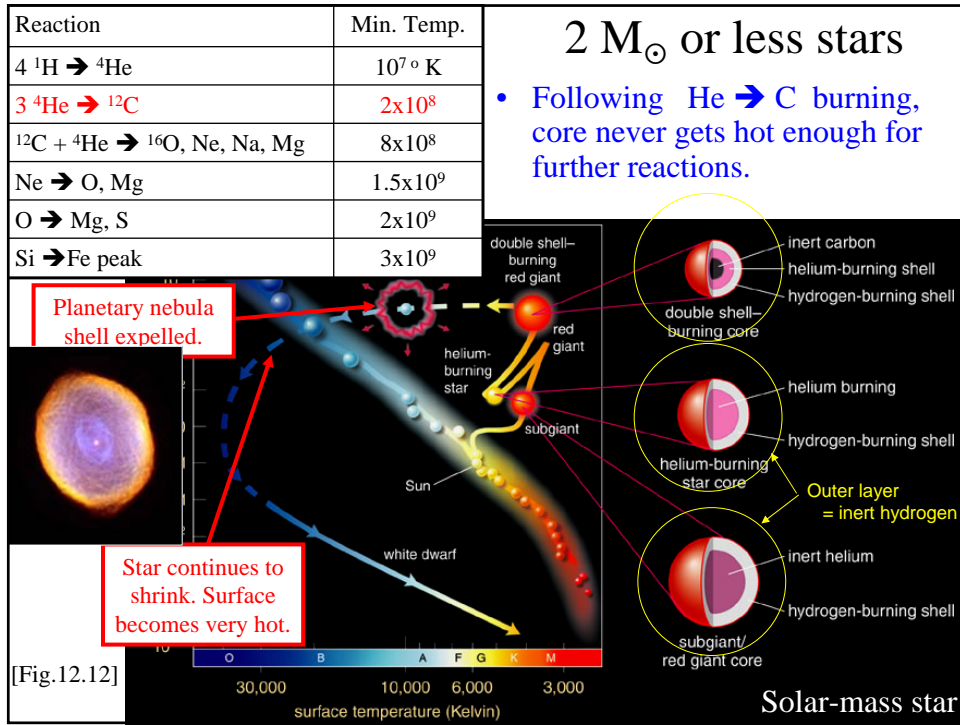
- Up until iron (Fe).



Periodic Table is in order of complexity





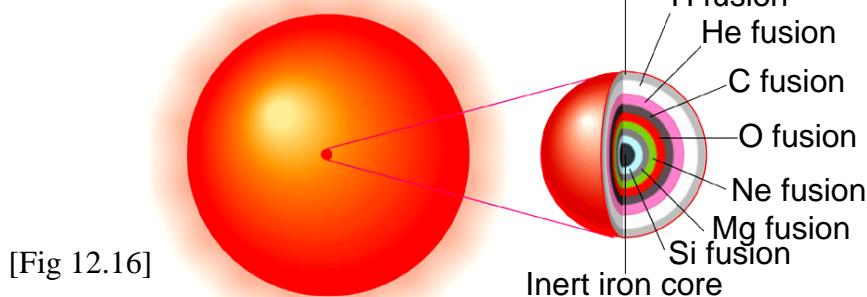


But in more massive stars ( $>2 M_{\odot}$ )...  
nuclear burning in successive shells

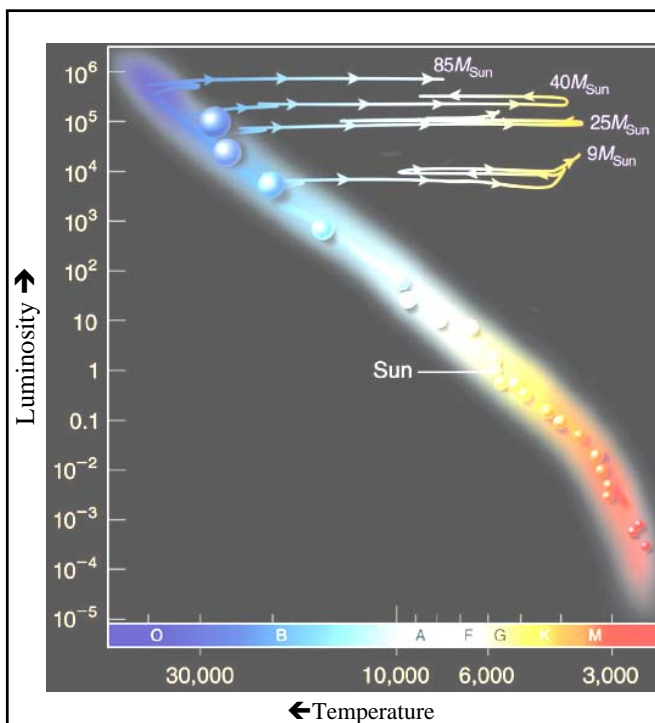
Reaction	Min. Temp.
$4 \text{ } ^1\text{H} \rightarrow \text{}^4\text{He}$	$10^7 \text{ } ^\circ\text{K}$
$3 \text{}^4\text{He} \rightarrow \text{}^{12}\text{C}$	$2 \times 10^8$
$\text{}^{12}\text{C} + \text{}^4\text{He} \rightarrow \text{}^{16}\text{O, Ne, Na, Mg}$	$8 \times 10^8$
$\text{Ne} \rightarrow \text{O, Mg}$	$1.5 \times 10^9$
$\text{O} \rightarrow \text{Mg, S}$	$2 \times 10^9$
$\text{Si} \rightarrow \text{Fe peak}$	$3 \times 10^9$

“Onion skin” model

- Central core is iron
- Outer layers correspond to each previous step in nuclear burning chain.



[Fig 12.16]



Here’s what happens on the H-R diagram for stars with  $> 2 M_{\odot}$ .

[Interactive HR Diagram](#)

[HR – The Movie](#)

[Fig. 12.14]