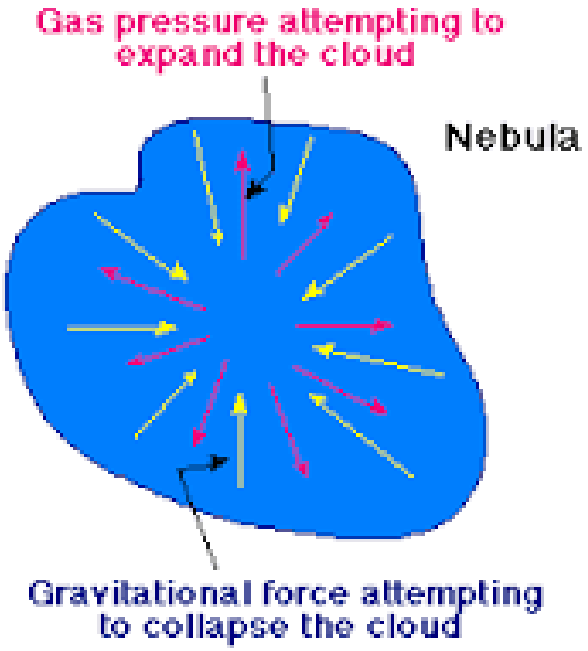
Option D4

Fusion

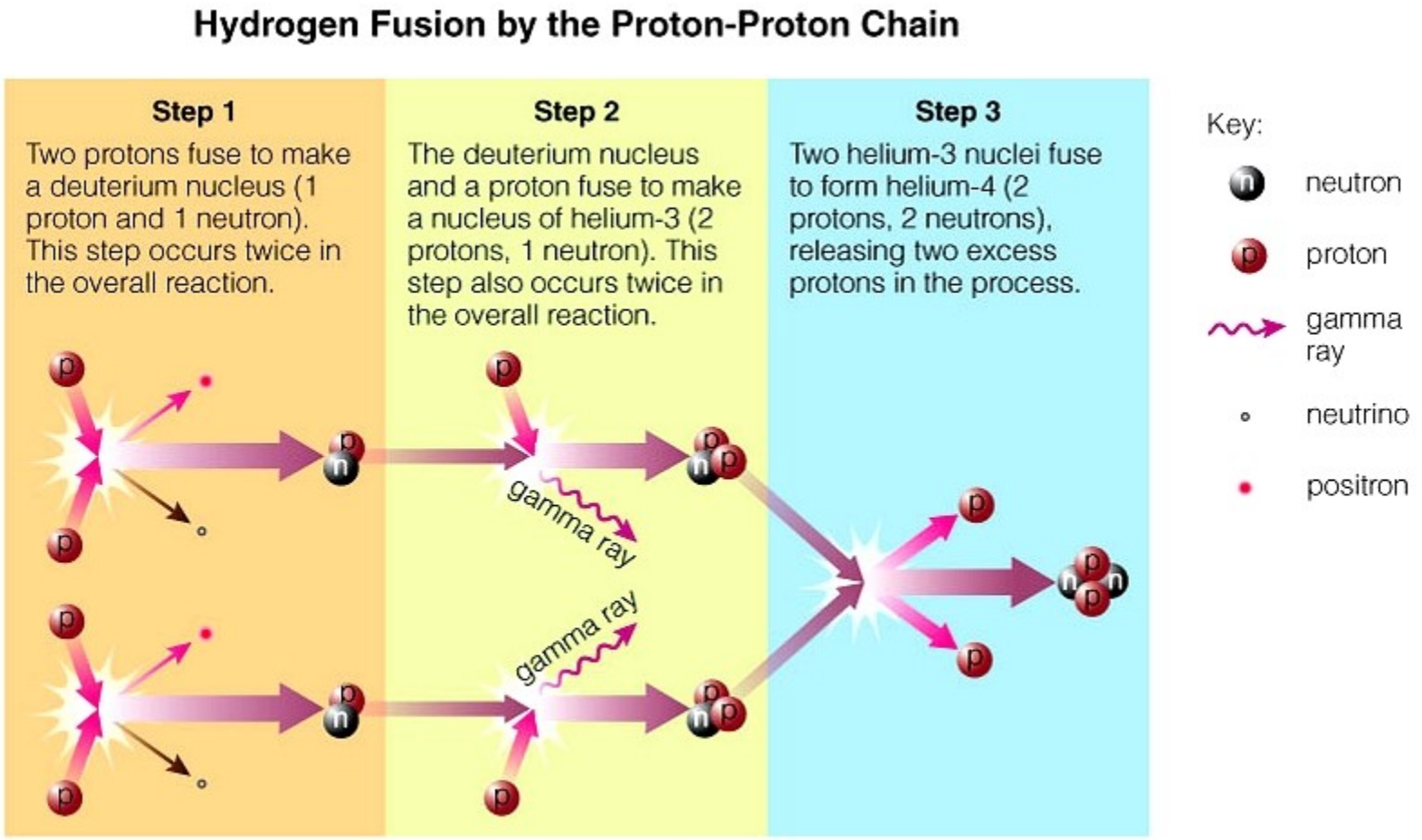
Jeans criterion

- Star formation starts when gravitational energy exceeds thermal kinetic energy for a gas cloud

