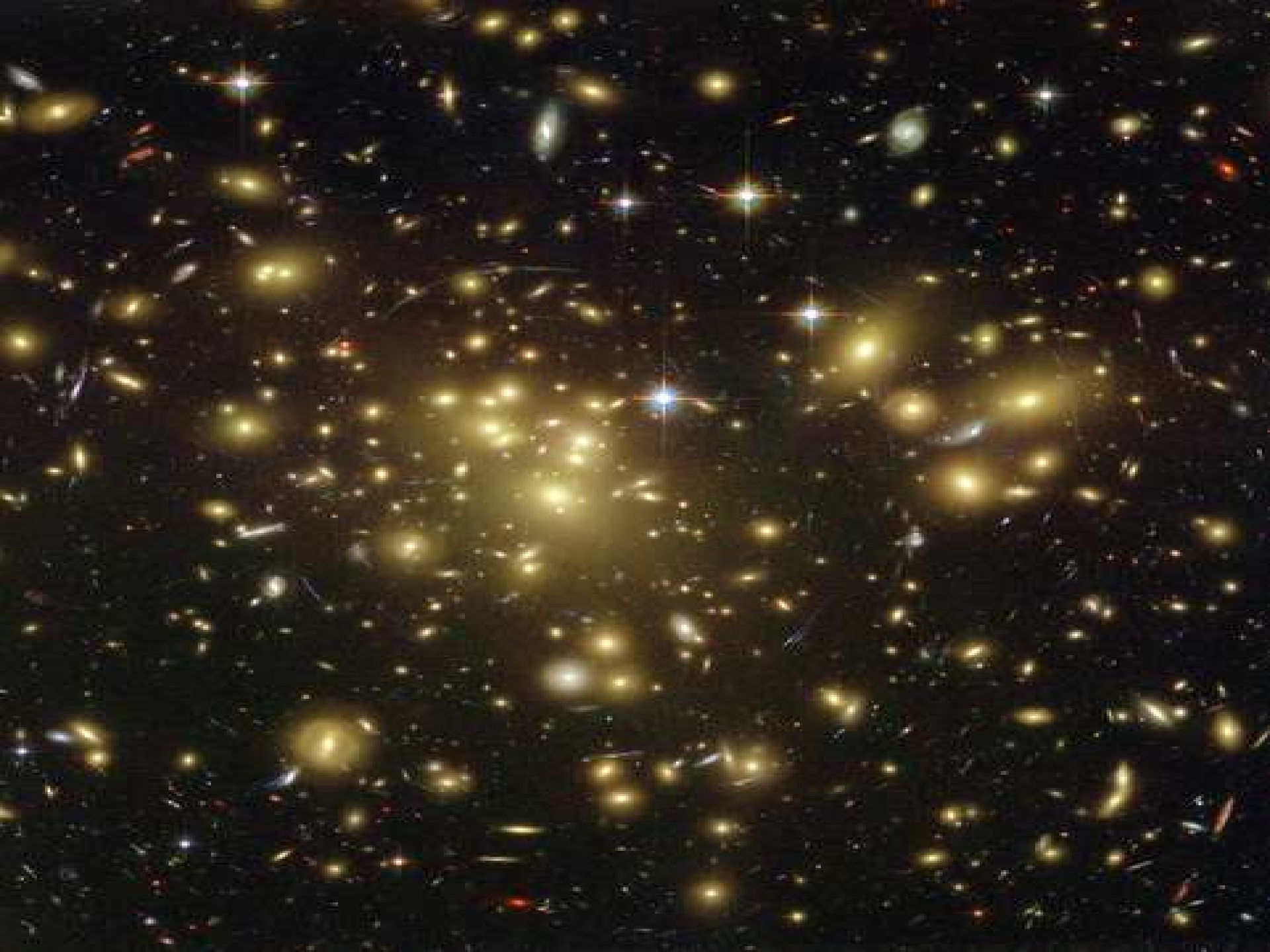
Life Cycle of Stars



Star Birth

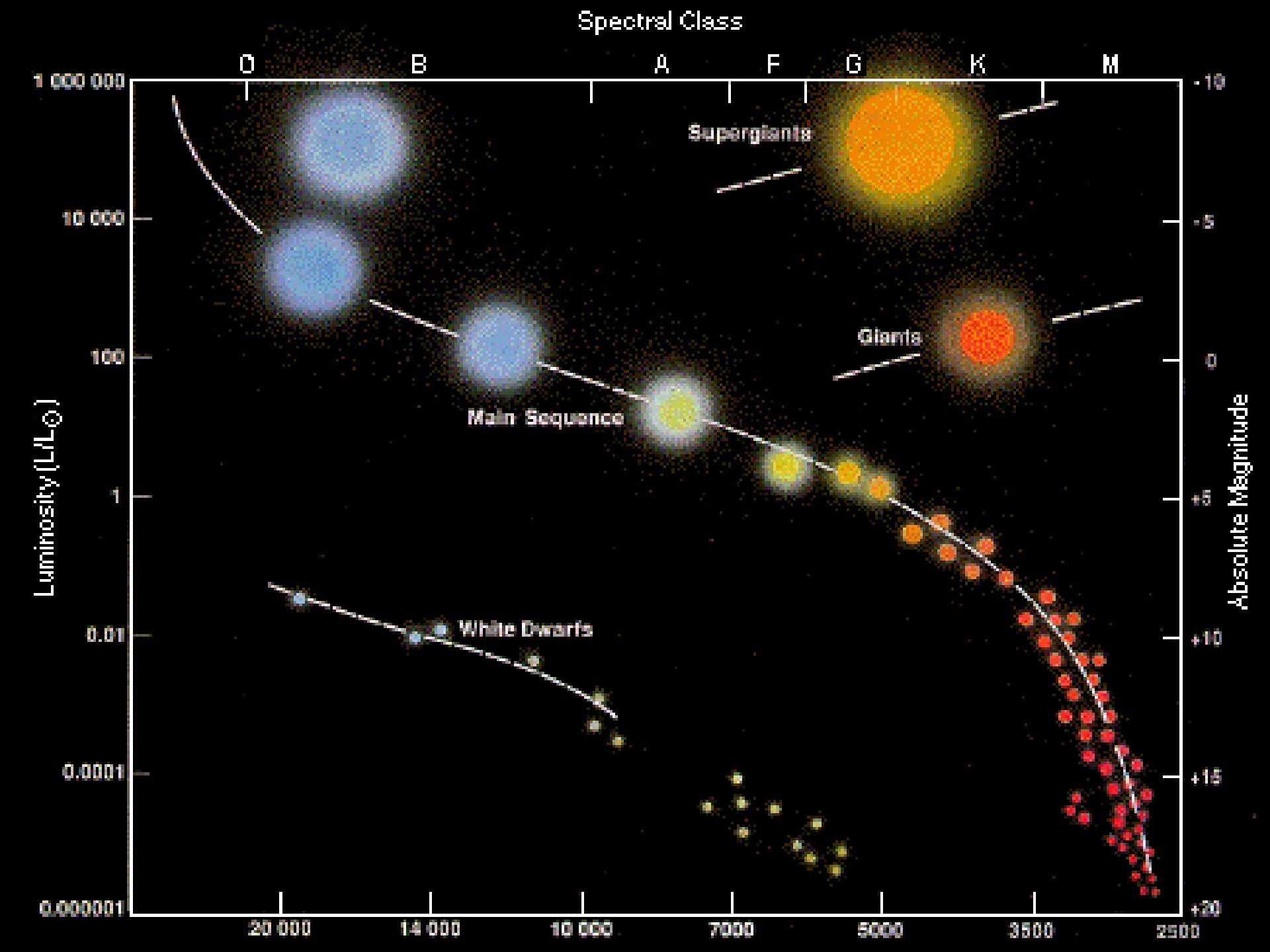
- Develops from nebula
  - Nebula is a collection of dust and gas
- Gravity overcomes pressure
- Gravitational contraction facilitates Nuclear Fusion
- Star is born!

Stellar Mass

- Stellar lives based upon **mass** of star
  - Low-mass = less than 2x's our Sun
  - Intermediate-mass = 2 to 8 solar mass
  - High-mass = greater than 8x's solar mass
- Mass affects temperature and luminosity
- H-R Diagram plots temp and luminosity

H-R Diagram

- Horizontal axis represents temperature
- Vertical axis represents stellar luminosity
- Based upon spectral sequence:
  - OBAFGKM


Spectral Class
O
B
A
F
G
K
M
1 000 000
10 000
100
1
0.01
0.0001
0.000001
Luminosity (L/L⊙)
-10
-5
0
+5
+10
+15
+20
Absolute Magnitude
Supergiants
Giants
Main Sequence
White Dwarfs
20 000
14 000
10 000
7000
5000
3500
2500

