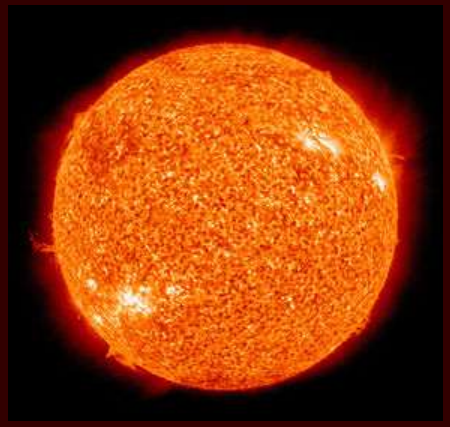
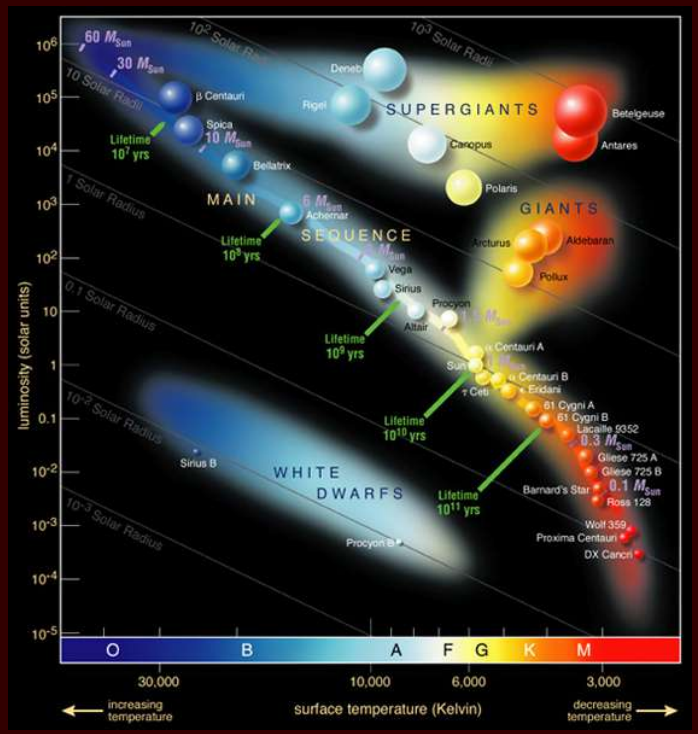
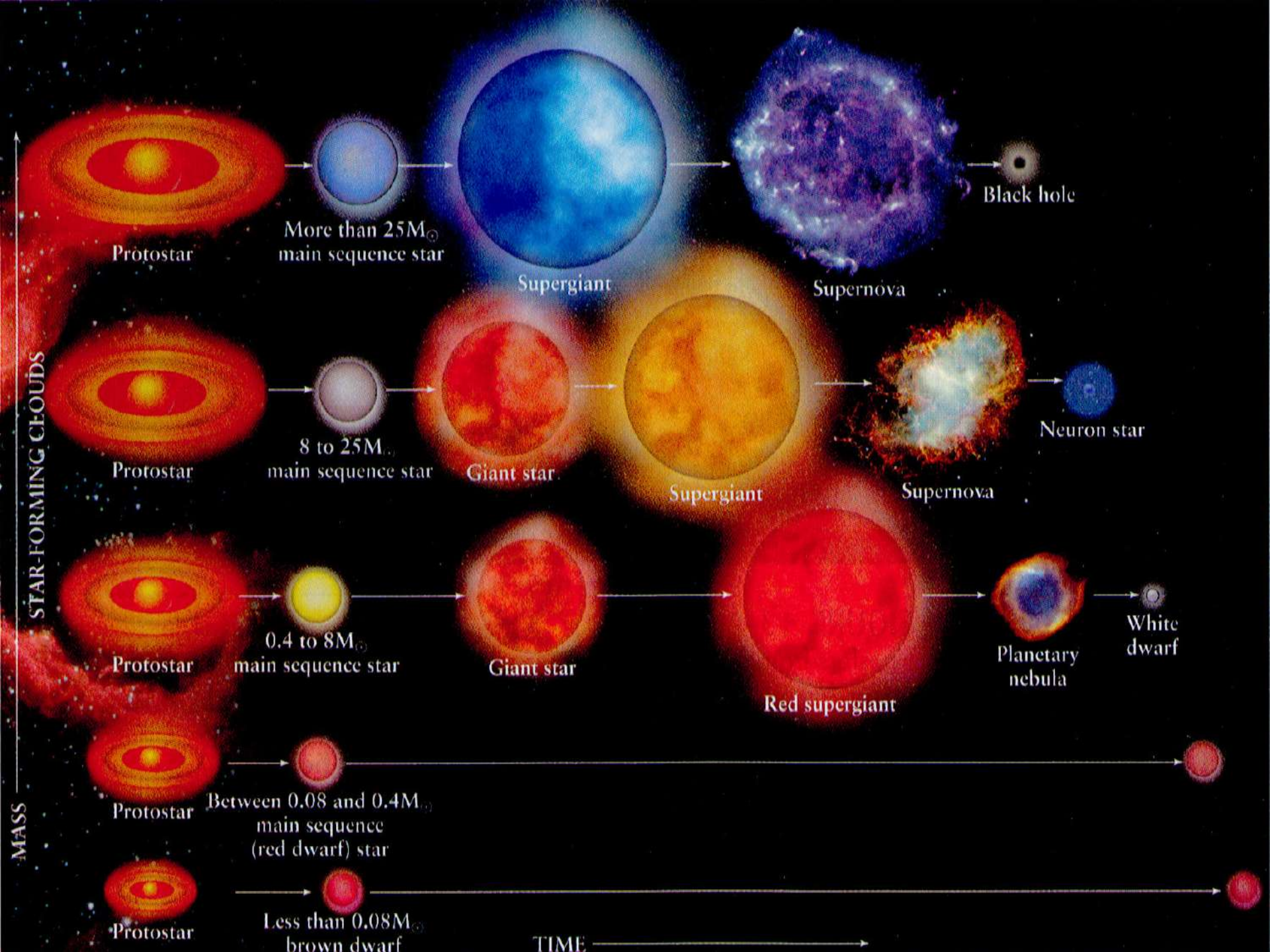
Space – The Life and Death of Stars

