
Life Cycle of a Star

What are the stages of a star's life?

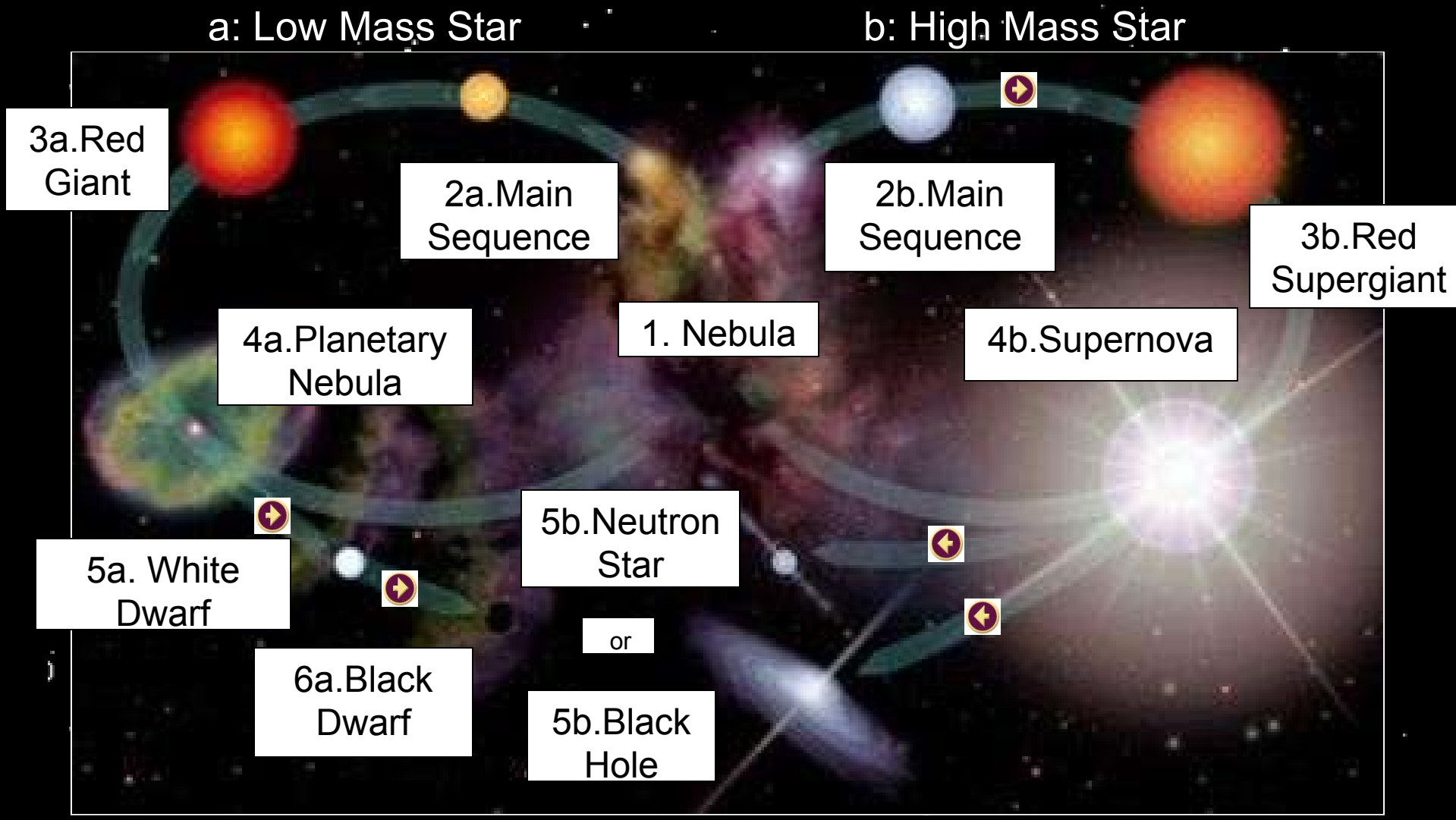
Depends on how they start their life!!!!

