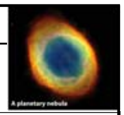
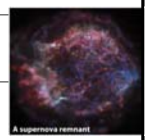
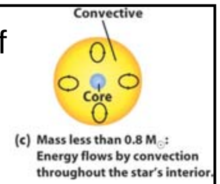
Fate of the stars

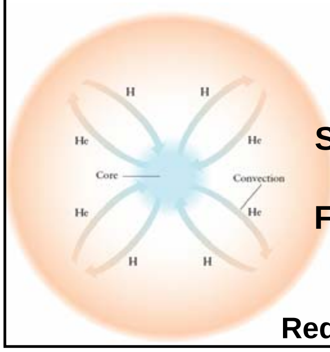


Initial mass (M sun)	Fate of the stars
Less than 1/12	
1/12 – 0.4	



Recall interior structure of the small stars:

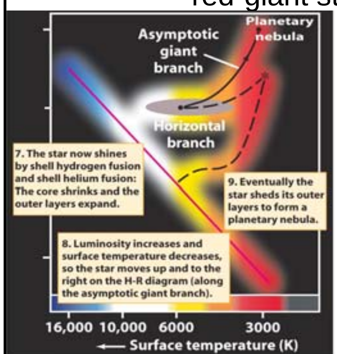




Small stars: less than 0.4 m_{sun} Fully Convective Star

Red Dwarf

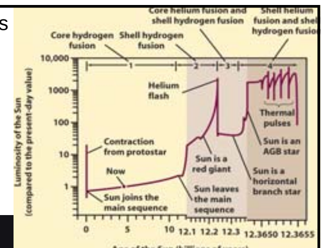
Low-mass stars go through two distinct red-giant stages

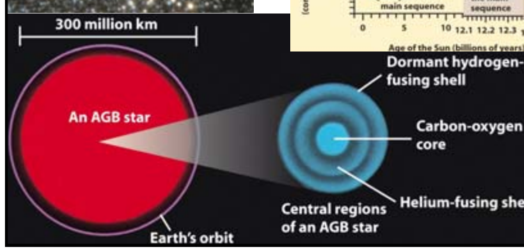


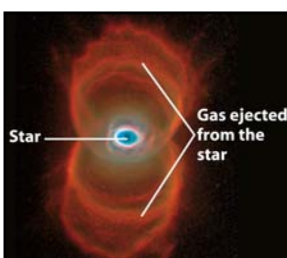
After core helium fusion ends: An AGB star

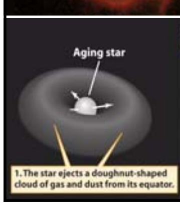
- A low-mass star becomes
  - a red giant when shell hydrogen fusion begins
  - a horizontal-branch star when core helium fusion begins
  - an asymptotic giant branch (AGB) star when the helium in the core is exhausted and shell helium fusion begins

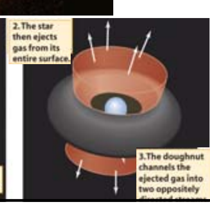
Dredge-ups bring the products of nuclear fusion to a giant star's surface