- A Star's beginning
  - Nebulas and Protostars
- Fusion
- Low-Mass Stars
- Intermediate-Mass Stars
  - Red Giants
- High-Mass Stars
  - Supernovas
  - Black Holes
- HR Diagram
  - Main Sequence Stars
- Inquiry Activities

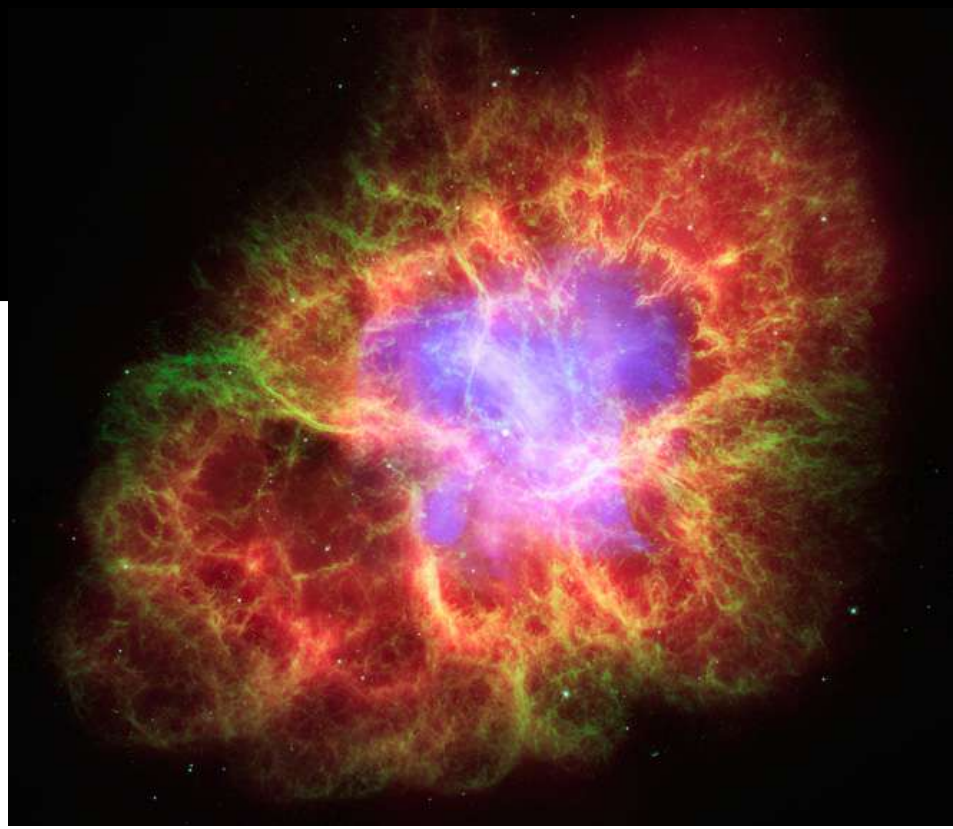





STAR-FORMING CLOUDS
MASS
Protostar
More than 25M⊙ main sequence star
Supergiant
Supernova
Black hole
Protostar
8 to 25M⊙ main sequence star
Giant star
Supergiant
Supernova
Neuron star
Protostar
0.4 to 8M⊙ main sequence star
Giant star
Red supergiant
Planetary nebula
White dwarf
Protostar
Between 0.08 and 0.4M⊙ main sequence (red dwarf) star
Protostar
Less than 0.08M⊙ brown dwarf
TIME

Stars

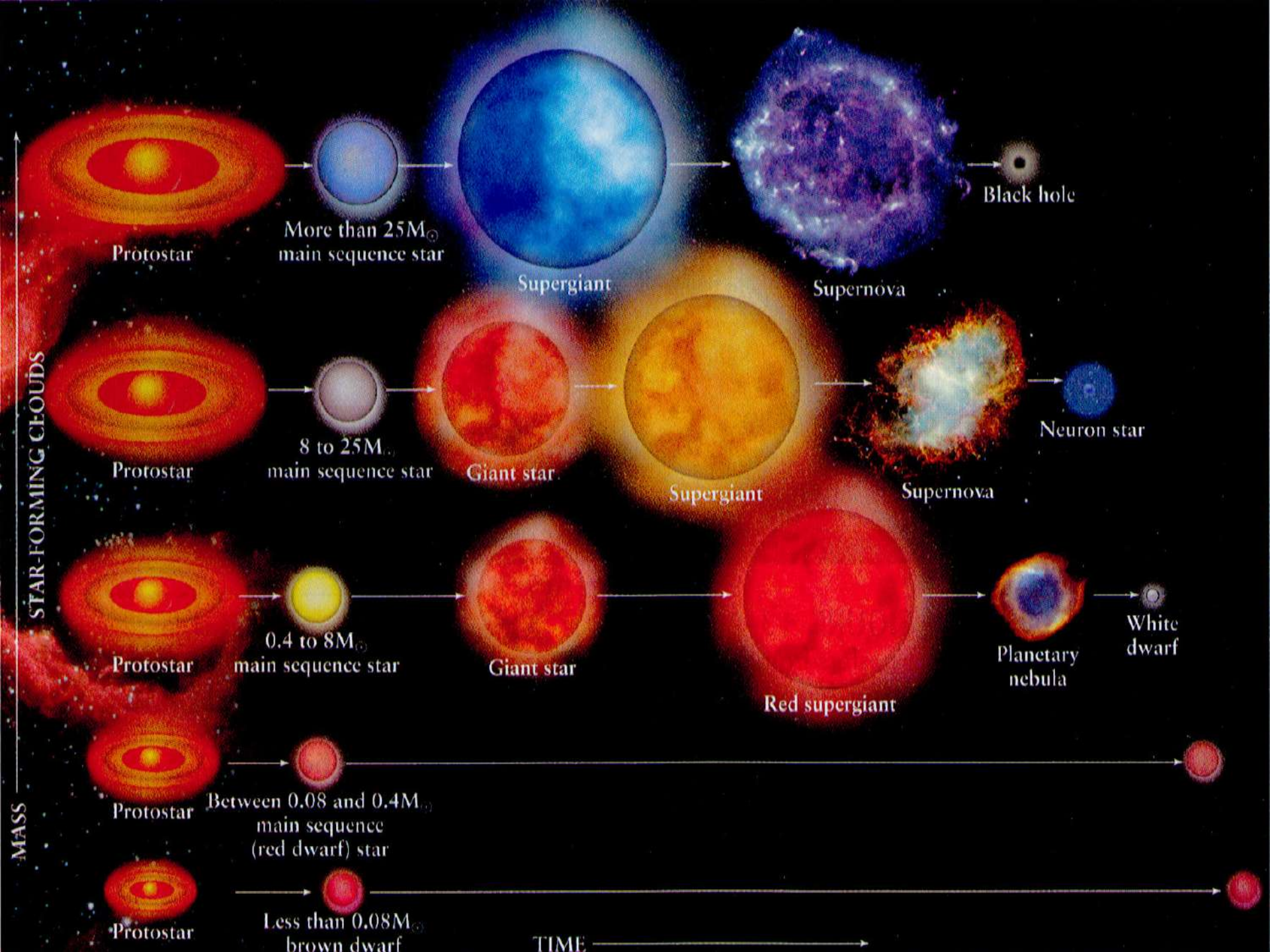
All stars begin their lives as a nebula, which are huge clouds of dust and gases, _____