High Mass

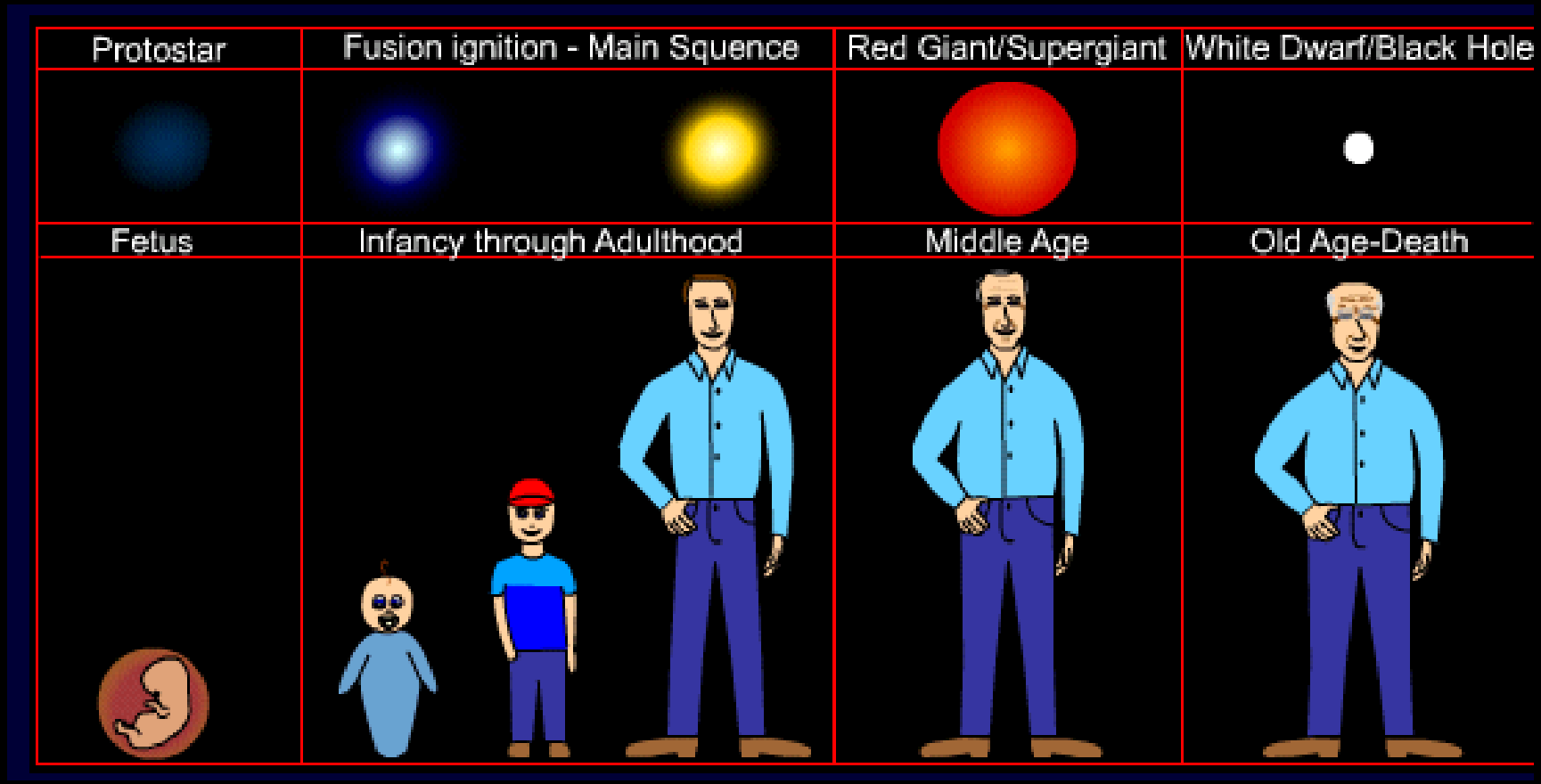
vs.

