BRIEF

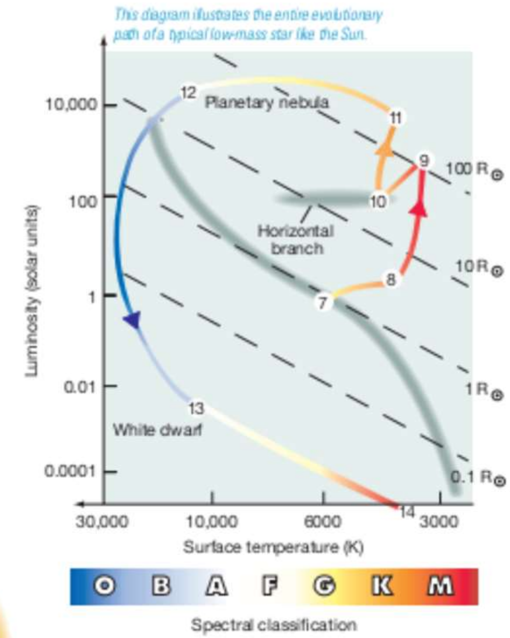
HR DIAGRAM
Stellar Death High Mass Stars

Overview

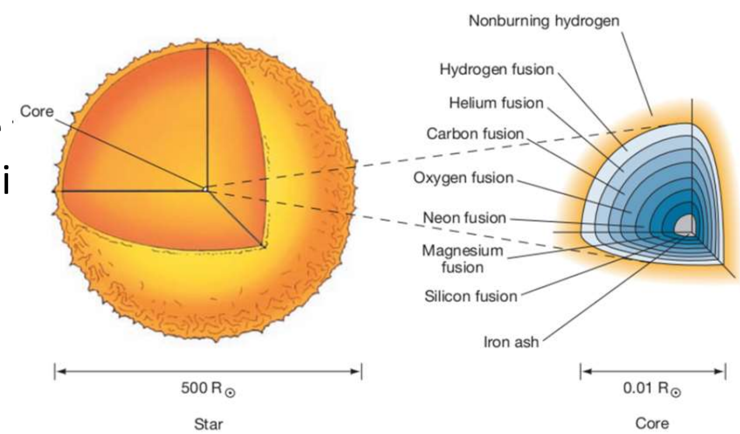
Previous lessons have outlined stellar evolution to Helium fusion.

The lifecycle after Helium fusion depends on a star's mass.

The image to the right shows the varying layers of fusion that a star can attain depending on its mass.