$$\frac{GM^2}{r} \geq \frac{3}{2} NkT$$

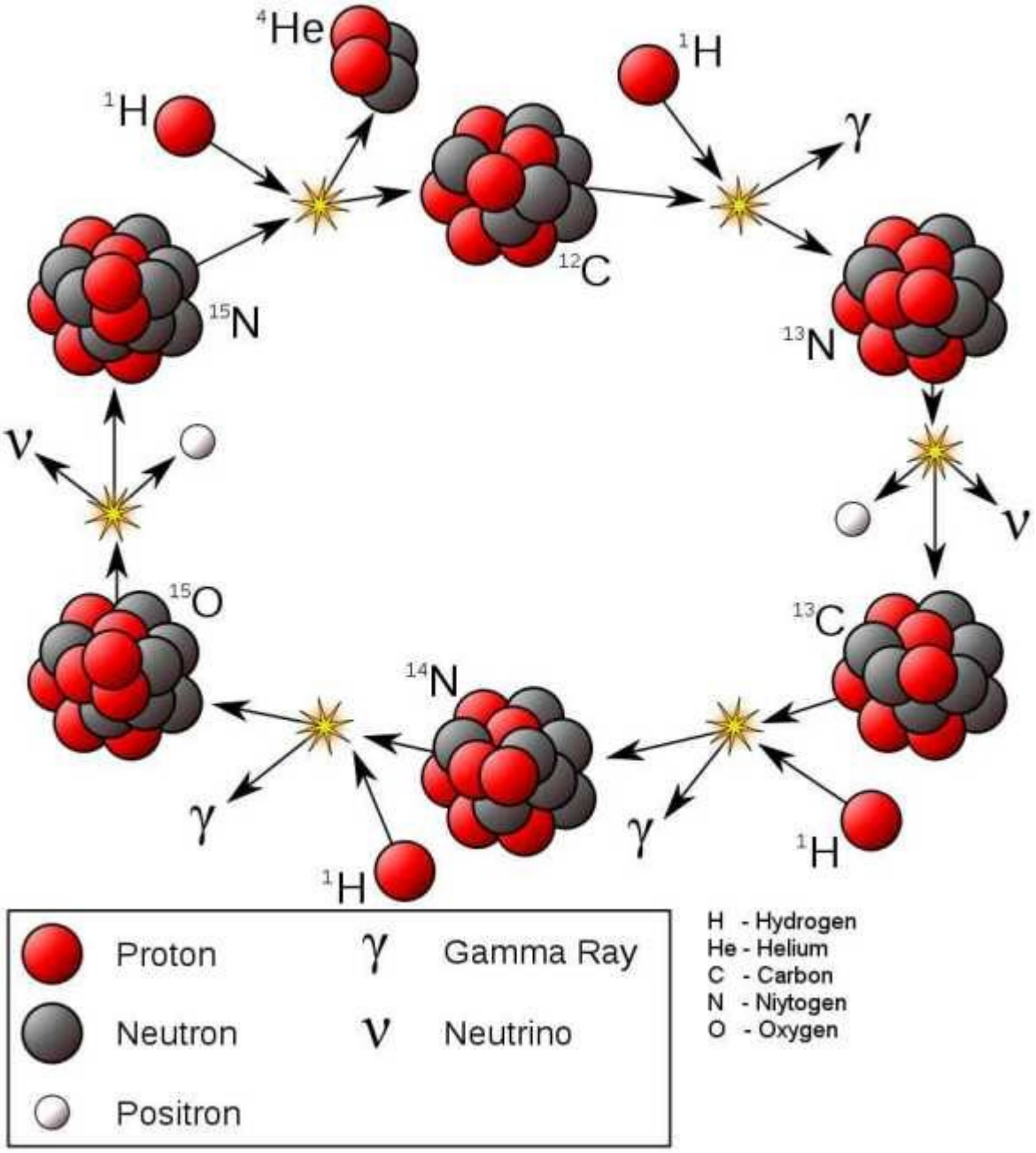


Proton Proton chain



CNO cycle

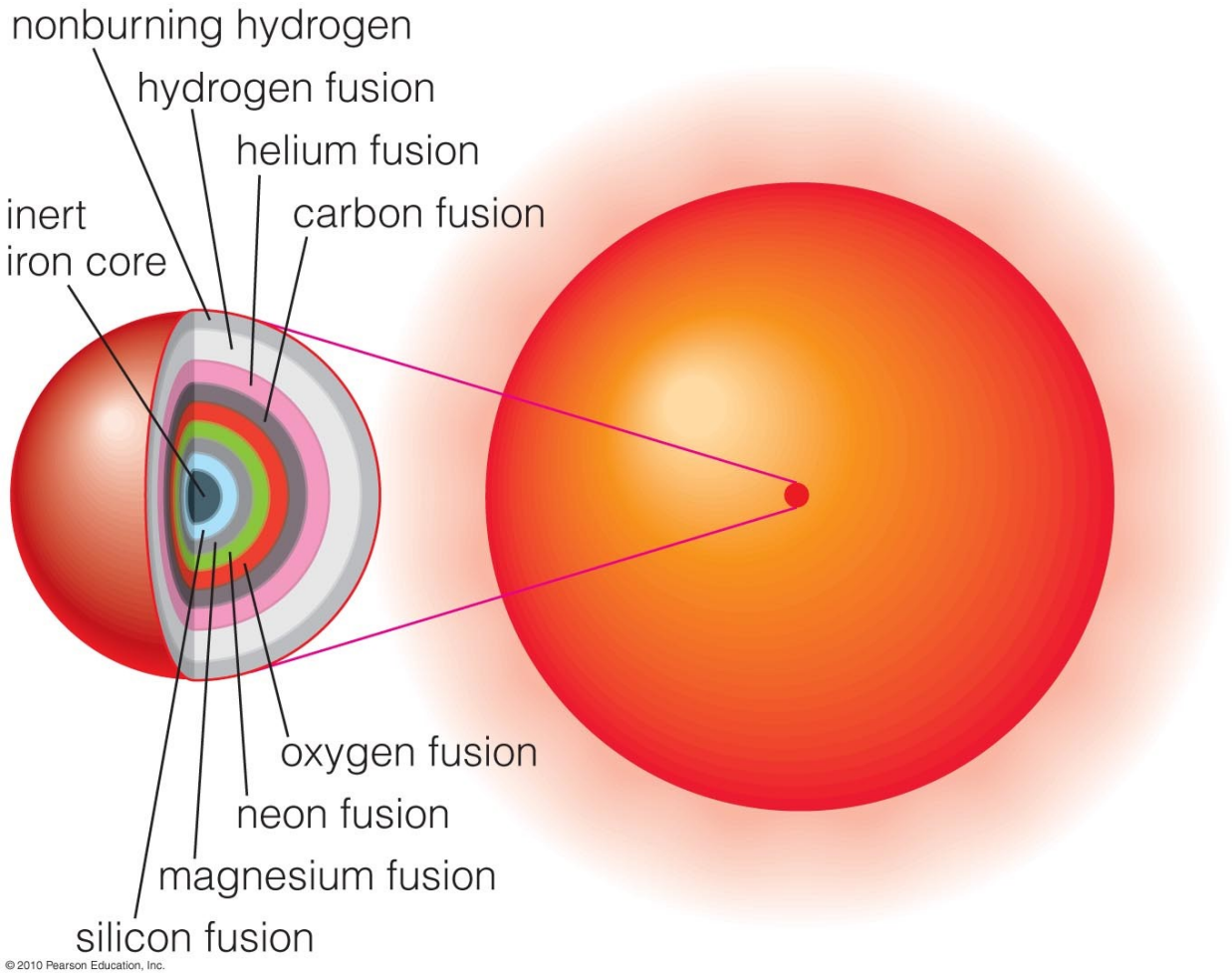
- Only for higher mass stars



After main sequence?

$$^4He + {}^4He \rightleftharpoons {}^8Be$$
$$^8Be + {}^4He \rightarrow {}^{12}C + \gamma$$

- Triple alpha process