Low Mass

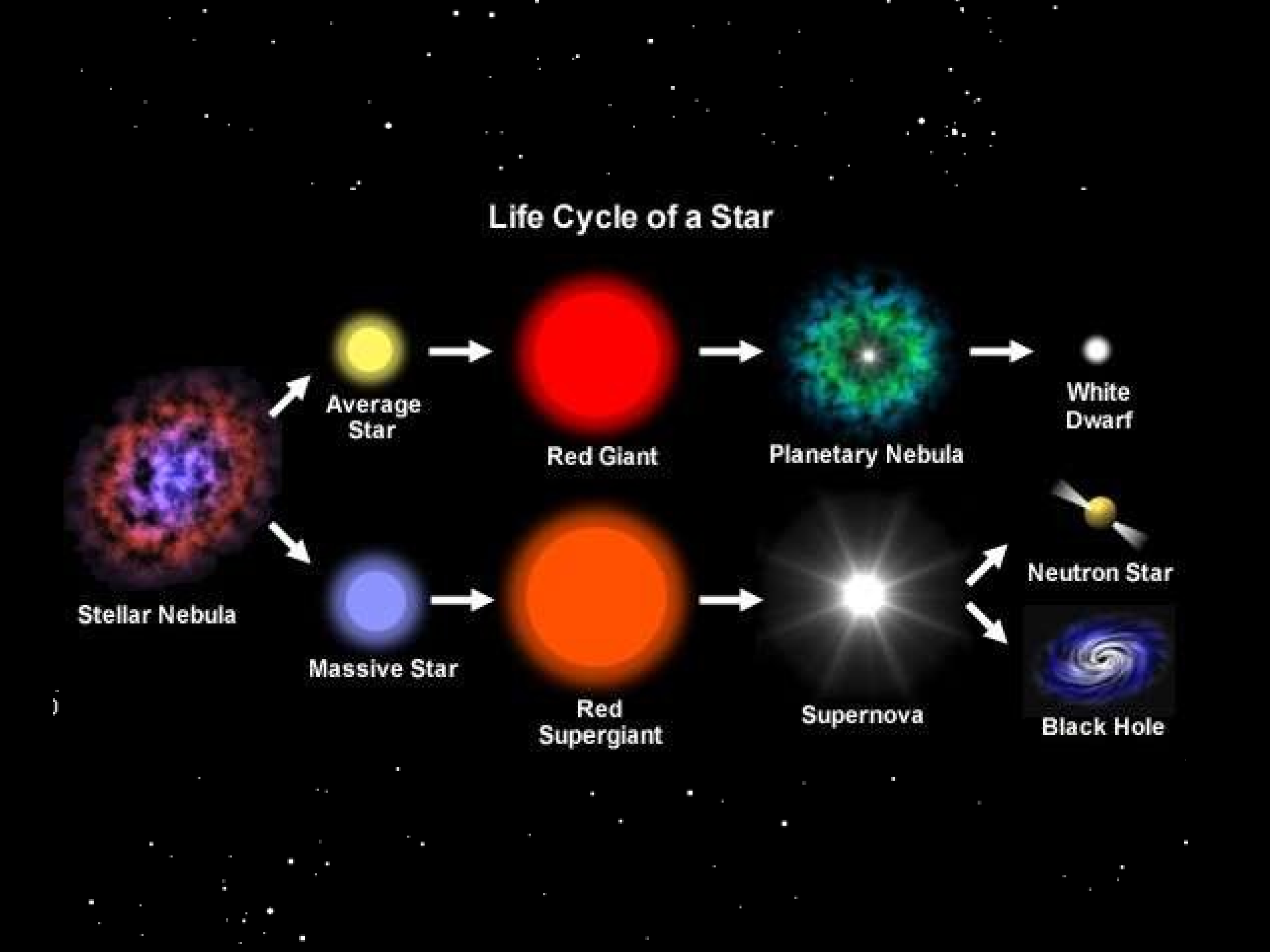
What are the stages ?



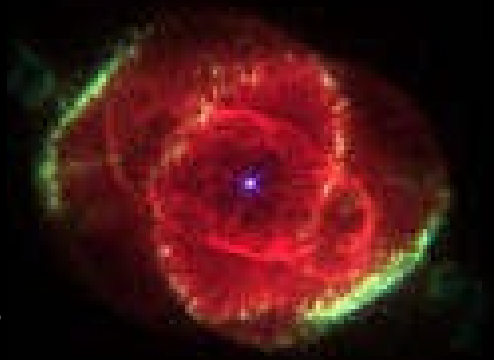
Compared to a Human Life Span



Graphic Courtesy of:
http://aspire.cosmic-ray.org/labs/star_life/starlife_main.html


Life Cycle of a Star
Stellar Nebula
Average Star
Red Giant
Planetary Nebula
White Dwarf
Massive Star
Red Supergiant
Supernova
Neutron Star
Black Hole

What happens during the stages?