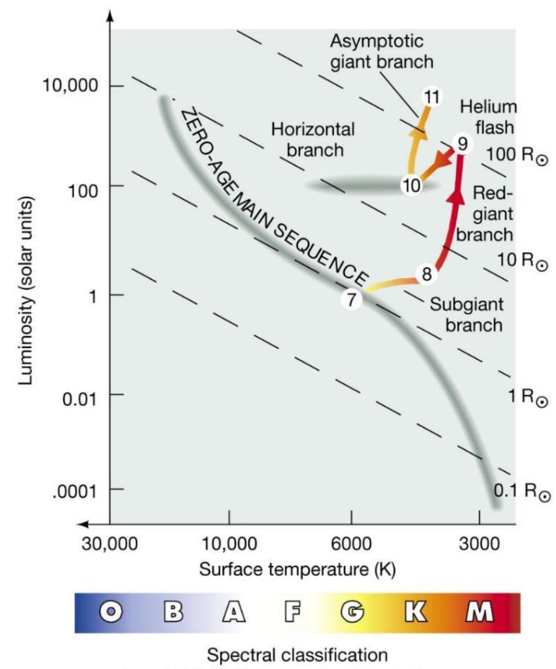


NOTE: Many of today's images will come
Astronomy Today by Chaisson and McMi



Review


High Mass
Stars Here
What's Your Mass?
Low Mass
Stars Here


Asymptotic
giant branch
Helium
flash
Horizontal
branch
ZERO-AGE MAIN SEQUENCE
Red-
giant
branch
Subgiant
branch
100 R⊙
10 R⊙
1 R⊙
0.1 R⊙
10,000
100
1
0.01
.0001
Luminosity (solar units)
30,000
10,000
6000
3000
Surface temperature (K)
O B A F G K M
Spectral classification
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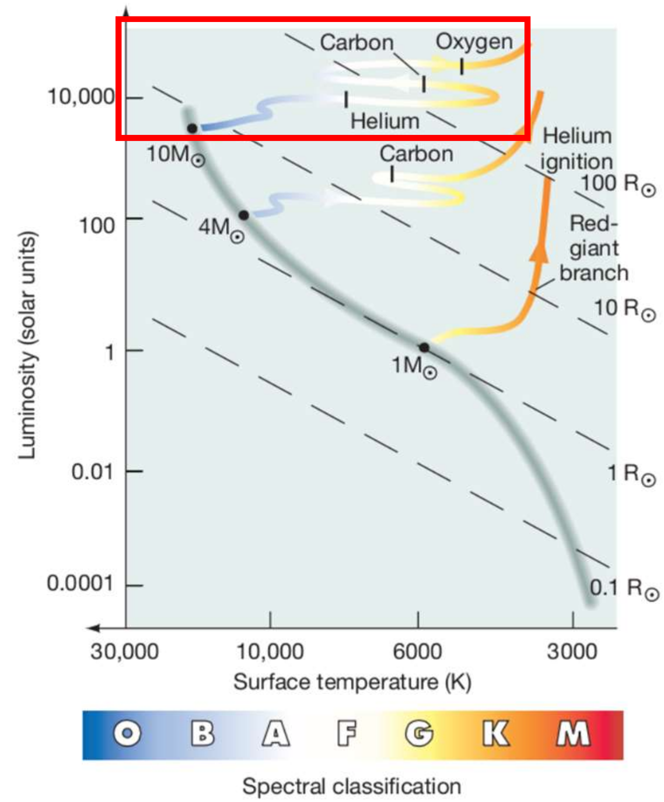
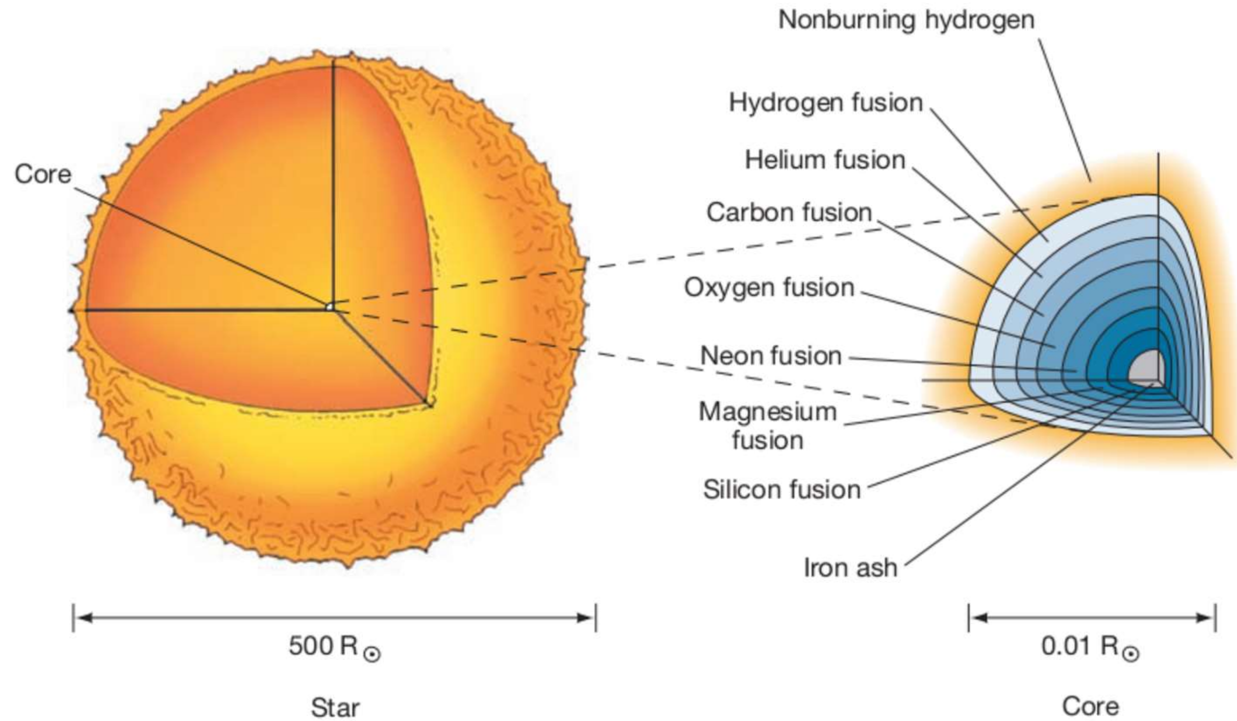
High Mass Stars