Patterns from H-R Diagram

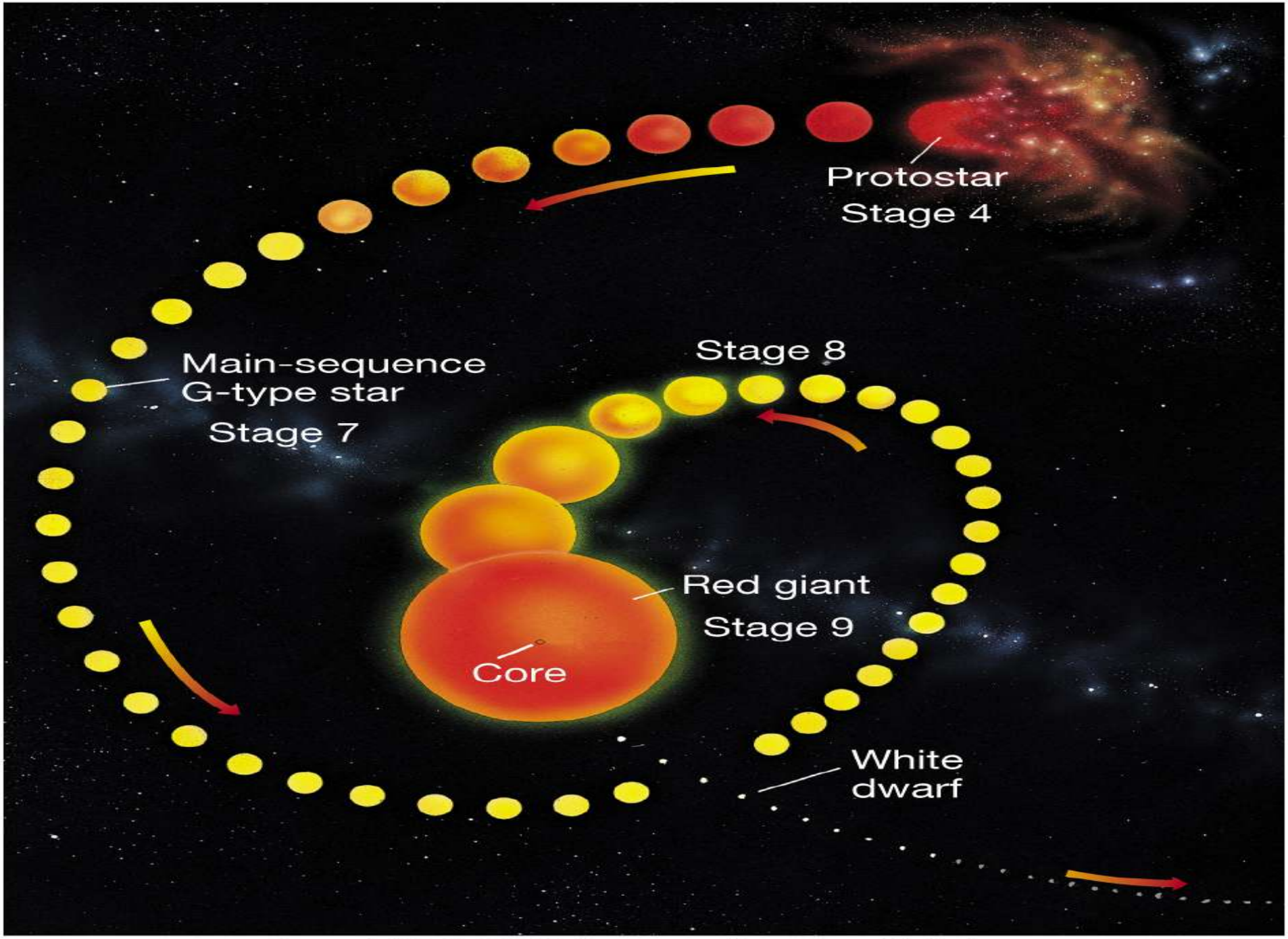
- Most stars fall along the main sequence
  - Line from upper left to lower right corner
- Stars on top are supergiants
  - Large and bright
- Giants located under supergiants
- White dwarfs are located in the lower left

Life of a Low Mass Star

- Spend life as a main sequence star
- Becomes a red giant as hydrogen is depleted
- Expands and collapses to facilitate helium burning
  - Becomes helium burning star
- Becomes a red giant