Stage 1 – Nebula

- A cloud of dust and gas
- When the gas and dust contracts under gravity, a protostar is born

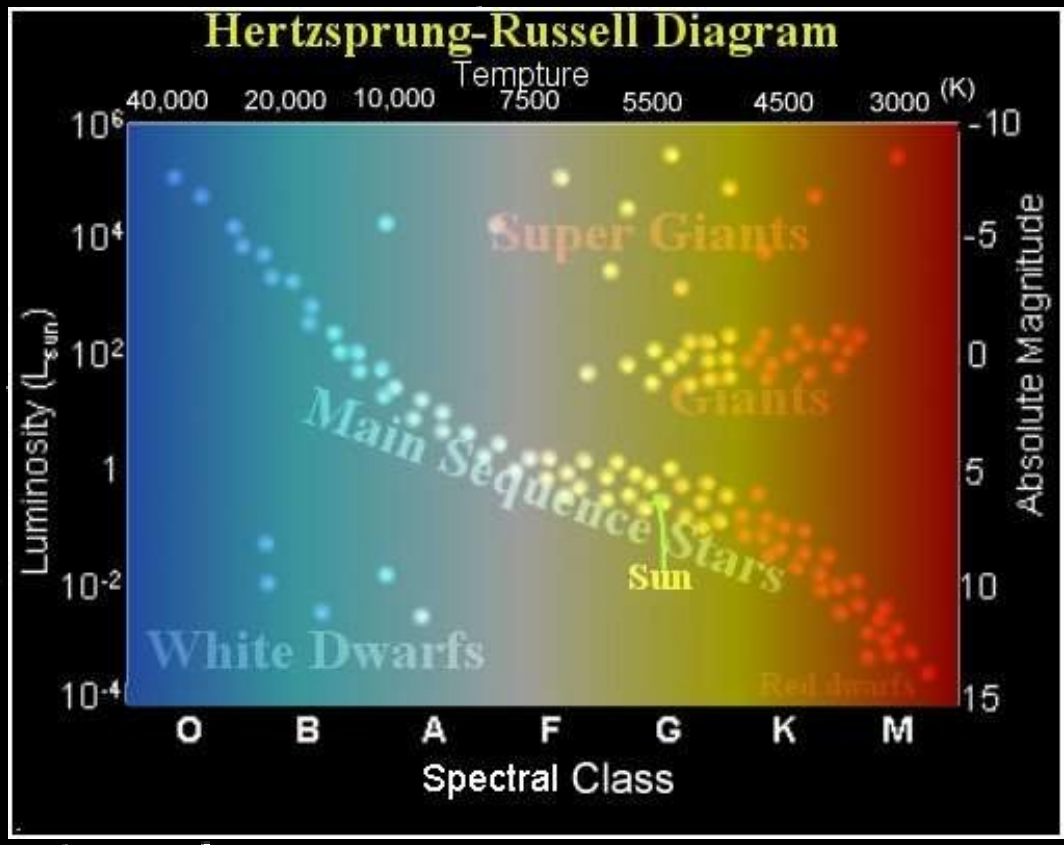
Stage 2 –Main Sequence

Stage 2a

- Star reaches equilibrium (it's stable)
- Can last up to 10 *billion* years

Stage 2b

- Can last less than 1 *million* years

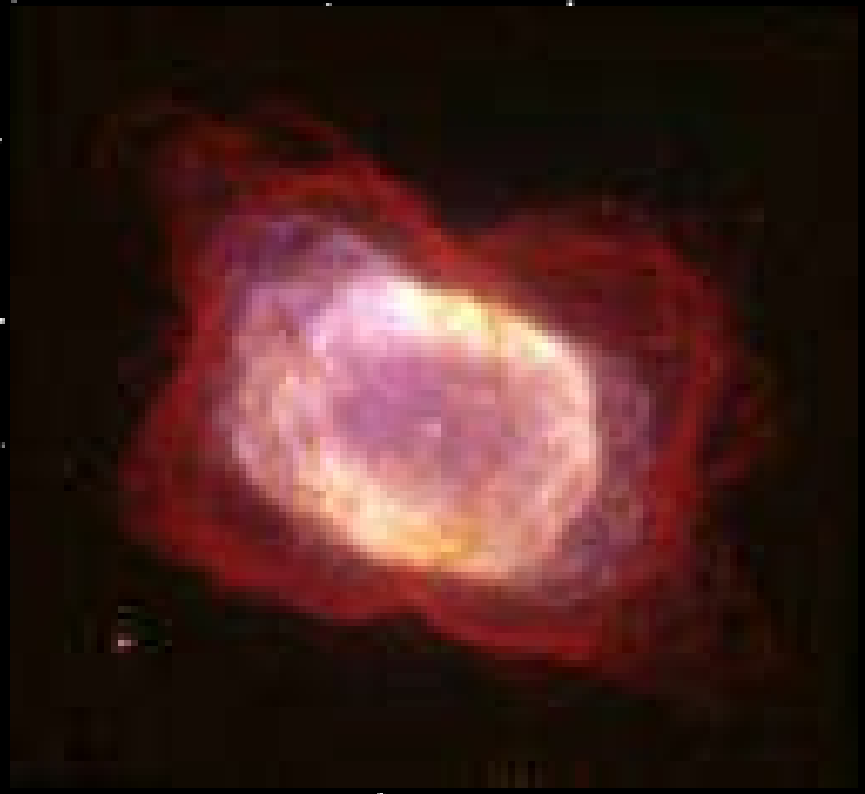


Stage 3a –Red Giant

1. Hydrogen in core is depleted
2. Core contracts and heats up
3. Heat causes the outer layers to expand
4. Expanding causes the layers to cool

4a –Planetary Nebula

1. All helium in the giant has fused into carbon