- Due to mass, have more stable evolution from one fusion process to the next
    - Degeneracy is not achieved as we saw in Low Mass stars



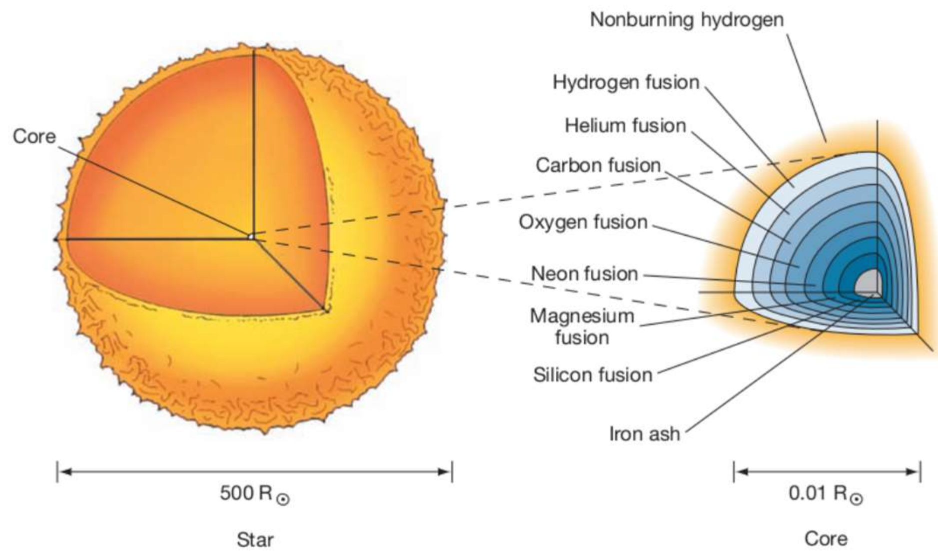
High Mass Stars

- Due to mass, have more stable evolution from one fusion process to the next
- For a $20M_{\odot}$ star, roughly, it burns:
  - Hydrogen for 10M years
  - Helium fro 1M years
  - Carbon a few thousand
  - Oxygen 1 year
  - Silicon for a week
  - Iron for less than a day