- These dust clouds bump into each other and combine.
- As the clouds get bigger, their gravitational pull gets stronger and they attract more particles.
- _____
- _____

Star – Life Cycle

- Fusion - combing two hydrogen atoms to form a helium atom and huge amounts of energy
- Eventually that fuel runs out and the star becomes either a Brown, Red or White Dwarf, A Neutron Star or a Black hole
- _____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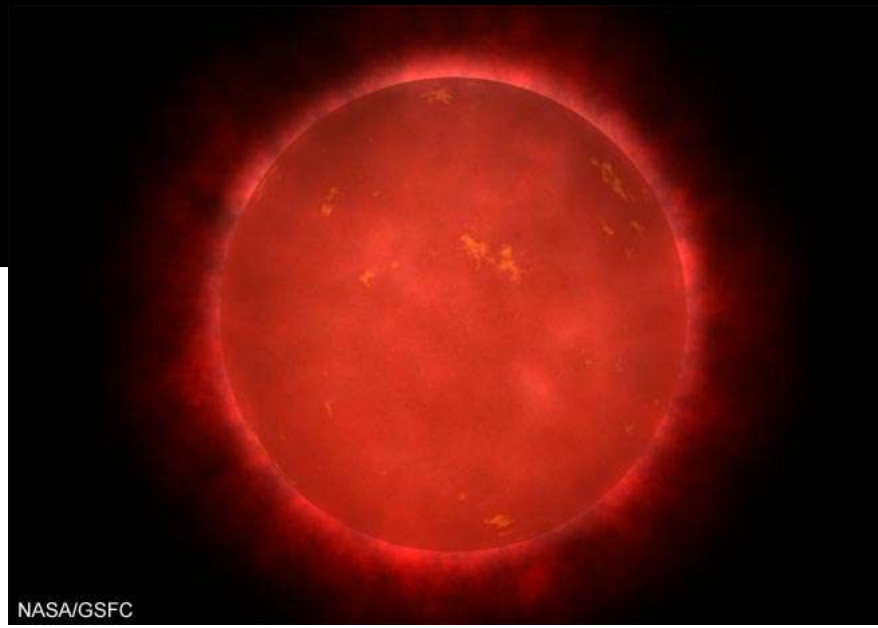
TIME