2. Core collapses again
3. Outer layers of star are expelled into space



5a –White Dwarf

1. Core contracts even more
2. More layers expelled into space
3. Leaves behind only a hot, dense core (about the size of Earth)

6a –Black Dwarf

- A non-radiating ball of gas where fusion has ceased.

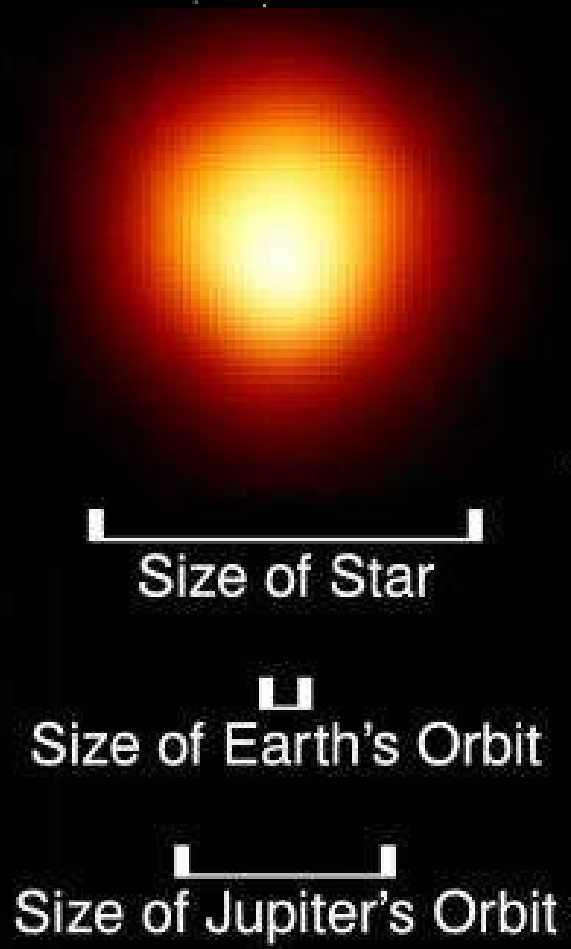
http://aspire.cosmic-ray.org/labs/star_life/hr_interactive.html

-click on “Interactive Lab” graphic in the middle

The Life of Our Sun

Step 3b –Red Supergiant

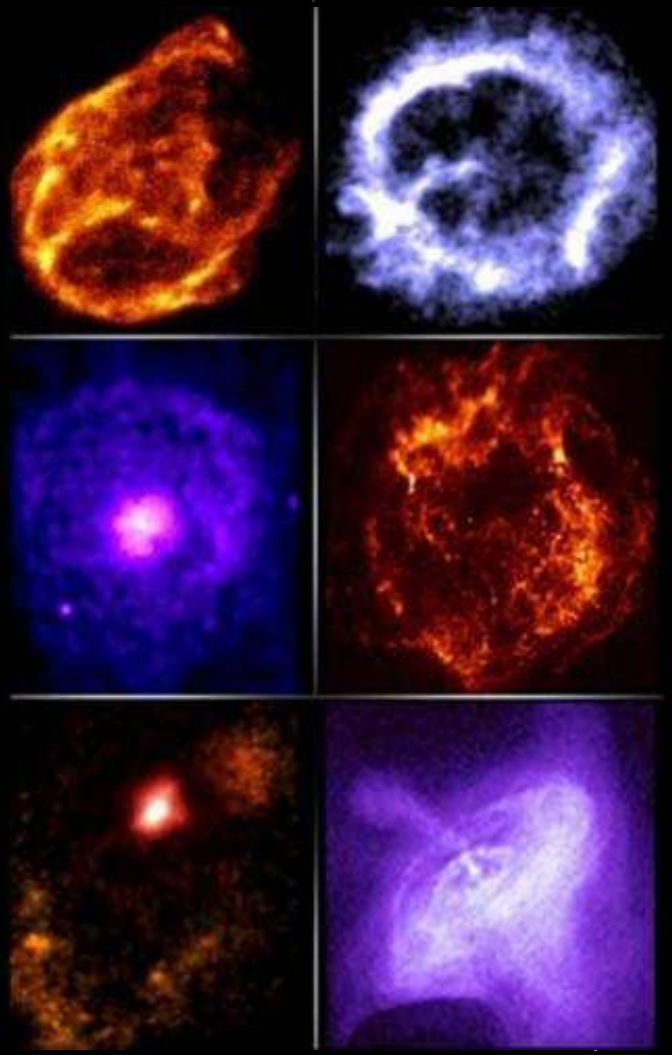
- Hotter, larger and more orange than a red giant