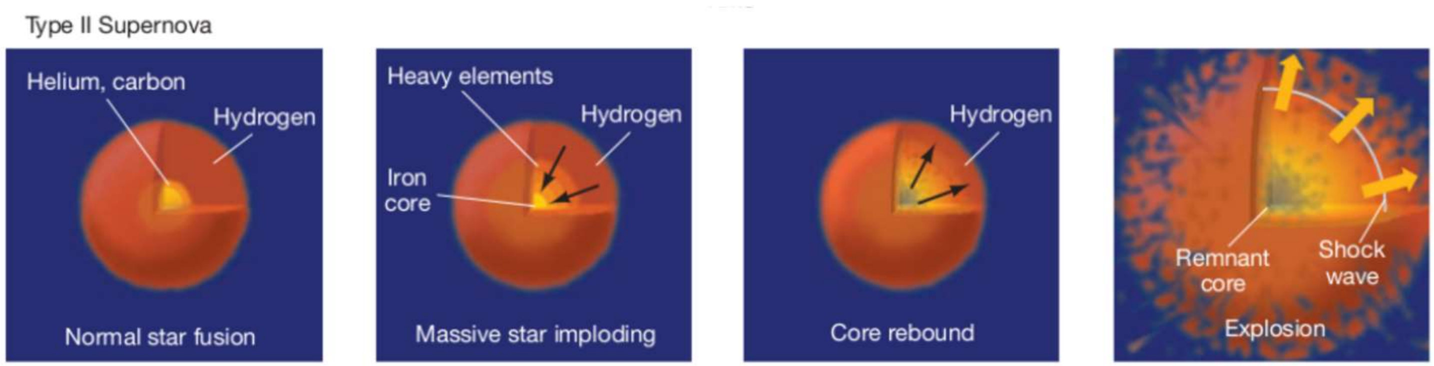
The Iron Core

- Iron is the most stable atom
- Iron represents the point at which energy can no longer be extracted either by Fusion or Fission (the opposite of Fusion)
- Iron thus acts as a "fire extinguisher" dampening the fusion in the core
- With the "fire" out a star can no longer reach an equilibrium
- Despite temps around a few billion K, Gravity will win the tug-o-war
- The star will begin to implode



High Mass Stars

- When Iron begins to fill the core: Central fires (fusion) is extinguished
- Previously, Gravity and Pressure held a delicate balance
- Without pressure from the temperature expansion created by fusion, the star begins to implode & fall in on itself
- Core collapse raises the internal temp in excess of 10B K
  - This breaks Iron nuclei apart in a process called Photo Disintegration which cools the core thus reducing pressure making it even more unable to oppose gravity
- Gravitational pressure compresses the core to a point where individual elements of the atom touch each other creating very high pressures.



Types of Supernova

Some supernovae contain very little hydrogen, according to their spectra, whereas others contain significantly more.

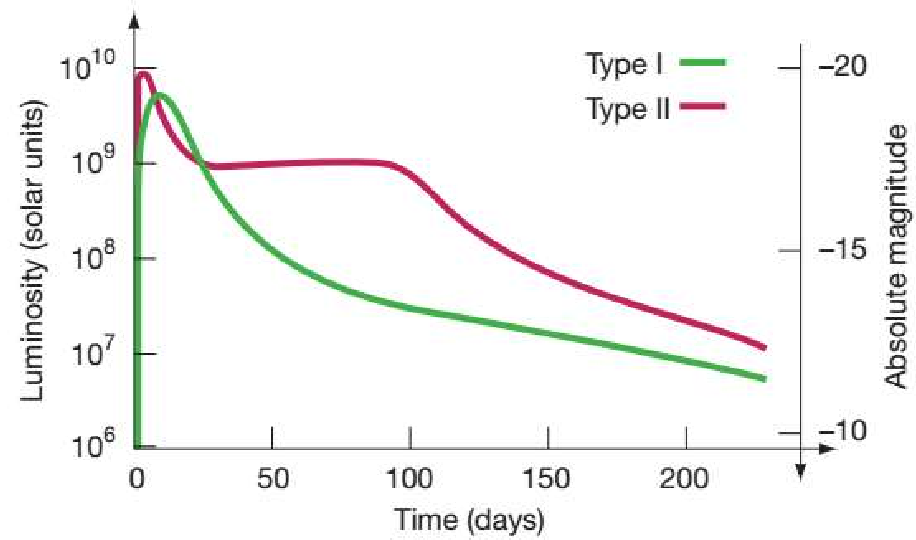
Light curves of the hydrogen-poor supernovae are different from those of the hydrogen-rich ones.