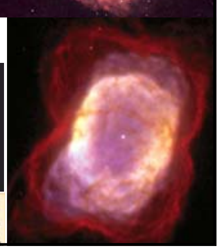






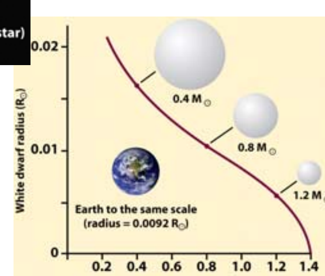


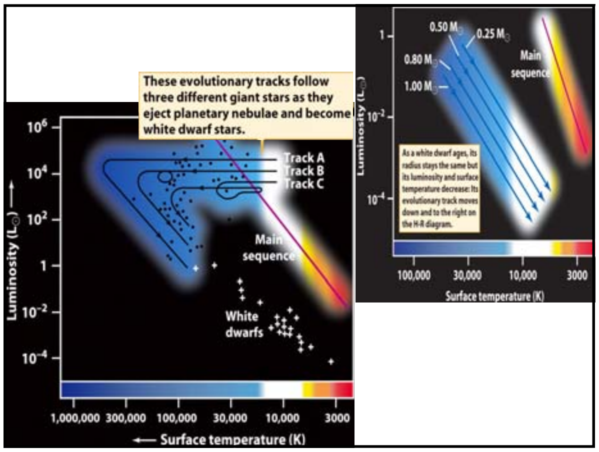




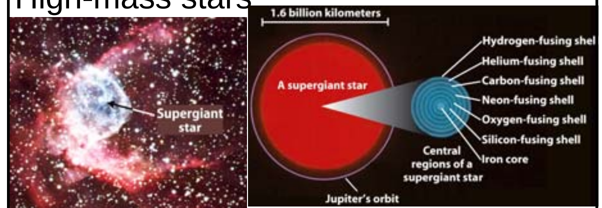
The burned-out core of a low-mass star cools and contracts until it becomes a white dwarf

- No further nuclear reactions take place within the exposed core. No new source of heat
- WD mass is related to its radius inversely.



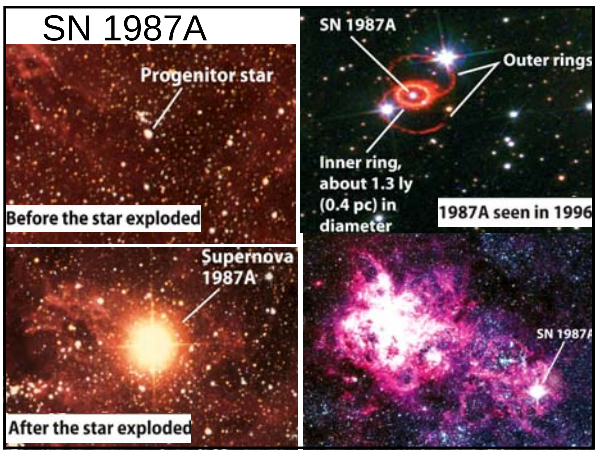


High-mass stars

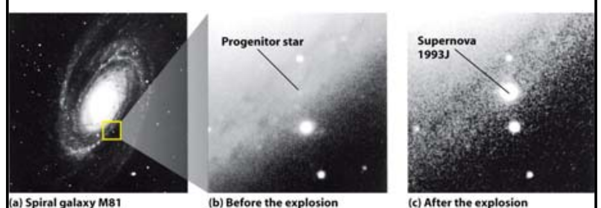


25-M⊙ Stage	Core temperature (K)	Core density (kg/m³)	Duration of stage
Hydrogen fusion	4×10^7	5×10^3	7×10^6 years
Helium fusion	2×10^8	7×10^5	7×10^5 years
Carbon fusion	6×10^8	2×10^8	600 years
Neon fusion	1.2×10^9	4×10^9	1 year
Oxygen fusion	1.5×10^9	10^{10}	6 months
Silicon fusion	2.7×10^9	3×10^{10}	1 day
Core collapse	5.4×10^9	3×10^{12}	¼ second
Core bounce	2.3×10^{10}	4×10^{15}	milliseconds
Explosive (supernova)	about 10^9	varies	10 seconds

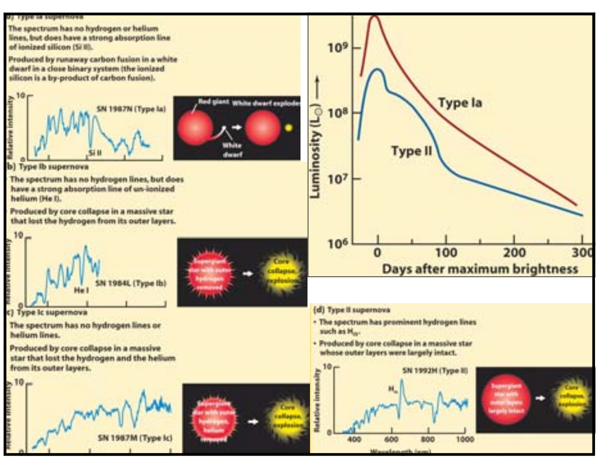
SN 1987A



White dwarfs in close binary systems can also become supernovae



- An accreting white dwarf in a close binary system can also become a supernova when carbon fusion ignites explosively throughout such a degenerate star



Pathways of Stellar Evolution