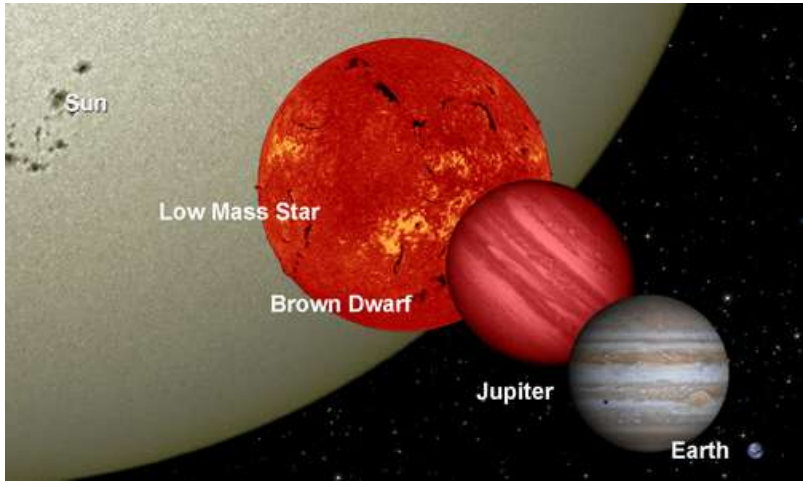
Low-Mass Stars

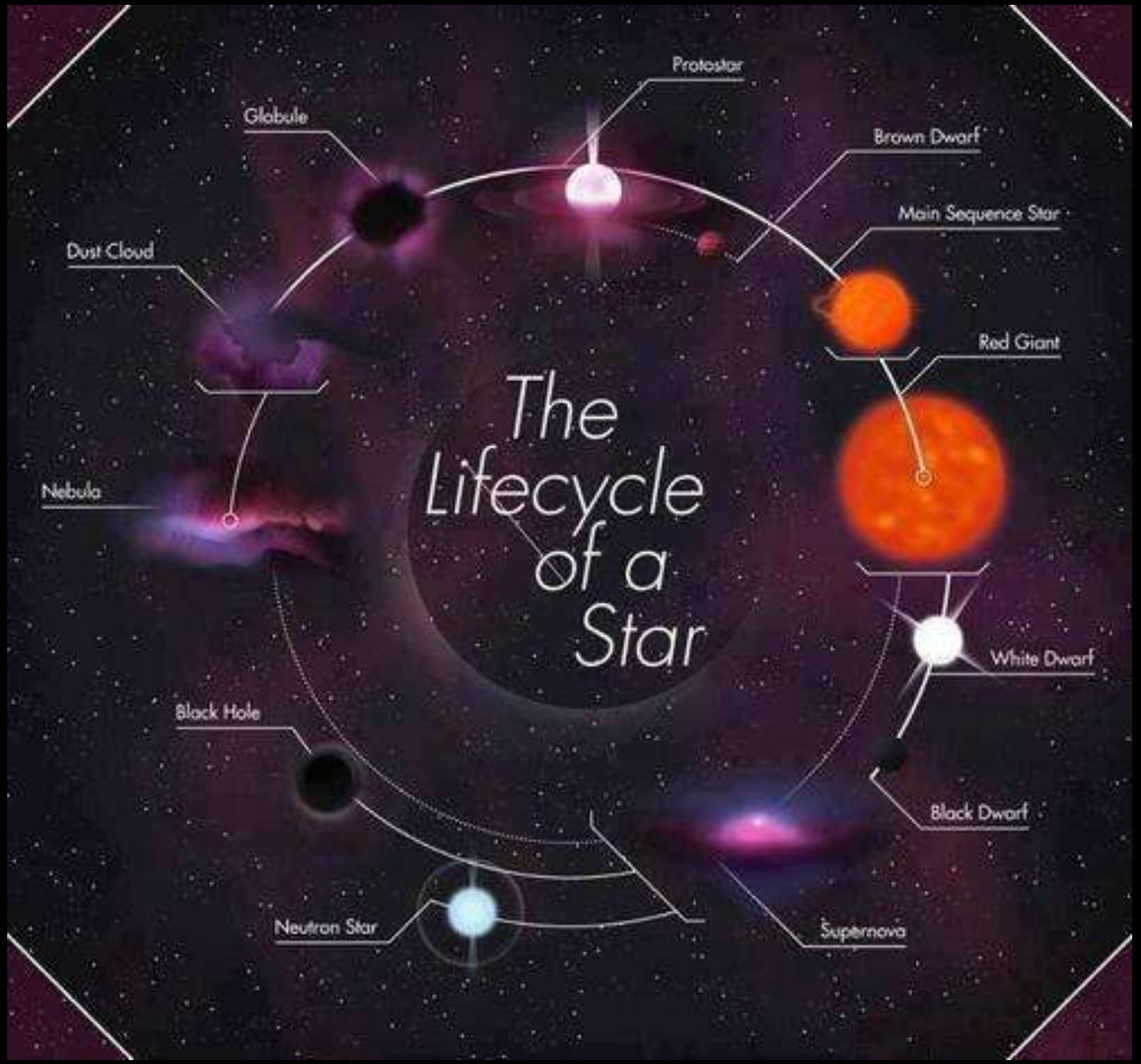


- Brown and Red Dwarfs – _____

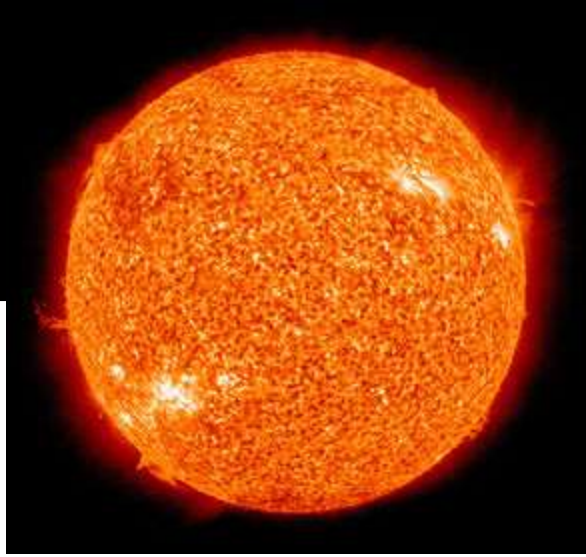
- Use fuel slowly - Last for 100 billion years

- Nothing spectacular about these guys!