Thus there are two classes: Type I and Type II.

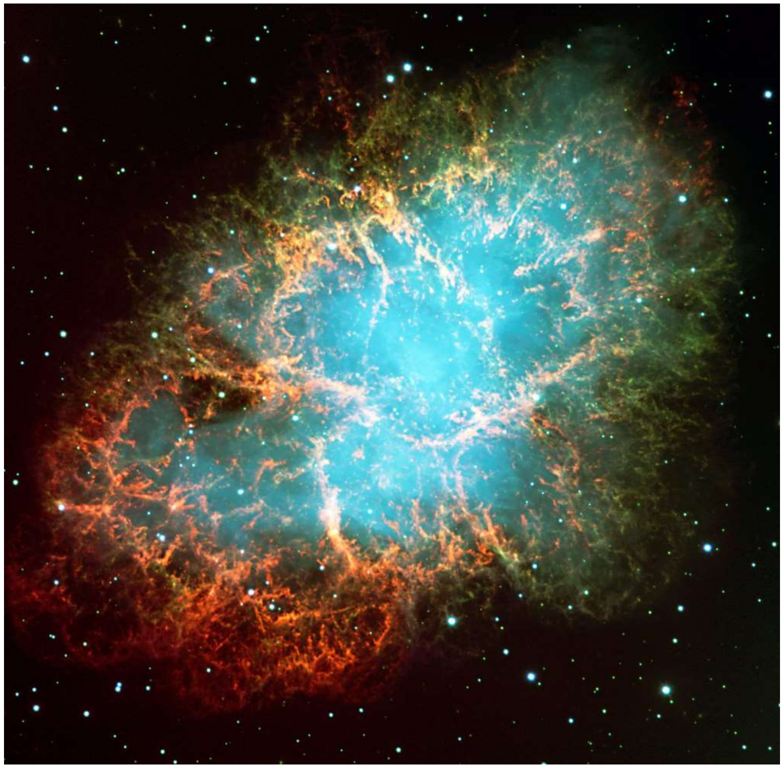
Type I: hydrogen-poor
Type II: Abundance of hydrogen

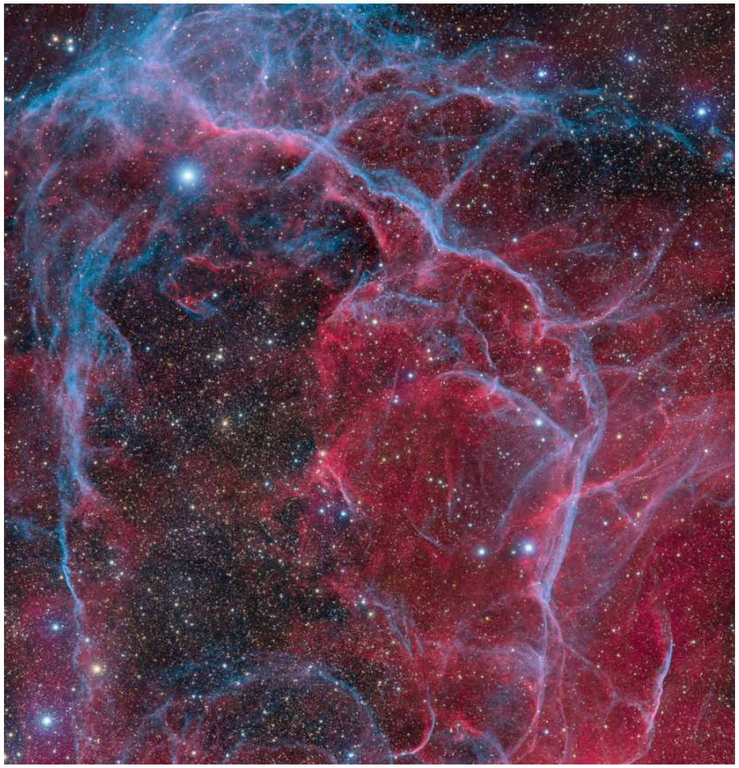
From a light curve perspective, the distinction arises around a couple months after the explosion.