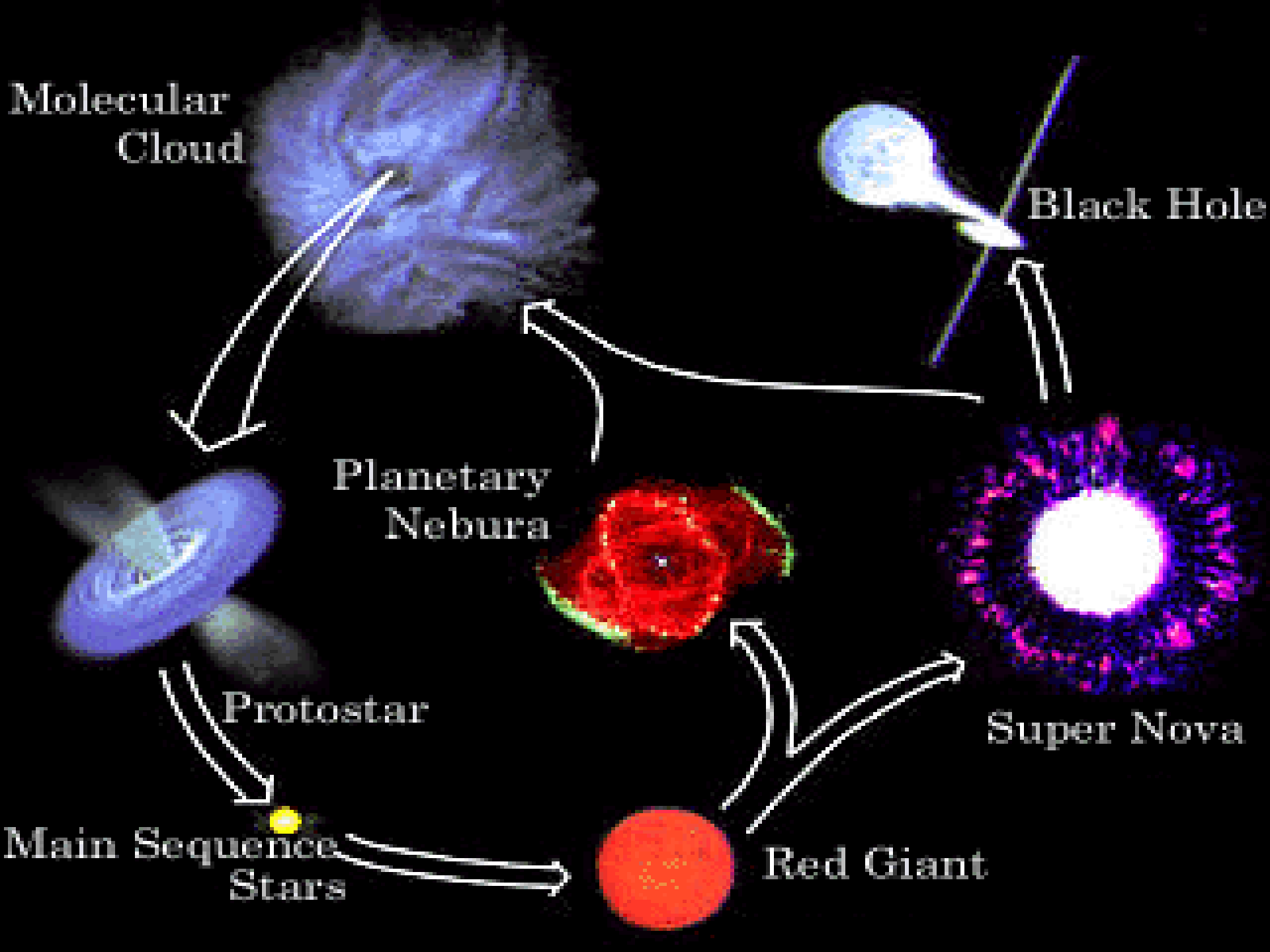
Low mass continued

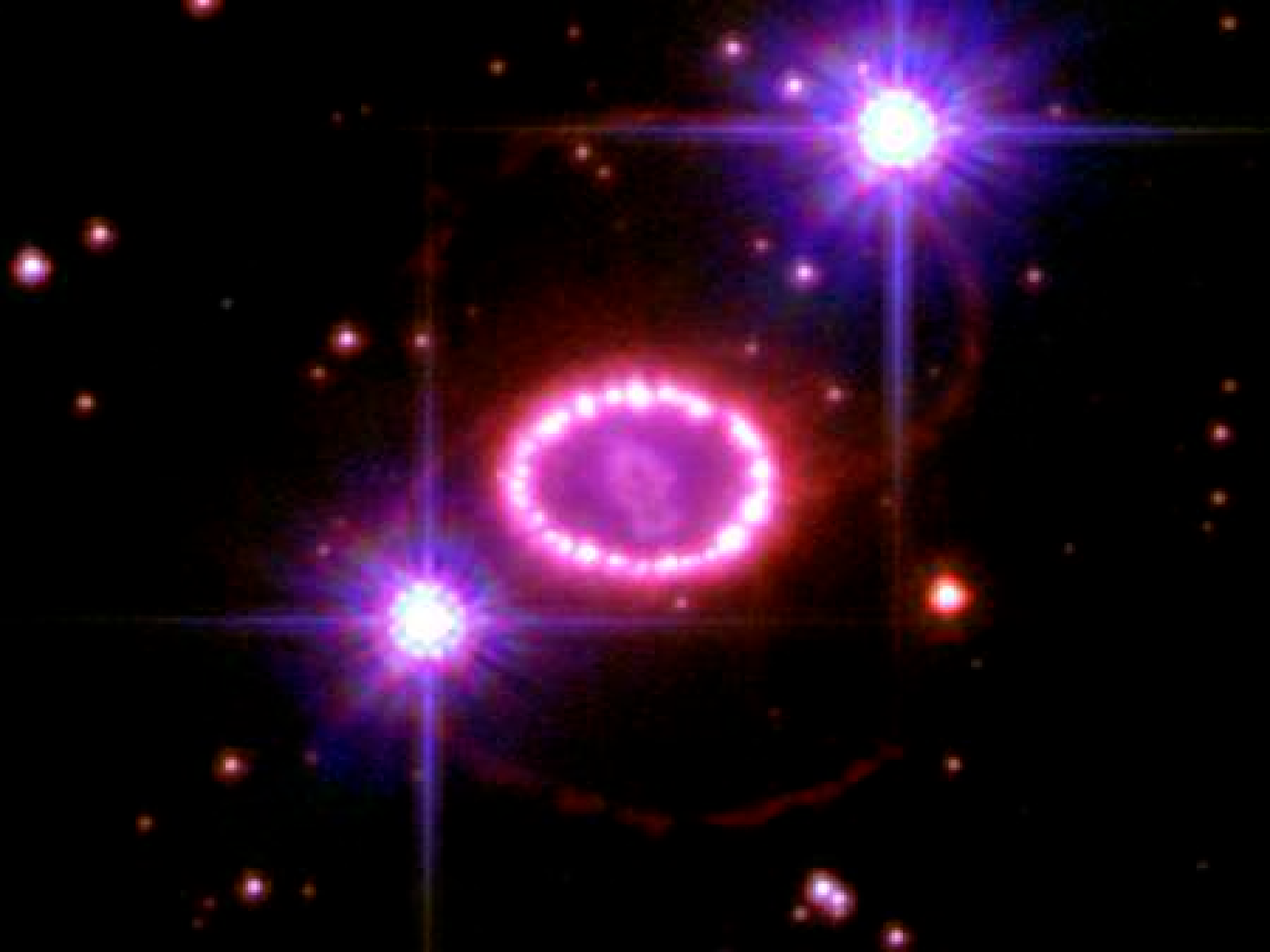
- Outer atmosphere ejected into space forming a planetary nebula
- Star fades into a white dwarf
- Eventually dies out as a black dwarf
- Our sun is a low mass star
- Cycle lasts for billions of years



Life as High-Mass Star = 8x's sun

- Birthed from nebula
- Core contains convective zone
- Nuclear fusion of heavier elements
  - Requires high temperatures
  - More gravitational contraction
- When fusion ceases, gravity causes the core to implode known as a supernova
- More massive, the shorter the life


Molecular Cloud
Black Hole
Planetary Nebura
Protostar
Super Nova
Main Sequence Stars
Red Giant



Stellar Graveyard

- Black holes
  - The collapse of the core of a mass 3x's sun
  - Core collapses without end = Singularity
- Neutron Stars
  - Ball of neutrons created by the iron core of a massive supernova, extremely dense
  - Has a mass as much as 3x's sun
  - **Pulsars** = Neutron star emitting radio waves