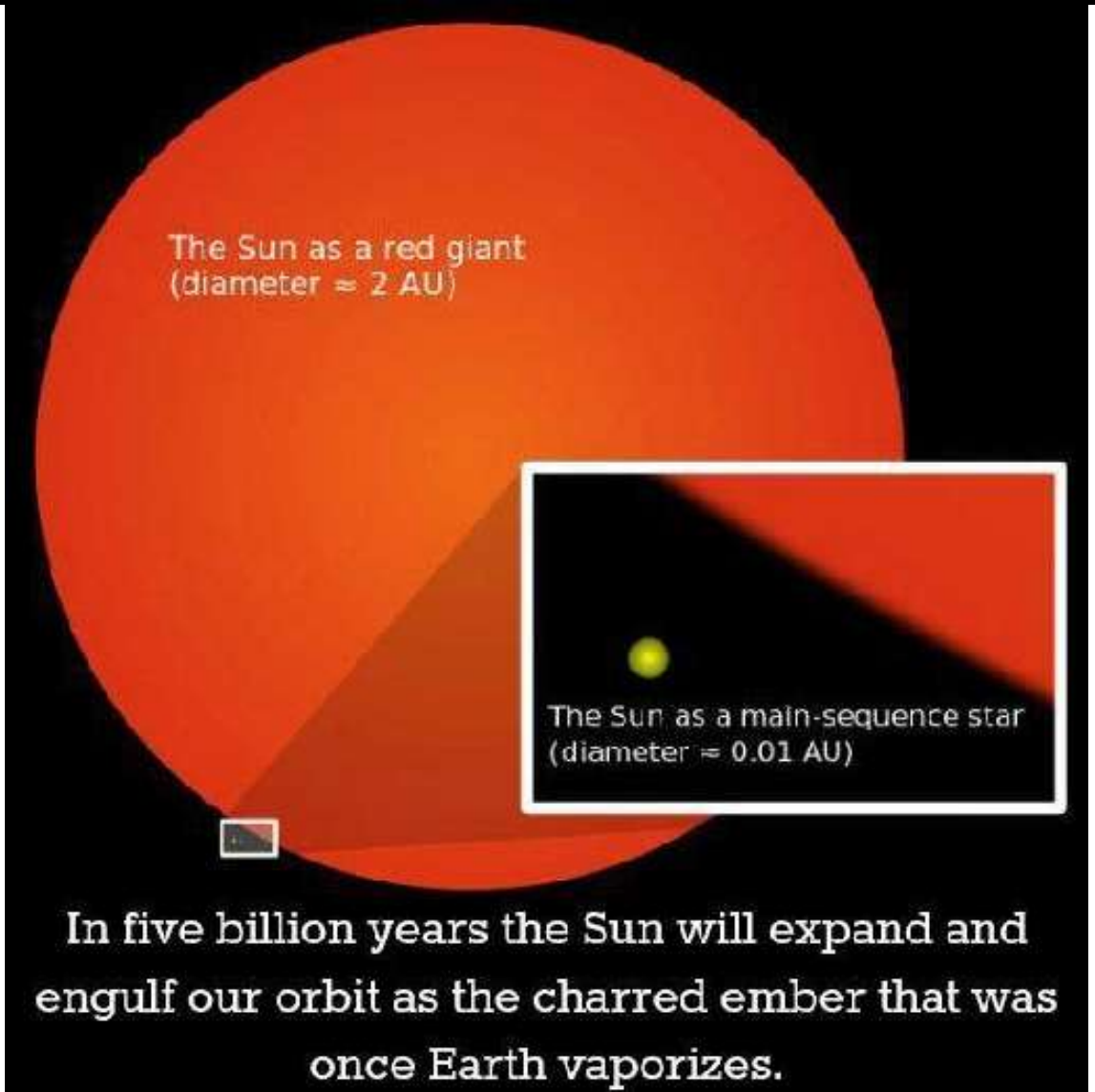

Protostar
Globule
Brown Dwarf
Main Sequence Star
Dust Cloud
Red Giant
The Lifecycle of a Star
Nebula
White Dwarf
Black Hole
Black Dwarf
Neutron Star
Supernova

Intermediate-Mass Stars



- Like our Sun (40-800% it's mass)
- _____
- Core collapses when hydrogen is used up which causes their outer layer to expand
  - Called a Red Giant or Red Supergiant
- Our Sun will become one in about 5 billion years and its outer diameter will extend to Mars
- Eventually outer layers disappear and it becomes a White Dwarf

A Red Giant


The Sun as a red giant
(diameter ≈ 2 AU)
The Sun as a main-sequence star
(diameter ≈ 0.01 AU)
In five billion years the Sun will expand and engulf our orbit as the charred ember that was once Earth vaporizes.

High-Mass Stars

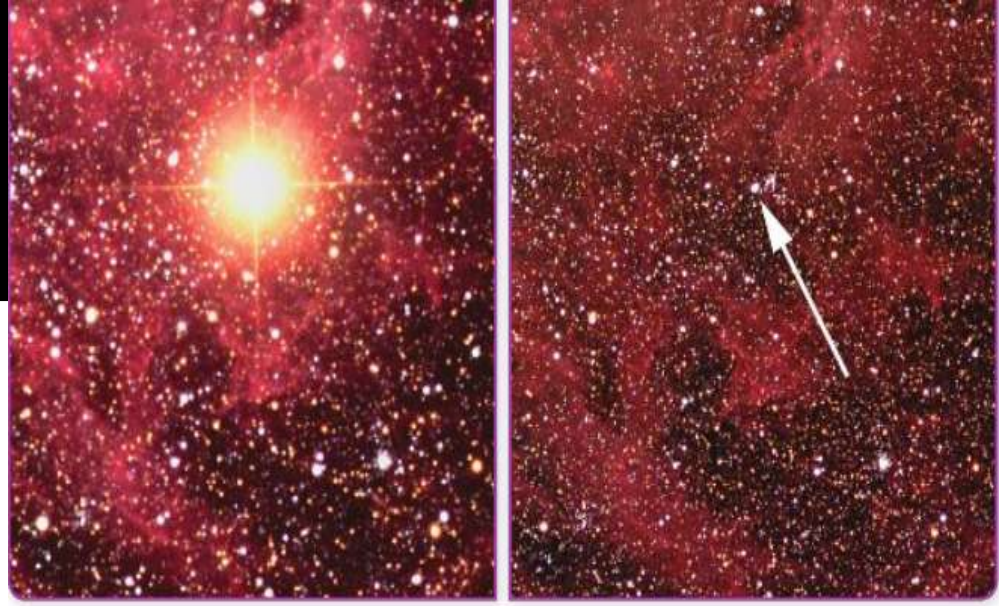


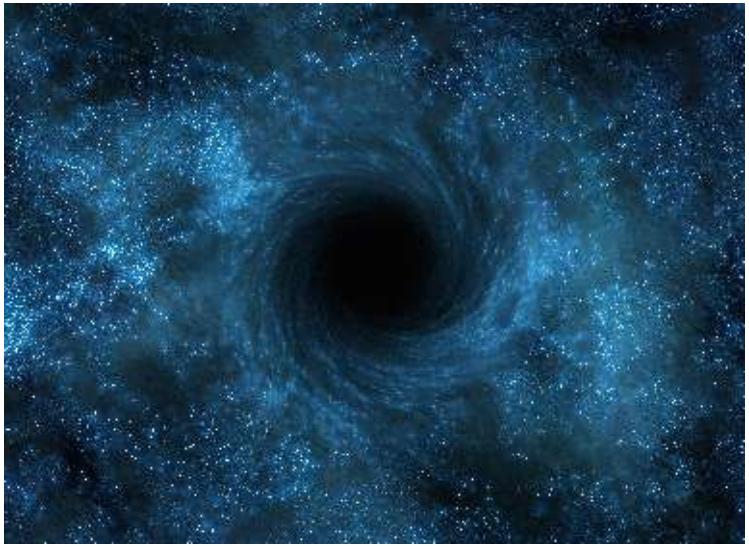
Figure 8.30 The image on the left shows the supernova discovered by Ian Shelton. The image on the right shows the same area before the supernova.