4b -Supernova

- All of the helium in a supergiant has fused into iron
- The core collapses *violently*
- The outer portion of the star explodes

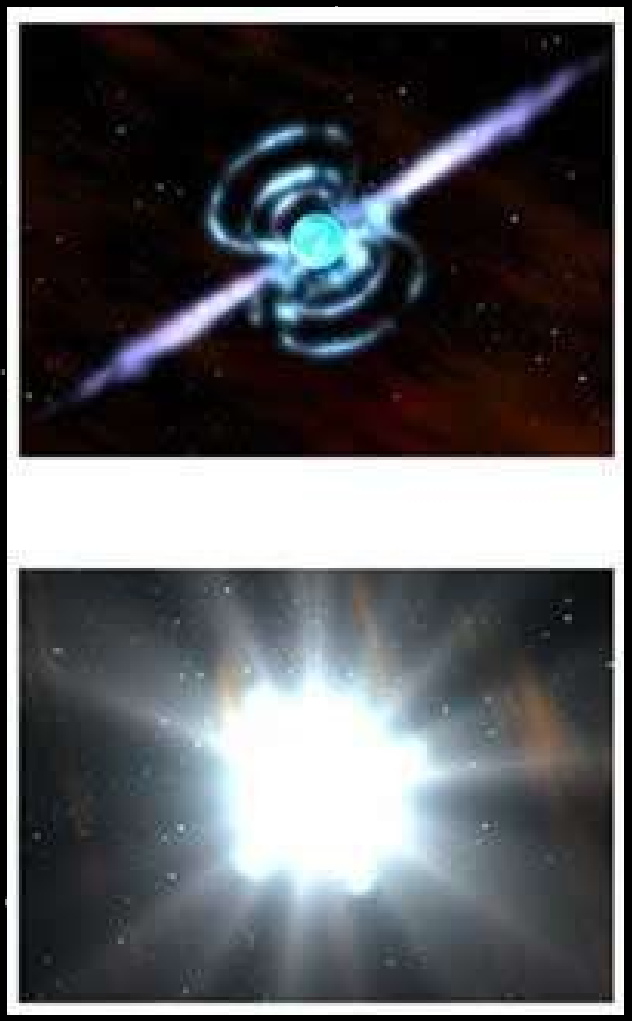
Very Bright!!!!



5b –Neutron Star

If the core of a supernova has 2 times more mass than the sun;

- The core shrinks to 20 km in diameter
- Only neutrons can exist there
- 1 tsp = 100 million tons