Type II usually have a characteristic plateau in the light curve a few months after the maximum

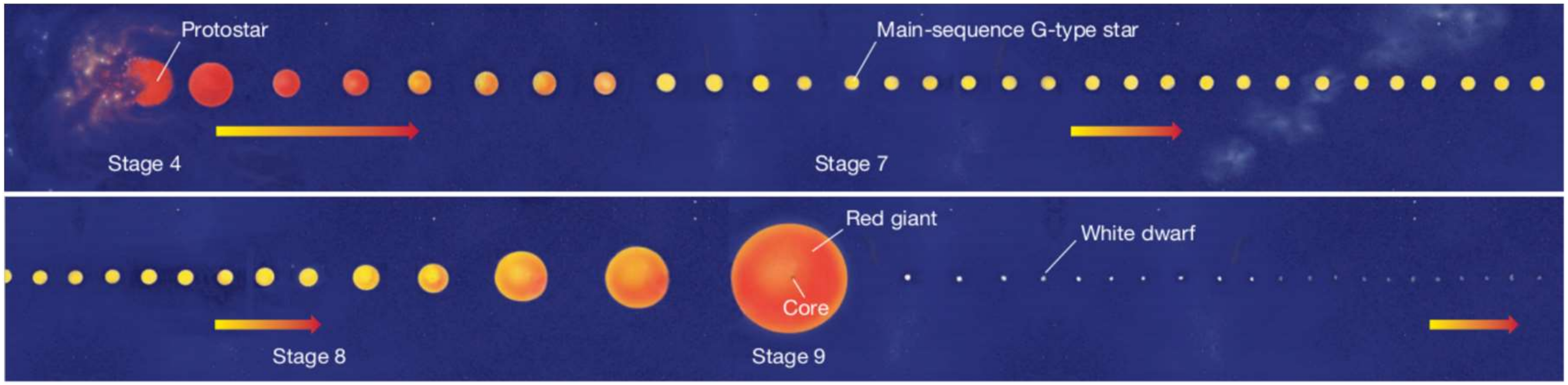


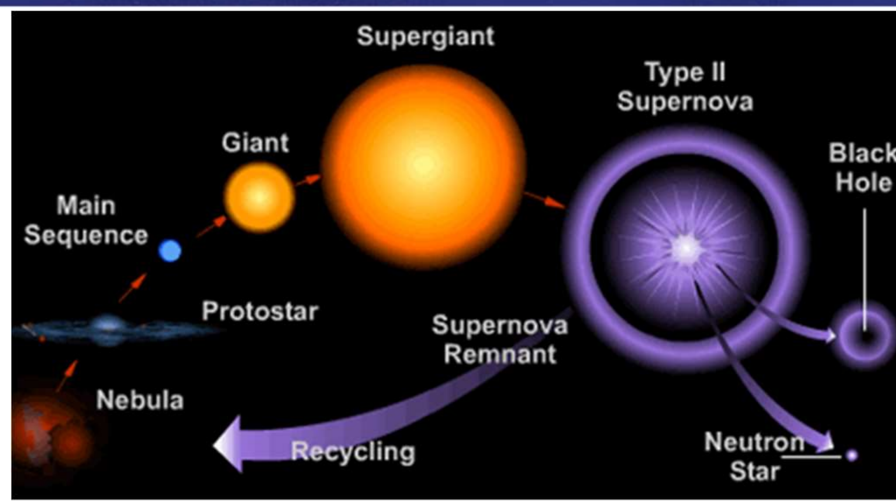
Supernova Remnants





Review and Summary





(Image credit: Brooks/Cole Thomson Learning)

Questions?