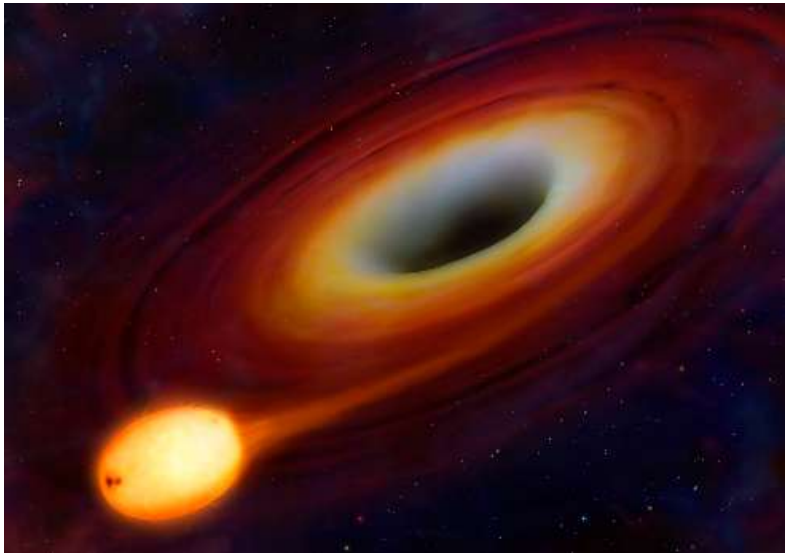
- 8-25X larger than our Sun
- Consume their fuel very fast – die more quickly and more violently
- _____

Black Holes

- _____

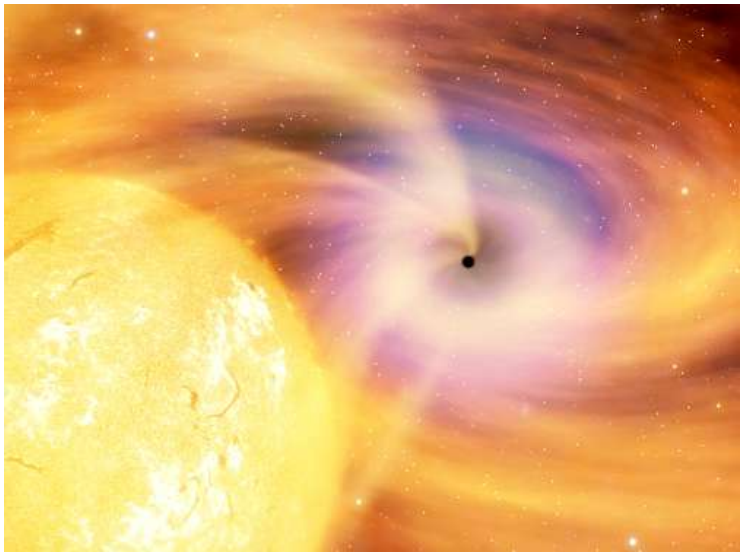
- The remains of the supernova explosion is so large that nothing can escape due to its immense gravitational force (even light)