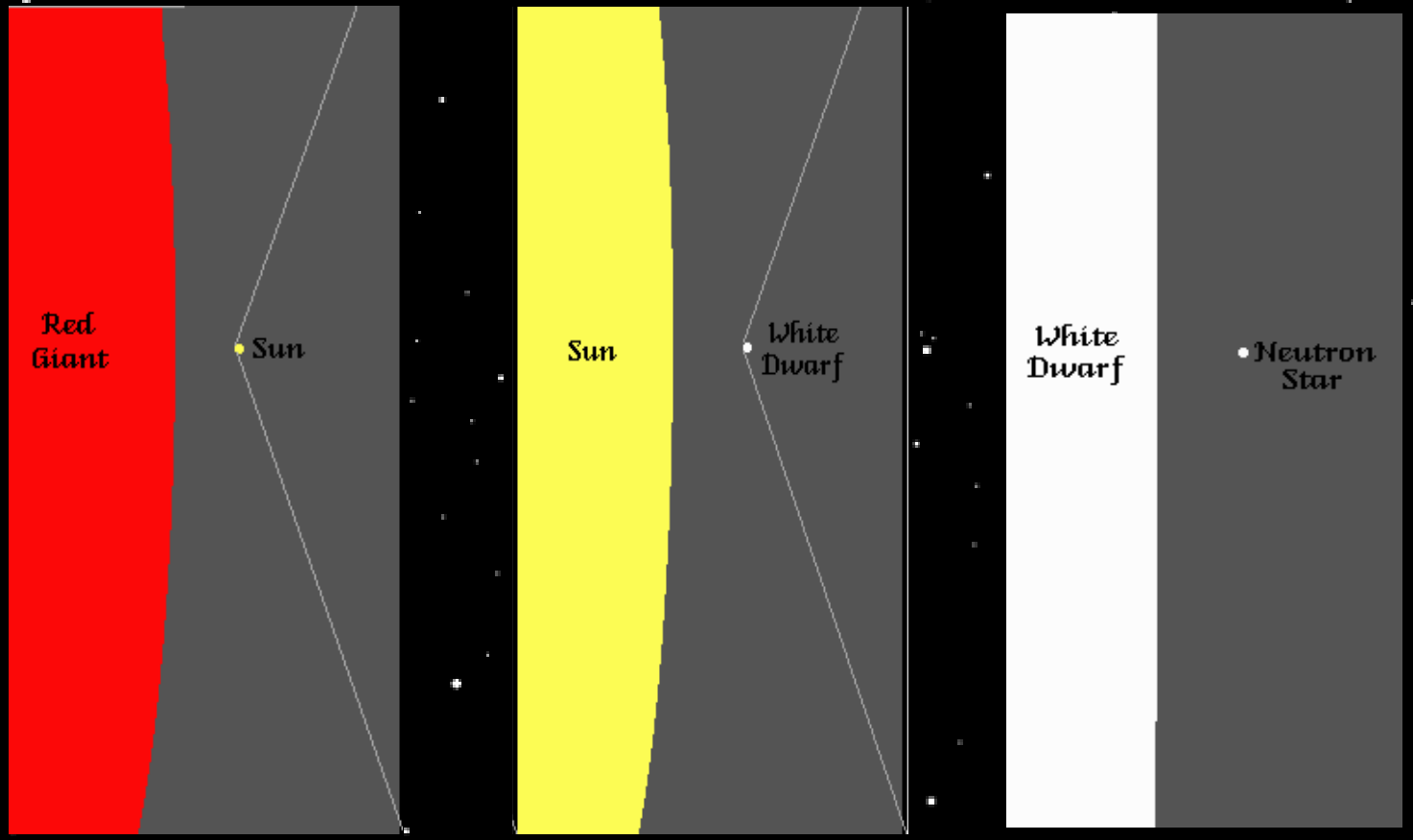


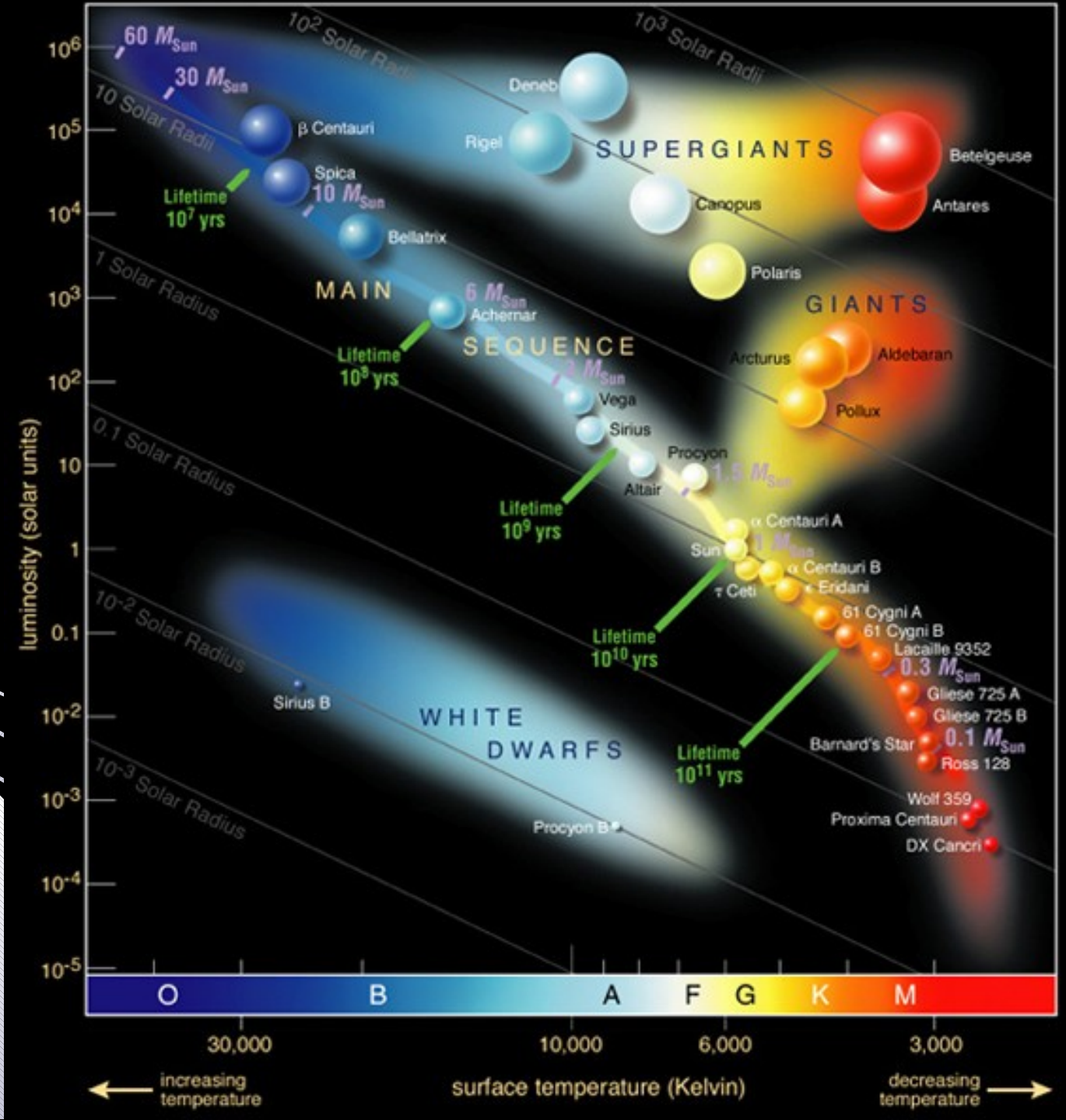
5b –Black Hole

If the core of a supernova has 3 times more mass than the sun;

- Core collapses to the point that It has no volume
- Gravity is so strong that nothing can escape, not even light

How do the sizes of the stars compare?




luminosity (solar units)
10^6
10^5
10^4
10^3
10^2
10
1
0.1
10^{-2}
10^{-3}
10^{-4}
10^{-5}
60 M_{Sun}
30 M_{Sun}
10^2 Solar Radii
10^3 Solar Radii
10 Solar Radii
1 Solar Radius
0.1 Solar Radius
10^{-2} Solar Radius
10^{-3} Solar Radius
Deneb
Rigel
SUPERGIANTS
Betelgeuse
Antares
Canopus
Polaris
β Centauri
Spica
10 M_{Sun}
Lifetime 10^7 yrs
Bellatrix
MAIN
SEQUENCE
6 M_{Sun}
Achernar
Lifetime 10^8 yrs
GIANTS
Arcturus
Aldebaran
Pollux
3 M_{Sun}
Vega
Sirius
Procyon
1.5 M_{Sun}
Altair
Lifetime 10^9 yrs
α Centauri A
1 M_{Sun}
Sun
α Centauri B
ε Eridani
τ Ceti
61 Cygni A
61 Cygni B
Lacaille 9352
0.3 M_{Sun}
Gliese 725 A
Gliese 725 B
Lifetime 10^{10} yrs
Barnard's Star
0.1 M_{Sun}
Ross 128
Lifetime 10^{11} yrs
Wolf 359
Proxima Centauri
DX Cancri
Sirius B
WHITE
DWARFS
Procyon B
O
B
A
F
G
K
M
30,000
10,000
6,000
3,000
increasing temperature
surface temperature (Kelvin)
decreasing temperature

- Where are stars with the highest luminosity located?
- Where are the stars with the highest temperature located?
- Where are average stars located?
- Where is our sun located and why?