- This continues to iron for a high mass star



Mass luminosity relationship

- Ex: Rigel is 18 M_s. What is its luminosity?
- How much shorter is its life?

$$L \propto M^{3.5}$$

$$L \propto 18^{3.5} = 25000$$

Mass luminosity relationship

- Ex: What is the mass of a red dwarf with 10^{-4} Ls?
- Could Jupiter be a red dwarf?

$$L \propto M^{3.5}$$

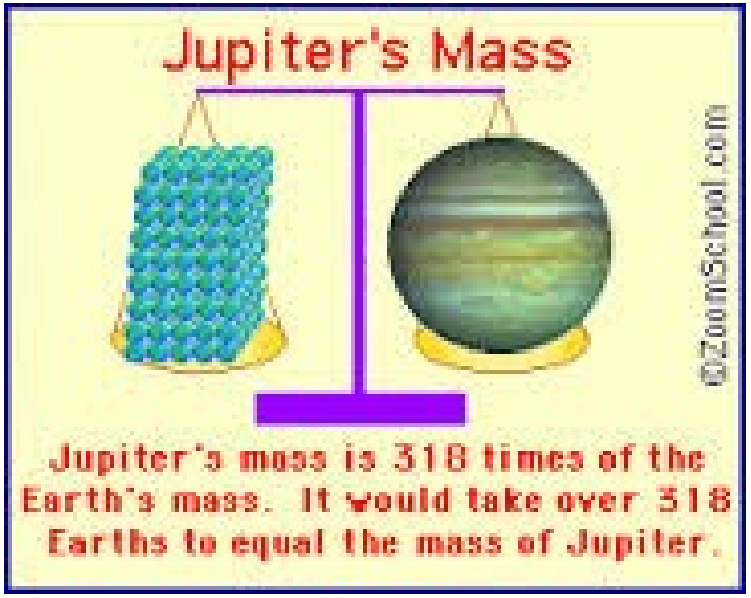
$$M \propto L^{1/3.5}$$

$$M \propto \left(10^{-4}\right)^{1/3.5} = 0.072$$

$$M = 0.072 \times 1.98 \times 10^{30}\, kg$$

- How many Jupiters to make a red dwarf?

$$\frac{M_{RD}}{M_J} = \frac{1.4\times10^{29}\,kg}{1.9\times10^{27}\,kg}$$



$$75 Jupiters$$