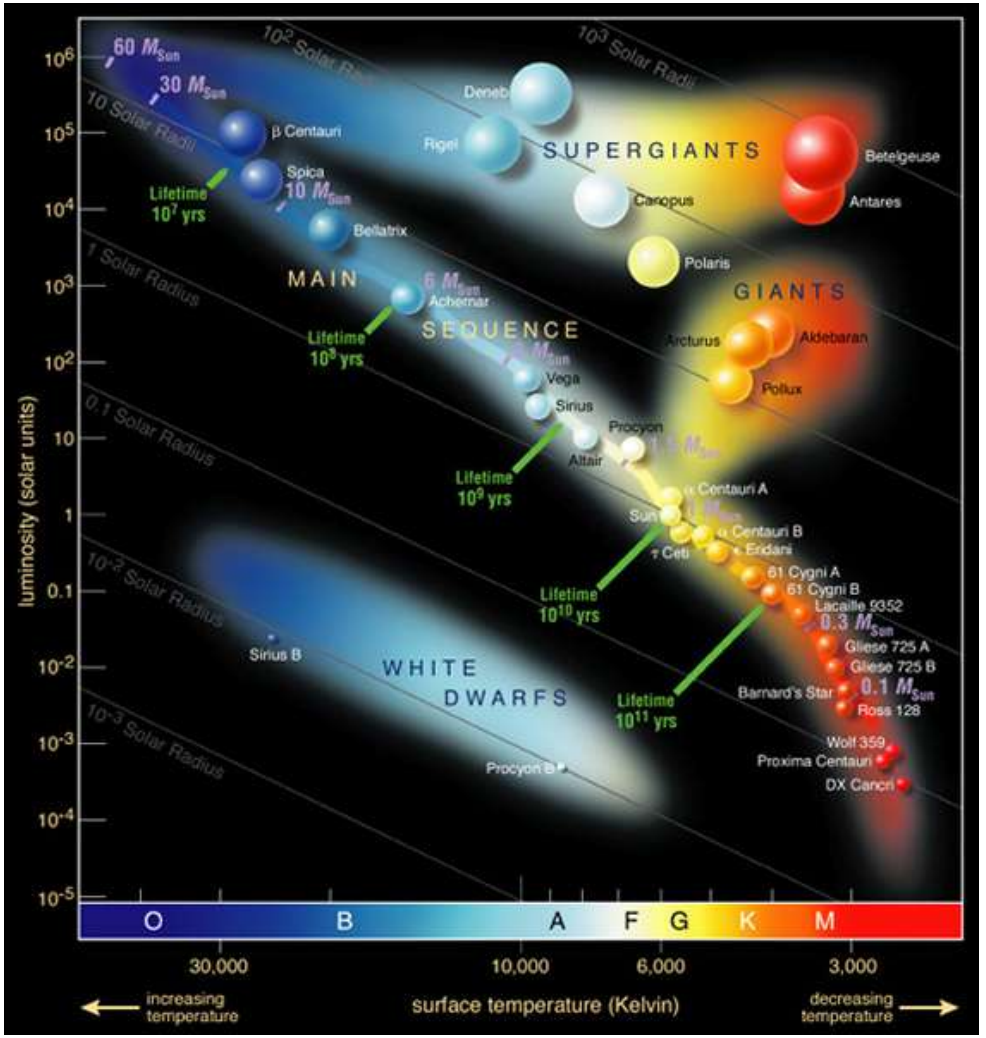
Black Holes

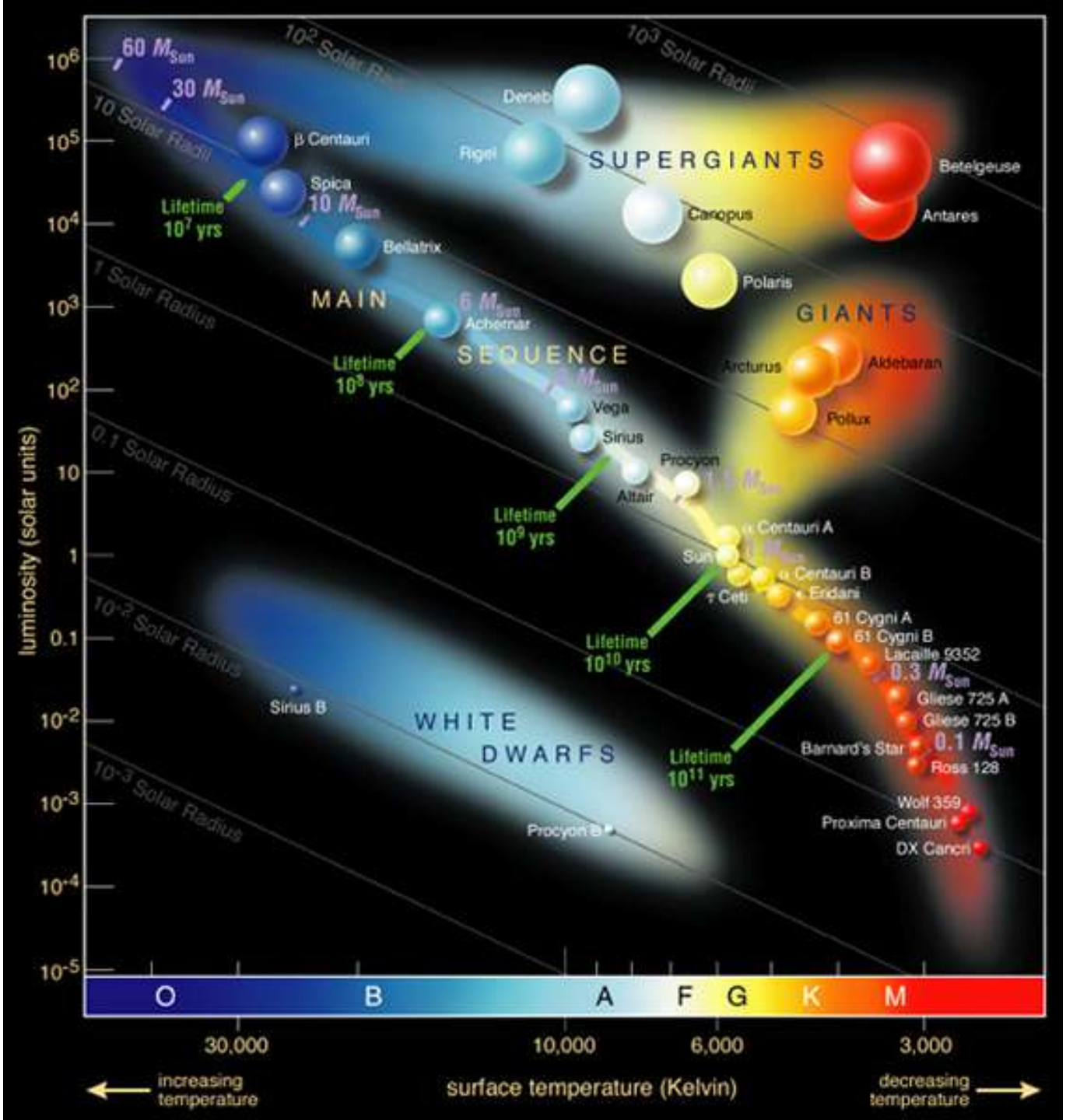
- We cannot “see” a Black Hole, we can only detect the gravitational effects created by one
- _____



H-R Diagrams

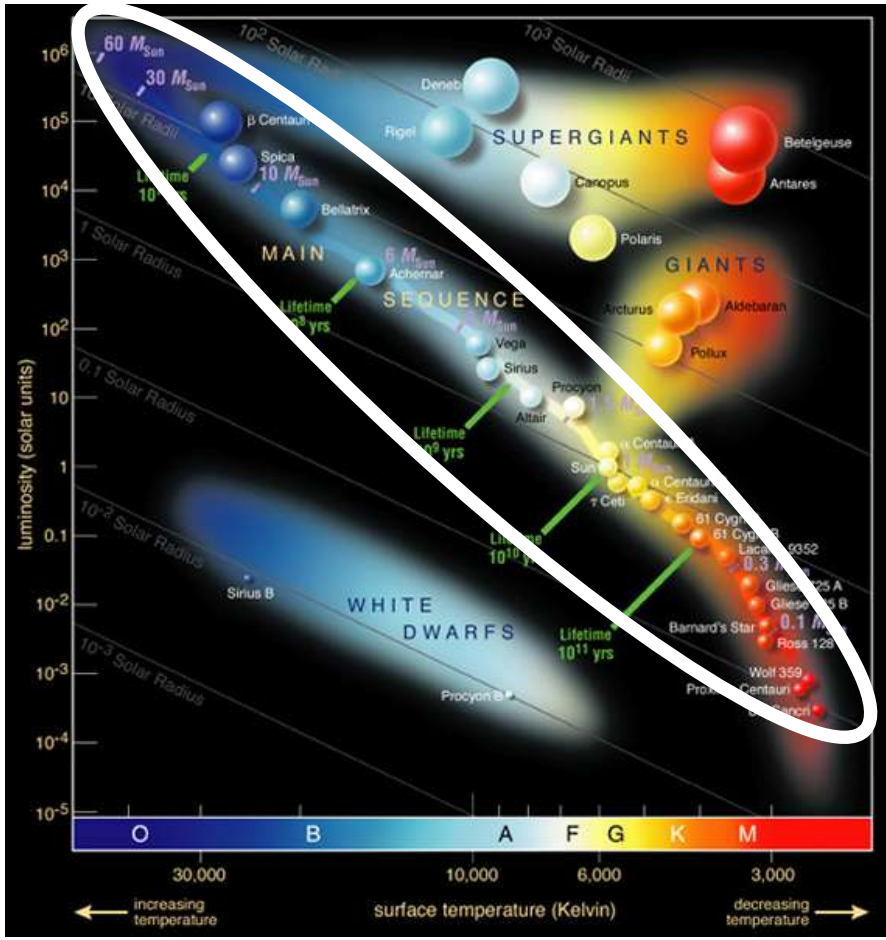
- Stars can be arranged on a chart based on their _____



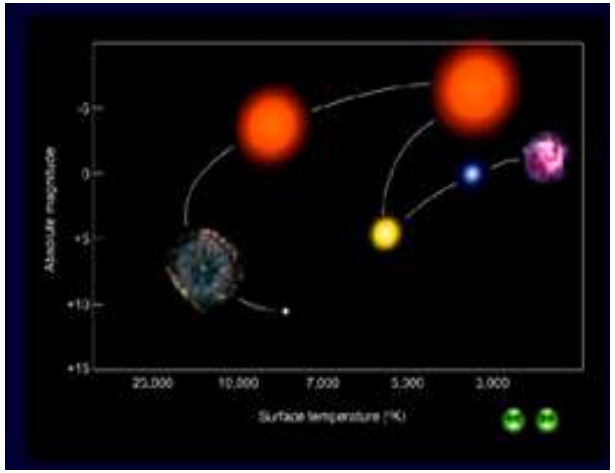

luminosity (solar units)
10^6
10^5
10^4
10^3
10^2
10
1
0.1
10^{-2}
10^{-3}
10^{-4}
10^{-5}
60 M_{Sun}
30 M_{Sun}
10^2 Solar Radii
10^3 Solar Radii
10 Solar Radii
1 Solar Radius
0.1 Solar Radius
10^{-2} Solar Radius
10^{-3} Solar Radius
Deneb
Rigel
SUPERGIANTS
Betelgeuse
Antares
Canopus
Polaris
β Centauri
Spica
10 M_{Sun}
Bellatrix
Lifetime 10^7 yrs
MAIN
6 M_{Sun}
Achernar
SEQUENCE
Lifetime 10^8 yrs
GIANTS
Arcturus
Aldebaran
Pollux
Vega
Sirius
Procyon
Altair
Lifetime 10^9 yrs
α Centauri A
Sun
α Centauri B
τ Ceti
ε Eridani
61 Cygni A
61 Cygni B
Lacaille 9352
Lifetime 10^{10} yrs
0.3 M_{Sun}
Gliese 725 A
Gliese 725 B
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

H-R Diagrams

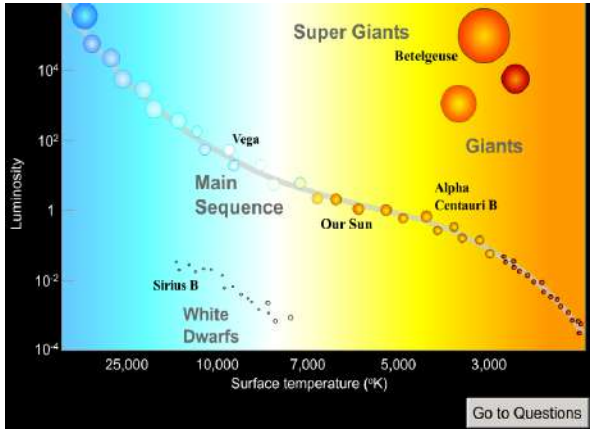
- About 90% of stars are located on the Main Sequence
- Main Sequence stars form helium from hydrogen atoms in their cores
- Main Sequence Lifetime depends on size - Larger stars burn their fuel faster and therefore, _____



Tracking the life of a star - Animation



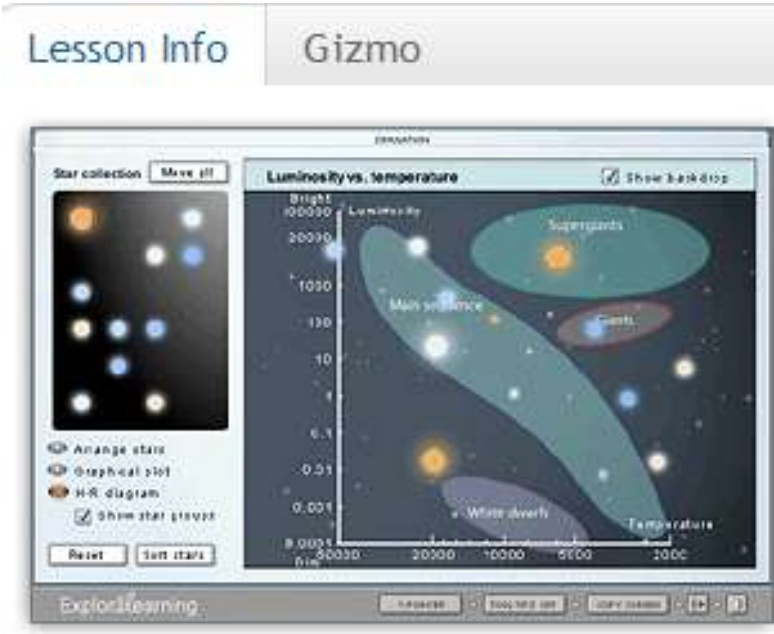
- Click the picture to access



- Click the image – take the challenge

Inquiry Activities

- Please complete the following Explore Learning Gizmo. The guided worksheet can be found on the simulation access page



- Click here for an engaging HR Diagram Lab